

# Safe and Sound:

## A Five Year Retrospective

Report on Sudden Infant Death  
in Sleep-related Circumstances



# dedication

The death of a child is the most profound loss a parent can experience. In order to reduce the number of these tragic losses, we must first understand how and why our children die.

In this report, we examine the lives and deaths of 113 B.C. infants who died suddenly and unexpectedly between January 1, 2003 and December 31, 2007. None of these infants reached their first birthday. They died during sleep – a time we may instinctively feel an infant is most safe from harm.

The report is intended to describe the trends and patterns found across the 113 infant deaths and to make meaningful recommendations that improve outcomes for all infants. It is hoped that the recommendations in this report will result in continued and strengthened collaboration across all child-serving jurisdictions.

As with all of our reports, we are grateful to the parents and family members who have courageously offered their individual and unique contributions to our examination of their children's lives and deaths. Through stories, pictures, memories and written words, parents have helped us to better understand the losses they have experienced. Thank you for your advocacy and generosity with the hopes of making a difference to all children.

We dedicate this report to the 113 infants, their families, friends and communities whose lives were changed forever, and thank a close family friend for the words she wrote in tribute to Dagny, an infant who died suddenly and unexpectedly at 9 weeks of age:

***Some people come to this world  
And live 80 or 90 years...  
And live small lives.  
And touch few hearts.  
And leave little behind to show they were here.  
This life is a tragedy.***

***Others come to this world  
For only 8 or 9 weeks...  
And transform lives.  
And awaken hearts.  
And leave lasting gifts  
in the lives they touched.  
Though brief, this life is a triumph!***

*(Sherene Kershner, on behalf of Dagny's family, 2008)*



# acknowledgements

The Child Death Review Unit wishes to thank the following organizations for sharing their knowledge, expertise and experience. Their assistance was invaluable.

- BC Association of Pregnancy Outreach Programs
- BC Council for Families
- BC Medical Association
- BC Perinatal Health Program
- BC Vital Statistics Agency
- Canadian Foundation for the Study of Infant Deaths
- Canadian Paediatric Society
- First Nations Health Council
- First Call: BC Child and Youth Advocacy Coalition
- Fraser Health Authority
- Health Canada - Maternal and Child Health
- Health Canada – Consumer Product Safety Branch
- Interior Health Authority
- Northern Health Authority
- Vancouver Island Health Authority
- Vancouver Coastal Health Authority
- Métis Nation BC
- Midwives Association of BC
- Ministry of Children and Family Development
- Ministry of Healthy Living and Sport - Aboriginal Health Branch
- Ministry of Healthy Living and Sport - Women's Healthy Living Secretariat
- Ministry of Housing and Social Development - Strategic Policy and Research Branch
- Representative for Children and Youth
- Office of the Chief Coroner of Ontario – Paediatric Review Committee
- Public Health Agency of Canada
- U.S. Centers for Disease Control
- SIDS Foundation of Washington

Through an e-survey, front-line practitioners also shared their perspectives with us, enriching our understanding of B.C.'s current strategies, successes and challenges with regard to sudden infant death. We would like to thank the family physicians, Aboriginal communities, maternity and public health nurses, paediatricians, midwives, program facilitators, pregnancy outreach workers, and maternal-child practitioners who participated.

**Special thanks to the following individuals for their review and contribution to this report:**

Dr. Charmaine Enns, MD, FRCP(C), Medical Health Officer, Vancouver Island Health Authority  
Deborah Robinson, Infant Death Investigation Specialist, Child Death Review, Washington State  
Dr. Guenther Krueger, PhD, Canadian Foundation for the Study of Infant Deaths  
Marilyn Ota, Vice President, Health Planning, First Nations Health Council  
Candace Robotham, Chair, Aboriginal Maternal-Child Health Committee, Seabird Island Band



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# executive summary

## Introduction

The Child Death Review Unit (CDRU) of the BC Coroners Service reviews the deaths of all children age 18 and under in B.C. The intent of these reviews is to better understand how and why children die, and to use those findings to prevent other deaths and improve the health, safety and well-being of all children in British Columbia.

This is a report about infants and risks associated with sleep. It is intended to provide health professionals and administrators with information to guide future policy development that promotes standardized practice guidelines and highlights areas for targeted action. The findings of the report will also be used to inform and support the development of safe sleep guidelines that are currently underway in B.C.

In August 2007, the CDRU observed an unusual pattern of sudden infant deaths taking place on Vancouver Island. This pattern, coupled by a lack of detailed provincial data on the epidemiology of sudden infant death in sleep-related circumstances, provided the impetus for the CDRU to conduct a comprehensive aggregate review.

This special report, *Safe and Sound: A Five-year Retrospective*, is the product of the CDRU's comprehensive review of 113 sudden infant deaths occurring in B.C. from January 1, 2003 to December 31, 2007. The report begins by putting the problem of sudden infant death into context with the evolution of relevant terminology and classification systems, as well as what we know about sudden infant death within the broader trends of infant mortality. Then, the detailed results of the case reviews into the 113 deaths form the core of the report, including demographic trends and common risk and mitigating factors relating to the infants, their physical and socioeconomic environments, and the health services provided to mother and infant. The report concludes with recommendations for improving British Columbia's collective approach to reducing the incidence of sudden infant death in sleep-related circumstances.

As a further note, for many years Aboriginal peoples have experienced higher rates of infant mortality than other residents of British Columbia, including higher rates of sudden infant death. In recognition of this inequity and the multiple factors underlying it, a separate section on Aboriginal infants is provided, which outlines key review findings specific to this population.

## Key Findings

The following are the key findings of the review of 113 sudden infant deaths:

### Population, place and time

- The majority of sudden infant deaths (65% or 73 infants) involved males.
- The incidence of sudden infant death peaked at two to four months of age, with 85% (78 infants) occurring by six months of age.
- Thirty per cent of the deaths (34) involved Aboriginal infants – approximately four times their representation in the B.C. infant population. Aboriginal infants represent only 8% of B.C.'s under-one population.
- Approximately one third of the infants (35% or 39 infants) were premature, although most were delivered near term.
- Over a quarter of the infants (28% or 32 infants) had viral symptoms within 48 hours of their death.
- Vancouver Island and Northern regions<sup>1</sup> had the highest rates of sudden infant death.
- Fall had 50% fewer sudden infant deaths in comparison to the other seasons.
- Sudden infant deaths were not exclusively a night-time occurrence. The infant was last seen alive during the daytime hours in 42 cases (37%), while 67 cases (59%) reportedly occurred during night-time.

### Physical environment

- Fewer than half of the infants (40% or 45 infants) were reported as being placed in the recommended supine (back) sleep position. Supine sleeping was more common among Aboriginal infants than other residents.
- Overheating was a risk factor for over one third of the infants (33% or 37 infants).
- Regardless of sleep location, the majority of infants were sleeping in an environment cluttered by pillows, duvets, blankets, stuffed animals or bumper pads. Of the 32 infants

sleeping in a crib at the time of their death, 26 (81%) had clutter present in the crib with them.

- Forty-five per cent (51 infants) were bedsharing at the time of their death. Of the bedsharing infants, the majority were on an adult mattress and 4 months of age or younger.
- Half (50% or 57 infants) were sleeping on an adult mattress at the time of their death; less than a third (28% or 32 infants) were in a crib, cradle or bassinette.
- More than half (54% or 61 infants) were prenatally exposed to cigarette smoke. Prenatal smoking was more common among mothers of Aboriginal infants than other residents.

### Socioeconomic environment

- Fifty-nine of the infants (52%) had mothers who faced economic challenges, either during pregnancy or during the lifespan of the infant. 40 mothers were known to be in receipt of Income Assistance; a further 19 mothers experienced economic challenges manifested through housing insecurity, small overcrowded homes, homes with rodent infestation or mould, inability to live independently and unemployment.
- Economic challenges were more common for Aboriginal mothers and infants than other residents.
- Eighteen of the infants did not have a safe sleeping surface available to them at the time of their last sleep.
- Fifteen infants (13%) were considered to be living in overcrowded conditions.

### Health Services

- Inadequate prenatal care was an issue for 52% or 59 of the mothers.

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<sup>1</sup> Refers to BC Coroners Service regions. See Appendix A.

## Recommendations

The recommendations in this report identify actions that governments, health and social systems, industries, and community organizations can take to support risk reduction. Informed by both available prevention literature and the expertise of health practitioners and policy-makers across the province, these recommendations call for multi-level action in nine distinct target areas:

1. Prenatal care
2. Public education
3. Education/training of health professionals
4. Infant death classification
5. Social determinants of health
6. Consumer product safety
7. Home visiting
8. Research
9. Aboriginal infants

The recommendations are not directed to any specific agency. Instead, they are crafted to address gaps in policy, practice, programs and partnerships or to advance prevention efforts already underway in the province. As well, the recommendations can be used by other child-serving jurisdictions in the development of their own policies.

The CDRU supports a multi-level approach to prevention that is non-punitive, guided by evidence, culturally sensitive and family-centred. Follow-up activities relating to the recommendations in this report will be highlighted in the CDRU's 2009 Annual Report.

## Terminology

Terminology used to describe and classify sudden infant death in sleep-related circumstances has changed over time and varies across jurisdictions. For the purposes of this report, the term *sudden infant death* refers to the group of cases that were included in the Child Death Review Unit's (CDRU) retrospective review – that is, the death of an infant less than one year of age that occurs suddenly and unexpectedly in sleep-related circumstances. This includes deaths resulting from *Sudden Infant Death Syndrome (SIDS)*, *Sudden Unexplained Death in Infancy (SUDI)*, accidental asphyxia and deaths due to undetermined causes in the sleep environment. For further information on the type of cases that formed the CDRU's review and the evolution of sudden infant death terminology, please see page 4.

In this report, the term Aboriginal is inclusive of First Nations (both Status and non-Status), Métis and Inuit peoples. In coroner cases, Aboriginal infants are identified through self-identification by the parent, notation on the designated portion of the Registration of Death certificate, or through records from child-serving organizations.

Throughout this report, the CDRU's review findings are compared with data from other sources and jurisdictions. Although valuable, direct data comparisons are rarely possible due to lack of consistent terminology and changes in classification systems over time. The CDRU has made every effort to place review findings into suitable context, but recognizes the limitations inherent in these comparisons. When referring to outside data sources or literature, the CDRU has maintained the terminology used in the original document.

**Additional key terms** used throughout the report appear in **bold** and are defined in the **Glossary** at the end of the document.



# 1 | introduction

## Background

In August 2007, the Child Death Review Unit observed a pattern of sudden infant deaths taking place on Vancouver Island. Five sudden infant deaths had occurred over a one-month period, all within a small geographical area under apparently similar circumstances. Other child serving jurisdictions in B.C. also noted this trend and a collaborative response was initiated.

The Ministry of Children and Family Development confirmed that all five of the infants were known to MCFD. In response to this, MCFD completed a cluster review into the deaths to analyze the fatalities at a systematic level and identify any policy or practice implications stemming from the group of cases (MCFD, 2008). The Provincial Health Officer and Representative for Children and Youth were closely monitoring this cluster and as sudden infant deaths continued to occur across the various regions over the following weeks, the Chief Coroner directed the CDRU to take a more detailed look at cases of sudden infant death, both on Vancouver Island and across the province. Preliminary examination found that the majority of deaths involved unsafe infant sleep practices such as placing infants to sleep on their stomachs, on adult beds and couches, or in cribs cluttered with heavy bedding and toys. Sudden infant deaths were seen across the province, across socioeconomic levels and during the day as well as at night.

Sudden infant death is the most common cause of death for infants between one month and one year of age, yet our understanding of the problem is limited by etiological uncertainty, lack

of data specific to the B.C. population and jurisdictional differences in the way sudden infant deaths are classified and reported. These limitations, in combination with the findings described above, provide the rationale for the CDRU's five-year retrospective review on sudden infant death in sleep-related circumstances.

The Child Death Review Unit (CDRU) of the BC Coroners Service has a legislated mandate to review, on an individual or aggregate basis, the facts and circumstances related to the deaths of all children 18 years and younger in British Columbia. The mission of the CDRU is to conduct a comprehensive review of all child deaths in the province to better understand how and why children die, and to translate those findings into action that aims to prevent other deaths and improve the health, safety and well-being of all children in B.C. In addition to issuing biannual reports on the state of child death in British Columbia, the Child Death Review Unit may also complete special reviews on a particular topic within the bigger picture of child health and safety. Special reviews provide an opportunity to take a closer look at problems that compel more in-depth analysis, whether due to public concern or a changing statistical trend.

# The Project

## The Cases

In preparation for the retrospective review, the CDRU compiled all cases of sudden infant death that took place in B.C. between January 1, 2003 and December 31, 2007. A total of 340 infants under one year of age died suddenly and unexpectedly in this five-year period, 113 of which were identified for inclusion in the special review based on the following criteria: the death occurred in circumstances relating to sleep; no anatomic or physiologic cause of death was found upon autopsy; a death scene investigation was completed and medical history of the infant obtained; and, the coroner's investigation into the death is complete<sup>2</sup>. By definition, all infant deaths due to other specified causes (e.g. prematurity, natural disease processes, motor vehicle incidents and homicides) were excluded from the review.

## Methodology

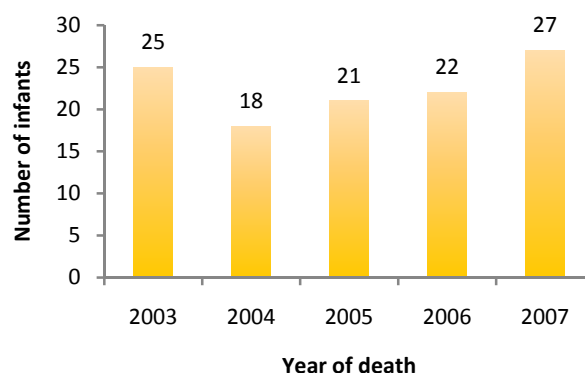
The 113 cases were compiled and assigned to a CDRU case reviewer for preliminary review. A protocol specific to sudden infant death was then developed using available literature on the etiology, epidemiology and prevention of sudden infant death. The protocol was applied to each case, allowing for systematic collection of data on demographics, risk and mitigating factors for sudden infant death, and other social determinants of health such as income, maternal education and health services.

Case reviews were primarily informed by information found on the coroner's file, supplemented by data from other sources that could enrich our understanding of the circumstances in which the infant lived and died. Additional data was obtained from the BC Perinatal Database Registry and from the Strategic Research

and Policy Branch of the Ministry of Housing and Social Development. The families of many of the infants were also given the opportunity to share their stories and strengthen the CDRU's understanding of the uniqueness of each infant's circumstances. Upon completion of individual case reviews, data was analyzed to identify trends in risk and mitigating factors, population characteristics, circumstances of death and socioeconomic factors. Armed with a greater understanding of the problem, the CDRU prepared for recommendation development. In addition to reviewing available literature on the prevention of sudden infant death, the CDRU underwent a comprehensive consultation process with public health organizations and health professionals across the province. The purpose of conducting stakeholder consultation was to gather information from the field on current strategies being used in support of risk reduction; to hear what health professionals recommend with respect to best practices; and, to contemplate how the province could improve on its collective efforts to reduce the incidence of sudden infant death in B.C.

Results of the best practice review and provincial consultation were analyzed and placed within the context of CDRU case review findings, resulting in recommendations across nine target areas for action. Further information on recommendations and their development is provided on page 33.

**Figure 1.1 Incidence of sudden infant death**



Source: Child Death Review Unit, BC Coroners Service

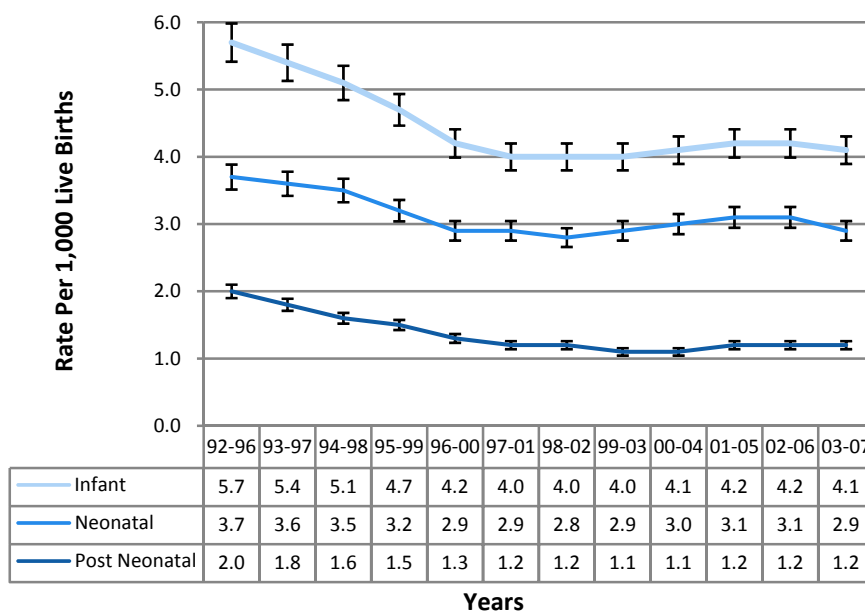
<sup>2</sup> As of September 1, 2009, four cases remained under investigation by the BC Coroners Service and were thus excluded from the review.

## Infant mortality and sudden infant death

Infant mortality rate is the rate at which babies less than one year of age die per 1,000 live births, in a given place and time. The infant mortality rate is a key indicator of child health and societal well-being. Infant mortality is a **multifactorial** phenomenon and reflects economic and social conditions of the mother and baby, as well as the efficacy of the health care system. It can be used as a tool to examine health disparities between differing populations within a country or province, such as those that exist between **Aboriginal** and other residents of B.C. (Conference Board of Canada, n.d.).

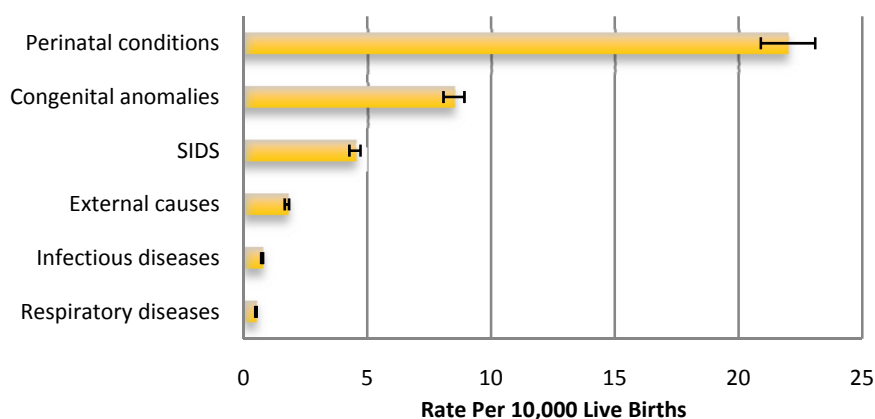
Infant mortality may be divided into **neonatal** and **post-neonatal mortality**. Sudden infant death traditionally has a low incidence in the first month of life, when deaths from prematurity or perinatal complications may be higher. Sudden infant death is the highest cause of death in the post-neonatal period.

Figure 1.2 Infant, neonatal and post neonatal rates



Source: BC Vital Statistics Agency 2009; Prepared by Population Health Surveillance and Epidemiology, Ministry of Healthy Living and Sport, 2009.

Figure 1.3 Infant mortality rates by cause of death, 2003-2007



Source: BC Vital Statistics Agency 2009; Prepared by Population Health Surveillance and Epidemiology, Ministry of Healthy Living and Sport, 2009.

**Infant mortality, neonatal mortality and post-neonatal mortality** had significant decreases between 1992 and 1996, but rates in 2003-2007 were not significantly different from rates in 1997-2001.

In B.C. between 2003 and 2007, an average of 169 infants died each year for an average rate of 4.09 deaths per 1,000 liveborn infants (BC Vital Statistics Agency, 2009). Canadian rates over the same time period averaged 4.74 deaths per 1,000 live births (Index Mundi, 2009).

Infant deaths are caused by many conditions, including perinatal trauma, congenital anomalies, infectious processes, sudden unexplained infant death and accidental injury. The top three causes of infant death in B.C. are perinatal conditions, congenital anomalies, and SIDS<sup>3</sup>. Together, these three causes comprised 87% of all infant deaths in 2003-2007.

The rate of SIDS<sup>3</sup>, as coded by BC Vital Statistics Agency, decreased from 9.9/10,000 in 1992-1996 to 4.2 in 1997-2001, and has leveled off at 3.7- 4.2 since that time.

## History of Sudden Infant Death

Sudden infant death is not a new phenomenon; however, it has only been since the 20<sup>th</sup> century that doctors and researchers have begun to attempt to understand its underlying cause.

At the National Institute of Health Second International Conference in the US in 1969, Dr. Marie Valdes-Dapena, a recognized expert on “crib death”, presented on **Sudden Infant Death Syndrome (SIDS)** and SIDS became recognized as a distinct entity (Bagwell, n.d.).

Infants who die suddenly and unexpectedly often have no definitive physical findings at autopsy. Thus, SIDS is a diagnosis of exclusion rather than a specific recognizable disease process. Historically, in order to be designated as “SIDS”, an infant had to be less

than one year at the time of death and the cause of death unexplained after completion of a complete autopsy, examination of the death scene, and review of the clinical history (Carolan, 2007; Hunt & Hauck, 2006).

As research into SIDS progressed, risk factors for sudden infant death were discovered. The *Back to Sleep* campaign was developed as research showed that babies who were placed to sleep on their backs (**supine**) had a significantly lower rate of sudden death than those placed on their tummies (**prone**). Globally, health professionals, researchers and educators committed to the messaging that encouraged caregivers to place infants on their backs to sleep. The *Back to Sleep* campaign was credited with significantly decreasing the rate of SIDS deaths around the world with various nations developing their own individual strategies. Canada’s *Back to Sleep* campaign was launched in 1999 by Health Canada, in collaboration with the Canadian Institute for Child Health, the Canadian Paediatric Society and the Canadian Foundation for the Study of Infant Deaths.

## Terminology: SIDS versus SUDI

Historically SIDS was a cause of death attributed to most infant deaths in sleep-related circumstances if no cause of death was determined on autopsy. Over the past few years there has been a shift in language and definition as we have learned more about the risks associated with sudden infant death in sleep-related circumstances.

All sudden infant deaths are investigated in the same manner, including a scene investigation, review of the medical and social history and a complete autopsy. If there is no cause of death determined upon autopsy, consideration is given to any risk factors that may have been present at the time of death. For example, an infant sleeping on his back in an approved crib with no clutter such as bumper pads, large blankets, pillows or stuffed animals would have no external risk factors noted, and the cause of death may be Consistent with SIDS.

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<sup>3</sup> Includes Sudden Unexplained Death in Infancy (SUDI)



Since 2004, the BC Coroners Service has adopted the term **Sudden Unexplained Death in Infancy (SUDI)** to reflect those deaths where there is no anatomical cause of death at autopsy but known risk factors are identified. Risk factors may be related to sleep position, sleep surface or sleep environment. Examples of this would be an infant sleeping with his parent on a couch or napping on his tummy on top of a soft duvet on his grandma's bed. Given that **prone** (tummy) sleep, bedsharing on a couch, and sleeping on soft surfaces are all risk factors for sudden infant death, and further, that the potential contribution of these factors to the death cannot be determined, the cause of death would be noted as SUDI. This change in terminology and classification can create difficulty in comparison of sudden infant death rates across jurisdictions or time. However, the distinction between SIDS and SUDI allows for a better understanding of the risk factors involved in these deaths and for targeted strategies to reduce the risk of further deaths.



# 2 | the infants

## Population

### Sex

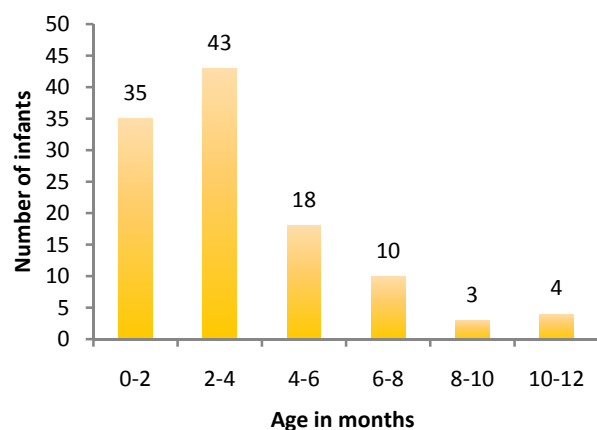
Seventy-three (65%) of the 113 infants who died suddenly and unexpectedly in circumstances related to sleep were male. Male infants are statistically at higher risk for sudden infant death, for unknown reasons. For more information see Risk Factors on page 11.

### Age at death

The 113 infants ranged from 16 hours to 11 months of age. Twelve of the infants died within their first month, including two who died within 24 hours of birth.

Figure 2.1 illustrates the age range of the infants at the time of death. In B.C., the deaths peak at two to four months of age, consistent with international statistics, with 69% of infants dying at four months of age or less and 85% dying at six months of age or younger.

Figure 2.1 Age at time of death\*



Source: Child Death Review Unit, BC Coroners Service  
\*Not adjusted for gestational age at birth

### Aboriginal ancestry

Although Aboriginal infants comprise only about 8% of B.C.'s population under one year of age, 30% (34) of the infants who died in this review were Aboriginal.

Thirty-one infants were of First Nations ancestry and two were of Métis ancestry. Specific Aboriginal ancestry was unknown for one infant.

For more findings specific to Aboriginal infants see page 27.

### MCFD involvement

Six infants were living in foster care at the time of death. One infant was in temporary weekend respite per voluntary parental consent and one was living with his parent in a supportive shelter partially funded by MCFD.

### Perinatal health

Perinatal health was examined using two variables: **Apgar scores** and Length of Stay in Level 2 or 3 nurseries after birth.

Apgar scores are a quick, consistent method of assessing infant status at birth to determine relative stability or need for intervention. The scores range from 0-10 and are assessed at 1 and 5 minutes, then again at 10, 15, and 20 minutes as necessary. Nineteen infants were known to have Apgar scores < 7 at one minute of age. Of these, only three remained at < 7 at 5 minutes and 2 were < 7 at 10 minutes.

Most infants require only **Level 1** nursery care after birth. **Level 2** (intermediate care) and **Level 3** (intensive care) nurseries support smaller, sicker or gestationally younger infants. Eleven infants required Level 2 or 3 nursery care after birth: three infants for a period of one to seven days, four infants for eight to 20 days and four infants for more than 21 days.

### Underlying medical conditions

Medical challenges inclusive to this group of infants included:

- **Reflux** (4 infants)
- **Neonatal abstinence syndrome** (4 infants)
- Congenital anomalies (4 infants)
- History of respiratory illness (3 infants)
- **Failure to Thrive**/developmental delay (2 infants)
- Chromosomal anomaly (1 infant)
- Other minor medical issues (3 infants)

None of these conditions were considered life threatening and at autopsy were not found to be causal for death.

### Findings at autopsy

None of the infants had findings at autopsy that were considered causal; however, in some cases a finding was found to be noteworthy:

- One infant had a previously undiagnosed brain anomaly that could not be linked to the death.
- One infant had a skull fracture and 1 had a brain laceration, both with histories that supported the possibility of injury; neither fracture was associated with significant brain injury or death.
- Two infants had high levels of over-the-counter medication in their toxicology. Literature did not support a causal finding between the medication level and the death.
- One infant had a rare chromosomal condition that was not considered to be fatal.

## Place

### Region

The table below shows the number of deaths occurring per year, by BC Coroners Service region. These findings should be interpreted with caution, as infant mortality rates, rather than incidence, need to be considered when making comparisons between regions. Table 2.2 shows the relative rate of sudden infant death over the 5-year period.<sup>4</sup>

**Table 2.1 Incidence of sudden infant death by region**

Region	2003	2004	2005	2006	2007	Total
Fraser	6	5	8	10	7	36
Interior	4	1	3	2	4	14
V. Island	7	8	3	5	8	31
Northern	6	2	4	3	2	17
V. Metro	2	2	3	2	6	15

Source: Child Death Review Unit, BC Coroners Service

**Table 2.2 Rate of sudden infant death by region**

Region	Number of deaths	Avg. # live births / 5 years*	Mortality rate / 1,000
Fraser	36	16,245.0	2.2
Interior	14	5,829.0	2.4
V. Island	31	5,958.6	5.2
Northern	17	3,433.8	5.0
V. Metro	15	9,804.4	1.5

Source: Child Death Review Unit, BC Coroners Service

\*As per health authority data. Health authority and BCCS regional boundaries vary slightly – see Appendix.

### Location of incident

Eighteen infants were not at home at the time of their death. Circumstances varied from being away with parent(s), at babysitters' apart from parents, and with **MCFD** approved caregivers. More information on the infants who were away from home can be found in the Risk Factor section.

<sup>4</sup> Health Authority and BC Coroners Service regional boundaries vary slightly – see Appendix for maps.

## Time

### Temporality

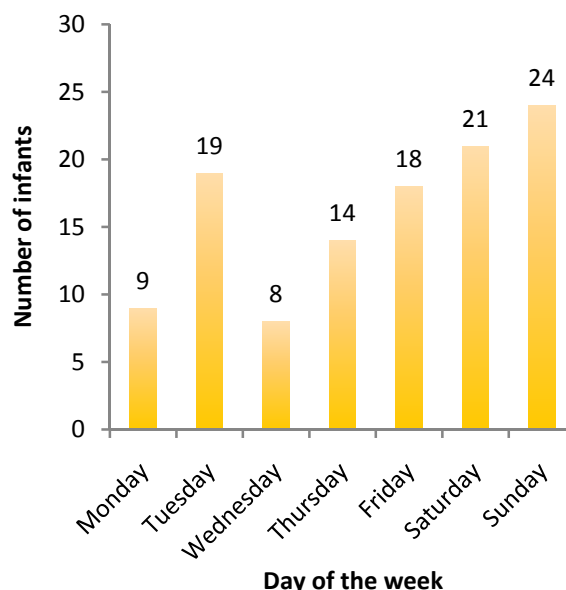
Sudden infant death traditionally had a marked seasonal peak in winter. The reasons for this were theorized to be related to increased viral illnesses at this time or overheating due to over-bundling. Several studies done after the *Back to Sleep* program was introduced demonstrated a decrease in the **seasonality** of SIDS once the **supine** (back) sleep position was promoted as safest for infants (Douglas, Helms, & Jolliffe, 1999; Leach, et al. 1999; Mage, 2004; Malloy, Freeman, 2004). Older studies showed that sudden infant death was more prevalent on weekends than weekdays. Newer studies have not necessarily paralleled those results, although some studies have shown potential associations between weekend deaths and maternal characteristics such as education level (Malloy, Freeman, 2004). Figures 2.2 and 2.3 illustrate the distribution of deaths according to weekday and season.

### Daytime versus Night-time Sleep

A newborn may sleep up to 16-20 hours per day. This decreases over time as a child grows, reaching about 10 hours a night during childhood (Benbadis, Rielo, 2008). Infants may die suddenly and unexpectedly during any sleep, day or night. This underscores the importance of making a safe sleep decision for an infant each time they are placed to sleep.

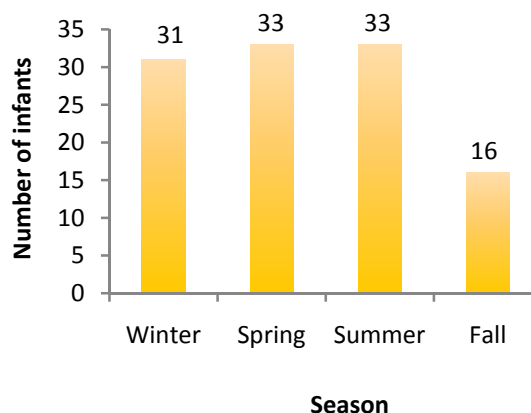
The infant was last seen alive during the **daytime** in 42 cases (37%) and the **nighttime** in 67 cases (59%). The time the infant was last seen alive was not clear in four cases. The interval between the time the infant was placed to sleep and subsequently found varied, though as might be expected longer intervals were noted during nighttime sleeps. Two infant deaths were witnessed, with intervals for unwitnessed deaths reportedly varying from three minutes to over 14 hours.

Figure 2.2 Incidence of sudden infant death by weekday



Source: Child Death Review Unit, BC Coroners Service

Figure 2.3 Incidence of sudden infant death by season



Source: Child Death Review Unit, BC Coroners Service



## 3 | risk factors

A risk factor is a variable associated with an increased risk of an outcome. Risk factors are **correlational** rather than **causal**. Research suggests that several combinations of risk factors may lead to sudden infant death.

As the cause(s) of sudden infant death is not known, and may involve a number of factors, elimination of a single risk factor does not mean that the death will be prevented; therefore, in this report we discuss risk reduction rather than prevention.

Risk factors often exist in association with each other. The “Triple Risk Model” theorizes that the cause of sudden infant death is multifactorial, or due to a number of intersecting risk factors. The three factors are: (1) a vulnerable infant; (2) a vulnerable time of development; and (3) external **stressors**. The theory suggests that a sudden death may occur when vulnerable infants are subjected to stressors at a time when their normal defence mechanisms may be structurally, functionally or developmentally diminished (Carolan, 2007; Kinney & Thach, 2009).

Risk factors in this report have been categorized as being related to the infant, physical environment, socioeconomic environment and delivery or utilization of health services.

### Infant

#### Sex

Male infants are statistically at higher risk for sudden infant death. Carolan (2007) also notes that the male-to-female ratio is 3:2. In B.C., 73 of the 113 infants (65%) who died suddenly and unexpectedly in circumstances related to sleep were male.

#### Age at death

The age at which sudden unexplained infant death occurs is a unique feature of this phenomenon. Statistically, sudden infant death occurs less frequently in the first month of life (Moon, Horne, & Hauck, 2007). The peak occurrence is from two to four months, with 90% occurring prior to six months of age. This time frame encompasses a period of dramatic developmental change involving sleep state organization. Brain weight nearly doubles, corresponding to rapid changes that integrate the functions of brain regions that direct cardiorespiratory control and arousal (Carolan, 2007).

The 113 infants ranged from 16 hours to 11 months of age. Twelve of the infants died within their first month, including two who died within 24 hours of birth. Both of these infants were bedsharing with a parent at the time of death. In B.C., the deaths peak at 2-4 months of age, consistent with international statistics, with 69% of infants dying at four months of age or less and 85% dying at six months of age or younger (see Figure 2.1).

### Prematurity

**Preterm** birth is one that occurs prior to the completion of 37 weeks gestation. Preterm birth may be **multifactorial** in origin, related to such diverse factors as maternal age, health, maternal education level and smoking status, fetal genetics, poverty, adequacy of prenatal care and multiple pregnancies (Public Health Agency of Canada, 2008). Preterm birth heightens the risk of sudden infant death, and the risk increases with decreasing gestational age (American Academy of Pediatrics, 2005; Moon, et al. 2007). Very preterm infants were found to have a later age of death than term infants, supporting the theory that a particular developmental stage is the most vulnerable for infants (Halloran, Alexander, 2006). Of the 113 infants, 39 (35%) were preterm. Of these, 24 were near term at 35-37 weeks.

### Low Birth Weight

Low birth weight is an independent risk factor for sudden infant death. Low birth weight infants were placed into two groups: **low birth weight** and **very low birth weight**. In 10% of cases, birth weight was unknown and in 73% of cases the birth weight was above 2500 grams and not a risk factor.

Twenty infants (18%) had birth weights that may have placed them at heightened risk. Eighteen infants had a low birth weight, sixteen of which were also preterm. Only two infants had a very low birth weight and both were also preterm.

### Multiple pregnancies

Infants from a multiple birth may be at heightened risk for sudden death, (Getahun, Demissie, Lu, & Rhoads, 2004). Four of the infants were from a multiple birth. The three infants from twin pregnancies were all near term (36-37 weeks) and only one was known to have a low birth weight. The triplet was preterm with a very low birth weight.

### Recent viral illness or symptoms

Hypotheses surrounding a possible link between an infectious or inflammatory etiology and sudden infant death were proposed in 1966 and research in this area continues today (Highet, 2007). Studies have shown that up to 70% - 80% of infants who die suddenly and unexpectedly have reported histories of recent mild viral symptoms, often respiratory in nature, or evidence of infection is found **post-mortem**. The extent of the illness is not sufficient to account for death (Mitchell, 2007; Highet, 2007; Carolan, 2007).

Of interest, research has found that the pattern of distribution for sudden infant death mirrors the level of **immunoglobulins** in the first year of life (Mitchell, 2009). Immunoglobulin levels drop from birth, remaining low for the first four months of life – a time when risk of sudden infant death peaks.

Infections, particularly of the respiratory system, are very common in the first year of life, and most infants with such illnesses or symptoms do not die, leading researchers to conclude that if infection does play a role it may be in conjunction with other risk factors. Prone sleeping and environmental tobacco smoke may contribute to the susceptibility of an infant with an underlying viral illness (Carolan, 2007; Highet, 2007; Mitchell, 2007; Zee, 2006).



On review, 32 infants (28%) reportedly had respiratory or gastric symptoms within 48 hours of their death. Of these 32:

- Nineteen had **prenatal exposure to tobacco smoke**
- Fourteen were either placed/found prone
- Ten infants had all three risk factors: recent viral symptoms, prenatal exposure to tobacco smoke and were placed/found prone

## Aboriginal infants

Indigenous infants are over-represented in rates of sudden infant death globally. Here in B.C. and across Canada, rates of sudden infant death among Aboriginal infants remain higher than rates for infants of other residents. Although Aboriginal infants comprise only about 8% of B.C.'s population under one year of age, 30% of the infants who died in this review were Aboriginal. For more information, see Section 5.

## Physical environment

### Sleep position

The *Back to Sleep* campaign has been credited with decreasing the number of sudden infant deaths. The initial recommendation in 1993 from the Canadian Paediatric Society (CPS) was for any non-prone sleep position - that is, **supine** or side lying. This changed in 2000 when the CPS began to recommend supine sleep only. The information was disseminated through the *Back to Sleep* campaign, which ran in Canada from February 1999 to 2000. Side lying is an unstable position as infants placed on their side may end up prone. Both the American Academy of Pediatrics (AAP) and CPS recommend supine sleep only, as do other international SIDS organizations.

Infants who are placed prone may cry less and wake less often, reasons parents may utilize this sleep position as a strategy to settle fussy infants or to promote longer nighttime sleep intervals. An infant's ability to be roused from sleep, however, is

an important protective factor against sudden infant death. Table 3.1, from the American SIDS Institute, illustrates some differences between **prone** (stomach) and **supine** (back) sleep (McEntire, n.d.).

Differentiation must be made between the position placed and the position found, as some infants may not remain in the position they are placed to sleep. Table 3.2 illustrates the positions the infants were placed and found in. Fewer than half of the infants were reportedly placed on their back to sleep. Of note, side lying is a particularly unstable sleep position; fewer than 40% of infants known to have been placed on their side to sleep were subsequently found side lying.

**Table 3.1 Differences between prone and supine sleep**

	Prone sleep	Supine sleep
Cries more		x
Wakes more		x
Harder to rouse	x	
More likely to overheat	x	
Re-breaths more	x	
Increases carbon dioxide	x	
Has more apnea	x	
Spits up more	x	x
More likely to choke	x	x
Greater risk of SIDS	x	

Source: American SIDS Institute

**Table 3.2 Comparison of infant's position when placed vs. found**

	Placed	Found
Prone (on stomach)	30	46
Supine (on back)	45	37
Side-lying	21	8
Suspended	3	3
Wedged	n/a	8
Unknown	14	11

Source: Child Death Review Unit, BC Coroners Service

When an infant is placed in the prone sleep position and is unaccustomed to it, the risk for sudden infant death increases dramatically (AAP, 2000; Paluszynska, Harris, & Thach, 2004). Infants who are inexperienced in prone sleep have a decreased ability to self-rescue from potentially unsafe sleep environments when placed prone (Paluszynska et al. 2004). This may include infants who are placed on their side but found prone. On review, data in this regard was limited. Six infants were reportedly placed in a new sleep position, and of these, only one was in an unaccustomed prone position.

### Sleep surface at time of death

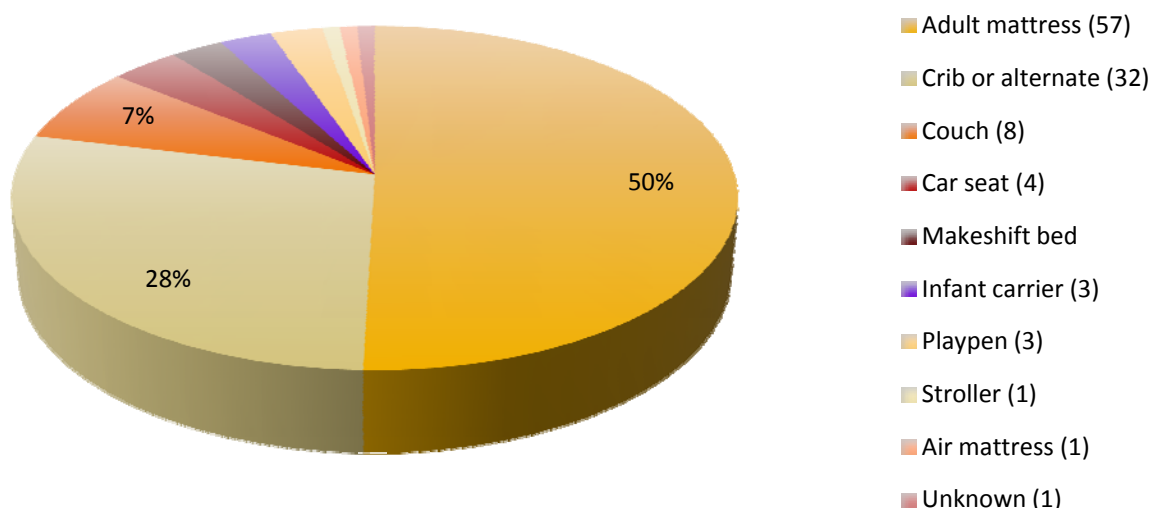
Infants are safest sleeping on a firm surface designed for infant sleep. The American Academy of Paediatrics and the Canadian Paediatric Society recommend infants sleep in cribs that conform to recognized safety standards. Surfaces such as car seats, strollers, sitting devices, adult beds, infant swings, playpens, couches, futons, waterbeds or air mattresses are not recommended (CPS, 2009).

Of the 113 infants, 32 (28%) were sleeping in a crib, cradle or bassinette designed for infant sleep. The majority of infants (57) were sleeping on an **adult mattress**; 43 were bedsharing and 14 were sleeping alone. Figure 3.1 illustrates the infant sleep surfaces at the time of death.

Four infants were sleeping in a car seat. Two of these infants were in a vehicle at the time of death. The other two infants were at home and the car seat was being used as an alternate sleep surface. Car seats are not recommended as a sleep surface outside of a vehicle as the configuration of the seat, the harness, and the infant's airway, may lead to respiratory compromise (Cote, Bairam, Deschesne, Hatzakis, 2007; Kornhauser Cerar, Scirica, Osredkar, Neubauer, & Kinane, T. 2009).

Three infants were being carried in an infant carrier, such as a Snuggli® or sling. Two of these were purchased and one was fashioned from a large scarf.

**Figure 3.1 Sleep surface used at time of death**



Source: Child Death Review Unit, BC Coroners Service

## Product safety

Two of the deaths involved problems with the use or design of a consumer product. One infant who had been napping in a borrowed playpen was found asphyxiated by collapsed side rails. The playpen was found to be a model that had been recalled. A second infant had been carried in an **infant carrier** that was too small for the infant and worn incorrectly.

The CDRU recommends that parents register newly purchased baby products with the manufacturer so that in case of recall they will be notified. Parents who obtain these products second-hand may wish to go on-line and research the appropriate instructions for use. Health Canada helps protect the Canadian public from potential health hazards by posting advisories, warnings and recalls. Parents may go to Health Canada's website at <http://hc-sc.gc.ca/index-eng.php> and access the Consumer Product Safety website, which identifies recalled products. Parents may also subscribe to the Consumer Product Safety newsletter, which emails subscribers updates when new information, consumer advisories, or product recalls are posted.

## Availability of a safe sleep surface

Not all of the infants had a crib, cradle or bassinette available for use at the time of their last sleep. The review found:

- Seventy-eight infants (69%) had a crib or safe alternative.
- Eighteen infants (16%) did not have a crib or alternative available.
- In 11 cases the availability of a crib or alternative is unknown.
- In 6 cases the availability of a crib or alternative is irrelevant, e.g. being transported in a car.

In the instances where a crib was available and not used, reasons given included:

- Preferred to bedshare (13)
- To settle/resettle a fussy baby to sleep (6)
- Ease of breastfeeding (4)
- Baby reportedly would not sleep in crib (3)
- Fell asleep feeding/cuddling on couch (2)

Of the 18 infants who did not have a crib, cradle or bassinette available, this was because:

- Eight were away from home at time of death
- Three lived in overcrowded homes
- Four lived in a family that preferred to bedshare so had not purchased a crib
- One family reported they did not have money to purchase a crib
- Two families had chosen to use a playpen as the primary sleep surface

## Sleep environment

Bumper pads were designed for infant safety at a time when crib design and mattress fit were potential hazards. Current cribs and mattresses are designed to eliminate these hazards. Bumper pads are unnecessary and pose a risk of strangulation, suffocation and entrapment (Canadian Foundation for the Study of Infant Deaths, n.d.). The American Academy of Pediatrics and the Canadian Paediatric Society recommend that the infant sleep environment also be free of quilts, comforters, pillows, pillow-like items, stuffed toys and sheepskins. Sleepers or sleep bags can be worn to eliminate the need for any other covering for the baby, except a thin blanket tucked in at the bottom and reaching only as high as the baby's chest. Thirty-two infants were in a crib when they died; 26 had **crib clutter** present.

Adult beds by design incorporate such items as pillows and loose bedding. Extra pillows are often added when infants sleep on these surfaces to prevent a fall or mark off a sleep area for baby. Unlike firm crib mattresses, adult mattresses are often soft or have a "pillow top", making them unsafe, particularly if the infant is prone. All infants sleeping on an adult bed were on a soft mattress, with soft bedding, pillows, or rolled towels in the sleep area, under, over or around them.

## Overheating

**Thermal stress** is the result of any event or process that is a threat to temperature regulation; however, it may be mild enough to cause stress to the infant without causing increased body temperature. Since 1989, thermal stress has been noted as a risk factor for sudden infant death (Guntheroth, W., Spiers, P., 2001). Thermal stress from warm weather is generally not problematic if the infant can sweat and there is no impediment to evaporation. Heat loss is determined by several factors including room temperature, external heat sources such as adults lying in close proximity during bedsharing, insulation from clothing and bedding, and infant sweating (Guntheroth, 2001).

The infant brain accounts for approximately 40% of an infant's total oxygen consumption and heat production, so sleep position and presence of head coverings are important variables in cases of sudden infant death. Heat loss is reduced (and risk of overheating is increased) when lying in a **prone** position, as the front surface of the infant's body allows for greater heat loss than the back surface. If an infant is lying prone, the risk for overheating is further increased if the head is covered by a bonnet or blankets (Guntheroth, 2001).

For the purposes of this review, overheating was identified as a possible factor in a case if relevant scene findings were present (i.e. perspiration), if the infant was found both prone and swaddled or heavily blanketed, or with head covered. Thirty-seven infants (33%) met these criteria. This number may be under-reported as one sleep study showed that 85% of infants who experienced head covering at some point during bedsharing were free from any head covering when the bedsharer later awoke (Baddock et al. 2007).

## Exposure to tobacco smoke

**Secondhand smoke** has a marked effect on the health of infants. Infants are more vulnerable than adults to the effects of secondhand smoke because their body systems are still maturing. The respiratory rate of an infant is higher than that of an adult, leading to inhalation of greater quantities of smoke (Mayo Clinic, 2008).

Nicotine from maternal smoking is known to cross the placenta, reaching levels in the amniotic fluid and fetus that exceed levels in the mother (Van Meurs, 1999). Maternal smoking increases the risk of fetal growth restriction, preterm birth, miscarriage, stillbirth and sudden infant death. It is associated with an overall increased risk of infant mortality (Public Health Canada, 2008). Babies exposed to secondhand smoke after birth have twice the risk for sudden death, and if the mother smoked both before and after the birth, the infant is at three to four times greater risk (Centre for Disease Control, 2004). Infants exposed to maternal smoking have decreased arousal from sleep (Horne, 2006; Kinney, & Thach, 2009).

In 2005, the rate of maternal smoking in B.C. was just less than 10% (Public Health Agency of Canada, 2008). Between 2003 and 2007, 61 B.C. infants (54%) who died suddenly and unexpectedly in sleep-related circumstances had **prenatal exposure to tobacco smoke**.

Most infants with prenatal exposure continue to be exposed after birth, regardless of parental efforts to minimize contact with secondhand smoke. It has been reported that urine cotinine levels (the metabolite of nicotine) of infants whose parents smoked only outside the home were one-sixth those of infants whose parents smoked in the home; however, they were still eight times higher than infants of non-smoking parents (Baddock, 2005).

**Thirdhand smoke** is residual tobacco smoke remaining after the cigarette is put out. It may be deposited onto clothing or surfaces such as couches or carpeting in the home, to be released back into the air over a period of time. Infants are vulnerable to thirdhand smoke because frequently they lay, crawl, touch, mouth and play on these contaminated surfaces. Research in this area is just beginning (Winickoff et al. 2009).

More information on smoking may be found in the bedsharing section below, and in the breastfeeding section under Mitigating factors.

Despite concerted efforts by researchers and healthcare professionals, maternal smoking during pregnancy remains a serious public health problem. Broad social and biological issues affect smoking cessation, such as low socioeconomic status, social environment, ethnicity, maternal age and nicotine dependence (Greaves et al. 2003). Effective screening and intervention with women prior to and during pregnancy, and into the post-partum period, can support cessation or reduction in women's tobacco use. Decreased maternal smoking will result in improved health for these women and their infants (BCRCP, 2006).

The CDRU supports evidence-based approaches to address maternal smoking, including best practices identified in Health Canada's *Expecting to Quit - A Best Practices Review of Smoking Cessation Interventions for Pregnant and Post Partum Girls* and the BC Reproductive Care Program's Guideline *Tobacco use in the Perinatal Period Women*.

## Bedsharing

Bedsharing is defined as sharing a sleep surface with an infant. Bedsharing can be a cultural norm, situational practice or economic necessity. The practice may be seen to have both psychological and physiological benefits, in particular with bonding and facilitation of breastfeeding (Ateah, Hamelin, 2008; Ball, 2003; Blanchard, Vermilya, 2007; McKenna, 2007; Thoman, 2006).

Bedsharing with an infant may be a risk factor for sudden unexpected death. Asphyxia can be caused by **overlay** or compression by a bedsharer, wedging or entrapment of the infant's head between elements such as a mattress, wall or other furniture, or obstruction of the infant's airway by lying against a bedsharer (Ateah, Hamelin, 2008; Ruys et al. 2007; Kemp et al. 2000). In a recent Canadian study of 212 respondents who bedshared with their infants on a regular or occasional basis, 13% reported experiencing an event where they had rolled onto or partway onto their infant (Ateah, Hamelin, 2008).

Research notes that the risk to an infant is increased if the infant is less than three to four months old or overheats, or if the bedsharer is a smoker, large, or has decreased arousal due to extreme fatigue or impairment by drugs or alcohol (Ateah, Hamelin, 2008; Blanchard, Vermilya, 2007; McGarvey et al. 2006; Ruys et al. 2007).

In May 2009, the Public Health Agency of Canada commissioned a systematic literature and policy review on the practice of bed sharing. Some key findings of this review include:

- Defining what relatively safe bedsharing is challenging; parental beds pose risks beyond SIDS, due to possibility of entrapment, wedging and falling out.

- Bedsharing seems to be increasing; upwards of 30-76% of mothers in (American) surveys reported bedsharing sometimes to always. Part time bedsharing seemed to be common in the latter part of the night in order to breastfeed, calm a fussy infant, or facilitate maternal or infant sleep.
- Seventy per cent of overlaid infants were less than three months old and more than 50% occurred in an adult bed.
- Bedsharing is particularly hazardous if mothers smoke and especially if the infant had a low birth weight.
- Bedsharing infants 10 weeks of age or younger are at greater risk of sudden death than non-bedsharers, even when maternal smoking is considered. Bedsharing for infants 30-61 days old with non-smoking parents is reported to have a nine-fold increase of sudden death.
- There is increasing evidence that the risk of bedsharing is not significant once the infant reaches 4-5 months of age, a time also associated with decreasing risk of sudden infant death.

Bedsharing methods differ from home to home and across cultures. It should not be assumed, even within an ethnically homogenous population, that all parents who bedshare do so in the same way or for similar reasons (Ball, 2009; McKenna & Volpe, 2007). There are currently no national or provincial statistics on the practice of infant/caregiver bedsharing (Ateah & Hamelin, 2008). Methods of bedsharing vary widely, including types of mattresses and bedding, position of baby within the bed, numbers and composition of bedsharers, and number of hours bedsharing per night. An international study looking at infant sleep environments in 17 countries noted that it was not possible to build a composite picture of “typical” bedsharing practices (Nelson & Taylor, 2001). The complexity and variability of the bedsharing experience must be considered when looking at results of mother-infant studies from sleep laboratories, which may not mirror practices that occur in the home (Nelson & Taylor, 2001). These

documented differences in sleep practices, as well as regional variations in definitions (**SIDS** vs. **SUDI** vs. **asphyxia**) and investigative practices for unexpected deaths make comparison of Canadian and other countries’ statistics difficult. This review found that 51 of the 113 infants (45%) were bedsharing at the time of death.

### Pattern of bedsharing

Bedsharing may be a regular, intentional occurrence due to personal philosophy, social factors such as poverty or overcrowding, or it may be a more reactive, irregular practice in response to either parental factors (fatigue, ease of breastfeeding) or infant factors (fussiness, illness).

Of the 51 bedsharers, 24 were known to be regular **intentional bedsharers**. Of the remaining 27, the review found:

- Eleven were **reactive bedsharing**, in an attempt to settle or warm an infant.
- Five were away from home and sleep arrangements were created when no crib was available.
- Five occurred when the mother fell asleep breastfeeding.
- Two infants began the night in a crib but were transferred to an adult bed at some point during the night by a parent who in the morning did not remember doing so.
- One mother suffered a medical event while bedsharing on a couch and lost consciousness.
- One infant died bedsharing in a hospital bed a few hours after birth.
- In 2 cases the pattern of bedsharing was unknown.

Two of the above infants were bedsharing with a parent who was awake at the time of death.

## **Bedsharing surfaces**

- The majority of bedsharing (43 of 51 infants) was on an adult mattress.
- Six infants were known to have been bedsharing on a couch at the time of death, including one infant whose parent experienced a medical event.
- Bedsharing on a couch is associated with a particularly high risk of sudden infant death (McGarvey et al. 2006; Canadian Paediatric Society, 2008).
- The remaining two infants were bedsharing on a makeshift bed on the floor.

## **Bedsharing position**

Parents who choose to bedshare should place their baby supine. In this review, the position the infant was placed to sleep is known in 44 of the 51 cases. Of these, 24 were placed supine, 11 were placed on their side and nine were placed prone.

## **Bedsharing partners**

Studies have shown that mothers bedshare differently than other bedsharers. There are also differences in the ways that breastfeeding and non-breastfeeding mothers bedshare. Mothers who breastfeed tend to curl around their infant, with the infant's face at breast level; non-breastfeeding mothers and infants tend to lie face to face, with the infant's head closer to the adult pillows (Ball, 2009; Baddock et al. 2007). Of the 51 bedsharing infants, more than half were bedsharing with their mother alone.

In the 13 cases with multiple bedsharers, the infant slept between bedsharers in three cases, between Mom and the edge of the bed in seven cases and between Mom and the wall in two cases. In one case, the position of the baby with respect to the other bedsharers is unknown.

In two bedsharing cases the parent was awake and witnessed the infant stop breathing.

## **Bedsharing and breastfeeding**

Of the 51 bedsharing infants, 41 were bedsharing with their mother at the time of death; of these, 17 were exclusively breastfed, 16 received formula feeding and seven received both breast milk and formula. One infant died bedsharing in hospital within hours of being born.

## **Bedsharing and smoking**

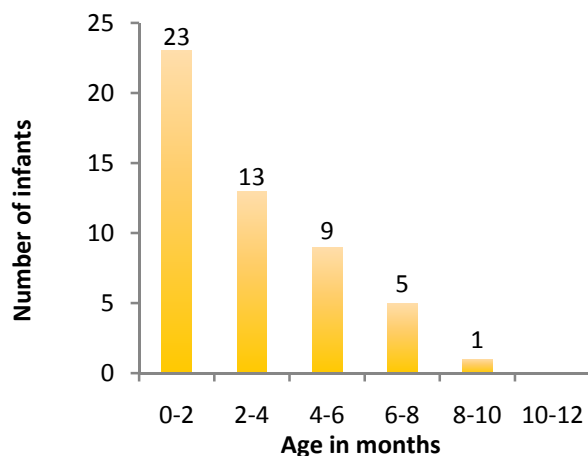
Bedsharing with a smoker is a significant risk factor for sudden infant death (Ateah, Hamelin, 2008; Kemp et al. 2000; McGarvey et al. 2006; Ruys et al. 2007). Risk remains even if the person smokes outside the residence (Baddock, 2007; Mayo Clinic, 2008). Of the 51 infants who were bedsharing, 26 were bedsharing with a smoker.

## **Bedsharing and substance use**

Bedsharing becomes higher risk if the bedsharer has a decreased level of arousal due to extreme fatigue or ingestion of alcohol, illicit drugs or sedating medications. This makes them less able to respond to infant cues or distress (Ateah, Hamelin, 2008; McGarvey et al. 2006). The review found that eight of the 51 infants were bedsharing with a person who had been intoxicated within 24 hours of bedsharing, while four infants were bedsharing with a person who had used an illicit drug within four hours of bedsharing.

Substance use is a variable that is difficult to isolate. Mothers who use substances such as alcohol or illicit drugs may also be more likely to smoke cigarettes, live in poverty, or have a lower level of education, all independent risks for sudden infant death. For example, of the eight bedsharers who had been intoxicated within 24 hours of the event, five were also smokers. All of the bedsharing partners who were under the influence of illicit drugs were also smokers. One infant was bedsharing with a person who was a smoker and also under the influence of both alcohol and illicit drugs.

**Figure 3.2 Age of infants bedsharing at the time of death**



Source: Child Death Review Unit, BC Coroners Service

### Bedsharing with the very young infant

Very young infants appear to be more at risk for sudden death while bedsharing, even among non-smoking parents. Studies vary regarding the age most at risk, generally recognizing infants younger than two to four months (Alm, et al. 1999; Fu, Colson, Corwin, & Moon, 2008; McGarvey et al. 2006; Mitchell, 2007; Moon et al. 2007; Ruys et al. 2007). Of the 51 bedsharing infants, the majority (36) were four months of age or less.

### “Safe Bedsharing”

There are many proponents for bedsharing as a normal, natural, biologically appropriate practice that facilitates bonding, breastfeeding and restorative sleep (Ateah, Hamelin 2008; Ball, 2003; Blanchard, Vermilya, 2007; McKenna, 2007; Thoman, 2006). The challenge is creating a safe bedsharing environment that does not include known risk factors such as exposure to tobacco smoke, impaired bedsharers, heavy or soft bedding. Three of the most common risk factors discussed in safe sleep risk reduction are bedsharers who are smokers or under the influence of drugs or alcohol. If these three factors are considered for the 51 infants:

- Twenty-two had none of the risk factors
- Twenty-one had one risk factor (generally smoking)
- Seven had two risk factors
- One had all three risk factors

Dr. James McKenna, 2007, a recognized advocate for bedsharing (which he terms “cosleeping”), describes the “proper way to cosleep” as involving “parents (who) do not smoke, are sober, have chosen to bedshare and are breastfeeding their baby. The bed frame (is) completely removed and the mattress, placed at the centre of the room away from walls and furniture. Light blankets and firm, square pillows are used. No older children, pets or stuffed animals are allowed in the bed.” (p. 90). None of the 51 infants who were bedsharing at the time of death were in a situation such as Dr. McKenna advocates. Once the infants who were exposed to environmental tobacco smoke, bedsharing with a caregiver under the influence of alcohol or illicit drugs, placed prone or side lying or bedsharing with a sibling were excluded, only two bedsharing infants remained. Neither infant was breastfeeding at the time of death.

### Away from home

A recent German study noted that the risk of sudden unexpected infant death is higher when the infant sleeps in a friend or relative’s house (Vennemann et al. 2009). American research suggests that 20% of sudden infant deaths in the US occur when infants are in the care of someone other than their parents (Moon et al. 2007). A total of 18 infants were not at home at the time of their death. Of these infants:

- Seven were sleeping at a babysitter’s house
- Three were in the community in an **infant carrier**
- Two were away from home, in parental care
- Two were in **MCFD**-approved respite care with caregivers who were new to the infant
- Two were being transported in a vehicle
- One was camping with a parent
- One was still in hospital post-partum



## Socioeconomic environment

### Income

Maternal socioeconomic status is an important determinant in considering both infant mortality and sudden infant death. Low neighbourhood income is associated with increased risk of preterm birth, **small for gestational age** birth, neonatal and **post-neonatal death**. A population-based study in Quebec from 1991-2000 analyzed and ranked neighbourhoods based on post-neonatal deaths and neighbourhood income. The wealthiest neighbourhood had a post-neonatal death rate of 1.4/1,000 while the poorest had a post-neonatal death rate of 2.0/1,000 (Luo, Wilkins, & Kramer, 2006).

For the purposes of this report, CDRU partnered with the Ministry of Housing and Social Development to determine if any mothers were on **Income Assistance** (IA) from the time of their infant's conception to the time of death.

Forty of the mothers were known to be in receipt of IA during pregnancy or the lifetime of their infant. Nineteen of these mothers also required additional crisis payments during this period, with an additional three mothers requiring crisis payments only around the time of death, possibly to assist with death expenses.

A further 19 mothers, though not known to be on IA, were noted during the coroner's investigation to have economic challenges manifested through housing insecurity, small overcrowded homes, homes with rodent infestation or mould, inability to live independently and unemployment. In total, 59 mothers (52%) had significant economic challenges.

### Maternal education

Low maternal educational level is a risk factor for sudden infant death. A population-based study out of Quebec noted that among individual measures of socioeconomic status, maternal education was the most powerful determinant of infant health; the effects of maternal education were larger than,

and independent of, the effects of low income. In a 10-year study from 1991-2000 in Quebec, the post-neonatal death rate for women with 14 or more years of education was 1.1/1,000; the rate for women with less than 11 years of education was 2.8/1,000 (Luo et al. 2006).

Education levels of the mothers in this report are difficult to quantify due to limited data. The Perinatal Database provided information on 22 mothers whose years of school completed ranged from eight to 21.

### Family structure

Single parent families may face challenges such as insecurity around food, shelter or finances, which may in turn impact infant mortality. Of the 113 families, 25 (22%) were known to be single parent and 62 (55%) were known to be two-parent families. In the remaining cases, the mother's relationship status was either unknown or there is conflicting information from various data sources.

### Maternal age

Young maternal age (less than 20 years) is associated with increased risk for sudden infant death (University of Rochester Encyclopedia, American SIDS Institute). Sixteen of the mothers (14%) were less than 20 years of age when they gave birth.

### Housing

Housing insecurity can be linked with maternal stress levels and income insecurity. Two families were known to have no fixed address or be living at a shelter. In three other cases, the housing situation is unknown. Six families lived in a trailer and six in a basement suite. In the remaining 96 cases, the family lived in a house, apartment, townhouse or condominium.

Overcrowding may be defined as the number of persons living in a private household at a density greater than one person per room (Last, 2001). Overcrowding may result in crowded sleeping surfaces or inadequate room to place a crib. Determination of overcrowding was not possible by definition; however, 15 infants (13%) were living in conditions that could reasonably be described as overcrowded.

### Prenatal substance use

Canadian studies show that from 2000-2005, approximately 10-14% of pregnant women consumed alcohol. This included all women who reported drinking, regardless of amount and frequency. The range of reported alcohol use varied according to the age of the mother (older mothers more likely to report consumption) and geographic location (lowest in Newfoundland and Labrador; highest in Quebec). As no safe level of alcohol consumption has been established, abstinence is recommended for women who are, or are considering becoming, pregnant (Public Health Agency of Canada, 2008; March of Dimes, 2006).

American studies note four to five per cent of American women use illicit drugs during pregnancy. Illicit use was seen among both higher and lower socioeconomic status groups and in both black and white women (Chasnoff, Landress, & Barrett, 1990; Mathias, 1995). Canadian statistics are more difficult to obtain. In 1990-91, slightly more than 12% of infants in downtown Toronto and three per cent in Toronto suburbs had prenatal cocaine exposure. As most studies are based on maternal self-reporting, these statistics should be interpreted with caution. (Hutson, 2006).

Although maternal use of alcohol and illicit drugs is detrimental to the infant, isolating substance use as an independent risk factor for sudden infant death is difficult. This is due to confounders that are often associated with alcohol and illicit use during pregnancy such as mental health issues, poverty, inadequate prenatal care, poor nutrition, high stress, maternal age and low birth weight

(Alm et al. 1999; Klonoff-Cohen, Phung, 2001; March of Dimes, 2006).

One study by Klonhoff-Cohen and Phong, 2001, noted no association between *maternal* recreational drug use and sudden infant death after adjusting for smoking, but that *paternal* marijuana use from conception through to the postnatal period was significantly associated with sudden infant death after adjusting for smoking and alcohol use. Paternal substance use was not data consistently collected by the BC Coroners Service from 2003 to 2007.

Of the 113 infants, 18 had **prenatal exposure to alcohol** and 20 had **prenatal exposure to illicit drugs**. These factors did not exist in isolation, but rather were associated with a cluster of other risk factors. For example, many mothers who used alcohol or illicit drug use during pregnancy also smoked cigarettes (89% and 85% respectively) or had income insecurity (83% and 85%). Eight mothers used both alcohol and illicit drugs during pregnancy.

## Health Services

### Obstetrical history

Personal health care practices have an impact on rates of sudden infant death. These practices may include individual variables such as pregnancy planning, smoking, drinking alcohol, using illicit drugs, or self-management of general health and well-being.

Shorter spacing between pregnancies leads to increased risk of sudden infant death (Hunt & Hauck, 2006). While data on spacing between pregnancies is unavailable, of the 107 mothers whose obstetrical history is known:

- Eighty were **Gravida 1-3** (were having their first, second or third pregnancy)
- Twenty-one were Gravida 4-5
- Six were Gravida 6-8
- One was Gravida 9 or higher

## Prenatal care

Infant mortality in general is influenced by the quality and frequency of prenatal care expectant mothers receive. This may be influenced by such disparate variables as maternal lifestyle choices, geographic isolation, finances, and mental health issues. Mothers who receive early and regular prenatal care are twice as likely to deliver babies with healthy birth weights (Vancouver Island Health Authority (VIHA). Late or no prenatal care may place an infant at heightened risk for sudden death (University of Rochester Medical Centre Encyclopaedia). Prenatal care directly influences birth outcomes, which then impact rates of infant mortality, including sudden infant death. In this report, prenatal care refers to contact with a primary care provider such as a physician or midwife. In practice, prenatal care may include broader programs such as nutritional support.

Figure 3.3 illustrates when mothers first sought medical/midwifery care for their pregnancy. Thirty-eight mothers (34%) were known to have sought care in the first **trimester**. The recommendations for prenatal visits are once a month until month eight, once every two weeks until month nine, and weekly until delivery, for an average of 10 to 14 visit (VIHA, n.d.). Sixty-two mothers (55%) were known to have less than the recommended number of prenatal visits; 22% had five prenatal visits or less.

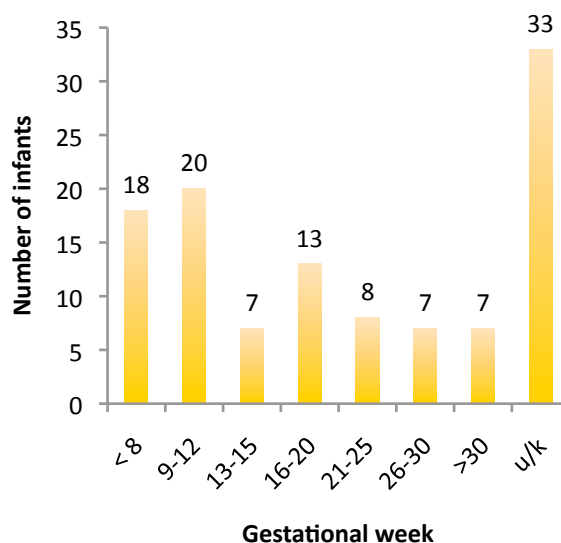
There may be many reasons why mothers do not access prenatal care, including hiding of a pregnancy, difficulty accessing prenatal care due to geographic isolation, cultural considerations, pregnancy undetermined until late in gestation, or maternal experience with previous pregnancies.

Of the 25 mothers who had five or fewer prenatal visits:

- This was the first pregnancy for three mothers and the second pregnancy for one mother who had no living children
- Twenty-one mothers already had children (seven had one child; seven had two children; and seven had three to five children).
- Four mothers were under 20 years of age
- Ten mothers were Aboriginal

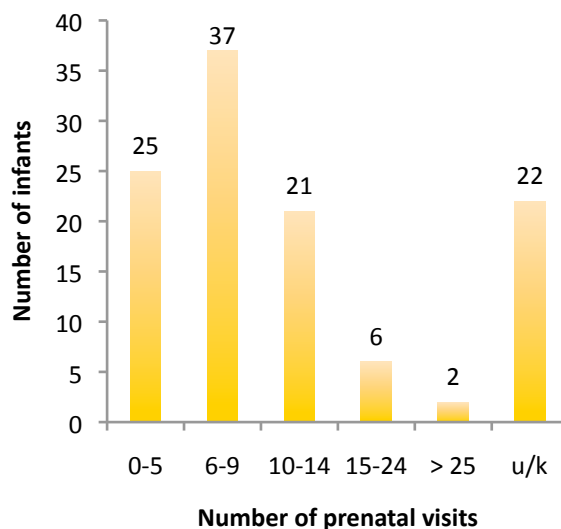
Mothers with increased numbers of prenatal visits may be experiencing high risk pregnancies or complications of pregnancy. In such cases, maternal hospitalization during pregnancy may be required. Eighty-five mothers were reportedly not hospitalized during their pregnancy.

**Figure 3.3 Onset of first contact with physician by gestational week**



Source: Child Death Review Unit, BC Coroners Service

**Figure 3.4 Number of prenatal physician visits**



Source: Child Death Review Unit, BC Coroners Service



## 4 | mitigating factors

A mitigating or protective factor is a variable associated with increased protection or reduced vulnerability from a specific outcome. In cases of sudden infant death, evidence-based mitigating factors include sleeping supine, breastfeeding, room-sharing and use of a pacifier.

### Back to sleep

The Back to Sleep program was launched nationally in 1999 with the goal of increasing awareness of the risk factors and risk reduction strategies for sudden infant death in Canada (Public Health Agency of Canada, 2008). Supine, or back sleep, is the recommended sleep position for infants (AAP Task Force on Sudden Infant Death Syndrome, 2005; Canadian Paediatric Society, 2008).

Many parents worry about the risk of choking when infants lie on their back. This risk is not borne out statistically. Additionally, one study tested sleeping infants who were instilled with a small amount of water into the back of their mouths. Infants sleeping prone swallowed only once within 10 seconds, their respiratory rate decreased and they did not rouse. Infants sleeping supine swallowed eight times in 10 seconds, their respiratory rate increased and they roused within two seconds (Jeffrey, Megevand, & Page, 1999). All these actions are protective mechanisms.

Forty-five infants (40%) were known to be placed supine at the time of their last sleep.

### Roomsharing

Roomsharing is the sharing of a room but not a sleep surface. Some jurisdictions may refer to this practice as co-sleeping. The infant sleeps close to the adult bed for easy access during the night. Evidence is growing that roomsharing is associated with a reduced risk for sudden infant death (AAP Task Force on Sudden Infant Death Syndrome, 2005; Canadian Paediatric Society, 2008). The American Academy of Pediatrics and the Canadian Paediatric Society both recommend a separate but proximate sleep surface for infants.

Seven infants were known to be roomsharing, although one infant was roomsharing in the living room. Of note, 42 infants died during daytime sleep, a time when roomsharing is less likely to be practiced.

### Breastfeeding

Breast milk is the most complete form of nutrition for infants. It has antibodies to help protect the infant from bacteria and viruses; infants who are not **exclusively breastfed** have higher rates of ear infections, gastric and respiratory diseases. Some studies suggest that non-breastfed infants have higher rates of

sudden infant death (National Women's Health Information Center, 2009). The Academy of Breastfeeding Medicine (ABM), in 2008 noted that although several studies and meta-analysis have found a significant association between breastfeeding (exclusively for the first four months) and a lowered risk of SIDS, there is insufficient evidence to show a causal link between breastfeeding and the prevention of SIDS. The ABM recommends that any recommendation that might impede the initiation or duration of breastfeeding be carefully weighed against benefits. The ABM supports counselling parents of potentially unsafe practices such as:

- Environmental tobacco smoke
- Placing infants in adult beds prone/side-lying or leaving them on an adult bed alone
- Infants bedsharing with other children
- Bedsharing with infants less than eight to 14 weeks of age

Bedsharing is often promoted by breastfeeding advocates, as breastfed babies who bedshare feed more often and for a longer duration (McKenna, Mosko, & Richard, 1997). Bedsharing is not without risk, especially for infants less than four months old, a time when exclusive breastfeeding is more common (Alm, et al. 1999; Fu et al. 2008; McGarvey et al. 2006; Ruys et al. 2007). Of the 31 infants who were exclusively breastfeeding at the time of death, 20 were bedsharing at the time of death. Of these 20, 17 were bedsharing with Mom or Mom and another person. Three infants were bedsharing with Dad.

The Canadian Perinatal Health Report 2008 Edition notes that in 2005, B.C. had a 93% breastfeeding initiation rate, with the rate of exclusive breastfeeding dropping to approximately 24% at six months. In the 113 cases reviewed, 53 (47%) mothers were known to have initiated breastfeeding at birth, significantly lower than the rates published for breastfeeding initiation in B.C. At the time of death, 31 mothers (26%) were still exclusively breastfeeding, 67 (60%) were feeding their infants formula and 10 (9%) mothers were offering both breast milk and formula. In five cases, the method of feeding is unknown.

## Pacifier Use

Several studies have reported a protective effect of pacifier use. Evidence in this area is emerging and the protective mechanism remains unknown. Pacifier use may be controversial among breastfeeding advocates, particularly if pacifiers are introduced prior to the establishment of breastfeeding. Currently, the American Academy of

Pediatrics recommends caregivers consider offering a pacifier at sleep time, although the pacifier should not be forced into use or reinserted once the infant has fallen asleep. In exclusively breastfed infants, pacifier introduction may be delayed for one month to firmly establish breastfeeding, as the risk of SIDS is lower at this time (AAP Task Force on Sudden Infant Death Syndrome, 2005). Historically, the use of pacifiers was not data consistently collected by the BC Coroners Service. As evidence grows to support pacifier use as a protective factor, this will become a data variable collected by protocol and reviewed by the BC Coroners Service.

Smoking one to three cigarettes just before breastfeeding is associated with a four- to five-fold increase in nicotine levels in breast milk. Nicotine is not listed as a drug contraindicated during breastfeeding; however, because the benefits to the baby outweigh the risks (Menella et al., 2007).

# 5 | aboriginal infants

For many years Aboriginal residents have experienced significantly higher rates of infant mortality than other residents, including higher rates of sudden infant death.

The reasons for this are **multifactorial** and may include inadequacy of prenatal care, rates of maternal smoking, poverty, and maternal age and education level (BC Provincial Health Officer, 2009). A recent study noted that SIDS<sup>++</sup> accounted for approximately 59% of **post-neonatal deaths** and one-third of overall infant deaths amongst B.C.'s First Nations population (BC Provincial Health Officer, 2009). The Provincial Health Officer reports B.C.'s mortality rate from SIDS<sup>5</sup> from 2002 to 2006 was 13.2 for **Status** Indians and 3.0 for other residents, demonstrating a four times over-representation (BC Provincial Health Officer, 2009).

In this review, 34 of the 113 infants (30%) were Aboriginal. Aboriginal infants comprise only about eight per cent of B.C.'s under one population, confirming an over-representation of this population.

One infant's ancestry was unknown, but of the remaining infants, 31 infants were of First Nations ancestry and two were of **Métis** ancestry.

The majority of B.C.'s Aboriginal peoples live off-reserve. From 1998-2004, Status Indian mothers who lived off-reserve had a significantly higher rate of infant mortality. Approximately 80% of the Aboriginal infants in this review lived off reserve (BC Provincial Health Officer, 2009).

In coroner cases, Aboriginal infants are identified through self-identification by the parent, notation on the designated portion of the Registration of Death certificate, or through records from child-serving organizations. Due to these limitations, it is generally accepted that these numbers are under-reported.

## Summary of findings for Aboriginal infants

- The sex and age at death for the Aboriginal infants parallels the findings for all B.C. infants and global statistics.
- Two Aboriginal infants were in the care of **MCFD** at the time of death. A third infant was living with his parent in a supportive shelter partially funded by MCFD.
- The majority (68%) of the Aboriginal infants died in the Vancouver Island and Northern regions.
- Over 40% of the Aboriginal infants were known to have died during daytime sleep.
- The rate of **preterm** birth for the Status Indian population is significantly higher than the rate for other residents, though the rate is increasing for both populations (BC Provincial Health Officer, 2009). This review did not demonstrate an over-representation among preterm Aboriginal infants.

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<sup>5</sup> See Appendix C for clarification on BC Vital Statistics Agency coding of SIDS

- There were 10 preterm Aboriginal infants. Most were near term at 35 to 37 weeks, paralleling the overall trend.
- Thirteen Aboriginal infants reportedly had viral symptoms within 48 hours of death. Half of these infants were also prenatally exposed to tobacco smoke.
- Almost half of the Aboriginal infants were placed **supine** (on their back) at the time of their last sleep. This is higher than the numbers seen in other residents.
- The majority of the Aboriginal infants (56%) were sleeping on an adult mattress, a number only slightly higher than other residents.
- Significantly fewer Aboriginal infants were found to meet the criteria for potential **overheating**. While less than 20% of Aboriginal infants met the criteria, almost 40% of other infants did.
- **Prenatal exposure to tobacco smoke** appeared more prevalent among the Aboriginal infants, with 62% being exposed to maternal smoking.
- Aboriginal and non-Aboriginal infants who died suddenly and unexpectedly had similar rates of bedsharing. More than half of the Aboriginal bedsharing was an **intentional** regular practice in the family.
- Half (eight of 16) of the Aboriginal infants were sleeping with a person who was sober and non-smoking.
- Five of the 16 bedsharing Aboriginal infants were with a person who had been intoxicated by alcohol within 24 hours of bedsharing. One infant bedshared with a person who had used an illicit drug within four hours of bedsharing.
- Bedsharing with a smoker was lower among Aboriginal infants. Six of 16 bedsharing infants were bedsharing with a smoker.
- Seven of 34 Aboriginal infants were away from home at the time of their death; 11 of 79 non-Aboriginal infants were away from home. Of the seven Aboriginal infants, four were in the care of a babysitter.
- Research has widely recognized associations between poverty and poor health outcomes (BC Provincial Health Officer, 2009). The majority of Aboriginal mothers (71%) were known to have economic challenges, compared to 44% of other mothers. Eight Aboriginal mothers also required additional crisis payments during this period with an additional two mothers requiring crisis payment only around the time of death, possibly to assist with death expenses.
- Maternal age of less than twenty years is also associated with increased risk for sudden infant death (University of Rochester Encyclopedia, n.d.; American SIDS Institute, n.d.). Although the teen pregnancy rate decreased significantly from 1992-2007 for both Status Indian and other populations, the Status Indian rate remained nearly four times higher than the rate for other residents. In 2006-2007, Status Indians had significantly higher teen pregnancy rates than other residents throughout B.C. Despite this, B.C. and Canadian studies have shown that teen pregnancy is not a risk factor for infant mortality in Status Indians, though it is for other residents (BC Provincial Health Officer, 2009). The CDRU review found there were 16 infants with teen mothers, eight of whom were Aboriginal.
- Adequate housing is vital for well-being and is a recognized social determinant of health. The BC Provincial Health Officer's 2009 Report on Aboriginal Health and Wellbeing notes an estimated 17% of housing units on-reserve in Canada need major repairs, and nearly 5,000 housing units need replacing. Additionally in the same year, a need for over 20,000 additional housing units was noted. Of the 15 infants in the CDRU review where overcrowding was identified as a risk factor, nine were Aboriginal.



- From 1998-2004, Status Indian mothers had a higher reported percentage of substance use than other mothers. Data was reported only if substance use was seen as a risk factor and in many instances physicians did not fill out the section on a prenatal form. Therefore, this increase may reflect increased use, increased screening for target populations, or that health care providers answered based on previous knowledge or assumptions. From 2002-2006, overall infant mortality rates were significantly higher for Status Indian and other mothers who reported using cigarettes, alcohol or illicit drugs during pregnancy. Status Indians mothers who used alcohol had the highest mortality rate (BC Provincial Health Officer, 2009).
- Of the 34 Aboriginal infants represented in this review, six had **prenatal exposure to alcohol** and six had **prenatal exposure to illicit drugs**. These numbers parallel those seen in the non-Aboriginal population.
- Globally, indigenous women suffer from a lack of prenatal care and poor pregnancy outcomes. Delayed onset and infrequent prenatal care may be a result of differing perceptions of pregnancy or barriers to accessing care. A Manitoba study found that women who received inadequate prenatal care were more likely to be Aboriginal, live in poverty, have stressful lives and have low self esteem (PHO, 2009).
- Studies have shown that Status Indian mothers initiate prenatal care after the first trimester in significantly higher numbers than other mothers (BC Provincial Health Officer, 2009). Nine mothers (26%) had first contact with their primary care provider (physician or midwife) in the first **trimester** of their pregnancy. Eleven mothers had first contact after 20 weeks gestation and four after 30 weeks gestation.
- The Provincial Health Officer's 2009 report notes that the rate of "inadequate prenatal care" (*defined as fewer than nine visits*) was more than twice as high as other mothers from 1998-2004 and that Aboriginal mothers on-reserve had less prenatal care than those off-reserve. In the CDRU's review, 21 mothers (62%) were known to have had nine or fewer visits with their primary care provider prior to delivery.
- Breastfeeding initiation rates approached 60% in the Aboriginal infant group, a rate slightly higher than the non-Aboriginal group. At the time of death, ten infants were being **exclusively breastfed**, a similar number to the non-Aboriginal cohort.
- An area of interest is emerging in the area of Aboriginal sudden death with regard to an inborn genetic condition called **CPT1 deficiency**. This condition appears to be quite common in certain Aboriginal populations and may be linked to adverse health outcomes. Historically, B.C. infants were not screened for this genetic condition; however, this practice has shifted. Research is underway to examine the historical deaths of Aboriginal infants and children to better understand CPT1 deficiency, its rates, who may be at greater risk and to further understand the implications to both the Aboriginal and non-Aboriginal populations. CDRU expects to be able to report out on this more thoroughly in the future.



# 6 | myths about sudden infant death

**Myth:** Bumper pads are the cause of most sudden infant deaths.

**Fact:** Bumper pads were created to keep babies safe in an era where crib design was not regulated and injury from entrapment between widely spaced crib rails was possible. Bumper pads today are unnecessary and may pose a threat of airway obstruction or strangulation; however, none of the deaths in this retrospective review were attributed to their presence.

**Myth:** Sudden infant death is no longer an issue.

**Fact:** Due to changes in terminology and classification of sudden infant death (**SIDS** vs. **SUDI** vs. **asphyxia**), the rate of SIDS has dropped in most jurisdictions. This is frequently offset by an increase in SUDI or asphyxial deaths. Sudden unexpected and unexplained infant death remains the leading cause of **post-neonatal death** of infants.

**Myth:** All bedsharing is practiced in the same way and for the same reasons.

**Fact:** Bedsharing is a complex phenomenon and defies generalizations for a “typical” depiction. Bedsharing may be practiced for cultural, philosophical, strategic or economic reasons, and variations include the number and composition of bedsharing partners, sleep position and surface and sleep environment.

**Myth:** Smoking is not harmful to the baby if done outside the home.

**Fact:** Infants remain exposed regardless of parental efforts to minimize contact with smoke. Urine cotinine levels (the metabolite of nicotine) of infants whose parents smoked only outside the home were one-sixth those of infants whose parents smoked in the home; however, they were still eight times higher than infants of non-smoking parents.

**Myth:** They call it “crib” death because sudden infant deaths happen in cribs.

**Fact:** The majority of infants who died in B.C. over the five year period were not in a crib, cradle or bassinette. Most were on an adult mattress.

**Myth:** Sudden infant death only happens during the night.

**Fact:** Sudden infant death in sleep-related circumstances may occur at any time, day or night, underscoring the need to make a safe decision each time an infant is placed to sleep.

**Myth:** Vaccinations cause sudden infant death.

**Fact:** Vaccinations are given to infants at two and four months of age, a time when the risk of sudden infant death is peaking, leading some to question a relationship between the two. There is no evidence to suggest a causal link between these two events.

**Myth:** If I'm sober and a non-smoker, bedsharing is safe.

**Fact:** Evidence now shows that bedsharing has some inherent risk, particularly for younger infants. That risk is heightened if the bedsharer is a smoker or is unable to rouse to infant cues due to substance impairment or extreme fatigue. Removal of these risk factors does not remove the risk.

**Myth:** Older generations know best.

**Fact:** Knowledge of sudden infant death and how it can be prevented has improved over time. Although elders should be respected for the knowledge, advice and tradition they pass down, new parents can benefit from the safe sleep practices that current research supports.

**Myth:** My family has bedshared for generations, so it must be safe.

**Fact:** Honouring your traditional practices is important, as long as the sleep practice and environment remains the same. For example, if your family traditionally bedshared on a firm flat mattress on the floor with a light blanket, and you now bedshare on a soft mattress covered by a duvet, the traditional practice is not the same, and the degree of risk to the baby is increased.

# 7 | recommendations

A key component of the Child Death Review Unit's mission is to move findings into preventive action that aims to improve the health, safety and well-being of all children in British Columbia.

This section outlines recommendations for improving the province's collective approach to reducing the incidence of sudden infant death. Recognizing the importance of a multi-level approach to risk reduction, recommendations provide specific actions that governments, health and social systems, industry and community organizations can take to support risk reduction and achieve healthier outcomes for infants and families.

CDRU recommendations were informed by available literature on the prevention of sudden infant death, in addition to the perspective of stakeholders who have expertise in addressing the issue and are responsible for providing services to infants and families. In preparation for recommendation development, the CDRU underwent a comprehensive consultation with health organizations and front-line health professionals across the province.<sup>6</sup> The CDRU conducted interviews with decision-makers working at the organizational-level and distributed an electronic survey to solicit input from those who work directly with infants and families. The survey was designed to gather information on what health professionals in B.C. recommend with respect to best practices for safe infant sleeping; what strategies, approaches and resources health professionals use to promote risk reduction; and how we, as a province, can improve our efforts to reduce the incidence of sudden infant death in B.C.. The survey was distributed to a variety of

practitioners across the province, including family physicians, paediatricians, public health nurses, maternity nurses, midwives, pregnancy outreach workers and those working in Aboriginal communities. The CDRU received over 1,000 responses to the survey, providing a rich body of practice-based evidence to learn and draw from.

Results of the CDRU retrospective case reviews, best practice review and provincial consultation were analyzed and consolidated into recommendations under nine target areas for action:

- 1) Prenatal care
- 2) Public education
- 3) Education/training of health care providers
- 4) Infant death classification
- 5) Social determinants of health
- 6) Consumer product safety
- 7) Home visiting
- 8) Research
- 9) Aboriginal infants

Recommendations were crafted to address gaps in policy, practice, programs and partnerships or to advance prevention efforts already underway in the province. A recommendation development tool created by the U.S. National Center for Child Death Review was applied to ensure that the proposed recommendations were evidence-based, feasible and linked to findings of the retrospective review.

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<sup>6</sup> Please see the *Acknowledgements* for a list of agencies involved in the consultation process

To ensure that actions being proposed reflect a multi-faceted approach, recommendations are organized across the Spectrum of Prevention (see Appendix C). The Spectrum of Prevention (Cohen, 1999) is endorsed by the National Center for Child Death Review as being a framework that review teams can use to create long-lasting, positive changes within their jurisdictions.

The CDRU supports and monitors the implementation of recommendations on an ongoing basis. Follow-up activities pertaining to the recommendations of this report will be highlighted in the CDRU 2009 Annual Report. Publicly reporting on the implementation of recommendations is a means of highlighting the efforts that are being made in support of prevention and is an opportunity to demonstrate the commitment of government, health systems, industry and community organizations in this regard. Monitoring the implementation of recommendations also provides the CDRU with a means of evaluating the positive impact that the child death review process is having on child health and safety in terms of improved policy, practice, program delivery and partnerships.

Although the underlying cause of many sudden infant deaths still remains unknown, there is a growing body of knowledge on how to mitigate the risk and improve outcomes for infants and families. The CDRU supports a multi-level approach to risk reduction that is non-punitive, guided by evidence, culturally sensitive and family-centred.

## 1 | Prenatal care

### ***Governments and the health system can:***

- Incorporate safe sleep education into all prenatal care programs and services delivered in B.C.
- Support the expansion of pregnancy outreach programs to improve service delivery and pregnancy outcomes for high-risk parents and families.
- Establish and promote early prenatal registration programs to increase early initiation of prenatal care and identify parents requiring additional supports.

## 2 | Public education

### ***Governments, the health system and community organizations can:***

- Establish a clear, balanced and standardized evidence-based best practice for safe infant sleeping in British Columbia.
- Ensure all provincial, regional and hospital-based resources align with provincial best practice guidelines to promote the delivery of consistent, uniform messaging to both health care providers and the public.
- Initiate dialogue and education with parents prenatally regarding safe infant sleep and reinforce risk reduction messages through to the post-partum period.
- Use a family-centred approach when providing safe sleep education to new parents, including engaging male partners and extended family such as grandparents.

- Develop specific messaging to engage fathers and male partners in safe sleep and other infant care issues.
- Move away from a reliance on print materials to an approach that uses multiple media to deliver safe sleep messages.
- Broaden the target population for safe sleep education to include extended family members that are known to influence parental decision-making, including grandparents.
- Develop and implement a social marketing strategy for sudden infant death and safe sleep to reinvigorate public awareness of the issue, building on existing resources, momentum and partnerships.
- Develop targeted educational strategies for populations at higher risk of sudden infant death, including young parents, tobacco-using households and Aboriginal families.
- Translate safe sleep materials and/or include clear illustrations to ensure understanding of safety messages despite language barriers and low literacy levels.
- Pursue sudden infant death prevention programs independent of the health care setting, for example, in schools.
- Review distribution pathways for existing safe sleep resource materials to ensure accessibility for high risk populations.
- In addition to infant sleep positioning, publish and discuss other well established risk factors for sudden infant death, such as maternal tobacco use and infant overheating.
- Increase public awareness on the association between exposure to environmental tobacco smoke and sudden infant death.
- Ensure the practice of supine sleeping is being modeled and promoted for healthy term infants in all maternity wards across the province.

### 3 | Education and training of health professionals

#### *The health system can:*

- Increase awareness of sudden infant death among health professionals, including trends in rates and risk factors, high-risk populations and classification.
- Provide health care provider education and training to promote uniform education and modeling of safe infant sleep practices across all health professions that provide services to infants and families.
- Provide health care providers with high quality, consistent resource materials to support education on safe sleep and other infant health issues.

### 4 | Infant death classification

#### *Governments can:*

- Adopt standard criteria for defining and classifying sudden infant deaths in sleep-related circumstances that reflects existing standards used by other jurisdictions.
- Contribute to reaching national and international consensus on a uniform definition and classification system for sudden infant death, allowing more meaningful jurisdictional data comparisons.
- Coordinate the provision of the CDC's Sudden Unexplained Infant Death Investigation training curriculum to death investigators and first responders across the province.

## 5 | Social determinants of health

### ***Governments, the health and social service system, and community organizations can:***

- Pursue strategies that address the social circumstances into which infants are born, such as poor housing.
- Increase outreach to low-income parents in order to positively connect them with available services, resources and supports for themselves and their infants.
- Increase supportive housing options for expectant economically disadvantaged parents and families.
- Pilot and evaluate a community-based crib lending program, modeled off effective programs being used in other jurisdictions (e.g. Cribs for Kids).

## 6 | Consumer product safety

### ***Industry can:***

- Make safe sleep recommendations and educational materials available to the consumer at the point of sale of infant products.
- Include safe sleep information on labels of relevant infant products.
- In the absence of a Canadian standard, voluntarily adhere to ASTM International's F1917 - 08 Standard Consumer Safety Performance Specification for Infant Bedding and Related Accessories.
- Clearly label products that adhere to current product standards so this information is readily available to the consumer.

### ***Governments can:***

- Establish organizational policies and protocols that ensure reporting of any consumer-product related infant deaths or critical injuries to the Consumer Product Safety Branch of Health Canada.
- Modernize federal product safety legislation to increase capacity for regulation of infant products and address implications associated with a globalized marketplace.

## 7 | Home visiting

### ***Governments and the health system can:***

- Review and formalize existing public health home visiting programs to reflect a more systematic approach that defines goals and objectives of the program, target populations and key competencies required for successful program delivery.
- Provide intensive home visiting services for higher risk mothers and families that include education on preventive child health and safety and provision of increased monitoring and support when required.
- Ensure that adequate and ongoing training of home visitors is built into home visiting programs, particularly for those working with higher risk families.

## 8 | Research

### ***Governments, health systems and research bodies can:***

- Continue research into the underlying etiology of sudden infant death in sleep-related circumstances, including investigation into whether the promotion of other risk reduction messages beyond 'back to sleep' will lead to further declines in sudden infant death.



- Increase communication of research findings to front-line health providers, public health decision-makers and the B.C. public.
- Pursue provincial research on the influences of parental decision-making regarding infant sleep practices.
- Pursue research that seeks to gain a better understanding of the relationship between sudden infant death and socioeconomic factors such as poverty, overcrowding and low maternal education.
- Include elders and the community as a whole in supporting the practice of safe sleep among Aboriginal families.
- Aim to reduce the disproportionate number of Aboriginal infant deaths by including sudden infant death risk reduction activities in the development of the Aboriginal Maternal Health Strategy.

## 9 | Aboriginal infants

### ***Governments, the health system and community organizations can:***

- Work with Aboriginal communities and organizations to develop culturally appropriate, community-based, practical programs to promote safe sleep and reduce the risk of sudden infant death.
- Support Aboriginal communities and organizations in addressing the socioeconomic factors that impact the ability of new parents to practice safe infant sleep, such as overcrowding, poverty and low maternal education.
- Work collaboratively with Aboriginal peoples to better understand parents' views and values regarding postnatal home visiting, and use this knowledge to inform and improve public health home visiting programs for both on and off-reserve populations.
- Improve discharge planning for Aboriginal women who deliver out of their home community to ensure appropriate postpartum follow-up care is provided.
- Pursue participatory research with Aboriginal peoples, under the principles of OCAP (ownership, control, access and possession); to better understand the association between variants of Carnitine palmitoyl transferase-1 (CPT-1) and sudden infant death.



## Glossary

**Aboriginal:** Refers to First Nations (**Status** and non-Status), Métis and Inuit peoples.

**Adult mattress:** For the purposes of this report, an adult mattress would include mattresses on adult beds, children's beds, futon beds or day beds.

**Apgar score:** Apgar scores are a quick, consistent method of assessing infant status at birth. The infant is scored on colour, heart rate, breathing, muscle tone and reflex irritability. Scores range from 0-10 and are assessed at 1, 5 and 10 minutes of age.

**Asphyxia:** Suffocation. A condition in which inadequate oxygen and carbon dioxide are exchanged, usually caused by an interruption of breathing.

**Bedsharing:** Sharing the same sleep surface as another. This does not include infants who bedshared for a portion of their sleep, but who were reportedly alive when the bedsharing partner left and were subsequently found unresponsive and alone.

**Causal:** Having to do with or being a cause; involving cause and effect.

**Causality:** The relating of causes to the effects they produce.

**Closed case:** A case in which the coroner has completed the investigation into the death.

**Correlational:** Being correlated, or related to one another.

**Co-Sleeping:** Also called Room sharing. Sleeping in the same room as your infant, with the infant on a proximate (close) but separate sleep surface.

**CPT1 deficiency:** CPT 1 or CPT 1A deficiency: carnitine palmitoyltransferase-type 1A deficiency. People require a number of different enzymes to break down fat into energy. Enzymes allow chemical reactions to take place. CPT 1A is one of these enzymes. If an infant is CPT1 deficient, he cannot use fat as a fuel source during times of fasting or stress, such as during an illness. A specific variant of this condition, the CPT1 P479L variant, is milder and appears to be more common in certain Aboriginal populations. Infants with this variant are as healthy as other infants unless they become ill or stop taking in food and fluids. Should these conditions occur, the infant may lack the ability to access energy from fats, possibly leading to a low blood sugar and sudden unexpected death.

**Crib clutter:** Unnecessary items in the crib environment; may include bumper pads, stuffed animals and toys, extra blankets or pillows.

**Daytime:** In this report, daytime is considered from 0700 hours– 1959 hours.

**Exclusively breastfed:** Receiving no other liquid than breast milk, except for medicines or vitamin/mineral supplements. For the purposes of this report, refers to infants who are fed breast milk and no formula at the time of death.

**Failure to thrive:** Poor weight gain and physical growth over an extended period of time.

**Gestational age:** Age of the baby in weeks, determined from the time of conception. The average gestational age is 40 weeks.

**Immunoglobulins:** A family of large protein molecules, also known as antibodies.

**Income Assistance:** A government program that provides monetary assistance to persons in financial need.

**Infant carrier:** A device suspended from a caregivers body that allows a caregiver to carry the infant while keeping their hands free. These carriers often are backpack- or sling-like in design.

**Infant mortality:** Deaths of infants during the first year of life, per 1,000 live births.

**Intentional bedsharing:** Bedsharing that is the result of an intentional decision made with forethought by the bedsharer, rather than a situational or reactive response to circumstances such as infant fussiness, being away from home or parental fatigue.

**International Classification of Diseases- Revision 10:** The International Classification of Diseases is a system of coding diseases, signs, symptoms, social circumstances and external causes of injury or disease endorsed by the World Health Organization. The 10<sup>th</sup> revision was completed in 1992 and includes a code set of over 155,000 different codes. International adherence to the ICD-10 allows for storage and retrieval of diagnostic information and compilation of consistent national statistics for nations who adopt the standard.

**Level 1, 2 and 3 nurseries:** Newborn nurseries offering differing levels of care: In general, **Level 1** is a basic newborn nursery for well term or near term infants of good birth weight; **Level 2** is an intermediate care nursery for babies of 32 weeks gestation/1500 grams or more, or who need monitoring or increased care, and **Level 3** is a neonatal intensive care nursery for infants requiring specialized critical care.

**Low birth weight:** Birth weight of less than 2,500 grams.

**Métis:** A person who self-identifies as Métis, is of historic Métis Nation Ancestry, is distinct from other Aboriginal Peoples and is accepted by the Métis Nation.

**Ministry of Children and Family Development (MCFD):** The Ministry within government whose mission is to promote and develop the capacity of families and communities, and whose general responsibilities include: child protection; family development; adoption; foster care; early childhood development and child care; child and youth mental health; youth justice; special needs children and youth; and adult community living services.

**Multifactorial:** Involving or controlled by multiple factors, generally genetic and/or environmental factors.

**Neonatal abstinence syndrome:** A constellation of behavioural and physiological signs and symptoms due to withdrawal from substances. In this review, refers to withdrawal that occurs at birth in infants who were prenatally exposed to illicit drugs.

**Neonatal mortality:** Death occurring in neonatal period of birth to 28 days of age.

**Night-time:** In this report, night-time is considered from 2000 hours (8 pm) – 0659 hours

**Open case:** A case in which the coroner is still investigating the death.

**Overheating:** See thermal stress. Overheating was identified as a risk factor if one or more of the following circumstances were present at the time of death: (1) relevant scene findings such as excessive perspiration; (2) infant was both prone and swaddled or heavily blanketed; or (3) head covered.

**Post-mortem:** Occurring after death.

**Post-neonatal mortality:** Death that occurs between 28 and 364 days.

**Prematurity:** Being born prior to 37 completed weeks of gestation.

**Prenatal exposure to alcohol:** Fetal exposure to alcohol through maternal consumption in pregnancy.

**Prenatal exposure to tobacco smoke:** Fetal exposure to the byproducts of cigarette smoke (i.e. nicotine) through maternal smoking during pregnancy.

**Prenatal exposure to illicit drugs:** Fetal exposure to illicit drugs through maternal usage in pregnancy

**Preterm:** Being born prior to term, or prior to 37 completed weeks of gestation.

**Prone:** Lying face downward (on one's tummy).

**Reactive bedsharing:** Bedsharing that occurs irregularly in response to a situation or set of circumstances, rather than with forethought. Includes bedsharing meant to settle a fussy infant, facilitate parental sleep, or creating a sleep environment when away from home.

**Reflux:** Abnormal movement of stomach acids from the stomach into the esophagus or food tube.

**Risk factors:** An aspect of personal behaviour or characteristic, lifestyle, or environmental exposure that evidence has shown to be associated with undesirable health outcomes.

**Seasonality:** Change in physiologic status or disease occurrence in relation to a regular seasonal pattern. For this report, the seasons are defined as: Winter: December 21 - March 20; Spring: March 21 - June 20; Summer: June 21 - September 20; Fall: September 21 - December 20.

**Secondhand smoke:** Environmental tobacco smoke containing more than 4,000 chemical compounds, more than 250 of which are toxic. Includes both sidestream smoke (coming directly from burning tobacco product) and mainstream smoke (exhaled from the smoker).

**Small for gestational age:** Having a birth weight below the 10th percentile for that gestational age.

**Status Indian:** An Aboriginal person who is registered with the federal government according to the terms of the Indian Act.

**Stressor:** An environmental condition or influence that causes stress for an organism.

**Sudden Infant Death Syndrome (SIDS):** The sudden and unexpected death of an infant under one year of age that remains unexplained after autopsy, an examination of the scene of death and review of the case history.

**Sudden Unexplained Death in Infancy (SUDI):** The sudden unexpected and unexplained death of an infant where external risk factors are noted as possibly contributory to the death.

**Supine:** Lying face upward (on one's back).

**Temporality:** The condition of being temporal, or relating to time.

**Thermal stress:** Any process or event that puts an organism's temperature regulation under stress.

**Thirdhand smoke:** Residual tobacco smoke remaining after the cigarette is put out. It may be deposited onto clothing or surfaces such as couches or carpeting in the home to "off-gas" back into the air over a period of time.

**Trimester:** A three month period.

**Very low birth weight:** Birth weight of less than 1,500 grams.

## Appendix A: BC Coroners Service regions (2003 – 2007)

### Fraser Region

Burnaby to the Coquihalla Highway Toll Booth, east to Manning Park and north to Jackass Mountain bordering Merritt.

### Interior Region

The region north to 100 Mile House and Blue River, east to the Alberta border, south to U.S border and west to the Manning Park gate, including Ashcroft, Lytton and Lillooet.

### Vancouver Island Region

Vancouver Island, the Gulf Islands and Powell River.

### Northern Region

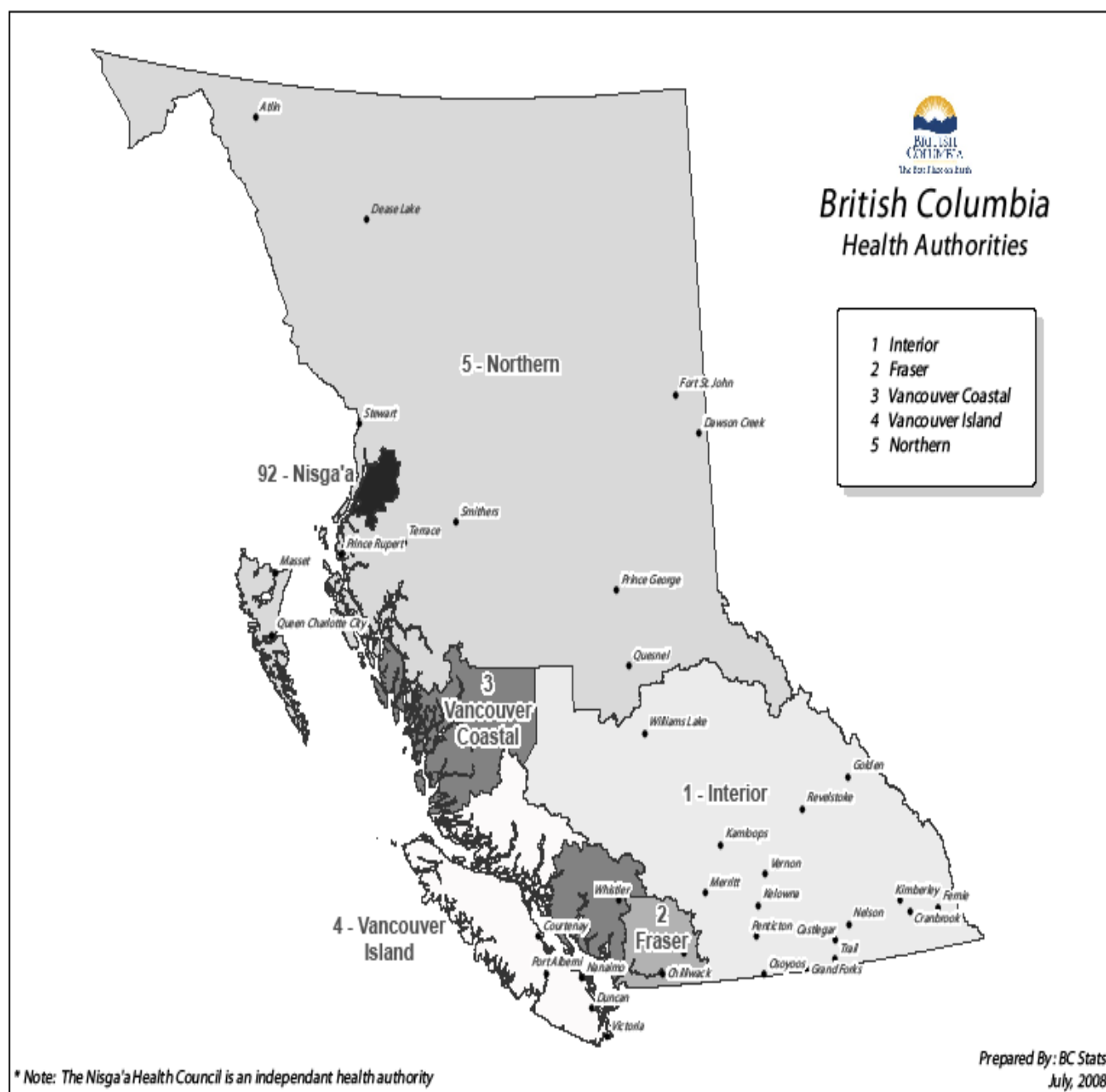
The region north, east and west from Williams Lake to all borders, Bella Bella and the Queen Charlotte Islands.

### Vancouver Metro Region

Includes Sunshine Coast, Sea to Sky Corridor, North Shore, Vancouver, UBC, Delta and Richmond.



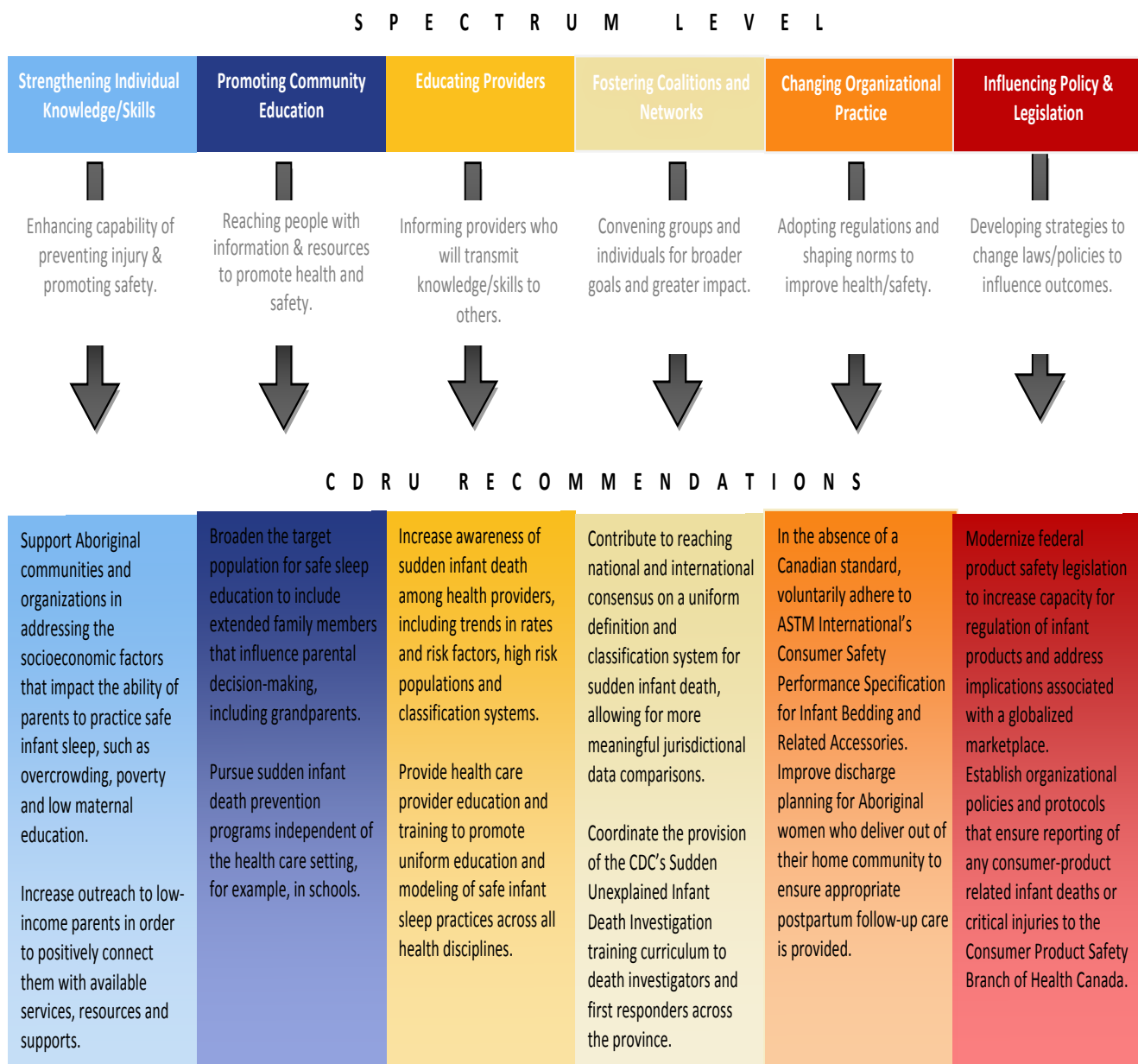
## Appendix B: British Columbia Health Authorities





## Appendix C: Spectrum of Prevention for Sudden Infant Death in Sleep-related Circumstances

The Spectrum of Prevention (Cohen, 1999) is a systematic tool that promotes a multifaceted range of activities for effective prevention (Prevention Institute, 2009). Moving beyond the perception that prevention is merely education, the Spectrum is a framework for a more comprehensive approach that includes six interrelated levels of strategy development. Prevention strategies involving activity at multiple levels creates a synergy that results in a greater impact than would be possible with action at one level alone. The following diagram demonstrates how the Spectrum framework is applied to a selection of the CDRU recommendations in *Safe and Sound – A Five Year Retrospective*.



**GOAL:** To reduce the incidence of sudden infant death in sleep-related circumstances

## Appendix D: An Opportunity to Improve Surveillance in Cases of Sudden Infant Death

### Background

The U.S. Centers for Disease Control and Prevention (CDC) in Atlanta discovered that although the rate of **SIDS** deaths had been decreasing since the early 1990s, this was offset by an increase in deaths attributed to SUDI or accidental asphyxia. In an attempt to ensure validity and consistency in infant mortality rates, the CDC used two strategies:

1. Investigation: The CDC's Sudden Unexplained Infant Death Initiative calls for a national pathway for investigation of infant death, ensuring data regarding risk and mitigating factors is uniformly and consistently collected.
2. Coding: The CDC was aware that deaths were being classified under various terms across the U.S. In order to maintain consistency in national infant mortality statistics they code an infant death as "SIDS" if the death certificate states the cause of death to be crib death, SIDS, SUDI, Sudden Infant Death or any variation thereof. This method of coding is in line with international standards dictated by the **International Classification of Diseases- 10<sup>th</sup> Revision**, or **ICD-10**.

### In B.C.

The BC Coroners Service (BCCS), in partnership with the BC Vital Statistic Agency (BCVSA) and the Provincial Health Office (PHO) became aware that differences in terminology and classification with regard to sudden infant death were also creating difficulties in B.C. These agencies began to work collaboratively to address this challenge, looking to the build from the CDC model.

1. Investigation: The BC Coroners Service seeks to enhance coroner investigation of sudden infant death investigation and data collection based on best practice. Recommendations in this report further efforts to improve the standard of infant death investigation in B.C.
2. Coding: The BC Vital Statistics Agency recognizes the merit of having consistent statistics for infant mortality over time. Traditionally, these deaths have been termed SIDS deaths. Continuing to code both **SIDS** and **SUDI** deaths as SIDS will allow for consistency in rate reporting and adherence to international standards. However, the BCCS, BCVSA and PHO recognize the inherent limitations in this approach – it does not allow for extrapolation of data based on presence of risk or mitigating factors, which hinders risk reduction efforts.

### Action:

The BCCS, BCVSA and PHO collaboratively developed a system to extract relevant information from sudden infant death cases. This information includes specific evidence-based external risk factors, mitigating factors and co-existing illness or injury. The documentation of these factors provides a B.C. - specific modification to the **ICD-10** coding system for use within our province, but which is also compatible with national Vital Statistics procedures.

The international ICD-10 code for SIDS is R95. The expanded SIDS coding system now utilized in B.C. is as follows:

**R95.0 Classical SIDS-no risk factors**

**R95.1 Non-supine sleep position**

**R95.2 Smoking**

R95.20 Prenatal

R95.21 Post-natal (in home environment)

R95.22 Both

**R95.3 Bedsharing**

R95.30 Simple bedsharing

R95.31 Bedsharing with arousal-impaired partner

**R95.4 Sleeping area factors**

R95.40 Superfluous items

R95.41 Sleeping area unintended for infants

**R95.5 Lack of breastfeeding**

R95.50 None

R95.51 Partial

**R95.6 Prenatal maternal alcohol/drug use**

R95.60 Alcohol

R95.61 Illegal/illicit substances

R95.62 Legal non-prescription (OTC) drugs/pharmaceuticals

R95.63 Legal prescription drugs/pharmaceuticals

**R95.7 Recent/concurrent illness or injury**

R95.70 Illness

R95.71 Injury

**R95.8 Other/multiple factors (i.e. environmental mould, overheating)**

**R95.9 Infant awake prior to death and/or witnessed cessation of vital signs**

The BCCS, BCVSA and PHO continue to work collaboratively on this initiative. Our goal is to have B.C. become a leader in the surveillance of sudden infant deaths for the purposes of compiling and analyzing the available information from these cases, disseminating the information for prevention purposes and evaluating the impact of prevention strategies.

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# KEEP YOUR BABY SLEEPING SAFE AND SOUND

Parents have the most important role to play in reducing the risk of sudden infant death in sleep-related circumstances. For more information on how to create a safe sleep environment for your baby, the Child Death Review Unit recommends the following resources:

**Baby's Best Chance – Parents' Handbook of Pregnancy and Baby Care:**

<http://www.health.gov.bc.ca/library/publications/year/2005/babybestchance.pdf>

**HealthLink BC File on Sudden Infant Death Syndrome (SIDS):**

<http://www.healthlinkbc.ca/healthfiles/hfile46.stm>

**Canadian Foundation for the Study of Infant Deaths:** <http://www.sidscanada.org/>

**Canadian Paediatric Society – Safe Sleep for Babies:**

<http://www.caringforkids.cps.ca/pregnancy&babies/SafeSleepForBaby.htm>

**First Candle:** <http://www.sidsalliance.org/>

**Public Health Agency of Canada:** <http://www.phac-aspc.gc.ca/dca-dea/prenatal/sids-eng.php>

**U.S. Centers for Disease Control and Prevention:** <http://www.cdc.gov/sids/ReduceRisk.htm>

The BC Perinatal Health Program is currently leading the development of provincial best practice guidelines for safe infant sleep, in collaboration with government and community partners across BC. These guidelines are expected to be complete by spring 2010.

## HOW TO REACH US

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