REDUCING INFANT MORTALITY IN SASKATOON HEALTH REGION

A Report of the Medical Health Officer
The authors wish to thank the following individuals for their gracious input into the report’s development. In Population and Public Health, thanks to Jill Werle, former Manager, Healthy Growth and Development (now Healthy Families), for content on programs and services; Tanis Kershaw, Joanne Tataryn and Amanda Clarke for writing assistance; and Johanna Bergerman, Nutritionist, Health Promotion Department, for information on breastfeeding. We are also grateful for ongoing feedback from Saskatoon Health Region’s maternal and child health committees chaired by Bette Boechler, Director, Maternal and Children’s Health Services, and from Noreen Agrey, Executive Director, Saskatchewan Prevention Institute. There are a number of others who made this report possible with their ongoing support and commitment to maternal and child health.

Suggested Citation

The Consultation Process
Throughout the planning, development and release of this report, there have been a number of individuals and organizations who provided content, reviewed and assisted in the report’s release. The consultation process consisted of formal and informal discussions, presentations, status updates and editorial review.

We collaborated with:
> Department of Pediatrics
> Department of Obstetrics and Gynecology
> Maternal and Children’s Health Services
> Population and Public Health
> Primary Health
> Saskatchewan Ministry of Health
> Saskatchewan Prevention Institute

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What is a Medical Health Officer Report?
The Medical Health Officer reports are a series of publications that profile a health issue of particular importance in Saskatoon Health Region. The purpose is to describe the issue: who is affected, over what particular time period, and where in the Region. Working in consultation with front line staff and key partners, these reports highlight what is being done in our Region to address these issues and also to identify best practices from the literature for prevention, detection and management. Ultimately, recommendations are brought forward to the Region and its partners, which are aimed at improving the health of residents of Saskatoon Health Region.
We are pleased to provide you with this report on reducing infant mortality in Saskatoon Health Region. This report is first in a series on child health starting with infancy, and will be closely followed by the Chief Medical Health Officer Report: Early Child Health and Development (0-6 age group) report in fall 2012.

In this report we examine several issues which impact infant health status in Saskatoon Health Region, as a part of the Medical Health Officers’ mandate to monitor, analyse and report health status of the whole population. This is done by examining trends in infant health indicators, rates of pregnancy and the outcomes of all births in the Region. A brief analysis of what can be done to prevent infant mortality is included along with identification of programs and services available within the Health Region that are intended to serve mothers and infants.

While not all infant deaths are preventable, and great strides have been made to reduce infant mortality in recent years, significant differences persist for infant mortality rates between populations. There remains a need for improvement, as certain populations, such as people of low socioeconomic status and teenage mothers, experience disproportionately higher rates of infant mortality. The disparity in infant mortality amongst groups in the community suggests that something more can be done to address these inequities.

We are confident that the recommendations in this report provide a course of action to reduce the high infant mortality rates experienced in some neighbourhoods and among population groups in Saskatoon Health Region, and in our partner health regions in the province of Saskatchewan. Many of the identified barriers that result in reduced access to perinatal care among certain populations may be removed with adequate programming support.

In addition, this report calls for a system-wide effort to better coordinate the mother-infant continuum of care. This improved coordination will provide guidance to all maternal and infant health services that impact birth outcomes, including collaboration with the new Children’s Hospital of Saskatchewan. We also anticipate that additional benefits for the community will result by effectively addressing root causes of infant and newborn mortality and morbidity such as improving the social circumstances and the lives of newborns, women and families in Saskatoon Health Region.

Recommendations were developed under the advisement of multiple, and diverse stakeholders. Strong commitment from Saskatoon Health Region, community organizations and the provincial government is required in order to implement these recommendations to improve birth outcomes and maternal health care. Many of the recommended actions have been implemented in other provinces with considerable success.

While many of the recommendations contained in this report will not require new investments as they suggest new ways of working, some may require the reallocation of funds. As such, finding the resources to implement the recommendations could be a challenge. A few potential options for funding could include: 1) part of the tobacco and alcohol excise tax given the adverse impact of tobacco and alcohol use on the health of girls, women and their unborn children and/or 2) potential funds acquired through the current provincial government class-action lawsuit filed against several tobacco companies.

We thank Saskatoon Health Region leadership for their continued support on this very important issue and for the privilege of interacting with various care groups and stakeholders to help us better define the needs of the most vulnerable segments of our population: girls, women, and infants. We thank you, most of all, on behalf of the many mothers and newborns in Saskatoon Health Region whose lives will be improved when these recommendations are implemented.

Sincerely,

Dr. Cory Neudorf, Chief Medical Health Officer
Dr. Johnmark Opondo, Deputy Medical Health Officer

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Infant mortality is the single most comprehensive measure of health and wellbeing of a nation, a province or a region. It is a true measure of a population’s health, as it has an impact on the most vulnerable members of our society: girls, women and infants. Infant mortality is closely associated with other indicators, such as teen pregnancy, preterm births and low birth weights. In addition, disparities in infant mortality by ethnicity and socioeconomic status are an important measure of the inequities in a society. New developments in the care of high-risk pregnancies and sick newborns, as well as the prevention of infant death from specific causes such as sudden infant death syndrome (SIDS), have enabled a steady decline in the infant mortality rate despite increasing trends of low and very low birth weight infants.

The purpose of this report is to examine the biomedical causes, social determinants of health and distribution of major risk factors associated with increased infant mortality in Saskatoon Health Region. This report describes who is most affected by infant mortality and poor pregnancy outcomes in the Region. The target groups discussed in this report are pregnant women, infants from 20 weeks gestation, and 1 year of age up to birth weight of at least 500 grams. The report also looks at what is being done in Saskatoon Health Region to reduce and prevent infant mortality in our community and offers a set of recommendations aimed at key stakeholders for moving forward.

**Key Findings**

**Births**

- In 2009, the Region’s crude birth rate of 13.5 per 1,000 population was higher than the Canadian average of 11.3 per 1,000 population in 2008.
- The absolute numbers of annual births in the Region have increased by almost 24 per cent (from 3,282 to 4,059) between 2005 and 2009.
- The Registered Indian Status (RIS) population has roughly a three times higher birth rate than the non-RIS population and significantly higher preterm birth rates than the non-RIS population.
- Residents of lower socioeconomic status neighbourhoods have higher birth rates and higher preterm births than those of higher socioeconomic status neighbourhoods in the Region.

**Infant Mortality Rate (IMR)**

- The IMR in Saskatoon Health Region has steadily declined over the years, and most recently ranged from 3.5 to 7.2 infant deaths per 1,000 live births (2007 to 2009) compared to the Canadian average of 5.1 per 1,000 live births (2007).
- Residents in the core neighbourhoods of Saskatoon have 1.5 times higher IMR compared to residents in other neighbourhoods and rural areas. In addition, infants born to mothers in core neighbourhoods are at higher risk of low birth weight, prematurity, being born to a teenage mother, death from sudden infant death syndrome, injuries, infections, and perinatal conditions.
- In Saskatoon Health Region, between 20 and 30 infants die before the age of one year every year. Most of these deaths remain concentrated among very young infants, particularly during the very early weeks after birth, or the neonatal period.

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**ii** A risk factor is a variable associated with an increased risk of disease or infection; sometimes, ‘determinant’ is also used interchangeably.

**iii** It is important to note that some desirable information for this report remains unavailable, as at present there is no systematic method to collect the following data elements routinely: The proportion of pregnancies that are spontaneously or artificially terminated by abortions; The percentage of births with late or no prenatal care; The percentage of first births to women ages 35 years and older; The percentage of births to foreign-born women; The percentage of births to women with at least a high school diploma; The percentage of births to unmarried women; The impact of assisted reproductive technology on births in Saskatoon Health Region; See the Technical Appendix for more information about data sources, definitions and limitations.

**iv** Core neighbourhoods in this report were defined as King George, Riversdale, Westmount, Pleasant Hill, Meadowgreen, and Confederation Suburban Centre.
Maternal Age

- Mothers under 20 years of age had a significantly higher IMR of 12.6 per 1,000 live births compared to those in other age groups (1992-2006 combined).
- The oldest age group (40+ years) had the lowest IMR at 3.8 per 1,000 live births (1992-2006 combined).

Teenage Pregnancy Rate

- The Region’s teenage pregnancy rate (36.5 per 1,000) has consistently remained below the Saskatchewan rate (48.4 per 1,000) in 2009, but above the Canadian average (29.2 per 1,000 in 2005).
- Significant disparities in teenage pregnancy rates exist between RIS and non-RIS, between urban and rural residents, and between low and high-income neighbourhoods.

Low Birth Weight

- Babies born very prematurely (before 22 weeks) and very low birth weight (less than 1,500 grams) represented 0.9 per cent of all live births in the Health Region in 2006 (29 out of 3409).
- Between 1997 and 2006, 46.6 per cent (146 out of 335) of all infant deaths were among babies born very prematurely and very low birth weight.
- Saskatoon residents had slightly higher low birth weight percentages than rural Health Region residents and the RIS population had slightly higher low birth weight percentages than the non-RIS population - though there were no statistically significant differences.

High Birth Weight

- In 2009, the proportion of all births that were high birth weight was 13.2 per cent. In 2008, the Region’s high birth weight percentage (13.3 per cent) was higher than the Canadian high birth weight percentage (12.2 per cent), but lower than Saskatchewan (15.1 per cent).

Factors Contributing to Infant Mortality

In 2005, birth defects/congenital anomalies accounted for the largest percentage (37.9 per cent) of infant deaths and were mainly the result of genetic disorders, cardiovascular and lung malformations, and neural tube defects. This was followed by conditions arising in the perinatal period (31 per cent) and Sudden Infant Death Syndrome (SIDS) (6.9 per cent). Similar percentages are seen nationally. The two leading risk factors of infant mortality are teenage pregnancy and low socioeconomic status.

About 60 per cent of infant deaths occur in the 0 to 27 day time period and, as such, any interventions which would address these deaths effectively are closely linked with maternal health and obstetric and neonatal services. In the perinatal time period (20 weeks to 7 days), congenital anomalies were the leading cause of infant death. In the post-neonatal time period (28 days to one year), SIDS was the leading cause (see Glossary for terminology).

The Link between Social Factors and Biological Factors in Infant Mortality

This report explores analytical frameworks to better understand the study of the determinants of child survival. Infant mortality is understood as the product of two major chains of events:

1) A sequence of socioeconomic and biological forces on the mother’s health that influence the outcome of her pregnancy. The adverse outcome of this sequence of events is usually the delivery of a premature, low birth weight or sick neonate.

2) The likelihood that the infant will survive given their health status at birth. This latter component often reflects the medical care provided to high-risk pregnant women and their small, sick neonates.
Both social and biological variables are important contributors to infant survival. All of the social and economic determinants of infant mortality (e.g., poverty, employment status, and housing) operate through a common set of biological mechanisms to exert an impact on infant mortality.

**What Can be Done to Reduce Infant Mortality in Saskatoon Health Region?**

Recommendations made in this report include efforts to help women stay as healthy as possible before pregnancy, to obtain quality health care during pregnancy, and to provide the care and support their babies need to thrive. Some of the recommendations will need a reorientation of the health system to provide the “wrap around” protection that pregnant woman and infants in our Region require. Some key initiatives to consider for expansion include breastfeeding support, safe-sleep education, nurse home visiting during pregnancy and early childhood development interventions.

**Summary of Recommendations**

> **Continuous Quality Improvement**
> - Conduct a comprehensive review of every fetal and infant death in the Region;
> - Enhance data collection and surveillance around maternal and infant health;
> - Ongoing support for a congenital anomalies surveillance system;
> - Establish a region-wide Maternal and Child Health Consortium;
> - Implement an educational campaign and cultural competence curriculum for providers in services that span maternal and child health care; and,
> - Scale-up, sustain and evaluate evidence-based interventions that address preterm births, low birth weight and teenage pregnancies for all communities.

> **Population-based Services**
> - Increase awareness of the importance of infant mortality and poor birth outcomes on the health status of Saskatoon Health Region residents, and promote a culture of wellbeing;
> - Improve prevention and management of chronic diseases among pregnant women.

> **Enabling Services: linking high risk individuals to needed services**
> - Ensure that current programs and services targeted to high risk populations are meeting the needs of those clients.

> **Direct Health Region Services: community-based health services providing a suite of essential health care**
> - Expand and improve access to comprehensive reproductive health and family planning services for key populations (e.g., teenagers and women of low socioeconomic status);
> - Expand access to prenatal care through targeted outreach and interventions;
> - Improve access to obstetric care through the primary health patient and family centered care approach.
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What is Infant Mortality?

The infant mortality rate (IMR) is the number of deaths for infants less than one year of age per 1,000 live births. It is considered the single most comprehensive measure of health and wellbeing of a nation, province, or region. Since mothers and infants are amongst the most vulnerable members of society, infant mortality is a measure of a population’s health. In addition, differences in infant mortality by ethnicity and socioeconomic status are an important measure of the inequities in a society.

Infant mortality, along with preterm birth, and low birth weight rates are internationally accepted indicators of maternal and child health. They not only reflect the state of health care and access to maternal and child health services within a jurisdiction, but also the existing social environments in which infants and children live, the policy supports available, and the priority that a society places on childbirth and on infant and maternal health. Major declines in infant mortality in many developed countries were a result of improvements in sanitation, nutrition and health care. More recently, new developments in the care of high risk pregnancies and sick newborns, as well as the prevention of infant death from specific causes, such as sudden infant death syndrome (SIDS), have enabled a further steady decline in IMRs despite increasing trends of low and very low birth weight infants; although the declines have slowed somewhat in more recent years. In 2008, the IMR for Canada of 5.1 per 1,000 live births is on the higher end for the more advanced economies in the world, and the prairie provinces of Manitoba (6.5 per 1,000 live births), Saskatchewan (6.2 per 1,000 live births) and Alberta (6.2 per 1,000 live births) have the higher IMR of the Canadian provinces (Figure 1).
In Saskatoon Health Region, as in most of Saskatchewan, the IMR has steadily declined to the point that it is close to the national average (Figure 2). However, reported declines in the Region’s IMR overall often mask a gap between those of low and those of high socioeconomic status. In addition, while much progress has been made in reducing the mortality of older, higher birth weight infants, high rates of death remain among younger infants, particularly during the neonatal period. More detailed information can be found in Chapter 3: Infant Mortality in Saskatoon Health Region.

**Figure 2: Infant Mortality Rate, Saskatoon Health Region, Saskatchewan and Canada, 1992-2009**

<table>
<thead>
<tr>
<th>Year</th>
<th>SHR</th>
<th>SK</th>
<th>Canada</th>
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</thead>
<tbody>
<tr>
<td>1992</td>
<td>7.6</td>
<td>7.0</td>
<td>6.1</td>
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<tr>
<td>1993</td>
<td>7.8</td>
<td>8.1</td>
<td>6.3</td>
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<td>1994</td>
<td>8.3</td>
<td>8.9</td>
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<tr>
<td>1995</td>
<td>10.9</td>
<td>9.1</td>
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<td>1996</td>
<td>7.1</td>
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<td>1997</td>
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<td>1998</td>
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<tr>
<td>2000</td>
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<td>5.3</td>
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<tr>
<td>2001</td>
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<td>5.3</td>
</tr>
<tr>
<td>2002</td>
<td>4.3</td>
<td>8.3</td>
<td>5.4</td>
</tr>
<tr>
<td>2003</td>
<td>4.7</td>
<td>6.1</td>
<td>5.3</td>
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<tr>
<td>2004</td>
<td>4.3</td>
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<tr>
<td>2009</td>
<td>7.2</td>
<td>7.0</td>
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</tr>
</tbody>
</table>

Source: Saskatchewan Ministry of Health, Vital Statistics
This report examines the biomedical and social causes of infant mortality and distribution of major risk factors\textsuperscript{vi} associated with increased infant mortality in Saskatoon Health Region. It describes which populations are most affected by infant mortality and poor pregnancy outcomes generally in the Region. The target populations discussed in this report are pregnant women and infants from 20 weeks gestation, or a birth weight of at least 500 grams, to 1 year of age. The report also looks at interventions to reduce infant mortality in our community and a set of key recommendations for moving forward.\textsuperscript{vii}

\textbf{WHAT’S THE BOTTOM LINE?}

> The infant mortality rate (IMR) is the number of deaths for infants less than one year of age per 1,000 live births.

> The IMR, along with preterm birth, and low birth weight rates are internationally accepted indicators of maternal and child health.

> The IMR for Canada of 5.1 per 1,000 live births is on the higher end for the more advanced economies in the world, and the prairie provinces of Manitoba (6.5 per 1,000 live births), Saskatchewan (6.2 per 1,000 live births) and Alberta (6.2 per 1,000 live births) have the higher IMR of the Canadian provinces.

> In Saskatoon Health Region, as in most of Saskatchewan, the IMR has steadily declined to the point that it is close to the national average.

\textsuperscript{vi} A risk factor is a variable associated with an increased risk of disease or infection; sometimes, ‘determinant’ is also used interchangeably.

\textsuperscript{vii} Please refer to the Technical Appendix for detailed information about the data sources used in this report, along with data limitations and definitions.
How Many Babies are Born Each Year in Saskatoon Health Region?

The following chapter provides birth-related indicators that are important to consider when examining the overall state of infant health in our Region.

Regional Trend: Births

The number of births in Saskatoon Health Region has fluctuated from year to year, increasing by approximately 7 per cent per year from 2005. In 2009, there were 4,059 live births in the Region. The absolute numbers of annual births have increased by almost 24 per cent (from 3,282 to 4,059) between 2005 and 2009 (Figure 3).
Regional Trends: Birth Rates

The birth rate is calculated by dividing the number of live births in a given area by the total population multiplied by 1,000. In Saskatoon Health Region, the birth rate was 13.5 per 1,000 in 2009, which is the highest level it has been since 1995. Birth rates in Saskatchewan were virtually identical to the Health Region’s rates over time, with Canadian rates slightly lower at 11.3 per 1,000 in 2008 (see Figure 4).

A Closer Sub-Regional Look at Birth Rates

Birth rates look much different for certain subgroups of Saskatoon Health Region’s population. For example, Figure 5 shows that the Registered Indian Status (RIS) population has birth rates up to three times higher than the non-RIS population (33.4 compared to 12.3 per 1,000 in 2009) (see Appendix A for RIS definition).

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More recent vital statistics data from the Saskatchewan Ministry of Health was not available at this time.

Registered Indian Status is the only ethnic identifier available within Saskatchewan Ministry of Health’s registry system. A person of Registered Indian Status means that the person is registered under Section 6 of The Indian Act and who has been assigned a ten digit number in the Indian Registry (Saskatchewan Ministry of Health, 2011) and has voluntarily declared this information to the Ministry of Health (see Appendices A and G for more information).
Lower Socioeconomic Status Associated with Higher Birth Rates

Figure 6 shows those living in the lowest socioeconomic status areas of Saskatoon have the highest birth rates (17.0 per 1,000 in 2009) compared to all other groups. It is interesting that there is a noticeable increasing trend between the highest socioeconomic status group (Quintile 1) and the lowest (Quintile 5).x (see Appendix A for information about the Deprivation index).

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x The deprivation index is a tool used to monitor socioeconomic inequities in health. The most widely used deprivation index for Canada is that developed in Quebec (Pampalon et al., 2009). The Deprivation Index measures two types of deprivation: material (e.g., income, employment) and social (e.g., marital status, lone parent family). Deprivation scores use 2006 Census data. Total deprivation quintiles were based on the results of the material and social factor scores for the city of Saskatoon, where each quintile represents approximately 20 per cent of the population of the city. Quintile 5 represents higher levels of material and social deprivation and Quintile 1 represents lower levels of material and social deprivation.
Key Birth Outcomes in Saskatoon Health Region

Table 1 (below) shows the number of live births for Saskatoon Health Region residents between 2005 and 2009 as well as key birth outcomes. Some of the key outcomes are discussed in more detail below.

Table 1: Births Outcomes, Saskatoon Health Region, 2005-2009

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
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<tbody>
<tr>
<td>Number of live births that were:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newborns</td>
<td>3,282</td>
<td>3,413</td>
<td>3,732</td>
<td>3,790</td>
<td>4,059</td>
</tr>
<tr>
<td>Registered Indian Status</td>
<td>535</td>
<td>540</td>
<td>600</td>
<td>548</td>
<td>590</td>
</tr>
<tr>
<td>To Teenage mothers (&lt;20 years)</td>
<td>230^b</td>
<td>238</td>
<td>288</td>
<td>234</td>
<td>246</td>
</tr>
<tr>
<td>To Mothers 35 years and over</td>
<td>376</td>
<td>409</td>
<td>457</td>
<td>443</td>
<td>485</td>
</tr>
<tr>
<td>Preterm (&lt;37 weeks gestation)</td>
<td>287</td>
<td>278</td>
<td>297</td>
<td>294</td>
<td>294</td>
</tr>
<tr>
<td>Low birth weight (&lt;2,500 grams)</td>
<td>206</td>
<td>181</td>
<td>225</td>
<td>220</td>
<td>231</td>
</tr>
<tr>
<td>High birth weight (&gt;4000 grams)</td>
<td>471</td>
<td>448</td>
<td>488</td>
<td>503</td>
<td>535</td>
</tr>
<tr>
<td>Multiple births^a</td>
<td>87</td>
<td>83</td>
<td>106</td>
<td>91</td>
<td>133</td>
</tr>
<tr>
<td>Still births</td>
<td>10</td>
<td>16</td>
<td>21</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Proportion of live births that were:</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>23.2</td>
<td>23.2</td>
<td>23.2</td>
<td>24.0</td>
<td>22.9</td>
</tr>
</tbody>
</table>

^a Multiple births include birth types 20, 21, 30, 50 for these years.
^b six births had no mothers age associated with it.

Preterm Births

The preterm birth rate is considered the most important risk factor for infant mortality and is defined as the proportion of live births with a gestational age of less than 37 completed weeks compared to all live births in the same specified time period. Preterm births are responsible for a large proportion of infant deaths in Saskatoon Health Region, which is consistent with findings in other industrial countries and in other Canadian provinces like Alberta.

Regional Trend: Preterm Births

The preterm birth rate in Saskatoon Health Region has been increasing slightly from 1992 to 2009. Figure 7 shows that the preterm birth rate in 1992 was 6.7 per cent (95 per cent CI 5.9 - 7.5 per cent), whereas in 2009 it was 7.2 per cent (95 per cent CI 6.4 - 8.1 per cent). However, since 2005, the preterm birth rate in the Health Region decreased from 8.8 per cent. Canadian preterm birth rates have been slowly increasing since 2000.
Potential explanations for the increase in preterm births are high rates of adolescent mothers (who may be less prepared for pregnancy), older mothers giving birth and more multiple pregnancies (see multiple birth section of this report) that have a greater likelihood of premature labour (20-27 weeks).

A Closer Sub-Regional Look: Preterm Births

Figure 8 displays the preterm birth rate for various subgroups within Saskatoon Health Region for the years 2007-2009 combined. The preterm birth rates for the RIS population was significantly higher than the non-RIS population at 10.5 per cent (95 per cent CI: 9.0 - 12.0 per cent) compared to 7.1 per cent (95 per cent CI: 6.6 - 7.6 per cent), respectively. Other differences to note, though not statistically significant, are that Saskatoon preterm birth rates were slightly higher than those in residents living in rural Saskatoon Health Region communities. Residents of the least deprived quintiles (quintiles 1 and 2) had lower preterm birth rates than those living in the most deprived quintiles (quintiles 4 and 5). The same picture is seen where residents of affluent neighborhoods of Saskatoon had lower preterm birth rates than those living in the core neighborhoods (see Appendix A for definition).
Key Birth Outcomes by Birth Weight

Birth weight is the first weight of the fetus or newborn obtained after birth (ICD-10).

<table>
<thead>
<tr>
<th>Definitions of Birth Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Birth Weight</td>
</tr>
<tr>
<td>= Birth weight of 2500-3999 grams</td>
</tr>
<tr>
<td>High Birth Weight</td>
</tr>
<tr>
<td>= Birth weight greater than 4000 grams</td>
</tr>
<tr>
<td>Low Birth Weight</td>
</tr>
<tr>
<td>= Birth weight less than 2500 grams</td>
</tr>
<tr>
<td>Intermediate Low Birth Weight</td>
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<tr>
<td>= Birth weight of 1500-2499 grams</td>
</tr>
<tr>
<td>Very Low Birth Weight</td>
</tr>
<tr>
<td>= Birth weight less than 1500 grams</td>
</tr>
<tr>
<td>Extremely Low Birth Weight</td>
</tr>
<tr>
<td>= Birth weight of less than 1000 grams (up to and including 999 grams)</td>
</tr>
</tbody>
</table>

Low Birth Weight

Regional Trend: Low Birth Weight

The low birth weight rate is the proportion of infants born under 2,500 grams compared to total live births during the same time period\(^\text{8}\). Low birth weight infants are at increased risk for a number of health and developmental problems and low birth weight is one of the strongest predictors of infant mortality\(^\text{9,10,11}\).

The low birth weight rate for Saskatoon Health Region infants in 2009 was 5.7 per cent of live births (95 per cent CI: 4.9 - 6.4 per cent). Since 2000, the low birth weight rate has been increasing slightly, though yearly variations are seen (see Figure 9). Saskatoon Health Region data has fluctuated above and below the Canadian low birth weight averages for the years examined. Both Canada’s and Saskatchewan’s rates have increased slightly since 1992.

**Figure 9: Low Birth Weight, Saskatoon Health Region and Canada, 1992-2009**

<table>
<thead>
<tr>
<th>Year</th>
<th>SHR</th>
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<th>Canada</th>
</tr>
</thead>
<tbody>
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<tr>
<td>2009</td>
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<td>5.8</td>
<td>6.</td>
</tr>
</tbody>
</table>

Source: Canada and SK up to 2008 from CANSIM table 102-4005. SK 2009 from Sharepoint website. Saskatoon Health Region from SK Ministry of Health Vital Statistics.
A Closer Sub-Regional Look: Low Birth Weight

Figure 10 shows low birth weight rates by various population subgroups between the years 2007 and 2009 combined. There were no statistically significant differences between subgroups, though differences between Saskatoon rates (6.2 per cent; 95 per cent CI: 5.6 - 6.7 per cent) and rural rates (4.9 per cent; 95 per cent CI: 4.1 - 5.7 per cent) were nearly significant. Other interesting differences to note were that RIS population (7.1 per cent; 95 per cent CI 5.8 - 8.3 per cent) had higher low birth weight rates than non-RIS populations (5.6 per cent; 95 per cent CI 5.1 - 6.1 per cent).

Regional Trend: Very Low Birth Weight

Very low birth weight babies are defined as the proportion of babies born less than 1,500 grams by the total number of live births. They are at even higher risk for negative health outcomes than low and intermediate birth weight babies. In Saskatoon Health Region, approximately 1 per cent of all live births are very low birth weight. The Region’s rate of very low birth weight infants is similar to Saskatchewan’s and Canada’s overall.

Regional Trend: Preterm and Low Birth Weight

Babies born very prematurely (before 22 weeks) and very low birth weight (less than 1,500 grams) are at particularly high risk of infant mortality; they represented 0.9 per cent of all live births in Saskatoon Health Region in 2006 (29 out of 3409).

High Birth Weights

Regional Trend: High Birth Weight

High birth weight babies are defined as the proportion of babies born > 4,000 grams by the total number of live births. High birth weight babies are at increased risk for birth injury compared to infants of normal birth weight, in addition to suffering other metabolic issues in the early neonatal period. High birth weight proportions for Saskatoon Health Region are shown in Figure 11. In 2009, the proportion of all births that were high birth weight was 13.2 per cent (95 per cent CI: 12.1 - 14.3 per cent) in Saskatoon Health Region. The Saskatoon Health Region rates have been higher than the Canadian proportions and lower than Saskatchewan proportions over the last number of years. It is thought that maternal obesity or high blood sugars caused either by gestational diabetes or secondary diabetes may be important contributors to very high infant birth weights.
Figure 11: High Birth Weight, Saskatoon Health Region and Canada, 1992-2009

<table>
<thead>
<tr>
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<th>Canada</th>
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<tr>
<td>2009</td>
<td>13.3</td>
<td>13.6</td>
<td>13.2</td>
</tr>
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</table>


A Closer Sub-Regional Look: High Birth Weight

Figure 12 shows high birth weight for various groups within Saskatoon Health Region. The RIS population had the highest high birth weight proportion at 18.3 per cent (95 per cent CI: 16.2 - 20.3 per cent), while the non-RIS population had a significantly lower proportion at 12.3 per cent (95 per cent CI: 11.6 - 13.0 per cent). No other significant differences were seen between residents of urban and rural areas of Saskatoon Health Region, nor within various area-level socioeconomic status groups whether categorized by deprivation quintile or neighbourhood income.

Figure 12: High Birth Weight (>4,000 grams), Subgroups in Saskatoon Health Region, 2007-2009

Maternal Age

Regional Trend: Maternal Age at Birth

Figure 13 shows that the birth rates for those females less than 25 years of age have decreased in Saskatoon Health Region between 1995 and 2009; increases are seen for those mothers aged 30 years and older during the same period. This increase in birth rates to older mothers is consistent with national trends. Note that these births are not first time only births (i.e. births to second or higher order children are included).

![Figure 13: Age Specific Live Birth Rates, Saskatoon Health Region, 1995-2009](Image)

Source: Saskatchewan Ministry of Health, Vital Statistics. (Reproductive health: Tab GFR)

MultipleBirths

Regional Trend: Multiple Births

Multiple births are associated with infant mortality because babies born in these pregnancies tend to be premature and of low birth weight. In Saskatoon Health Region, the multiple birth rate has been slowly increasing from 2.2 per 100 live and still births in 1992 to 3.2 per 100 live and still births in 2009 (Figure 14). A more consistent upward trend is seen for Canada, where rates steadily climbed between 1992 and 2008. The vast majority of the multiple births in Saskatoon Health Region were twins, with only two instances of quintuplets since 1999, and between one and two cases of triplets yearly since 1999.
Births

> The absolute numbers of annual births have increased by almost 24 per cent from 3,282 in 2005 to 4,059 in 2009. It is the first time the number of births has reached that mark in over 15 years.

> In 2009, the Region’s crude birth rate of 13.5 per 1,000 population is higher than the Canadian average of 11.3 per 1,000 population.

Subgroup populations

> Registered Indian Status (RIS) populations have roughly a three times higher birth rate than non-RIS population and significantly higher preterm birth rates than non-RIS population.

> Residents of lower socioeconomic status neighbourhoods have higher birth rates and higher preterm births than those of higher socioeconomic status neighbourhoods in Saskatoon.

Preterm births

> Rates of preterm births have been slowly increasing in Saskatoon Health Region so that they account for over 7 per cent of all births, an increase from about 6.5 per cent in the early 1990s. Similar increases are seen for all of Canada.

Low birth weight

- Low birth weight for Saskatoon Health Region infants in 2009 was 5.7 per cent of live births (95 per cent CI: 4.9 per cent - 6.4 per cent). Since 2000, the low birth weight rate has been increasing slightly, though yearly variations are seen.

- No significant differences were found between population subgroups. Saskatoon residents had slightly higher low birth weight rates at 6.2 per cent (95 per cent CI: 5.6 - 6.7 per cent) than rural Region residents at 4.9 per cent (95 per cent CI: 4.1 - 5.7 per cent). RIS populations had slightly higher low birth weight rates at 7.1 per cent (95 per cent CI: 5.8 - 8.3 per cent) than non-RIS populations at 5.6 per cent (95 per cent CI: 5.1 - 6.1 per cent).

- The proportion of births that are considered very low birth weight has been relatively stable regionally, provincially and nationally at about 1 per cent of births.

- Babies born very prematurely (before 22 weeks) and very low birth weight (less than 1,500 grams) represented 0.9 per cent of all live births in Saskatoon Health Region in 2006 (29 out of 3409).

High birth weight

- In 2009, the proportion of all births that were high birth weight in the Region was 13.2 per cent (95 per cent CI: 12.1 - 14.3 per cent). The Region’s rates have been higher than the Canadian rates and lower than Saskatchewan rates over the last number of years.

- The RIS population had the highest high birth weight rate at 18.3 per cent (95 per cent CI: 16.2 - 20.3 per cent) with the non-RIS population having a significantly lower rate at 12.3 per cent (95 per cent CI: 11.6 - 13.0 per cent). No significant differences were seen between residents of urban and rural areas of Saskatoon Health Region.

Maternal Age

- Mothers aged 30 and over have much higher birth rates now than in the mid-1990s, whereas birth rates for those females less than 25 years of age have decreased in Saskatoon Health Region.

Multiple Birth Age

- In Saskatoon Health Region, the multiple birth rate has been slowly increasing, between 1992 and 2009 (2.2 per 100 live and still births compared to 3.2 per 100 live and still births, respectively)
Regional Trend: Infant Mortality in Saskatoon Health Region

Saskatoon Health Region’s infant mortality rates have been higher than the national average and slightly lower than Saskatchewan rates over time. The Region’s rates decreased slightly from 7.6 per 1,000 live births in 1992 to 7.2 per 1,000 live births in 2009. In 2005, the Health Region experienced a sizeable increase in infant mortality from 4.3 per 1,000 live births in 2004 (which represents 14 infant deaths), to 8.8 per 1,000 live births in 2005 (which represents 29 infant deaths). Premature births and low birth weight babies were associated with 74.1 per cent of infant deaths in 2005. Note that the infant mortality numbers for 2006, 2007, 2008, and 2009 were 20, 13, 25 and 29, respectively.

In statistical terms, the small number of infant deaths will cause rates to fluctuate, thus, a rolling three year average gives a better idea about trends over time (see Figure 15).
Figure 15: Infant Mortality Rates, Saskatoon Health Region, Saskatchewan, and Canada, 1992-2009, Three Year Rolling Average*

<table>
<thead>
<tr>
<th>Year</th>
<th>SHR</th>
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<th>Canada</th>
</tr>
</thead>
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Sub-Regional Trend: Infant Mortality

Figure 16 below shows infant mortality rates for the years 2000 to 2009 combined for different subgroups of Saskatoon Health Region. Residents from rural communities had slightly lower infant mortality rates compared to Saskatoon residents. Registered Indian Status (RIS) residents had the same infant mortality rate as non-RIS residents. Residents from lower socioeconomic neighborhoods in Saskatoon (Quintile 5) had higher infant mortality rates than residents from other quintiles, but interestingly a U-shaped pattern was seen in that residents from the highest socioeconomic quintile (Quintile 1) had a similar or higher mortality experience than the middle quintiles (Quintiles 2, 3, and 4). When analysing infant mortality rates by neighbourhood of residence in Saskatoon, infant mortality rates were 1.5 times higher in the core neighborhoods, than in the more affluent neighbourhoods. Note that none of the differences between subgroups are statistically significant, as the confidence intervals overlap. This could be due to the small numbers in certain subgroups.

Figure 16: Infant Mortality Rates, Subgroups in Saskatoon Health Region, 2000-2009 Combined

Source: Saskatchewan Vital Statistics linked births and deaths
Infant Mortality and Registered Indian Status

Information on RIS was based on self-declaration. In total, about 53 per cent of the Aboriginal population in Saskatoon Health Region was of Registered Indian Status based on the 2006 census. As a result, this information may not be complete. Based on this self-declared status, an estimated 13.8 per cent of infant deaths in 2005 in Saskatoon Health Region occurred to infants of RIS (Figure 17). While the 2005 figure is higher than 2002 and 2003, it represents a notable drop from 2004.

Figure 17: Proportion of Infant Deaths of Registered Indian Status, Saskatoon Health Region and Saskatchewan, 2002-2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Saskatoon Health Region</th>
<th>Saskatchewan</th>
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</thead>
<tbody>
<tr>
<td>2002</td>
<td>8.3%</td>
<td>19.7%</td>
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<tr>
<td>2003</td>
<td>11.5%</td>
<td>7.1%</td>
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<tr>
<td>2004</td>
<td>28.6%</td>
<td>19.7%</td>
</tr>
<tr>
<td>2005</td>
<td>13.8%</td>
<td>28.6%</td>
</tr>
</tbody>
</table>

Source: Saskatchewan Vital Statistics linked births and deaths (infant health)

In the early part of the 1990s, the RIS population had infant mortality rates nearly double that of non-RIS population. However, between 2007 and 2009 the RIS population in Saskatoon Health Region had an infant mortality rate of 5.8 per 1,000 live births (95 per cent CI: 2.2 - 9.3 per cent), the same as for the non-RIS population (5.8 per 1,000 live births, 95 per cent CI: 4.3 - 7.3 per cent) (Figure 18). These results differ from other reports showing infant mortality rates for First Nations people in Canada double that for non-First Nations. Though more recently Smylie et al. have found that the calculation of accurate infant mortality rates for Aboriginal populations in Canada is complicated by the lack of uniform and consistently available information regarding identity in birth and death registration databases and limited academic literature exists. Keeping in mind the potential data complications, the recent trend seems to suggest improvements in the gap between the RIS population and the non-RIS population; however, further investigation may be needed to explain these local findings.
Figure 18: Infant Mortality Rate, Registered Indian Status, Saskatoon Health Region, 1992-2009, Three Year Averages

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Source: Saskatchewan Vital Statistics linked births and deaths (Infant health).

Cause-Specific Infant Deaths in Saskatoon Health Region

What are the Causes of Infant Mortality in Saskatoon Health Region?

The three leading causes of infant mortality in 2005 were congenital anomalies (birth defects) at 37.9 per cent, conditions arising in the perinatal period (31 per cent) and Sudden Infant Death Syndrome (SIDS) (6.9 per cent) (Table 2). Similar percentages are seen nationally.

Table 2: Proportion of Specific Bio-Medical Causes of Infant Mortality, Saskatoon Health Region 2002-2005

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<tr>
<th>Cause</th>
<th>2002 (%)</th>
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<th>2005 (%)</th>
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<tbody>
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<td>42.9</td>
<td>14.3</td>
<td>31.0</td>
</tr>
<tr>
<td>Congenital anomalies xii</td>
<td>8.3</td>
<td>28.6</td>
<td>28.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Sudden Infant Death Syndrome</td>
<td>16.7</td>
<td>-</td>
<td>14.3</td>
<td>6.9</td>
</tr>
<tr>
<td>Injury / Infection</td>
<td>8.3</td>
<td>-</td>
<td>-</td>
<td>3.4</td>
</tr>
<tr>
<td>Other xiii</td>
<td>16.7</td>
<td>28.6</td>
<td>35.7</td>
<td>6.9</td>
</tr>
<tr>
<td>Not coded</td>
<td>-</td>
<td>-</td>
<td>7.1</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Source: Saskatchewan Vital Statistics linked births and deaths (Infant health).

xi Conditions arising in the perinatal period include: premature rupture of membranes or premature labour, oligohydramnios, prolapsed umbilical cord, chorioamnionitis or infection of amniotic fluid and membranes, primary alectasis, neonatal cardiac failure.

xii Congenital anomalies include: Anencephaly, Congenital hydrocephalus, Discordant atrioventricular connection, Hypoplastic left heart syndrome, Hypoplasia and dysplasia of lung, Down’s syndrome, Pallud’s syndrome, Osteochondrodysplasia, and Situs inversus.

xiii Other causes of infant mortality include: Asphyxia, infection, respiratory distress syndrome, and early feeding failures.
Congenital Anomalies

What are Congenital Anomalies and What Causes Them?

Congenital anomalies are an abnormality of structure, function or body metabolism that is present at birth (even if not diagnosed until later in life) and results in physical or mental disability, or is fatal. A congenital anomaly is considered to be multifactorial in origin when there is a combined influence of genetics and environmental factors that interfere with normal embryologic development. Congenital anomalies pose a significant impact on medical and non-medical resources and create considerable emotional and economic burden for families and communities.

The Congenital Anomalies Data Gap in Saskatchewan

Although congenital anomalies are amongst the most common causes of infant deaths in Saskatoon Health Region, presently no reliable provincial congenital anomalies surveillance system exists to accurately track this indicator. The lack of a surveillance system remains a major shortcoming, as conditions arising in the perinatal period and congenital anomalies combined are the leading cause of infant mortality in the province. As an example, some rare conditions are found in pockets in Saskatchewan (e.g., Hyperornithinemia-hyperammonemia-homocitrullinemia (HHH) syndrome, a very rare inborn error of metabolism), but because there is no surveillance system in place, a lack of data is available to monitor and explain this trend. Without this data it is difficult to implement appropriate health interventions to improve health outcomes.

Although a formal provincial surveillance system has not yet been established, a pilot congenital anomalies surveillance system (CASS) was launched in Saskatoon Health Region in 2011 and data collection began in spring 2012. More information is available at: www.saskatoonhealthregion.ca/CASS/index.htm.

Vaccine Preventable Infections

Although all vaccine preventable illnesses present a serious challenge to the unvaccinated newborn, surveillance data in Saskatoon Health Region show that specifically Bordetella pertussis, Haemophilus influenzae Type B, Nissereia meningitides, and the viral pathogen influenza A have continued to contribute to infant illness and deaths in some years; in these instances, the infants were found to be behind on their vaccination schedule or not immunized at all in most cases. Attention is brought to these conditions because they are all considered preventable or at least modifiable by age appropriate routine vaccination.

Infections

Preterm infants are more susceptible to various infectious diseases, due to a poorly developed immune response. Infectious diseases of concern may range from bacteria, which would not normally infect a healthy newborn, to common vaccine preventable illnesses that newborns will encounter in the community once discharged from the hospital.

Infant Deaths by Stage of Infancy

There are several different classifications of time periods used to describe infant mortality. The key time frames for the analysis of infant deaths used in this chapter are shown in Figure 19.
Perinatal Deaths (from 20 weeks gestation to up to 7 days after delivery)

Perinatal deaths made up 67 per cent of all infant deaths in the Health Region between 1992 and 2006. These are defined as stillborn births and live born babies who died between approximately 20 weeks gestation and up to 7 days after delivery. This typically includes a very high proportion of premature births and low birth weight infants. Between 1997 and 2006, 46.6 per cent (146 out of 335) of all infant deaths were among babies born very prematurely and very low birth weight.

Infants born preterm in Saskatoon Health Region experience some of the highest rates of infant mortality, especially those born between 20 to 28 weeks gestation. Figure 20 shows that the infant mortality rate for this group was 405 per 1,000 live births, which is 150 times higher than infants of normal gestation (37 to 41 weeks). This is consistent with numbers from the United States, where infants born less than 28 weeks had infant mortality rates 144 times higher than those within normal gestation\[18\].

Neonatal Deaths (from birth to 27 days after delivery)

Between 1992 and 2006 in Saskatoon Health Region, neonatal mortality made up 60.3 per cent of all infant mortality. This is lower than the 70 per cent reported for Canada in 1996\[19\]. In the neonatal time period, birth defects or congenital anomalies (39.3 per cent), prematurity (31.0 per cent) and asphyxia (12.5 per cent) were the leading specified causes of death in Saskatoon Health Region.
Post Neonatal Death (28 to 364 days after birth)

Between 1992 and 2006 in Saskatoon Health Region, post-neonatal mortality made up 39.7 per cent of all infant mortality. No increasing or decreasing trend over time in the proportion of post-neonatal deaths was noted.

The leading specified cause of death for the Region in the post-neonatal time period is SIDS (31.0 per cent), followed by birth defects or congenital anomalies (12.7 per cent). These results are consistent with those reported for Canada\textsuperscript{18}. Although the exact cause of SIDS is unknown, risk factors such as exposure to second hand smoke, unsafe sleep positions and not breastfeeding are thought to play a role\textsuperscript{20}.

Neonatal and Post Neonatal Deaths: A Closer Examination

In response to the 2005 spike in infant deaths a review of the cases was conducted to determine reasons for this spike. Of the 50 cases reviewed from 2002 to 2005, 40 (80 per cent) of them were “neonates” or newborns. Neonatal cases were typically born with serious medical problems and were not discharged home.

Thirty-three of the 40 neonates (82.5 per cent) were preterm babies (<37 weeks gestation). Of those preterm infants 13 were <24 weeks gestation, 12 were 24-31 weeks, and 8 were between 32-36 weeks gestation (Table 3). Fifty-eight per cent (23 of the 40) of the infants included in this chart review died within their first day of life (Table 3). Of those deaths that were <24 weeks gestation, 92 per cent died within their first day of life.

Table 3: Baby Age at Death by Gestational Age - Neonate Deaths, Saskatoon Health Region, 2005

<table>
<thead>
<tr>
<th>Gestational Age (weeks)</th>
<th>Baby Age at Death (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;1</td>
</tr>
<tr>
<td>&lt;24</td>
<td>12 (30%)</td>
</tr>
<tr>
<td>24 to 31</td>
<td>7 (18%)</td>
</tr>
<tr>
<td>32 to 36</td>
<td>3 (8%)</td>
</tr>
<tr>
<td>37+</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Total</td>
<td>23 (58%)</td>
</tr>
</tbody>
</table>

There were 7 term neonates comprising 18 per cent of the total number of neonates (n=40). Of these 7 term neonate deaths, 6 (85.7 per cent) had been diagnosed with one or more congenital anomalies. The causes of infant mortality in the fetal and neonatal stage are prematurity or preterm births, low birth weight, congenital anomalies, and infections. These are often all interrelated causes. For example, prematurity is often associated with low birth weight, and low birth weight babies are often more prone to infections and birth trauma. In many places, the exact causes of both fetal and neonatal death are not well documented, and recognizing the factors associated with infant deaths is a first step in addressing this problem. It is often difficult to classify neonatal deaths in part because many neonatal conditions present with non-specific symptoms, such as poor feeding or lethargy. Stillbirths are even more difficult to classify, and even with sophisticated technology about 40 per cent of stillbirths cannot be conclusively classified\textsuperscript{21}.

In this same review (2002 to 2005), the distribution of cause specific mortality of the ten post neonatal cases were as follows: congenital anomalies (30 per cent), SIDS (30 per cent) and infectious diseases (30 per cent). When broken down further, vaccine preventable diseases accounted for 20 per cent of the deaths, while other infectious diseases accounted for the remaining 10 per cent. Trauma and injuries were also reported as causes of post-neonatal death. In Saskatoon Health Region in 2005, post neonatal infant deaths accounted for about a quarter of all infant deaths.

\textsuperscript{1} When case numbers for comparison are low, readers are urged to interpret these findings with caution.
Birth Weight and Infant Mortality

Birth weight is a major predictor of neonatal mortality. A decline in the proportion of births that are of low birth weight, or an improvement in the survival of low birth weight infants would reduce neonatal mortality rates. In Saskatoon Health Region, a large proportion of infant mortality (34 per cent) occurs among low birth weight infants (<1,500 grams) (Table 4).

Table 4: Numbers of Fetal Infant Deaths by Birth Weight and Gestation, Saskatoon Health Region, 1992-2006

<table>
<thead>
<tr>
<th>Birth weight (grams)</th>
<th>Late fetal (28+ weeks)</th>
<th>Early neonatal (&lt; 7 days)</th>
<th>Late neonatal (7-27 days)</th>
<th>Post-neonatal (28-364 days)</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>34</td>
<td>102</td>
<td>16</td>
<td>19</td>
<td>171</td>
<td>34%</td>
</tr>
<tr>
<td>1,500 – 2,499</td>
<td>46</td>
<td>35</td>
<td>6</td>
<td>18</td>
<td>105</td>
<td>21%</td>
</tr>
<tr>
<td>2,500 +</td>
<td>92</td>
<td>29</td>
<td>19</td>
<td>91</td>
<td>231</td>
<td>46%</td>
</tr>
<tr>
<td>Total</td>
<td>172</td>
<td>166</td>
<td>41</td>
<td>128</td>
<td>507</td>
<td>100%</td>
</tr>
<tr>
<td>Percent</td>
<td>34%</td>
<td>33%</td>
<td>8%</td>
<td>25%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Note: N=172 late fetal stillbirths and 335 infant mortality. 23 have unknown weight.

Birth weight specific mortality is shown in Figure 21. Those babies born with birth weights less than 1500 grams have an extremely high mortality rate (262.8 per 1000), whereas this rate is 2.8 per 1,000 at normal birth weight between 2,500 and 3,999 grams. The differences between these two weight categories are consistent with numbers published in the United States\(^{17}\) and in Saskatchewan\(^{22}\). The high birth weight infant mortality rate is slightly lower than the normal birth weight rate at 2.4 per 1,000 live births. Birth weight is one of the strongest risk predictors of infant mortality\(^{9,10}\) and the statistics for Saskatoon Health Region are consistent with this notion.

Figure 21: Birth Weight Specific Mortality Per 1,000 Live Births, Saskatoon Health Region, 1992-2006 Combined

**Infant Morbidity**

While infant mortality remains a key measure of the health of the population, measures of morbidity and mortality viewed together become more important when mortality rates are low, as is the case in much of Canada, because it presents a better picture of infant health needs. Issues of infant morbidity are beyond the scope of this report, but are flagged as an important area of future enquiry and will be discussed in more detail in the Chief Medical Health Officer Report: Early Child Health and Development set to be released in fall 2012.

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**Infant Mortality Rate**

- Between 20 to 30 infants die in the Region before age one every year.
- Overall, the infant mortality rate has steadily declined over the years, and most recently ranged from 3.5 to 7.2 infant deaths per 1,000 live births (2007 to 2009) compared to the provincial average of 5.8 to 7.0 (2007 to 2009), and the Canadian average of 5.1 (2007 as the last available year).
- In 2009, the Region’s infant mortality rate reached a high of 7.2 infant deaths per 1,000 live births, not seen that high since 2005 when the Region’s rate spiked at 12.0. The 2009 rate is higher compared to Canada, but similar to the province.
- The three leading causes of infant mortality in 2005 were congenital anomalies (birth defects) at 37.9 per cent, conditions arising in the perinatal period (31 per cent) and Sudden Infant Death Syndrome (SIDS) (6.9 per cent).

**Infant Death by Stages**

- Perinatal deaths made up 67 per cent of all infant deaths in the Health Region between 1992 and 2006.
- Between 1992 and 2006, neonatal mortality made up 60.3 per cent of all infant mortality and post-neonatal mortality made up 39.7 per cent of all infant mortality.

**Infant Mortality and Birth Weight**

- A large proportion of infant mortality (34 per cent) occurs among low birth weight infants (<1,500 grams).
- Those babies born with birth weights less than 1,500 grams have an extremely high mortality rate (262.8 per 1000), whereas this rate is 2.8 per 1,000 at normal birth weight between 2,500 and 3,999 grams.
- The high birth weight infant mortality rate (2.4 per 1,000 live births) is slightly lower than the normal birth weight (2.8 per 1,000 live births).


**Infant Mortality by Maternal Age**

Between 1992 and 2006 mothers under 20 years of age had a significantly higher infant mortality rate of 12.6 per 1,000 live births (95 per cent CI: 9.3 - 15.9 per cent) compared to those in other age groups (Figure 22). Interestingly, the oldest age group of mothers in Saskatoon Health Region (40+ years) had the lowest infant mortality rates, which is somewhat different from the literature that tends to show that both younger ages and older ages have the highest infant mortality rates. In Saskatchewan, the 40 years and older age group also had a relatively low infant mortality rate between 2001 and 2007 at 5.2 per 1,000 live births.

**Figure 22: Infant Mortality Rates by Maternal Age, Saskatoon Health Region, 1992-2006 Combined**

<table>
<thead>
<tr>
<th>Maternal Age</th>
<th>Infant Mortality Rate (per 1,000 live births)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20 Years</td>
<td>12.6</td>
</tr>
<tr>
<td>20-29 Years</td>
<td>6.9</td>
</tr>
<tr>
<td>30-39 Years</td>
<td>5.1</td>
</tr>
<tr>
<td>40+ Years</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Note: 3 deaths were of unknown maternal age.
Teenage Pregnancy

Health and Social Implications

Teenage pregnancy is a concern for any society. Teen mothers are more likely to deliver low birth weight babies, have preterm births and have lower rates of prenatal care than mothers in older age groups, increasing the risk of adverse health outcomes including infant death and poorer health throughout childhood in general. Tobacco, alcohol, substance and sexual abuse rates are reported to be higher amongst teenage moms.

There are other social aspects that can weigh heavily on teen moms, which are all acknowledged risk factors for infant mortality. Teen mothers are more likely to be single, have less educational and employment opportunities, and are more likely to have larger families or more children, consequently increasing their financial need. In 1996, the Robinhood Foundation published a report, Kids Having Kids, which estimated the cost of teen pregnancy on taxpayers in the United States to be $6.9 billion annually. More recently, that figure has been raised to 10.9 billion in 2008 from updated analysis by The National Campaign to Prevent Teen and Unplanned Pregnancy. The Robinhood Foundation report also found that in the United States only 30 per cent of a teen mother’s total income is from employment; the remainder is more likely to come from welfare assistance rather than a partner when compared to older women. Teen pregnancies can put teen mothers and their infants at increased risk of perpetuating a cycle of poor health and poverty.

Children of teen moms are at increased risk for developmental and schooling problems: they attain lower levels of education, perform worse in school and have higher drop-out rates, live in less educationally and emotionally stimulating homes, are more likely to live in poverty; are more likely to run away from home; are more likely to be victims of abuse and neglect, daughters are more likely to themselves become teen mothers, and sons are more likely to be incarcerated.

Teenage Pregnancy Rates

The teenage pregnancy rate is the number of live and still births plus induced abortions per 1000 females aged 15 to 19 years of age. The teen pregnancy rate in Saskatoon Health Region had decreased in the late 1990s until 2002, where it has remained fairly static. Saskatchewan trends show a continual increase from 2002 to 2009, while national figures show a decrease; although data nationally is only available to 2005 (see Figure 23). The Region rates have consistently remained below the Saskatchewan rates, but above the Canadian average.

Decreases in teen pregnancy rates had been attributed to increased availability and use of contraceptives and increased awareness about the risks associated with unprotected sex. However, Saskatoon Health Region is still above the Canadian average which indicates room for improvement in the area of preventive sexual health education in the teenage population.
Figure 23: Teen Pregnancy Rates 15 to 19 years, Saskatoon Health Region, Saskatchewan and Canada, 1997-2009

![Graph showing teenage pregnancy rates from 1997 to 2009 for Saskatoon Health Region, Saskatchewan, and Canada.]

<table>
<thead>
<tr>
<th>Year</th>
<th>SHR</th>
<th>SK</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>48.8</td>
<td>53.3</td>
<td>42.8</td>
</tr>
<tr>
<td>1998</td>
<td>48.3</td>
<td>51.9</td>
<td>42.4</td>
</tr>
<tr>
<td>1999</td>
<td>46.7</td>
<td>48.5</td>
<td>40.1</td>
</tr>
<tr>
<td>2000</td>
<td>43.7</td>
<td>46.0</td>
<td>38.0</td>
</tr>
<tr>
<td>2001</td>
<td>39.2</td>
<td>42.6</td>
<td>36.1</td>
</tr>
<tr>
<td>2002</td>
<td>32.9</td>
<td>40.2</td>
<td>33.9</td>
</tr>
<tr>
<td>2003</td>
<td>36.2</td>
<td>42.1</td>
<td>32.1</td>
</tr>
<tr>
<td>2004</td>
<td>34.4</td>
<td>43.6</td>
<td>30.5</td>
</tr>
<tr>
<td>2005</td>
<td>32.9</td>
<td>42.3</td>
<td>29.2</td>
</tr>
<tr>
<td>2006</td>
<td>34.3</td>
<td>45.1</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>40.7</td>
<td>47.2</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>32.9</td>
<td>49.2</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>36.5</td>
<td>48.4</td>
<td></td>
</tr>
</tbody>
</table>


A Closer Sub-Regional Look: Teen Pregnancy

Figure 24 shows that between 2006 and 2008, the teenage pregnancy rates for Saskatoon residents were significantly higher than for rural Saskatoon Health Region residents (40.4 and 23.6 per 1,000 respectively). There was also a definite socioeconomic gradient, as residents of the lowest socioeconomic areas (Quintile 5) had higher teen pregnancy rates than those from Quintile 1 through Quintile 4 areas (Figure 24). Teen pregnancy rates for the RIS population were significantly higher than for the non-RIS population (160.5 and 23.5 per 1,000 respectively). In addition, teenage pregnancy rates among residents of the core neighborhoods were significantly higher than both middle income and affluent neighborhood resident rates (Figure 24).

Figure 24: Teenage Pregnancy Rates by Subgroups in Saskatoon Health Region, 2006-2008

![Graph showing teenage pregnancy rates by subgroups for Saskatoon Health Region, 2006-2008.]

**Maternal Age**

- Mothers under 20 years of age had a significantly higher infant mortality rate of 12.6 per 1,000 live births compared to those in other age groups (1992-2006 combined).
- The oldest age group (40+ years) had the lowest infant mortality results at 3.8 per 1,000 live births (1992-2006 combined).

**Teenage Pregnancy Rate**

- The Region’s teenage pregnancy rates have consistently remained below the Saskatchewan rates, but above the Canadian average.
- Between 2006 and 2008, teenage pregnancy rates for Saskatoon residents were significantly higher than for rural Saskatoon Health Region residents (40.4 and 23.6 per 1,000 respectively).
- Teen pregnancy rates for the RIS population were significantly higher than for the non-RIS population (160.5 and 23.5 per 1,000 respectively).
- Residents of the lowest socioeconomic areas (Quintile 5) had higher teen pregnancy rates than those from Quintiles 1-4 areas.
- Teenage pregnancy rates among residents of the core neighborhoods were significantly higher than both middle income and affluent neighborhood resident rates.
CHAPTER 5
Risk Factors Associated with Infant Mortality

What are the Risk Factors Associated with Infant Mortality?

The distribution of some of the risk factors for infant mortality in the Saskatoon Health Region is explored in detail below. Due to the lack of systematic data collection, data is not available for all risk factors at this time, but is presented when available. Factors cited in literature as associated with increased infant mortality and other poor pregnancy outcomes can be grouped into three general categories: 1) maternal factors, 2) infant factors and 3) environmental factors.

What Maternal Risk Factors Contribute to Infant Mortality?

Chronic Illness

Chronic conditions, such as hypertension and other cardiovascular diseases, pre-existing or gestational diabetes, asthma and other chronic lung conditions, increase the risk of an adverse pregnancy outcome and maternal complications\(^\text{21}\). Older mothers and women of Aboriginal and new immigrant backgrounds may be at particular risk of such conditions.

Diabetes prevalence shows an increasing trend in the Region, in particular there is a significantly higher prevalence rate of diabetes amongst residents of the core neighborhoods in Saskatoon and the Registered Indian Status (RIS) population\(^\text{29}\). This is a trend worth noting due to the increased potential for complications compared to the general population, including perinatal mortality, congenital malformations, hypertension, preterm delivery, and large-for-gestational-age infants\(^\text{30}\).
Infections

Sexually transmitted infections, cervical and uterine infection, and asymptomatic bacterial vaginosis are all recognized as increasing the risk of preterm delivery and may be important factors in explaining higher preterm birth rates. Bacterial vaginosis, T. vaginalis, syphilis, gonorrhoea, and HIV are just some of the maternal infections that have been associated with poor pregnancy outcomes.31

Infrequent or Absent Prenatal and Postnatal Care

Women who receive no prenatal care or who initiate prenatal care late in pregnancy are at increased risk of an adverse pregnancy outcome. High quality, comprehensive prenatal care may have some role in recognizing risks during pregnancy and addressing these through preventive interventions. In addition, postnatal care services that connect postpartum mothers to contraceptive and family planning services have been shown to be effective in reducing infant mortality rates by allowing new mothers to better plan for the timing of subsequent pregnancies.32,9,33

Low Socioeconomic Status and Unhealthy Nutrition

Low levels of income and low maternal education are associated with higher risks of preterm birth, low birth weight and infant mortality.34,17 For example, a mother’s poor nutrition during pregnancy is a reflection of food insecurity as a result of low income. Poor nutrition or under nutrition plays a major role in the likelihood of low birth weight. Both poor nutrition and consumption of excessive amounts of calories may place pregnant women at increased risk of an adverse pregnancy outcome. Low folic acid levels in the pre-conception period and very early pregnancy are now recognized as an important risk factor for neural tube defects among infants.35 The rising levels of obesity in society place mothers at additional risk for chronic conditions like hypertension and Type II diabetes.36

Stress

Chronic and persistent stress associated with poverty and discrimination is now thought to be an important cause of adverse pregnancy outcomes. Increased stress from discrimination and its relation to preterm births has been discussed but not researched extensively. Stress may have both direct and indirect effects on birth outcomes through biological and behavioral pathways. Stress may be an important determinant of preterm birth because it leads to reduced immune functioning and increases susceptibility to infections.31 Stress avoidance may also lead some individuals away from accessing needed services in a timely manner.

Marital Status

Infant mortality rates for unmarried mothers have been shown to be 1.8 times higher than for married mothers. This is likely because many other factors like income, education level, social support, maternal age, and prenatal care interact and put unmarried mothers at higher risk for poor pregnancy outcomes.17

Maternal Age

The risk of an adverse pregnancy outcome increases at either end of the maternal age spectrum. Teenage pregnancy has been long recognized as a risk factor for poor outcomes, though the rates of teen pregnancy have declined in the last decade (see Chapter 4 on Teen Pregnancy)23,24,4. On the opposite end of the spectrum, older women also have a higher risk for poor birth outcomes.37,38

Multiple Pregnancies and Births

Multiple births are associated with increased risk of preterm delivery, low birth weight, and intrauterine growth restriction and their associated consequences.4,6,5 Multiple births have increased substantially in recent years due to increasing use of assisted reproductive technology. Women who use assisted reproductive technology and other fertility treatments have greater rates of preterm birth and low birth weight, among both multiple and single births.39
**Previous Preterm Birth**

Preterm birth is one of the most important risk factors associated with increased infant mortality. One of the most important predictors of preterm birth is a previous preterm birth\(^2\).  

**Drinking, Smoking, and Other Drug Use**

Smoking, heavy alcohol consumption, and the use of illicit substances all increase risk of adverse perinatal outcomes. Of these, smoking is most common and may carry added risk for newborn health with second hand exposure after birth. Maternal smoking is the principal cause of low birth weight and has been associated with preterm births, sudden infant death syndrome and respiratory distress syndrome\(^4\). The prevalence of maternal smoking (all ages) in Saskatoon Health Region based on 2009 in-hospital birth questionnaires is estimated at 17.1 per cent. The prevalence of prenatal alcohol consumption (all ages) based on the same in-hospital birth questionnaire is estimated at 6.1 per cent. Babies born to substance abusing mothers run the risk of being born addicted to the same drugs themselves and need intensive acute care support early in the postnatal period to wean them off the effects of these drugs.

**Time Interval Between Pregnancies**

Short (less than 18 months) intervals between pregnancies increase the risk of preterm birth and low birth weight\(^2\).  

**Unplanned Pregnancies**

Unplanned pregnancies are at higher risk of resulting in preterm or low birth weight newborns\(^4\). Women involved in multiple high risk activities such as injection drug use and alcohol abuse risk unplanned pregnancies and are more likely to be lower socioeconomic status, suffer greater food insecurity and often delay accessing prenatal care\(^2\).  

**What Infant Risk Factors Contribute to Infant Mortality?**

**Congenital Anomalies or Birth Defects**

Of the approximately 350,000 children born in Canada each year, most are born healthy and to term. However, 2-3 per cent of these babies will be born with a serious congenital anomaly. More commonly, these babies are born to women with no family history and no known risk factors for congenital anomalies. Major congenital anomalies remain a leading cause of death among Canadian infants in both the neonatal and postneonatal periods. The fatality rates for the most severe anomalies, such as anencephaly, trisomies 13 and 18, and severe congenital heart defects, are virtually 100 per cent by the child’s first birthday\(^1\). Although less severe birth defects are often not fatal, the emotional and economic burden on the family and society is considerable and invariably leaves families and health care providers with unanswered questions regarding the causes, recurrence risks and preventive measures.

Congenital anomalies, defects or malformations, and chromosomal abnormalities are an important cause of infant death in the U.S., and Canada. Of these, neural tube defects are known to be preventable through preconception and prenatal folic acid supplementation. In general, however, the prevention of all congenital anomalies is difficult since the causes of approximately 70 per cent of defects are not known, and the associated risk factors are multifactorial. See Chapter 3 for more information on congenital anomalies.

**Infants from Multiple Births**

Multiple births are associated with infant mortality because babies born in these pregnancies tend to be premature and of low birth weight. The Saskatoon Health Region multiple birth rate in 2009 was 3.2 per 100 births with the vast majority of these births being twins. The trend both nationally and regionally is an increase in multiple births.
Low Birth Weight Babies

Lower birth weight is often seen with early gestation. Infants at low birth weight (less than 2,500 grams) are approximately 20 times more likely to die than babies born at birth weights greater than 2,500 grams\(^6\). See Chapter 3 for more information on birth weight.

Preterm Births Babies

Preterm birth (gestation less than 37 weeks) is considered the most important cause of infant mortality\(^5,6\). In the US and other developed countries, preterm delivery is the leading component of low birth weight\(^5\). In Canada in 2006-07, approximately 72 per cent per cent of low birth weight babies were born prematurely\(^43\).

Respiratory Distress Syndrome

Preterm infants frequently experience respiratory distress because of incomplete lung maturation. Deaths due to respiratory distress syndrome have decreased substantially after the widespread use of medical treatments including surfactant and prenatal steroids. These advances in medical technology have had a significant impact on this formerly leading cause of infant mortality\(^44\).

Sudden Infant Death Syndrome

While the exact causes of sudden infant death syndrome (SIDS) are unknown, the campaign to change infant sleep positions from the stomach to the back and campaigns to address co-sleeping and excessive soft bed coverings and toys in the baby’s crib have corresponded with substantial declines in SIDS-related death rates\(^21\).

What Environmental Factors Contribute to Infant Mortality?

Bed Sharing

In most western countries, a mother sharing a bed with her infant (co-sleeping) has been described as a risk factor for the development of SIDS and is strongly discouraged. There is mixed evidence about whether co-sleeping poses an increased risk for SIDS in non-western countries. In some circumstances risks of death are higher for bed sharing such as with infants under four months of age, or sleeping on a couch with the parent\(^45\).

Environmental Toxins

Environmental tobacco smoke, pesticides and other environmental toxins have been shown to increase the risk of low birth weight and preterm births\(^46\).

Injury

Injuries are predictable and preventable. Despite this, injuries remain an important cause of hospitalization and mortality among infants under one year of age. The leading causes of injury related hospitalization are falls, drowning and assault, while the leading causes of injury related death are drowning, motor vehicles and assault (see Table 5). There is little injury prevention programming occurring in Population and Public Health with the exception of safe infant handling and position and infant car seat education, which are provided as part of prenatal education. Other providers in Saskatoon Health Region such as MD Ambulance and SGI conduct infant and baby car seat fitting clinics. The Saskatchewan Prevention Institute is a key stakeholder in this area as well.
### Injury Rates among Infants in Saskatchewan

#### Table 5: Leading Causes of Injury-Related Hospitalization and Deaths for Saskatchewan Children Under One Year of Age

<table>
<thead>
<tr>
<th>Injury-Related Hospitalization</th>
<th>Cause</th>
<th>%</th>
<th>Injury-Related Deaths</th>
<th>Cause</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falls</td>
<td>31.5</td>
<td></td>
<td>Drowning</td>
<td>29.7</td>
<td></td>
</tr>
<tr>
<td>Drowning, submersion</td>
<td>11.7</td>
<td></td>
<td>Motor vehicles</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>Assault</td>
<td>11.0</td>
<td></td>
<td>Assault</td>
<td>10.8</td>
<td></td>
</tr>
</tbody>
</table>


---

**Lack of Social Support**

Studies suggest that social support plays an important role in increasing the likelihood of not only a healthy full term pregnancy, but positive long term outcomes on infant and mother\(^47\). The benefits of social supports change with changing maternal needs from pregnancy to delivery and postpartum. Examples of social supports that have shown positive effects include a spouse/partner, information (e.g. prenatal classes), healthcare providers, a companion during pregnancy, and practical support for household activities and childcare\(^48\). Social supports act as a protective factor for maternal psychosocial stress which has been associated with preterm birth, low birth weight and other postnatal health issues\(^49\).

**Breastfeeding**

Breastfeeding has been found to be a protective factor, potentially lowering the risk of infant mortality. Breastfed babies are less likely to get infections, develop SIDS, asthma, diabetes and other chronic conditions. Breast milk is filled with vitamins and nutrients to build the immune system and brain development and breastfed babies are less likely to become obese later in life. In addition to its nutritive role, breast feeding encourages bonding and nurturing of the newborn.\(^47^\)

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Breastfeeding and Vitamin D Supplementation Rates in Saskatoon Health Region

In 2009-10, 97.2 per cent of Saskatoon Health Region mothers reported breastfeeding their most recent baby compared to 83.5 per cent in 2007/08. This is higher than both the Saskatchewan and Canadian averages of 90.1 per cent and 87.4 per cent, respectively, though is only statistically different than the Canadian average (See Table 6).

Table 6: Prevalence of Breastfeeding Initiation, Saskatoon Health Region, Saskatchewan, and Canada 2007/08-2009/10

<table>
<thead>
<tr>
<th></th>
<th>Saskatoon Health Region</th>
<th>Saskatchewan</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007/08</td>
<td>83.5% (72.1%-94.9%)</td>
<td>87.5% (82.7%-92.4%)</td>
<td>87.7% (86.6%-88.9%)</td>
</tr>
<tr>
<td>2009/10</td>
<td>97.2% (93.8%-100.5%)</td>
<td>90.1% (85.9%-94.2%)</td>
<td>87.4% (86.2%-88.6%)</td>
</tr>
</tbody>
</table>

Source: Statistics Canada, Canadian Community Health Survey (CCHS). CANSIM table 105-0502

Rates of exclusive breastfeeding to 6 months of age are considerably lower in Saskatoon Health Region at 47.4 per cent in 2009/2010. However, this represents an improvement from past years and is higher than the Saskatchewan and Canadian averages (Table 7). Exclusive breastfeeding rates from the Canadian Community Health Survey (CCHS) are derived from the amount of time that mothers only breastfed the baby before the introduction of other liquids or solid foods to the baby’s feeds.

Table 7: Exclusive Duration of Breastfeeding for at least 6 Months, Saskatoon Health Region, 2007/08 and 2009/10

<table>
<thead>
<tr>
<th></th>
<th>Saskatoon Health Region</th>
<th>Saskatchewan</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007/08</td>
<td>36.5* 23.1 - 49.9</td>
<td>27.2 21.4 - 33.1</td>
<td>23.0 21.5 - 24.6</td>
</tr>
<tr>
<td>2009/10</td>
<td>47.4* 31.0 - 63.8</td>
<td>33.1 26.0 - 40.3</td>
<td>26.2 24.5 - 27.9</td>
</tr>
</tbody>
</table>

Source: Statistics Canada, Canadian Community Health Survey (CCHS). CANSIM table 105-0502
* Interpret with caution: high sampling variability

Vitamin D Supplementation

About 79 per cent of Saskatoon Health Region mothers reported giving their breastfed infants vitamin D supplements in 2007/08. This is an increase from just 43 per cent in 2003. Similar increases are seen in Saskatchewan and Canada (Table 8).

Table 8: Vitamin D Supplementation for Breastfed Infants, Saskatoon Health Region, Saskatchewan, and Canada, 2003 and 2007/8

<table>
<thead>
<tr>
<th></th>
<th>Saskatoon Health Region</th>
<th>Saskatchewan</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>43.1%</td>
<td>54.0%</td>
<td>52.4%</td>
</tr>
<tr>
<td>2005</td>
<td>62.9%*</td>
<td>65.1%</td>
<td>61%</td>
</tr>
<tr>
<td>2007/08</td>
<td>78.8%</td>
<td>72.0%</td>
<td>67.4%</td>
</tr>
</tbody>
</table>

The Link between Social Factors and Biological Factors in Infant Mortality

It is important to note that many of the factors mentioned in this chapter interact with each other and a person can be susceptible to more than one risk factor. Both social and biological variables are important contributors to infant survival. All the social and economic determinants of infant mortality (e.g., poverty, employment status, and housing) operate through biological mechanisms to exert an impact on infant mortality. Mosley and Chen\textsuperscript{50} propose a framework that provides for the measurement of morbidity and mortality through a single variable, growth faltering, and helps to organize the seemingly disparate measures of environmental conditions, dietary, reproductive and healthcare practices, and disease states into a coherent framework in which they are linked to one another (see Appendix B for the Mosley and Chen Model).

Risk Factors

Factors cited in the literature as being associated with increased infant mortality and other poor pregnancy outcomes can be grouped into three general categories: 1) maternal factors, 2) infant factors and 3) environmental factors.

Maternal Factors

- Maternal risk factors associated with infant mortality include: chronic illness, infection, infrequent or absent prenatal care and postnatal care, smoking, low socioeconomic status and unhealthy nutrition, marital status, maternal age, multiple pregnancies and births, previous preterm birth, drinking, smoking and other drug use, stress, time interval between pregnancies and unplanned pregnancies.

Infant Factors

- Infant risk factors associated with infant mortality include: congenital anomalies or birth defects, low birth weight, preterm births, respiratory distress syndrome and sudden infant death syndrome.

Environmental Factors

- Environmental risk factors associated with infant mortality include: bed sharing, environmental toxins and a lack of social support.

The Link between Social and Biological Factors

- Both social and biological variables are important contributors to infant survival. All the social and economic determinants of infant mortality (e.g., poverty) operate through a common set of biological mechanisms to exert an impact on infant mortality.
**Interventions to Improve Pregnancy Outcomes**

Infant mortality is a social problem as well as a health problem so working towards any solution needs community involvement. In practical terms, infant mortality can be addressed by focusing on critical periods in the health of women and their infants and adopting a series of interventions that target specific risks, while considering the broader socioeconomic environment.

Using the framework described by Health Canada, and shown in Table 9, certain services or approaches to care such as maternal health, maternal care, newborn care and infant environment can reduce fetal and infant mortality based on birth weight and age at death (or gestational age). According to the framework, maternal health considerations should be paramount when examining deaths among infants less than 1,500 grams. Behaviors including alcohol use, smoking, stress, and physical activity are important here as are social circumstances such as income and employment status. Babies born with a birth weight of less than 1,500 grams in the early to late neonatal stage could benefit from the use of optimal neonatal care. For normal birth weight babies in the late neonatal stage and those that die in the post-neonatal period, the environment in which the infant is being cared for can be a concern with issues such as missed opportunities for immunization for vaccine preventable infectious disease and injury prevention.
Table 9: Framework for Estimation of Preventable Fetal-Infant Mortality

<table>
<thead>
<tr>
<th>Birth weight (grams)</th>
<th>Late fetal (28+ weeks)</th>
<th>Early neonatal (&lt; 7 days)</th>
<th>Late neonatal (7-27 days)</th>
<th>Post-neonatal (28-364 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>Maternal health or preconception care = 33.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,500 – 2,499</td>
<td>Maternal care = 27.2%</td>
<td>Newborn care = 13.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,500 +</td>
<td>Infant environment = 25.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Health Canada, 2000 pg. 58.
NB: The Percentage calculations come from Table 4 numbers using the 507 total late fetal and infant mortality number as the denominator.

The factors that underlie infant death are multiple and complex and there is no single “magic bullet” to reduce infant mortality. It is important to note that while most interventions focus on women, we must also recognize the critical role of male partners in supporting the health of women and their infants. Further, the focus on the biological and medical pathways should not be interpreted as relieving society of the need to address underlying social inequities.

The following sections mention just a few of the many programs and services available in Saskatoon Health Region to help new and expectant mothers and their infants. The focus here is largely on services and programs offered through Population and Public Health, and it is acknowledged that many more programs and services exist in the Region. Other programs and services include: other areas in Saskatoon Health Region such as Primary Health, Pediatrics, Mental Health and Addictions, and Home Care; other government agencies such as Social Services, Education, Justice; Aboriginal organizations like Central Urban Métis Federation, Inc and Saskatoon Tribal Council; and community-based organizations that include the Mothers’ Centre, Westside Community Clinic, Family Services Saskatoon, and Catholic Family Services; as well as countless others. It is also important to acknowledge the role of the family physician, nurse, midwife and doula throughout the continuum of care.

Currently, no single group oversees or manages all maternal and child health services in Saskatoon Health Region. There are many programs and services that work to address maternal risk factors (e.g., chronic disease management, maternal mental health, improved access to prenatal care), infant risk factors (e.g., safe sleeping, promotion of breastfeeding), and environmental factors (e.g., social support for mothers). In addition, many of the postnatal services are provided by a variety of Saskatoon Health Region departments, which can lead to duplication or gaps in services. For example, there is a gap in services offered for newborns over four weeks old who are discharged from hospital, but have ongoing medical concerns (e.g., repositioning of the feeding tube).

As such, this report should be considered in discussions with other programs and services particularly with the Region’s new Maternal and Child Services value stream and the greater community.

**Comprehensive Preconception Care**

Healthy “girlhood” is the key to healthy pregnancy and safe motherhood. Improving the reproductive health of a population must first involve ensuring the health of girls and young women who will become mothers. Investing in the health of girls must continue into adulthood and the peak childbearing ages to promote the delivery of healthy infants. Among the key elements of such a strategy are:

- Promoting the healthy development of young girls and adolescents to be active, well-nourished and well-educated about their bodies and their sexuality, so that they can make responsible choices.

- Improving access to primary and preventive care for girls and women of all ages is necessary to promote the health of mothers. This includes screening and treating pre-existing infections and conditions, and the counselling to prevent them. Contraceptive counselling and access to family planning services to reduce unplanned and closely spaced pregnancies, especially among high-risk populations (e.g., teens and older women).

- Preconception care also includes health education and policies that discourage smoking and drug use and promote physical activity and good nutrition to improve behavioural and physical health prior to pregnancy.
The above elements of preconception care as a combined service may currently only be available in primary care, including the family physician’s office, although individual elements of this type of care are offered from a variety of services.

**Family Planning Clinical Services**

Population and Public Health aims to improve sexual health outcomes and reduce unintended pregnancies (particularly youth) in Saskatoon by providing drop in clinical services. The Sexual Health Program has as one of its goals, to reduce teenage pregnancy\(^5\). Part of its function is to offer individual and group education on healthy sexuality and also to provide contraceptive services to clients. This role is needed in the community, as few other groups engage in this activity.

Availability and distribution of contraceptives is a necessary service to help reduce unintended pregnancies, especially in teens. In 2009, the Sexual Health Program in Saskatoon Health Region distributed over 68,000 condoms free of charge to clients of the Street Health Program, Sexual Health Clinic and in physician offices. They also prescribed the emergency contraceptive pill to over 60 clients and the contraceptive inter uterine device to 20 clients in that year. These totals vary year to year but this gives some idea of the magnitude of the contraceptive services offered.

In addition to contraceptives distributed, the Sexual Health Program also delivered over 1,900 client education sessions on condoms and safer sex along with over 1,500 client education sessions on female health in 2009. In addition, sexual health education school sessions were held in select schools throughout the year. The number of school presentations for sexual health education has been significantly reduced, and continue only in Health Promoting Schools (see Appendix A for definition).

Other groups in Saskatoon Health Region are also involved in contraceptive programming (e.g., the Saskatoon Sexual Health Centre). Without any form of contraception an estimated 85 per cent of heterosexual couples who engage in regular intercourse would conceive within one year\(^5\).

**Saskatoon Teen Wellness Center (CRU)**

Connections & Resources for U (CRU) is a teen wellness centre in the community that provides a fun and safe atmosphere for youth between the ages of 13-19. CRU principally serves as a resource center on issues of sexuality and healthy living, and offers programs, workshops, drop-in activities and clinical services for young people.

Some of the topics regularly covered in CRU programming include: preventing sexually transmitted infections, peer pressure, drugs and alcohol, body image, healthy relationships, stress, racism, self-awareness, teamwork/consensus building, birth control and contraceptives and youth leadership development.

The objectives of the CRU Youth Wellness Centre Inc. are:

- To assist with the development of young people and promote healthy choices through prevention and intervention.
- Increasing awareness of and involvement in, Aboriginal youth issues and Aboriginal culture.
- To build positive and supportive relationships in the community and allow youth to develop leadership and responsibility.
- To be proactive in the work of and recognize the Youth Engagement Model of Community Development.

**Prenatal Care**

High quality and comprehensive prenatal care has the potential to identify and address maternal risks, resulting in both healthier mothers and infants. Ideally, many of the pre-existing risks identified during prenatal care should be addressed, prevented or treated prior to labour and delivery. The prenatal period is an important time to address these and other complications that may arise during pregnancy. Prenatal care can include any combination of
health education, psychosocial and nutrition counseling, referrals to specialists, and routine medical and obstetrical care. Prenatal care is found to be most effective if it is tailored to the needs of the mother (e.g., a teenager).

The following are critical components of comprehensive, high-quality prenatal care that should be incorporated into prenatal care services:

- Early entry and continued use of quality prenatal care with a full array of enabling and psychosocial services.
- Screening and treatment services for reproductive tract infections and monitoring pre-existing conditions that may affect pregnancy.
- Counseling to encourage healthy lifestyle and good nutrition, including adequate folate and iron intake.
- Education about recognition of the early signs of pregnancy-related problems, and what action to take.
- Management of high-risk pregnancies in maternal-fetal medicine units within regionalized systems of care.
- Nutrition interventions, such as folic acid intake by mothers in their early weeks of pregnancy, have been shown to reduce neural tube defects (i.e., spina bifida, anencephaly, etc.). Since 1996 in Canada, flour products are mandated to be fortified with folic acid to prevent these adverse birth outcomes. Proper prenatal nutrition is especially important for mothers of low socioeconomic status, as nutrition counseling as well as food vouchers has been shown to encourage proper prenatal nutrition in this population subgroup. The Canada Prenatal Nutrition Program is set up to help communities develop comprehensive programs for at-risk women.
- Smoking cessation services either through advice, information sharing or repeated contacts with health professionals is a recommended intervention to help improve pregnancy outcomes. Smoking has a well known association with low birth weight outcomes. Smoking cessation has been shown to improve birth weight outcomes.
- Alcohol cessation services are recommended for optimal pregnancy outcomes. Fetal Alcohol Syndrome is a set of alcohol related disabilities (e.g., central nervous system, physical abnormalities) associated with the use of alcohol during pregnancy. Even though large amounts of alcohol ingestion at one time are more damaging than moderate intake, there is no safe level of alcohol consumption for pregnant women. Prevention strategies like information sharing should be used with more intensive screening and programming for populations at risk.

The following are examples of some of the perinatal services currently offered in the Region:

**Healthy Mother Healthy Baby: Primary Health Department, Saskatoon Health Region**

The Healthy Mother Healthy Baby program in Saskatoon Health Region provides prenatal and postnatal services for urban moms, especially those who are at risk for poor infant and poor maternal health outcomes. Information, education, advocacy, and support in clients’ homes and venues around Saskatoon are available. Milk, vitamin and mineral supplementation is available for pregnant teens and women whose diets are poor and whose incomes are inadequate to meet basic daily requirements.

**KidsFirst: Primary Health Department, Saskatoon Health Region**

The KidsFirst Targeted Program is an early childhood development and family support program using home visitation as the primary service delivery strategy. The program provides multifaceted services to families living in vulnerable circumstances in the context of an interdisciplinary team model. The program aims to:

- increase utilization of prenatal care;
- promote positive parenting and improve parent-child interaction;
- optimize child and family health, development and safety;
- enhance parent self-efficacy and family functioning,
The KidsFirst Program model is theoretically rooted in a strength-based approach. Human ecology, attachment, and self-efficacy are key theories. Participation is voluntary and services are tailored to the needs of KidsFirst enrolled children and families.

Local sites are encouraged to formulate program services and activities that correspond to the specific needs of their communities. Eligible families are enrolled prenatally or as soon after a child’s birth as possible. Home visitors help families build their own abilities to manage challenges. Eligible families include those facing challenges such as single parenthood, low income, low education, substance abuse, and/or mental health issues. Once enrolled, KidsFirst provides services to families until the child reaches the age of five.

Birth

Labour and Delivery: Royal University Hospital and Humboldt District Health Complex, Saskatoon Health Region

As a majority of infant deaths occur in the perinatal period (from 22 weeks gestation to 7 days post neonatal life), it is important for the health system to provide appropriate technological solutions that can address and correct any serious obstetric or perinatal complications that may occur. It is also just as important for the system to begin to act on the precursors and predictors of poor birth outcomes (as described in Chapters 3 and 4). There are many services that are offered during labour and delivery in the Region; however, this is outside the scope of this report.

Postpartum Continuum of Care: Focusing on the Mother

The postpartum continuum of care encompasses all services provided by home visit or phone support within Saskatoon Health Region during the postpartum period (6 weeks following birth). Through a process of liaising and transferring relevant client information between agencies in the postpartum period, client assessment is completed, priority clients for Public Health Nurse home visits are identified, at risk infants and mothers are identified, and families are directed to the appropriate care provider. The objectives of the continuum are to enhance the capacity of parents to support the healthy growth and development of their infants and to create supportive environments that nurture families and recognize their strengths.

Maternal Mental Health

The Feelings in Pregnancy and Motherhood Study, a Saskatchewan-based project, examined maternal depression and found that as many as one in five mothers suffer from depression during or after pregnancy. Depression during early pregnancy was highest with 14.1 per cent of women having scores indicative of probable depression. Rates in the early postpartum period were lower with 8.1 per cent of women having scores indicative of probable depression. This falls within the range of 6.5 - 12.9 per cent, which was found in a systematic review of prevalence and incidence of postpartum depression. These findings resulted in a series of actions to address maternal mental health in the community. For example:

- A Maternal Mental Health program running out of West Winds Primary Health Centre and the University of Saskatchewan’s Department of Psychiatry was initiated. A Postpartum Hotline (221-6806) was also developed.
- A Provincial Maternal Mental Health awareness campaign was established.
- MotherFirst, a policy working group composed of a variety of stakeholders from academia (Chair), nursing, medicine, mental health, and Aboriginal and community organizations, was created. MotherFirst released a report last fall which contains a provincial strategy for maternal mental health and four key recommendations available at: https://sites.google.com/site/maternalmentalhealthsk/.
Neonatal and Post Neonatal Care

In the neonatal and post neonatal period (7 days to one year), for normal growth and development, the newborn requires adequate and safe nutrition, as well as protection from infectious diseases and other environmental dangers. Maternal breast milk is sufficient adequate nutrition to support the growth and normal development of the newborn for the first six months of life. This needs to be supplemented with age appropriate foods introduced ideally after six months of exclusive breastfeeding.

Healthy growth and development requires family centered community-based, culturally competent, coordinated care and support throughout the life course. This is required starting from the preconception period through prenatal care and from the perinatal periods, infancy, childhood, adolescence and adulthood.

Healthy and Home Early Discharge Program: Maternal and Child Services, Saskatoon Health Region

The Healthy and Home Program provides postnatal care for mothers who are discharged within the first 48 hours of birth from hospital. This program provides clinical support care for new mothers and infants who are discharged from the hospital, who live in or near Saskatoon. This service, provided by Maternal Child Nurses, may include telephone assessment and support, home visits or a combination of both.

Neonatal Screening

Universal neonatal screening for in-born errors of metabolism is routinely performed in Saskatoon Health Region for several rare abnormalities that can be fatal if not detected and treated promptly. These screening tests are best performed 24 hours after birth. This screening process has been challenged by the early postnatal discharge policy introduced in Saskatoon Health Region in the last few years, where mothers can be released if stable from twelve hours after delivery. As a result, it has become more difficult to ensure continued high levels of coverage of all newborns in the Region for this important test.

Postpartum Home Visit: Population and Public Health, Saskatoon Health Region

Clients are contacted by Public Health Nurses within 5 to 10 days after discharge. Rural clients outside of Healthy and Home boundaries are contacted as soon as possible. Home-based visits or a telephone assessment call is routinely done for both mother and infants. An information package is given to all clients whether a home based-visit is made or not.

Newborn Care: Neonatal Intensive Care Unit, Royal University Hospital

Over the last 50 years, the major improvements in infant mortality rates in Canada and the US have resulted from successful reductions in post-neonatal deaths that are not birth weight dependent and, more recently, from innovations that have dramatically improved birth weight specific survival. Neonatal intensive care units play a crucial role in providing the care and therapies necessary to sustain premature and otherwise fragile newborns.

Pediatric Home Care, Homecare Saskatoon Health Region

Home Care Services, Saskatoon Health Region provide respite, caregiver relief to families of infants and children with medical needs who require a nursing assessment and intervention during the respite. The program began in 1991 and serves all Saskatoon Health Region residents. In 2000, the Ministry of Health introduced funding for complex care pediatric clients. These clients have complex medical needs which require increased hours of respite. The age range for clients is less than one year of age to 18 years of age. Home Care works collaboratively with acute care providers when planning discharges from hospital as well as ongoing admissions and discharges.
**Child Health Clinics (CHC): Population and Public Health**

The early identification of priority risks to a child’s optimal health and development may influence the health outcome of children and their potential contribution to society.

Periodic well baby visits during the first year of life for healthy term infants are recommended in Canada. The visits should include the routine assessment of baby for normal growth and development and parenting skills; counseling on nutrition, safety, and common problems like night time crying; a physical examination with hearing and reflex tests; and immunizations. Within the infant’s first year, the visits should take place within the 1st week, and then at 2 months, 4 months, 6 months, and 12 months. The child health clinic is an appropriate setting where potential risk factors may be identified and planning for interventions can begin. The Public Health Nurse possesses the knowledge and skills necessary to identify potential risk factors and identify possible interventions to enhance the health and well-being of the child and family (see Appendix C for a complete summary of services offered at CHCs). Intervention in partnership with the family and other service providers are essential.

**Key Services and Supports Offered in Child Health Clinics**

The following section lays out key services delivered in Child Health Clinics as well as other supports offered in the Region.

**Growth Monitoring and Physical Assessments**

Periodic growth monitoring and physical assessments of all infants to ensure that they are meeting the timely growth and developmental milestones are key services offered in CHC clinics. Ideally, the baby’s weight and growth should be plotted on the accepted national growth standard. A steady increase in weight pattern that trends upwards is the norm for most appropriately nourished infants. Flattening or a decline in the growth curve could be an early indicator that normal growth is not occurring and should be investigated further to determine the cause, which may or may not require higher level intervention (see Appendix D for sample WHO growth charts).

**Breastfeeding Support**

Breastfeeding has been well documented as the standard way (both in terms of nutrition content and cost-effectiveness) to ensure infants get adequate and food secure nutrition. The World Health Organization recommends exclusive breastfeeding for the first six months of life, followed by the provision of safe and appropriate complementary foods, and continued breastfeeding for up to two years of age. As of 2004, Health Canada recommended supplementing breastfeeding with 400 IU of Vitamin D drops, until the child is one year of age or begins to consume at least 500 ml of regular milk per day.

Recent published research and systematic reviews have reinforced the conclusion that breastfeeding and human milk are the normative standards for infant feeding and nutrition (AAP 2012). The benefits of breastfeeding for the infant include:

- Reduced risk of infant respiratory tract infection
- Reduced risk of infant gastrointestinal infections
- Reduced risk of infant necrotizing enterocolitis
- Reduced risk for sudden infant death syndrome and infant mortality
- Protective effect against allergies
- Reduction in celiac disease later on in life
- Reduction in childhood inflammatory bowel disease
- Reduced risk of adolescent and adult obesity
- Reduction in the incidence of type 1 diabetes in childhood
- Reduction in leukemia and lymphoma

Source: American Academy of Pediatrics 2012
There are a number of maternal benefits to breastfeeding as well. However, breastfeeding is not recommended for women with HIV and certain other conditions\(^5\). Very few medications are contraindicated in lactation, but all providers should review carefully any maternal medications for safety. All breastfeeding newborn infants should be seen by a pediatric health care provider at 3 to 5 days of age to ensure proper lactation has been established and to help mother with any breastfeeding concerns. Breast-feeding infants should have a second ambulatory visit between 2 to 3 weeks so that the health care professional can monitor weight gain and provide support to the mother during this critical period\(^5\).

**Parenting Supports: Client Centered Care**

Based upon the provincial child health clinic’s goals\(^6\), parental supports in the CHCs are designed to increase parents’ confidence in their ability to maintain and promote the health of their family in the long-term. In the short term, the supports are designed:

- To establish a client centered and therapeutic relationship with parents. This permits parents to express needs to a Public Health Nurse in a short time frame.
- To identify parents having difficulty coping with their infant’s crying or sleep habits, and to provide support and education or refer to other services (e.g. physician or early childhood psychologist), when indicated.
- To ask key questions at 2 months, 4 months and 6 months, that focuses on the issues of nighttime waking and crying patterns.
- To provide parents with health education through discussion and handouts that will assist in the development and maintenance of positive parenting and coping skills.

**Continuity of Care**

Presently rural Child Health Clinics are scheduled in a manner that promotes continuity of care. The same Public Health Nurse routinely attends the CHCs offered in their designated community. Anecdotal reports from parents and staff indicate that this continuity fosters the development of the client-professional relationship, which in turn, increases the ability of the nurse to support and positively influence the health practices of parents. The Early Years Study\(^6\) indicates that early, consistent intervention by the same professional increases parent’s willingness to access and follow through with parenting suggestions.

**Nighttime Sleeping and Crying**

The issues of nighttime sleeping and crying are related to healthy family dynamics, bonding, healthy weight gain, healthy parenting and prevention of abuse. Parents’ lack of sleep affects their ability to function in all areas of life. Ten to thirty per cent of newborn babies, whether breastfed or formula fed, are affected by colic. Colic has been defined as bouts of crying longer than 3 hours a day, for at least 3 days a week, for at least 3 weeks in row. One in 6 families consults health care professionals for infant colic. It is vital that parents have a feeling of self-confidence in their parenting abilities in order to effectively manage a crying infant. Nighttime waking and crying occurs in 20 per cent of infants and toddlers who do not require night feeding. Counseling around recognizing child fatigue cues, creating sleep supporting environments and establishing night routines can reduce nighttime waking and crying. There is good evidence that anticipatory guidance for management of nighttime crying and sleeping concerns is effective\(^5\).

**Oral Health**

Periodontal disease has been associated with risk of preterm birth and low birth weight. There is thought to be an association between salivary levels of two cariogenic bacteria as shown by maternal caries history, and the chronic inflammation posed by periodontitis and preterm delivery and low birth weight\(^6\). This new understanding has lead the Canadian Pediatric Society to issue a position statement recommending addressing treating dental caries in pregnancy and promoting the prevention of dental caries in the newborn.
Safe Sleep and Sudden Infant Death Syndrome

As noted in chapter 3, approximately 90 per cent of SIDS deaths, also known as cot death, occur before infants reach 6 months of age. Although the exact cause of SIDS is yet to be determined, many associated risk factors for SIDS have been identified, such as sleep position, exposure to second hand smoke in the home, overheating while sleeping by the use of excessive covers and soft toys in the baby’s crib. Prevention strategies have primarily focused on sleep position and have been met with success due to the fact that SIDS rates in the United States and Canada have been dropping. In the CHCs, the following topics are discussed by public health nurses with families: safe sleep guidelines, tight swaddling, prevention of overheating and co-sleeping.

Immunization

In past centuries, infectious diseases have been the leading cause of mortality of children and this remains the case in many developing countries even today. In Canada, infectious diseases cause less than 5% of all deaths. This is due in large part to the introduction of vaccines against vaccine-preventable infectious diseases.

Recommended Childhood Immunization Series

The recommended schedule for early childhood immunization begins in infancy, preferably before the waning of the protective effects of maternal antibodies. A newborn’s immune system is exposed to thousands of foreign antigens, to which the baby’s immune system responds competently. This fact explains why even very young infants can still appropriately process multiple antigens presented in modern vaccine formulations. The immunization schedule for Saskatchewan infants up to eighteen months is presented in Tables 10 below.

<table>
<thead>
<tr>
<th>Table 10: Saskatchewan Immunization Schedule for Infants up to 18 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP-Polio</td>
</tr>
<tr>
<td>2 months</td>
</tr>
<tr>
<td>4 months</td>
</tr>
<tr>
<td>6 months</td>
</tr>
<tr>
<td>6+ months</td>
</tr>
<tr>
<td>12 months</td>
</tr>
<tr>
<td>18 months</td>
</tr>
</tbody>
</table>

Source: Saskatchewan Ministry of Health (nd) - http://www.health.gov.sk.ca/immunization-schedule

*Note: This schedule does not include vaccines recommended for clients with high risk factors e.g., immune compromised or an infant with a chronic medical condition.

DTaP = Diptheria, Tetanus, Acellular Pertussis.
Hib = Haemophilus Influenzae type b
MMRV = Measles, Mumps, Rubella, Varicella
PC = Pneumococcal Conjugate 13
MC - Quadrivalent Meningococcal Conjugate A,C, W and Y
*Seasonal influenza for infants and children 6 months to 4 years of age, one to two doses per season

There are certain times when the immunization schedule may need to be altered. For example, while Hepatitis B vaccine is normally not given until grade 6, the vaccine is recommended for infants at birth, 1 month, and 6 months of age whose parents or siblings are Hepatitis B carriers.

Immunization coverage is a measure of the protection of communities against vaccine preventable infectious disease. High rates of coverage contribute to herd immunity, a state of conferred protection that prevents infectious diseases from circulating in communities where large numbers of individuals are protected. In 2011, Government of Canada, Reforming Health Protection and Promotion in Canada: Time to Act http://www.parl.gc.ca/Content/SEN/Committee/372/soci/rep/repfinnov03-e.pdf
67.4 per cent of children at fourteen months of age had received the recommended immunizations for children at one year of age (i.e., one dose of MMR and 3 doses of DaPto-Hib). This number was lower for children living in the core neighbourhoods of Saskatoon (51.8 per cent) compared to the non-core neighbourhoods (69.3 per cent) and rural areas of the Region (68.3 per cent). This is less than optimal coverage for herd immunity, particularly against pertussis, or whooping cough, a respiratory vaccine preventable disease that circulates in communities and against which infants under two months cannot be immunized.

In 2010, the Saskatchewan Ministry of Health (MoH) introduced a program for adults who are primary caregivers of infants less than 6 months of age with a pertussis antigen containing vaccine TdaP (Tetanus, Diphtheria, and acellular Pertussis). Then, in 2011, the MoH introduced an adult booster vaccine program expanding to all adults who had not received a pertussis containing vaccine after the age of 18. Part of this program continued to target the parents of newborns and care givers who have contact with infant’s less than six months of age (e.g., grand-parents, day-care operators and siblings).

**Immunization Interventions in Saskatoon Health Region**

An initiative to increase uptake of immunizations for children living in the core neighborhoods started in late 2007. This initiative included a reminder system for parents to ensure they were up to date with their children’s immunizations. More resources were targeted to the core neighborhoods in this initiative. Immunization rates have increased across all groups in Saskatoon Health Region starting in late 2007. For more information see the Annual Immunization Report: Saskatoon Health Region (2010). Available at: [www.saskatoonhealthregion.ca/PHO](http://www.saskatoonhealthregion.ca/PHO)

**Other Parenting Supports Offered in the Region**

**Parent Talk and Nobody’s Perfect**

Nobody’s Perfect and Parent Talk are facilitated parent education programs. Nobody’s Perfect was developed nationally in 1989 and is a program for parents with children up to 5 years of age. Parents who qualify may have one or more of the following characteristics: young, single, low income, little formal education, and/or isolated geographically or socially. Parent Talk is a program developed in Saskatoon for first time parents of children under 7 months of age.

Currently Population and Public Health partners with the Saskatoon Open Door Society (SODS) and co-facilitates both of these programs with immigrant and refugee parents. Nobody’s Perfect program is also facilitated with clients living in the core neighbourhoods who attend the OASIS (Opportunity, Acceptance, Support, Invitation and Safe) program.

**Alvin Buckwold Child Development Program**

The Alvin Buckwold Child Development Program (ABCDP) is a unique program based in Saskatoon for children who display, or are at a significant risk for developmental, cognitive and/or physical challenges to learn and grow. The program offers diagnostic and treatment services to children, as well as support for families. The ABCDP works in partnership with parents, using a family-centered approach to try to understand and provide for the specific needs of children. This is one of few programs for families in Saskatoon Health Region coping with the effects of nurturing a child born with developmental disorders. However, distance and the need for daily transport have been expressed as a challenge for some families that need to travel to and from rural communities in Saskatoon Health Region.

**Saskatoon Health Region: Baby Friendly Initiative - Program**

Saskatoon Health Region has developed a Region wide Baby Friendly Initiative (BFI) policy in 2008 and a BFI program with the following objectives:

- To enable mothers to make an informed decision about how to feed their newborns.
- To support early initiation of breastfeeding.
> To promote exclusive breastfeeding for the first 6 months.
> To ensure the cessation of free and low cost infant formula supply to hospitals.
> To include, possibly at a later stage and where needed, other mother and infant health care issues.

Breastfeeding support to meet the BFI standards based on the WHO/UNICEF *Tens Steps to Successful Breastfeeding* is offered in Saskatoon Health Region by trained staff in hospital. In the community, mothers receive lactation support through the Health and Home and public health nursing programs. Breastfeeding women have access to specialized services provided by lactation consultants in the hospital and through the Saskatoon Breastfeeding Centre. In order to improve women’s access to lactation services in rural Saskatoon Health Region, rural public health nurses participate in regular education and certification to maintain lactation consultants’ skills. Public health nutritionists support the promotion of appropriate and timely introduction of solids and complementary feeding practices with the use of local food resources.

Additionally, the BFI program is based on the work of the Saskatoon Health Region BFI Coalition. The prime focus of this Coalition has been working with West Winds Primary Health Centre to achieve the full Baby Friendly (BFI) designation. This was accomplished in October 2011. This is the first primary health care facility in Canada that is in partnership with a university providing pre-service training, to receive full BFI designation.

In addition, the BFI coalition has been working on:

> Strengthening staff orientation and commitment to the BFI standards for department policies, education, training and information on infant and young child feeding. Staff has recently participated with the Provincial Breastfeeding Implementation Committee in the development of professional education DVD 2012.
>
> Supporting collaboration with community agencies such as La Leche League and Saskatoon Breastfeeding Matters Inc. and healthcare providers to update breastfeeding handout information for new mothers. This collaborative approach provides for consistency in information which is vital to women’s confidence in breastfeeding.
>
> Promotion of the health and social status of women in relation to infant and young child health and feeding. The BFI Coalition reviewed support needs of vulnerable populations. As a result, a pilot breastfeeding incentive program has been organized to provide Good Food Store coupons to breastfeeding women in the core neighbourhoods who attend immunizations clinics in 2012.
>
> Compliance with the International Code on the Marketing of Breast Milk Substitutes and curtailment of inappropriate marketing and distribution of breast-milk substitutes: Population and Public Health and the Health and Home Program regularly monitor for in house violations. The BFI collation continues to advocate to Royal University Hospital that they also become code compliant.
>
> Researching the feasibility of a donor human milk bank for the new Saskatchewan’s Children Hospital as recommended by Canadian Paediatric Society. BFI Coalition has been working with Royal University Hospital neonatal staff in authoring a feasibility paper on donor human milk banking for endorsement by professional groups in the province.

**Care Between Births**

There are unique opportunities to improve the health among women who have suffered an adverse pregnancy outcome (preterm, low birth weight, fetal or infant death) for subsequent pregnancies. These inter-natal interventions are important because an adverse pregnancy outcome is the highest risk factor for a second adverse pregnancy outcome. Interventions may include:

> Addressing any known risk factors present in the previous pregnancy and ensure closer clinical monitoring of subsequent pregnancies in pre-conception or prenatal care.
>
> Continue contraceptive counseling and family planning services to prevent unplanned and closely spaced pregnancies, especially among high-risk populations.
Infant mortality can be addressed by focusing on critical periods in the health of women and their infants and adopting a series of interventions that target specific risks, while considering the broader socioeconomic environment. There are a number of programs and services currently offered in Saskatoon Health Region.

The Sexual Health Program within Population and Public Health has, as one of its goals, to reduce teenage pregnancy.

Connections & Resources for U (CRU) is a teen wellness centre in the community that provides a fun and safe atmosphere for youth between the ages of 13-19.

The Healthy Mother Healthy Baby program in Saskatoon Health Region provides prenatal and postnatal services for urban moms, especially those who are at risk for poor infant and poor maternal health outcomes.

The KidsFirst Targeted Program is an early childhood development and family support program using home visitation as the primary service delivery strategy.

Through a process of liaising and transferring relevant client information between agencies in the postpartum period, client assessment is completed, priority clients for Public Health Nurse home visits are identified, at risk infants and mothers are identified, and families are directed to the appropriate care provider.

The Feelings in Pregnancy and Motherhood Study, a Saskatchewan-based project, examined maternal depression and found that as many as one in five mothers suffer from depression during or after pregnancy.

The Healthy and Home Program provides postnatal care for mothers who are discharged within the first 48 hours of birth from hospital.

Universal neonatal screening for in-born errors of metabolism is routinely performed in Saskatoon Health Region for several rare abnormalities that can be fatal if not detected and treated promptly.

Home Care Services, Saskatoon Health Region provide respite, caregiver relief to families of infants and children with medical needs who require a nursing assessment and intervention during the respite.

Child Health Clinics provide important services to infants once they are home from the hospital. These services include: growth monitoring and physical assessments, breastfeeding support, parenting support, oral health education, safe sleep education, injury prevention and immunizations.

The Alvin Buckwold Child Development Program is a unique program based in Saskatoon for children who display, or are at a significant risk for developmental, cognitive and/or physical challenges to learn and grow.

An initiative to increase uptake of immunizations for children living in the core neighborhoods started in late 2007. This initiative included a reminder system for parents to ensure they were up to date with their children’s immunizations.
RECOMMENDATIONS

The recommendations in this report focus on preventing and reducing the incidence of infant mortality in our community to improve overall health status. It calls for a system wide approach with collaboration and commitment from multiple and diverse stakeholders, including Saskatoon Health Region, community organizations and the provincial government. Taken together, the recommendations provide a comprehensive approach to address the needs of families and infants and ensure better birth outcomes.

Several of the recommendations that have been touched on previously by the Chief Medical Health Officer in the Health Status Report 2008 should be reviewed as they too contribute to improving maternal and infant health (see Appendix F). In addition, the recommendations aimed at tackling the social determinants of health and reduce gaps in health inequity should continue to be pursued as they provide the “upstream” foundations in which communities can thrive.

Continuous Quality Improvement

1) Conduct a comprehensive review of every fetal and infant death in Saskatoon Health Region.

As a result of a “spike” in fetal and infant deaths in 2005, a quality review was conducted in 2006 and found that morbidity and mortality reviews were not conducted following every infant death. It is recommended that an infant death intra-departmental review process is created that will investigate and report on all infant and paediatric deaths within Saskatoon Health Region boundaries.

2) Enhance data collection and surveillance around maternal and infant health.

Information is vital in making informed decisions about resource allocation and targeting interventions to populations at highest risk. A Pregnancy Risk Assessment Monitoring System (PRAMS)\(^{xvi}\) has the ability to link databases, which separately contain important information but together can increase our knowledge and potentially inform improved birth outcomes. For example, exploration of such databases as the In Hospital Birth Questionnaire already used in the Saskatoon Health Region and other medical records should be pursued while ensuring privacy and confidentiality remain protected.

3) Ongoing support for a congenital anomalies surveillance system.

The major cause of infant deaths in Saskatoon Health Region comes from birth defects or congenital anomalies. Prevention and early intervention for birth defects and disabilities can have a profound positive effect on a child’s health. As such, the Region should continue to support the implementation and evaluation of a Congenital Anomalies Surveillance System Pilot project.


To best meet client/patient needs, effective coordination and oversight is required to manage a complex system that includes community services, specialized acute care services and ambulatory community services. A MCHC could help to ensure the effective implementation of the recommendations of this report. The Consortium could be mandated to:

> ensure the effective collaboration of community services with the new Children’s Hospital of Saskatchewan through the clarification and establishment of referral patterns for the pre and postpartum continuum of care;*

\(^{xvi}\) The Pregnancy Risk Assessment Monitoring System (PRAMS) is a surveillance project of the Centers for Disease Control and Prevention and state health departments. PRAMS collects state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after pregnancy (CDC, Feb 2012 Available at: http://www.cdc.gov/prams/)
> review and analyze evaluations and reports from the Maternal Child Health sector of Saskatoon Health Region;

> make recommendations to the Saskatoon Health Region Senior Leadership Team for system improvement.

* Please refer to Appendix H for an example of a maternal/infant continuum of services.

5) Implement an educational campaign and cultural competence curriculum for providers in services that span maternal and child health care.

Quality health care - particularly reproductive health care and family planning services - should ensure that providers listen; that clients are able to make informed and voluntary decisions about their care; are responsive to clients’ needs; maintain clients’ privacy; and practice proper infection prevention.

6) Scale-up, sustain and evaluate evidence-based interventions that address preterm births, low birth weight and teenage pregnancies for all communities.

There are a number of evidence-based interventions that should be assessed by the MCHC consortium for large scale community-wide implementation. For example, taking folic acid supplements could prevent as many as 70 per cent of certain serious birth defects. Age-appropriate sexuality education for school children in grades 6 to 12 reduces sexual risk-taking by delaying initiation of sex, reducing the frequency of sexual activity, reducing the number of sexual partners, and/or increasing use of condoms or other forms of contraception. Other evidence based interventions include increasing breast feeding rates, continuing the back to sleep program and decreasing smoking and alcohol use among expectant mothers.

**Population-Based Services**

1) Increase awareness of the importance of infant mortality and poor birth outcomes on the health status of the Saskatoon Health Region community, and promote a culture of wellbeing.

A lack awareness of services or care needs often means late or no entry into prenatal care for women, which can lead to a host of pregnancy complications and delayed diagnosis of treatable conditions. Promoting a culture of wellbeing and engagement amongst all residents of Saskatoon Health Region is a key goal.

2) Improve prevention and management of chronic diseases among pregnant women.

Preconception and prenatal care provides an opportunity to identify and manage chronic and acute medical conditions that can negatively affect birth outcomes. Preconception care should be addressed from a population health perspective. This could include education on healthy nutrition in preteens. It could also look at treating existing medical problems (e.g., hypertension and other cardiovascular diseases, pre-existing or gestational diabetes, and asthma and other chronic lung conditions), which increase the risk of an adverse pregnancy outcome and maternal complications.

**Enabling Services: Linking High Risk Individuals to Needed Service**

1) Ensure that current programs and services targeted to high risk populations are meeting the needs of those clients.
Direct Health Region Services: Community-Based Health Services Providing a Suite of Essential Care

1) Expand and improve access to comprehensive reproductive health and family planning services for key populations.

Unplanned and closely spaced pregnancies can result in adverse birth outcomes. Three dollars are saved on pregnancy medical costs for every public dollar spent for family planning. Savings and long-term benefits are particularly advantageous in the prevention of teen pregnancy.

2) Expand access to prenatal care through targeted outreach and interventions.

The timing and quality of prenatal care that a woman receives during her pregnancy has a critical impact on the infant’s health and survival. Late or no entry into prenatal care is associated with adverse pregnancy outcomes, such as increased risk of low birth weight, premature birth, and neonatal and maternal mortality. Targeted outreach and interventions should focus on high risk populations, such as teenagers, Registered Indian Status and low socioeconomic status populations.

3) Improve access to obstetric care through a patient and family-centred care approach.

Accessible, affordable obstetric care is best provided as close as possible to the woman’s home community. Poor birth outcomes have been associated with the frequency of the need for external patient transfers, particularly in the event of an obstetric emergency.

Conclusion

Infant mortality is one of the most significantly utilized population health status indicators globally. It is a comprehensive indicator because it not only measures how well clinical care is performed for both mother and baby, but also incorporates the broader health determinants like socioeconomic status and environmental factors. While we have seen success in decreasing infant mortality rates in the Region in recent years, there remain significant inequities. Further action is required to address the causes of why residents in the core neighborhoods of Saskatoon have increased infant mortality rates compared to those in other neighborhoods and rural areas of Saskatoon Health Region. Teenage pregnancies, preterm births and low birth weight rates are also higher in the core neighborhoods. The leading causes of infant mortality: congenital anomalies, pre-term births, low birth weight, and sudden infant death syndrome also need to be addressed.

A comprehensive continuum of care approach that includes multiple, and diverse stakeholders from prevention to treatment will be needed. While there is good work already occurring in the Region, more can be done. The recommendations proposed in this report should be considered and implemented. With a steadily growing population in Saskatoon Health Region infant and maternal health outcomes will continue to demand our attention and require a collective community response.
**Glossary**

**Affluent neighbourhood:** Based on 2001 census information, these neighbourhoods had some of the lowest percentages of families living below the Low Income Cut Off (LICO) in Saskatoon and were in a contiguous area. The affluent neighbourhoods include: Briarwood, East College Park, Arbor Creek, Erindale, Lakeridge.

**Birth weight:** the weight of an infant determined at birth, or shortly thereafter, expressed in grams. Can be expressed in four categories: very low birth weight is less than 1,500 grams, low birth weight is less than 2,500 grams, normal birth weight is a birth weight equal to or greater than 2,500 grams and less than or equal to 4,000 grams, and high birth weight is a weight greater than 4,000 grams.

**Birth-weight-specific mortality rate:** The number of infant deaths per 1000 live births in a given birth weight range.

**Congenital anomaly:** is an abnormality of structure, function or body metabolism that is present at birth (even if not diagnosed until later in life) and results in physical or mental disability, or is fatal. 

**Core neighbourhood:** see Low income neighbourhood.

**Crude birth rate:** total number of live births during a year per 1000 population.

**Deprivation Index:** The deprivation index is a tool used to monitor socioeconomic inequities in health. The most widely used deprivation index for Canada is that developed in Quebec. The Deprivation Index measures two types of deprivation: material (e.g., income, employment) and social (e.g., marital status, lone parent family). Deprivation scores use 2006 Census data. Total deprivation quintiles were based on the results of the material and social factor scores for the city of Saskatoon, where each quintile represents approximately 20 per cent of the population of the city. Quintile 5 represents higher levels of material and social deprivation and Quintile 1 represents lower levels of material and social deprivation.

**Fetal death:** Defined in this report as a fetus of at least 350 grams or, in the absence of weight, 20 weeks’ gestation, born without a heartbeat, spontaneous respirations or purposeful movement.

**Fetal mortality rate:** the number of fetal deaths (stillbirths) greater than or equal to 500 grams or greater than or equal to 20 weeks gestation per 1,000 live births plus stillbirths.

**Gestational age:** the interval between the first day of the mother’s last normal menstrual period and the date of delivery. Preterm is gestational age less than 37 completed weeks of pregnancy. Term is a gestational age of 37 or more completed weeks of pregnancy, but less than 42 completed weeks.

**Health inequity:** Health inequities result from differences and variations in health outcomes and distributions of health care resources, which are deemed to be unfair, unacceptable or stemming from some form of injustice. Health inequities arise from the societal conditions in which people are born, grow, live, work and age.

**Health Promoting Schools:** The Health Promoting Schools approach is being used in many schools across Canada and around the world. In these schools, students, parents, teachers and community members work together to support the health and well-being of the entire school community. In the Saskatoon Health Region, a partnership between school divisions and Public Health Services has launched a Health Promoting Schools Program in 20 schools. The program began in the spring of 2011.

**Incidence:** The number of new cases of a disease in a certain time period.

**Induced abortion rate:** the number of induced abortions for women in a specified age category per 1,000 women in the same age category.

**Infant mortality rate:** The number of infant deaths under 1 year of age per 1000 live births. Note that stillbirths are not included in infant mortality calculations.
Live birth: The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which after such separation, breathes or shows any other evidence of life - e.g. beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles - whether or not the umbilical cord has been cut or the placenta is attached.

Low income neighbourhood: Low income neighbourhoods were determined by using 2001 census information and the percentage of families living under the Low Income Cut Off (LICO). Having 30 per cent or more families living under LICO and being a contiguous area in the west side of Saskatoon designated the following neighbourhoods as low income: Westmount, Meadowgreen, Confederation Suburban Centre, Pleasant Hill, Riversdale, King George.

Middle income neighbourhood: All other residential neighbourhoods in Saskatoon (excluding low income and affluent neighbourhoods).

Miscarriage: the loss of a pregnancy during the first 20 weeks gestation.

Morbidity: the incidence or prevalence of a disease or of all diseases in a population.

Multiple birth rate: the number of live births and stillbirths following a multiple gestation pregnancy expressed as a proportion of all live births and stillbirths.

Neonatal mortality rate: the number of infant deaths under 28 days of age per 1000 live births.

Perinatal Period: The perinatal period commences at 28 completed weeks of gestation and ends seven completed days after birth. The perinatal period has been described as three periods by various institutions.

  - Perinatal Period I: 28 weeks gestation up to 7 days old (WHO)
  - Perinatal Period II: 20 weeks gestation up to 28 days old
  - Perinatal Period III: 20 weeks gestation up to 7 days old

For the purposes of this report the discussion of the perinatal period will focus on the Perinatal Period III.

Perinatal Deaths (Late fetal and early neonatal): Perinatal deaths are the late fetal deaths (stillbirths) plus the early neonatal deaths. Period III limits the infant death group to those less than 7 days of age; during this early infant period, prenatal conditions and circumstances surrounding labour and delivery have more effect on mortality than do postnatal factors. Period I limits fetal deaths to those at 28 weeks of gestation or more; such deaths appear to be better reported than those occurring before 28 weeks of gestation. More than two-thirds of all perinatal deaths by the broadest definition (II) occurred within the period encompassed by Definition I in 1991. Period I is generally used for international comparisons. These represent fairly large newborns for which there exist effective population and public health interventions.

Perinatal mortality rate: the total number of deaths of a fetus or infant between the end of the 20th week gestation and the end of the 6th day of life in a calendar year per 1,000 total births (live and still) in the same calendar year.

Post-neonatal mortality rate: the number of infant deaths between 28 days and 364 days of age per 1000 live births.

Preterm (or premature) birth rate: The number of preterm births per 100 live births in any given year.

Prevalence: The number of existing cases in the population.

Primiparous: relating to a woman who is pregnant for her first time (para 0 + 0).

Risk factor: A risk factor is a variable associated with an increased risk of disease or infection; sometimes, ‘determinant’ is also used interchangeably.
Registered Indian Status (RIS) and Aboriginal populations:

Hospitalization analysis

Registered Indian Status is the only ethnic identifier available within Saskatchewan Ministry of Health’s registry system. A person of Registered Indian Status means that the person is registered under Section 6 of The Indian Act and who has been assigned a ten digit number in the Indian Registry and has voluntarily declared this information to the Ministry of Health.

Registered Indian Status is an underestimate of the total Aboriginal population because it excludes those that have Aboriginal ancestry but are not registered through The Indian Act or who have chosen not to disclose this information. It also does not include people of Métis or Inuit heritage. In total, about 53 per cent of the Aboriginal population in Saskatoon Health Region was of Registered Indian Status based on the 2006 census.

Death analysis

Registered Indian Status was included on the vital statistics death file compiled by the Saskatchewan Ministry of Health. This information comes from the death registration and is an optional field.

Respiratory Distress Syndrome: Respiratory distress syndrome (RDS) is a breathing disorder that affects newborns. RDS rarely occurs in full-term infants. The disorder is more common in premature infants born about 6 weeks or more before their due dates.

Statistical Significance and ‘Significance’: Where differences between two areas are compared in this report, the word significant is used only if it is a statistically significant difference. If the differences are not statistically significant, other language is used (e.g. considerable, substantial, etc.) or else it is explicitly stated (e.g. no statistically significant differences found between the two groups). Confidence intervals at the 95 per cent level were used to test statistical significance, whereby if there were overlapping confidence intervals, the differences could be said to be not statistically significant.

Stillbirth: the complete expulsion or extraction from its mother, after at least 20 weeks pregnancy, or after attaining a weight of at least 500 grams, or a product of conception in which, after the expulsion or extraction, there is no breathing, beating of the heart, pulsation of the umbilical cord, or unmistakable movement of voluntary muscle.

Sudden Infant Death Syndrome: the sudden death of an infant less than one year of age, which remains unexplained after a thorough case investigation, including the performance of a complete autopsy, an examination of the death scene, and a review of the clinical history.

Teen pregnancy rate: the number of pregnancies (live births, stillbirths, and therapeutic abortions) divided by the population of females aged 15 to 19 in the same year. It is expressed as a rate per 1,000 females aged 15 to 19.

Teen birth rate: the number of babies born to females aged 15 to 19, divided by the population of females aged 15 to 19 in the same year. It is expressed as a rate per 1,000 females aged 15 to 19.
The Proximal Determinants of Child Survival - Mosley and Chen Model\textsuperscript{49} and modified by Population and Public Health, Saskatoon Health Region\textsuperscript{73}

**Socioeconomic determinants:**

Individual-level variables: employment / productivity (fathers, mothers), maternal stress, poor nutrition, smoking, depression, drug abuse, Traditional norms and attitudes on child rearing, lack of a maternal/paternal role model

Household-level variables: income, wealth, poverty, isolation, adverse living environment and domestic abuse

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**Maternal Fertility**
- Age
- Parity
- Birth interval

**Environmental contamination**
- Chemicals
- Microbiological pathogens

**Nutrient availability**
- Proteins
- Vitamins
- Trace elements

**Injuries**

**Disease Control Programs**

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**Prevention Programs**

**Healthy Child**

**Sick Child**

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**Treatment Programs**

**Personal Efficacy at illness control**
- Employ effective preventive health strategies
- Employ appropriate care seeking behavior

**Growth Faltering**

**Child Mortality**

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**APPENDIX B**
### Child Health Clinic Services by Child Age

<table>
<thead>
<tr>
<th>Element</th>
<th>2 months</th>
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<th>6 months</th>
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Note: For clients attending clinics in core neighbourhoods, West Winds PHC, Souris Hall, and Duck Lake clinics the above elements are modified.
Sample World Health Organization Growth Charts for Boys, Adapted for Canada

WHO GROWTH CHARTS FOR CANADA

BIRTH TO 24 MONTHS: BOYS
Length-for-age and Weight-for-age percentiles

NAME: ___________________________ DOB: ___________________________ RECORD #: ___________________________

Source: Based on the World Health Organization (WHO) Child Growth Standards (2006) and adapted for Canada by Dietitians of Canada, Canadian Paediatric Society, the College of Family Physicians of Canada and Community Health Nurses of Canada.

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Reducing Infant Mortality in Saskatoon Health Region - Appendix D

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Sample World Health Organization Growth Charts for Girls, Adapted for Canada

WHO GROWTH CHARTS FOR CANADA

GIRLS

BIRTH TO 24 MONTHS: GIRLS
Length-for-age and Weight-for-age percentiles

NAME: ____________________________ DOB: ___________ RECORD # ________

GIRLS

BIRTH TO 24 MONTHS: GIRLS
Length-for-age and Weight-for-age percentiles

SOURCE: Based on the World Health Organization (WHO) Child Growth Standards (2006) and adapted for Canada by Dietitians of Canada, Canadian Paediatric Society, the College of Family Physicians of Canada and Community Health Nurses of Canada.

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APPENDIX E

Saskatoon Health Region - Maternal/Infant Services: An Open System with Multiple Entry and Exit Points (Proposed MCH Value Stream)

The Maternal Infant Continuum of Services (Adapted from Calgary Health Region, 2005)

APPENDIX E

Pre-conception care

The Expectant Family

Physicians

Prenatal Care in Community PHNs

Prenatal Care Primary Care

Best Beginning Program

Social Worker

Perinatal Education

Coordination of information sharing with PNC, L&D and PPC units and specialist clinics

Birth of Baby - 2 hour observation period in L&D

Healthy Baby

Bereavement in Hospital

NICU

Postpartum Unit

Referral to Postpartum community services (PPCC) and postpartum depression service

For follow-up by PPCC and Neonatal Transition Care Team (NTT)

Meets Discharge Guidelines

Follow-up NTT up to 4 months and referral to Child Health Clinic (CHC)

CONTINUED ON NEXT PAGE

Services that Support Expectant Parents in the Community

The Early Post-partum up to 48 hours after discharge from hospital

Best Beginning Program:
Group support and home visiting for PG teens and women on low income. Provides free vitamins, food and milk. Prenatal care and home nursing services for medical high risk pregnancies.

High Risk Pregnancy Registry
No program at present.

Perinatal Education
Classes on pregnancy and childbirth preparation e.g. Lamaze classes. Early pregnancy and breastfeeding classes. Income assistance from social services.

Perinatal Bereavement Support
Early intervention and postpartum support for children with developmental delays and disabilities.

PPCC-NIT
Community-based nursing services for target group of families. Post-partum continuum of care for all newborns.
**APPENDIX E**

**Saskatoon Health Region - Maternal/infant Services: An Open System with Multiple Entry and Exist Points (Proposed MCH Value Stream)**

**Home Visiting to Child Health Clinics (Well Child Services)**

- **Discharge from Hospital**
  - Notification of birth (NOB)/referral faxed to healthy in home (if early discharge) or PHS.
  - PHS central support staff process NOB according to protocol to produce an infant/maternal record which is distributed to the local health center closest to the newborn's residence. (Mon to Fri)

**Within 2 Hours of Discharge**

- PHN triage the NOB in to those that require a postnatal home visit, and contacts all families within 2 to 14 hours of discharge to make an initial telephone assessment. (See PHS Initial Telephone Assessment Guidelines)

- **Failed to Contact Client**
  - Client accepts home visit
  - Client defers home visit (refer to PHN)
  - Client declines home visit

**Within 2-14 Hours of Discharge**

- Arrive for an early postnatal home visit within 24 hours of discharge (H&H)

**Within 24 Hours of Discharge**

- Early home visit made within 24 hours of discharge. (See home visit assessment guidelines)
  - Fax family physician or refer to family physician if concerns are identified at the early postnatal home visit
  - Leave a note in mailbox if no one is at home
  - Refer to hospital social worker if a problem is suspected

**Within 48 Hours of Discharge**

- Fax physician communication form or refer to FP if medical concerns identified
  - Early postnatal home visit within 48 hours of hospital discharge achieved

**Services that Support Parents in the Community**

- **Postpartum Community Services:**
  - Public Health and primary care services provide the above continuum of services; early maternal and infant assessment, breastfeeding support, car seat safety, SIDS prevention, home support

- **High Risk Parent Support Program**
  - KidsFirst
  - PHS postpartum home visit
  - SK Health Line support

- **Breastfeeding Support**
  - PHN telephone, home and clinic support visits.
  - Lactation consultant certification for rural PHNs
  - LaLeche league support groups
  - WWPCHC BFN designation
  - Peer support
  - Postpartum drop in support

- **Linkage with Physicians when medical concerns are recognised:**
  - E.g., Failure to thrive, delayed developmental milestones

- **In Home Medical Supports**
  - Serum bilirubin screening
  - Newborn metabolic screening tests (heel-prick)
  - Screening for Postpartum Depression
Home Visiting to Child Health Clinics (Well Child Services)

- **Follow-up home visit is required**
  - Notify Physician
    - Declined
      - Yes
      - No
    - Yes
  - Follow-up telephone assessment and triage is made 3-5 days post birth (see follow-up home visiting guidelines)
    - Coordination of information sharing with primary care specialist clinics
      - Newborn and/or mother need additional follow-up
        - Healthy Baby / Mother Dyad
          - Follow-up phone call 3-6 weeks post birth to assess adjustment. Apply a universal postpartum depression screen
            - Requires additional follow-up
              - Yes
            - Yes if infant is less than 2 months
              - Follow-up home visit, telephone call or referral
                - Yes and if infant is over 2 months old
      - Requirements for follow-up
        - Yes
          - Requires follow-up through well child services
          - No
          - Referral to well child services or referral to Child Health Clinic (CHC)

3-5 Days (72-120 Hours) Post

- Routine follow-up through well child services

Beyond 5 Days Post-Partum

Services that Support Parents in the Community

- **Postpartum Depression Support Groups:**
  Support groups facilitated by Parents Groups in the city, provide support to mothers experiencing postpartum adjustment difficulties.

- **Drop in Parent Support:**
  Drop in support is offered at some public health centers, and at each CHC. Questions and concerns are answered by a PHN and babies are weighed and measured. Mothers can seek breastfeeding support and other health promotion materials.

- **Evening and Weekend Assessment and Home Visiting Services:**
  Primary care staff provide assessment and home visiting services during off work hours evenings and weekends.

- **Postnatal Parenting and Education:**
  A range of programs designed to increase parent knowledge and understanding (e.g., Nobody is perfect, Baby and you). Both are intended to improve parent’s confidence.

- **Ongoing Home Visits and Telephone Support Services:**
  Support to families is provided on an as needed or referral basis in relation to safety, parenting, mental health, normal growth and development, child welfare issues, bereavement and others.
Several recommendations were made by the Chief Medical Health Officer in the 2008 Health Status Report released in 2009. Below are two of the recommendations that were made that are relevant to this Infant Mortality Report.

1) The Region and partners should improve services for pregnancy planning to help ensure a healthy mother, healthy baby and healthy families to include:
   > Interventions aimed at improving the overall health of childbearing women, especially in core neighbourhoods;
   > Addressing pre-conception care from a population health perspective;
   > Implementing evidence-based interventions that reduce pre-term births and low birth weight babies;
   > Enhanced, comprehensive social and prenatal services including family planning and counselling targeted to Saskatoon’s core neighbourhoods due to the higher rates of infant mortality;
   > Better coordination of existing SHR and community programs and resources throughout the peri-partum continuum of services and care;
   > Ensuring HIV testing protocols are universally applied for pregnant women, and also address barriers to prenatal care among women with addictions.

2) Saskatoon Health Region should develop prevention strategies to reduce unintended teen pregnancies and better support teen mothers and their babies.

Teen pregnancy places the mother and her infant at increased risk for socioeconomic disadvantages potentially perpetuating a cycle of poor health and poverty. Infants of teen mothers are more likely to be born low birth weight, increasing the risk of adverse health outcomes including death. Teens require a number of supports including:
   > Guidance to ensure that informed decision-making occurs for healthy relationships;
   > Access to teen-friendly reproductive health services, adequate counseling, and a full range of preventive reproductive health programs and services.

Priority should be focused on lower socio-economic youth with higher rates of teen pregnancy and sexually transmitted infections.
It is important to clarify that some desirable information for this report remains unavailable, as at present there is no systematic method to collect the following data elements routinely:

- The proportion of pregnancies that are spontaneously or artificially terminated by abortions
- The percentage of births with late or no prenatal care
- The percentage of first births to women ages 35 years and older
- The percentage of births to foreign-born women
- The percentage of births to women with at least a high school diploma
- The percentage of births to unmarried women
- The impact of assisted reproductive technology on births in Saskatoon Health Region

**Sources of Data**

Data from the infant death and stillbirth files were obtained from the Vital Statistics Unit of Saskatchewan Health for the time period 1992 to 2006. Live birth files were also requested from 1995 to 2005. Mortality statistics were coded using the International Classification of Disease (ICD)-9th edition for the years prior to 2000 and ICD-10th edition afterwards.

Contraceptive use information came from the Sexual Health Program, Population and Public Health.

Immunization rates were calculated using data from the Saskatchewan Immunization Management System (SIMS), a web-enabled information system that collects immunization data for all children receiving services.

Breastfeeding rates came from the Statistics Canada Canadian Community Health Survey CANSIM tables for 2007/08 and 2009/10.

**Variables from Infant Death Files**

Information contained in the death files includes sex of infant, infant age, cause of death, Registered Indian Status, and mother’s residence postal code. Infant age was grouped into four age categories:

- very early neonatal birth up to the first 24 hours of life,
- early neonatal 1-6 days or the first week of life,
- late neonatal 7-27 days, and
- post neonatal 28-364 days.

Each infant death contains either an International Classification of Disease 9th edition (ICD-9) or International Classification of Disease 10th edition (ICD-10) code that describes the major factor contributing to death. Causes of death are listed by the ICD-9 for pre-2000 and ICD-10 codes are given from 2000 onwards.

Registered Indian Status was given to infants if either the mother or father self-declared.

**Variables from Birth Registration**

Variables contained in the birth file include maternal age at the time of birth, length of gestation in fully completed weeks, type of birth (e.g., singleton or multiples) and birth weight in grams.
Merging Birth and Death Registrations

The Vital Statistics Unit at Saskatchewan Health provided us with a file that contained all of the infant death and birth variables linked. All infant deaths for Saskatoon Health Region between January 1, 1992 and December 31, 2007 were included. This linkage enabled us to assess birth variables like gestation and birth weight that could play a key role in infant mortality. Not all mothers and/or birth records could be found for each infant death due to how the infant deaths were recorded at the time of occurrence.

Variables Describing Residence Location

Mother’s residence was used to determine the RHA of residence for each infant death. Deaths to Saskatoon RHA residents occurring in other provinces were not included. Deaths occurring in Saskatoon RHA to non-residents of the Saskatoon RHA are not included. In some cases individuals living in Saskatoon had a missing or invalid postal code; these are designated as “Unknown”.

Analysis by neighbourhood type was performed to see if there were differences between groups of neighbourhoods. For our purposes, and as defined in Lemstra, Neudorf and Onyongo13, the neighbourhoods of Riversdale, Pleasant Hill, King George, Meadowgreen, Westmount, and Confederation Suburban Centre are considered the core neighbourhoods. The neighbourhoods of Briarwood, East College Park, Arbor Creek, Erin Dale and Lakeridge are considered the affluent neighbourhoods. All other neighbourhoods within the City of Saskatoon boundary are considered middle-income neighbourhoods. When the term non-core is used, that is referring to both affluent and middle-income neighbourhoods.

Any residence type found outside the City of Saskatoon boundaries but within the Saskatoon Health Region borders are considered rural.

Registered Indian Status (RIS) and Aboriginal Populations:

Registered Indian Status is the only ethnic identifier available within Saskatchewan Ministry of Health’s registry system. A person of Registered Indian Status means that the person is registered under Section 6 of The Indian Act and who has been assigned a ten digit number in the Indian Registry70 and has voluntarily declared this information to the Ministry of Health.

Registered Indian Status is an underestimate of the total Aboriginal population because it excludes those that have Aboriginal ancestry but are not registered through The Indian Act or who have chosen not to disclose this information. It also does not include people of Métis or Inuit heritage. In total, about 53 per cent of the Aboriginal population in Saskatoon Health Region was of Registered Indian Status based on the 2006 census.

Infants Less than 500 Grams

The definition of a live birth by the World Health Organization is “a product of conception, irrespective of the duration of the pregnancy, which breathes or shows any other evidence of life.” This definition is inclusive and countries that adopt this definition into their birth registration practices tend to have many more live births (and subsequently infant deaths) than do countries that have a more stringent registration process2. Babies with births at less than 500 grams have questionable viability for life, but because it is still the common practice to report infant mortality in Canada regardless of the birth weight, we include birth weights less than 500 grams in all of the infant mortality indicators in this report.
Birth Weight Versus Gestational Age

For live births, birth weight should be measured within the first hour of life before significant postnatal weight loss has occurred. Some researchers emphasize birth weight more than gestational age because of difficulties accurately assessing gestation. Wherever possible, it is recommended that the following three measurements should be taken:

- Gestational age
- Birth weight
- Crown to heel length

The following equivalents between gestational age and birth weight have been accepted as standard.

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<th>Gestational Age (weeks)</th>
<th>Birth Weight (grams)</th>
<th>Crown to Heel Length (cm)</th>
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<td>20</td>
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<td>25</td>
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<tr>
<td>28</td>
<td>1000</td>
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Data Analysis

The data analysis used is primarily descriptive. All analysis was bivariate, that is between two variables. For example, we examine a number of maternal and infant health outcomes in core neighbourhoods versus non-core neighbourhoods. Any differences found are not necessarily only because of the neighbourhoods, but could also be attributed to other factors like age, sex, and socioeconomic status. Therefore, some caution is needed when interpreting the results published in this report. More detailed multivariate analysis may be needed in future to accurately account for multiple risk factors and their relation to the outcomes of interest.

Where data is available we compare our indicators to those from other jurisdictions, primarily the province of Saskatchewan or Canada. Most indicators though are strictly Saskatoon Health Region.

In order to compare rates between groups and to give a sense of the variability associated with certain indicators, 95 per cent confidence intervals are calculated for most parameters of interest. Confidence intervals are typically used for samples though they are an indication of the level of certainty for instances like infant death counts. Statistical significance is determined by whether the confidence intervals overlap or not. If the intervals overlap, then there is no statistically significant difference between the rates, though there could still be clinical or practical differences.

Classification of Causes of Infant Death

Congenital Anomalies

ICD-9: 740-759

ICD-10: Q00 - Q99

Description: Congenital anomalies are a group of conditions present at birth. Included in this category are chromosomal anomalies such as Down’s syndrome, heart, lung, and brain defects. Congenital anomalies may be inherited or acquired; inheritance or acquisition may occur during the gestation period or during delivery. Acquired defects are generally the result of intrauterine conditions influenced by maternal factors such as the use of alcohol, antibiotics, or other drugs.
Conditions Arising in the Perinatal Period

ICD-9: 760-768, 770-779
ICD-10: P0 - P21, P23 - P96

Description: Conditions in this category may originate in the perinatal period, even though death may occur later. This category includes complications of the placenta, umbilical cord, or membranes. Other conditions such as the length of the gestation period and birth weight, intrauterine hypoxia, and birth asphyxia are included.

Respiratory Distress Syndrome (RDS)

ICD-9: 769
ICD-10: P22

Description: RDS is a condition that occurs most often among infants born before the 37th week of gestation or who weight less than 2200 grams (5 lbs.) at birth. Surfactant, which is produced in the alveoli or air sacs of the lungs, is lacking in premature infants. This substance is necessary to move air in and out of the lungs, and is not produced until shortly before birth, normally around 40 weeks after conception. There were not any cases during the 2002 to 2005 period.

Sudden Infant Death Syndrome (SIDS)

ICD-9: 798.0
ICD-10: R95

Description: SIDS occurs without warning in otherwise healthy infants for reasons not completely understood.

Unintentional and Intentional Injuries

ICD-9: 800-999
ICD-10: S00 - T98, V01 - Y98

Description: This category includes bodily harm resulting in death that occurs because of such incidents as falls, poisoning, drowning, burns, choking, or motor vehicle accidents. Intentional injuries such as homicide are included in this category.

Other

ICD-10: All other causes not listed above.

Description: This category covers all other conditions not mentioned above, including infectious and parasitic disease, cancer, and conditions of the respiratory system, including cardio-pulmonary arrest.
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<th>Conditions</th>
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<td>External Causes</td>
<td>260; 261; 262; 263; 2630; 2631; 2632; 2638; 2639; 507; 5070; 5071; 5078.E800; E912; E913-E999</td>
<td>E40; E41; E42; E43; E440; E441; E45; E46; E460; E690; E691; E698; J958; V*; W*; X*; Y* Except (W75; W76; W77; W81; W83; W84)</td>
</tr>
<tr>
<td>Others</td>
<td>Any code not mentioned above</td>
<td>Any code not mentioned above</td>
</tr>
</tbody>
</table>

**Categories of Infant Deaths**

**Birth defects or congenital anomalies:** both structural deformities and biochemical abnormalities; such as: Down’s syndrome, cleft lip, neural tube defects, and heart and blood disorders.

**Prematurity:** feto-maternal conditions associated with preterm birth; such as: premature rupture of membranes, respiratory and cardiovascular disorders and intra uterine growth retardation.

**SIDS:** all cases of sudden death where cause is unknown. Generally more associated in the post-neonatal time period.

**Asphyxia related:** conditions that arise during or shortly before the onset of labour and delivery; such as: newborn asphyxia, damage to placenta, birth trauma.

**Infection:** All diagnoses of infections general or local, both those specific to perinatal period and other; such as septicemia haemophilus meningitis, congenital viral diseases.

**External causes:** All deaths due to accidents, poisoning, and violence; such as injury due to transport, falls, being struck by object.

**Other specified:** All neoplasms, endocrine disorders, asthma and others.

**Other:** All remaining ICD-9 or ICD-10 codes.


43 Canadian Institute for Health Information. Too early, too small: a profile of small babies across Canada. Ottawa; CIHI; 2009.


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