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Perinatal Health Indicators for Canada

A Resource Manual

Canadian Perinatal Surveillance System

Canada

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Canadian Perinatal Surveillance System

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CHAPTER

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Introduction

Surveillance Using Indicators

The concept of using observation, recording and analysis of facts to guide decision-making in health is an ancient one, going back to the time of Hippocrates. However, it was not until the 17th century that numerical data on a population were used to describe and understand patterns of disease. According to Eylenbosch and Noah: "The French word 'surveillance' was introduced into English at the time of the Napoleonic wars and meant: keeping a close watch over an individual or group of individuals in order to detect any subversive tendencies."[1]

Public health surveillance was originally applied to disease and primarily used in the context of rapidly spreading infectious disease. Modern public health surveillance, however, is not limited to communicable diseases. The World Health Organization's (WHO) definition of surveillance emphasizes the concept of health rather than disease, as follows: "1. Systematic measurement of health and environmental parameters, recording, and transmission of data. 2. Comparison and interpretation of data in order to detect possible changes in the health and environmental status of populations."[1]

A public health surveillance system is a core system of ongoing data collection, analysis and interpretation on vital public health issues. The result is information that is used to develop and evaluate interventions, with the aim of reducing health disparities and promoting health.[2] Surveillance systems may vary in design according to the disease or condition in question and the country or jurisdiction of operation. Figure 1 depicts the cycle of surveillance, adapted from a conceptual framework described by Dr. Brian McCarthy, Centers for Disease Control and Prevention, Atlanta, Georgia.

Public health surveillance systems report on health indicators, which the WHO defines as "variables which help to measure changes."[3] More specifically, an indicator is "a measurement that, when compared to either a standard or desired level of achievement, provides information regarding a health outcome or important health determinant."[2] Indicators are used to monitor and report on progress towards health goals and objectives, and allow for interjurisdictional comparisons of health status. If indicators are carefully selected, they can serve an important role in focusing the attention of policy-makers.[3] Indicators should be:

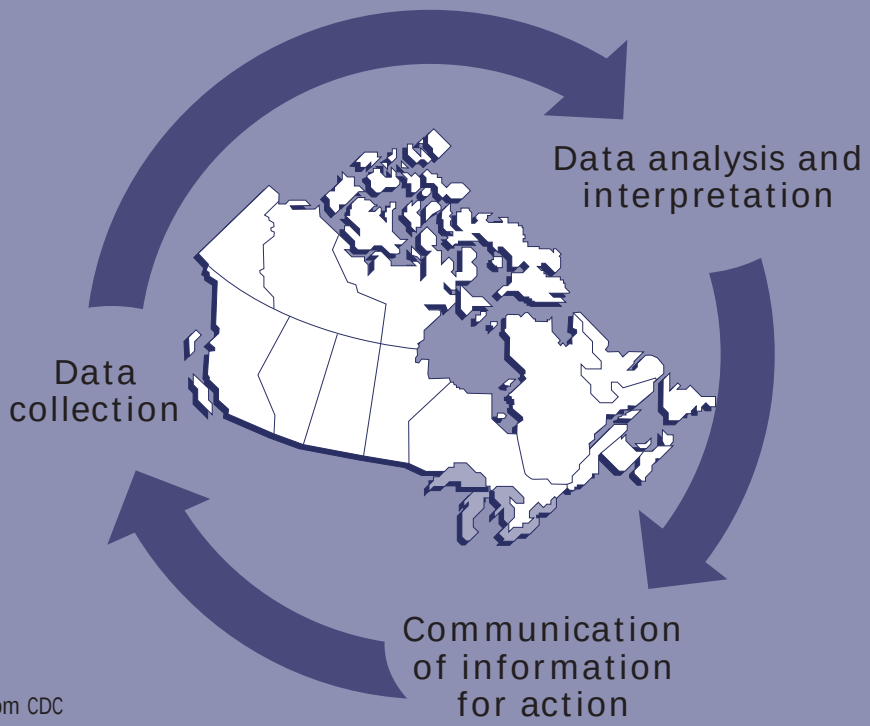
- valid — that is, measure what they are supposed to measure
- reliable — the same if measurements are repeated under identical conditions
- sensitive — detect true changes in the health condition of concern
- specific — reflect changes only in the health condition of concern[3,4]

In reality, few indicators will meet all of the above criteria; careful judgment is required to ensure that appropriate inferences are made.

The Canadian Perinatal Surveillance System

The Laboratory Centre for Disease Control (LCDC) is Canada's national public health agency. "The Centre's core activities are national health surveillance, disease prevention and control. These involve the monitoring and investigation of infectious and non-infectious diseases and injuries, the study of their associated risk factors and the evaluation of related prevention and control programs."[5]

Figure 1 National Health Surveillance



Source: Adapted from CDC

In 1995, LCDC's Bureau of Reproductive and Child Health began to develop the Canadian Perinatal Surveillance System (CPSS), to provide expert analysis and timely reporting on perinatal health determinants and outcomes for Canada. The CPSS is undertaken in collaboration with Statistics Canada, the Canadian Institute for Health Information (CIHI), provincial and territorial governments, health professional organizations, advocacy groups and university-based researchers. The mission, principles and objectives of the CPSS are described elsewhere.[2,6]

One of the earliest tasks in the development of the CPSS was the identification of indicators that should be monitored by the system. The national, multidisciplinary Steering Committee for the CPSS established a Problems, Indicators and Tables Subcommittee, which developed a process for selecting indicators that included consideration of scientific properties of the indicator, such as validity; feasibility of collecting the data; and importance of the health problem. The resulting indicators are listed in Appendix A, ranked according to the Steering Committee's assessment of health importance. After subsequent deliberations and consultation with perinatal health groups across the country, nine more indicators were added, also listed in Appendix A.

This set of indicators consists of measures of health outcome and measures of risk and protective factors. It is important to monitor not only maternal, fetal and infant health outcomes, but also factors, such as behaviours, practices and health services, that may affect those outcomes. This approach reflects the concept of the determinants of health — that health status is influenced by a range of factors including, but not limited to, health care.[7]

The list of indicators in Appendix A constitutes a current, best assessment of what should be monitored in a comprehensive national perinatal surveillance system. It serves as a goal for the CPSS as the system develops. At the present time, the CPSS can report on a subset of these indicators, using the data sources currently available: vital statistics, hospitalization data and national health surveys. These data sources are described in detail

in Section A. Over time, as existing data sources are modified, systems are better integrated and new databases are built, more perinatal health data will be available at the national level, and the number of indicators on which the CPSS can report will increase.

This Resource Manual provides information on 24 indicators currently being monitored by the CPSS. The presentation of each indicator follows a standard format: definition, relevance, background information, background data, data limitations and key current references from the relevant health literature.

Many regions in Canada are in the midst of reviewing their perinatal health data collection and analysis activities to ensure that the resulting information adequately supports better targeting of programs and policies. It is the hope of the CPSS that this Resource Manual will be useful as a reference guide for perinatal health data collection and analysis, not only nationally, but at provincial, territorial and regional levels as well.

The CPSS anticipates the production of a regular perinatal health status report for Canada, based on the indicators in this document. The development and use of indicators should be viewed as a dynamic and evolving process; i.e., this set of 24 indicators will not remain static. In the future, some of the indicators presented here may need to be abandoned if their validity is inadequate or if they do not prove to be as useful for planning or evaluation as first expected. Similarly, indicators may be excluded or added to the CPSS as existing perinatal health problems are solved or as new issues emerge. This evolving process will direct our data collection, analysis and reporting plans.

This Resource Manual has been authored and peer reviewed by members of the CPSS Steering Committee and staff of the Bureau of Reproductive and Child Health, past and present. In particular, we wish to acknowledge the hard work and intellectual contribution of Dr. Sylvie Marcoux (as chairperson of the Problems, Indicators and Tables Subcommittee) in developing the form and content of indicators for the CPSS.

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Principal Sources of National Perinatal Health Data

Section **A**

Overview

This section reviews sources of national perinatal health data for Canada. The presentation of each data source uses the following format: overview, perinatal health relevant content and data quality. The principal data sources that may be used to monitor national perinatal health indicators are:

- Vital statistics
- Hospitalization data: the Discharge Abstract Database (DAD) and the Hospital Morbidity Database (of the Canadian Institute for Health Information), the Système de maintenance et d'exploitation des données pour l'étude de la clientèle hospitalière (Med-Écho) and the Canadian Congenital Anomalies Surveillance System (CCASS)
- National health surveys: the National Population Health Survey (NPHS) and the National Longitudinal Survey of Children and Youth (NLSCY)

In addition, population estimates, provided by Statistics Canada from the census, are used. The census will not be reviewed in this section.

Table 1 presents a listing of sources of national perinatal health data for the indicators in this document.

Table 1 **Principal sources of national perinatal health data**

Indicator	Data source		
	Vital statistics	Hospitalization data	National health surveys
Prevalence of prenatal smoking			x
Prevalence of prenatal alcohol consumption			x
Prevalence of breastfeeding			x
Rate of live births to teenage mothers	x		
Rate of live births to older mothers	x		
Labour induction rate		x	
Cesarean section rate		x	
Rate of operative vaginal deliveries		x	
Rate of trauma to the perineum		x	
Rate of early maternal discharge from hospital after childbirth		x	
Rate of early neonatal discharge from hospital after birth		x	
Maternal mortality ratio	x		
Induced abortion ratio*	x	x	
Ectopic pregnancy rate	x	x	
Severe maternal morbidity ratio	x	x	
Rate of maternal readmission after discharge following childbirth		x	
Preterm birth rate	x		
Postterm birth rate	x		
Fetal growth: small-for-gestational-age rate, large-for-gestational-age rate	x		
Fetal and infant mortality rates	x		
Severe neonatal morbidity rate	x	x	
Multiple birth rate	x		
Prevalence of congenital anomalies†	x	x	
Rate of neonatal hospital readmission after discharge at birth		x	

* Should include abortions performed in abortion clinics.

† Vital Statistics data only provide information on congenital anomalies that cause fetal or infant death.

CHAPTER

1

Vital Statistics

Overview

Registration of births and deaths is compulsory under provincial and territorial *Vital Statistics Acts* or equivalent legislation. While the provincial and territorial *Vital Statistics Acts* may vary slightly between provinces and territories, they follow a model *Vital Statistics Act* that was developed to promote uniformity of legislation and reporting among the provinces and territories. The Vital Statistics Council for Canada provides a forum for developing common approaches for collecting vital statistics and for sharing information with external parties. This Council is composed of representatives from Statistics Canada and all provincial and territorial jurisdictions.[1-4]

Every year, the provinces and territories send their birth, stillbirth and death registration data to Statistics Canada. Statistics Canada compiles these data into national databases of births, stillbirths and deaths, called the Canadian Vital Statistics System. The vital statistics registration system covers all births and deaths occurring in Canada. Births and deaths of Canadian residents occurring in the United States are also included, being reported under a reciprocal agreement. However, births and deaths of Canadian residents occurring in countries other than Canada and the United States are not reported.[1] The preparation and maintenance of these national databases requires incorporation of late registrations and amendments, and the elimination of duplicate registrations. As part of the Health Data Gaps initiative at Statistics Canada in 1993-1994, the Canadian Birth Data Base project was initiated. This enabled the creation of a birth file starting in 1985 in a form suitable for long-term medical follow-up studies.[3]

Perinatal Health Relevant Content

The following data elements are used in national perinatal health surveillance:

Stillbirths and livebirths

- date and province/territory of birth
- place of birth (home, institution, other)
- sex
- weight of the newborn
- age of both parents
- marital status of the mother
- residence (province/territory, census division, census subdivision) of the mother
- type of birth (single or multiple)
- birth order (for multiples only)
- gestational age in completed weeks
- birth attendant
- total number of stillbirths to the mother (ever)
- total number of live births to the mother (ever)
- number of stillborn (if multiple birth)

Deaths

- age
- sex of the deceased
- residence (province/territory, census division, census subdivision) of the deceased
- date of death
- locality of death
- underlying cause of death
- nature of injury
- place where death occurred (home, institution, other)

Recently, as part of the Canadian Perinatal Surveillance System (CPSS) initiative, Statistics Canada, under contract to the Bureau of Reproductive and Child Health in the Laboratory Centre for Disease Control (LCDC), has conducted a record linkage of the birth and mortality databases (infant deaths only).[5] With the permission of the provinces and territories, the resulting fetal and birth-infant death linked analysis file is an important data source for CPSS analyses. This file has personal identifiers removed.

Data Quality

The legal reporting requirements in Canada are considered to provide complete registration of births and deaths occurring in Canada.

Statistics Canada evaluated the accuracy of data capturing and coding in a sample of vital records for 1981 for the 10 provinces, showing a very low error rate. This study is currently being updated in expanded form. In addition, a recent study on data quality found that 99% of infant birth and death records abstracted from Statistics Canada's vital statistics data for the provinces of Nova Scotia and Alberta were successfully located in corresponding provincial data that are primarily hospital discharge records. The distributions of gestational age and birth weight also demonstrated high agreement between the two data sources.[5]

Strengths of national vital statistics data include the following:

- The legislation for the collection of vital statistics data is similar across provinces and territories.
- Coverage for births and deaths is nearly complete.
- The data forms, definitions and collection methods are similar across the provinces and territories for most variables.
- Much work has been invested in assessing and improving data quality.
- The large number of records permits analysis within subpopulations.
- Data are available at the individual level and can be linked to other data sources.
- Causes of death are coded to an international classification.[6]

Limitations of national vital statistics data include the following:

- There is evidence of recent data quality problems for some data elements, such as gestational age. However, it is anticipated that these problems will be corrected.
- National data are not available on as timely a basis as would be desirable. For example, the 1997 birth, stillbirth and death files were available to LCDC and CPSS in the second half of 1999.
- Cause of death information may not always incorporate the results of coroner and medical examiner investigations.

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CHAPTER

2

Hospitalization Data

Canadian Institute for Health Information (CIHI)

Discharge Abstract Database

Overview

The Canadian Institute for Health Information (CIHI) maintains the Discharge Abstract Database (DAD), which captures hospital separation — transfer, discharge or death — from the majority of Canada's acute care hospitals. The DAD is an electronic database that includes information on inpatient acute, chronic and rehabilitation care and day surgery, accounting for about 85% of all acute care hospital inpatient discharges in Canada. The information is obtained directly from the participating hospitals.[1] The DAD contains considerable data on each hospitalization, including demographic and residence information, length of stay, most responsible diagnosis, secondary and co-morbid diagnoses and procedures performed during the hospitalization. Diagnoses are coded in the DAD according to the International Classification of Diseases (ICD) and procedures are coded according to the Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures (CCP). The DAD also categorizes hospitalizations by case mix group (CMG, a classification according to diagnosis and intensity of care required).

Perinatal Health Relevant Content

The data elements used in national perinatal surveillance include the following:

Maternal variables

- birth date and admission date (to derive maternal age)
- place of residence
- length of in-hospital stay
- diagnoses
- procedures
- CMG

Infant variables

- date of birth
- sex
- birth weight
- vital status at birth (live/stillbirth)
- neonatal in-hospital death
- length of in-hospital stay
- diagnoses
- procedures
- CMG

Data Quality

The Bureau of Reproductive and Child Health has evaluated the DAD to see if it could serve the needs of a national perinatal surveillance system.[2,3] The quality of data for delivering mothers and newborns recorded in the DAD from April 1, 1984 to March 31, 1995 was examined. The number of illogical

and out-of-range values in the data was found to be low, the occurrence of maternal and infant diseases estimated from the data was similar to that in the literature, and major medical or obstetric complications recorded in the DAD were good predictors of adverse pregnancy outcomes.[2]

Major diagnoses and procedures appear to be well captured. However, complex or obscure diagnoses are likely coded variably. Accuracy is also likely to be lower for codes other than the primary or most responsible diagnosis. CIHI is undertaking a quality assurance study of the DAD that will involve comparison of information in charts with information coded in the DAD for a sample of hospitals. The Canadian Perinatal Surveillance System (CPSS) is collaborating with CIHI to expand this study to include specific maternal and newborn diagnoses.

In addition to the general limitation of potential coding errors, there are several other problems in using the DAD for national perinatal surveillance:

- Out-of-hospital births are not captured.
- Pregnancies with non-birth outcomes (e.g., terminations) are often ended in an outpatient setting and may not be captured.
- The DAD does not include all acute care hospital admissions/separations in Canada. Québec is not included in the DAD.
- The DAD does not capture information on key perinatal variables, such as gestational age and parity. However, CIHI is open to suggestions for additions to the DAD and has been exploring this matter with the CPSS.

Hospital Morbidity Database

Overview

CIHI also maintains the Hospital Morbidity Database, which covers 100% of acute care hospital separations — transfer, discharge or death — in Canada. This database contains fewer data elements than the DAD. In addition to demographic and administrative information, the database contains the primary, or most responsible, diagnosis and some procedure codes.[1]

Perinatal Health Relevant Content and Data Quality

In the past, the Laboratory Centre for Disease Control has acquired only certain summary data from the Hospital Morbidity Database, which are not useful for national perinatal health surveillance. Therefore, the CPSS has little experience with analyzing this database and cannot comment on data quality.

CIHI is working towards merging the DAD and the Hospital Morbidity Database.[1]

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Système de maintenance et d'exploitation des données pour l'étude de la clientèle hospitalière (Med-Écho)

Overview

Med-Écho is a comprehensive administrative database of all patient admissions to acute care institutions in the province of Québec. The database is produced at the end of each fiscal year (April 1 to March 31) by the provincial Ministry of Health and Social Services. Each hospital admission is entered into the database using the form "Abrégé admission/sortie — AH — 101P." After each patient discharge, the form is completed and transmitted to the Ministry by the hospital's medical records department. Entry in the database is mandatory by law.

Perinatal Health Relevant Content

Home births and deliveries performed in provincial birthing centres are not included in the database unless the newborn is admitted into hospital in the first 24 hours after birth. In cases of multiple birth, each live-born neonate has its own record. Data available on mothers and newborns include:

- institutional code
- hospital admission number
- primary and up to 15 secondary diagnoses (coded according to the International Classification of Diseases [ICD])
- diagnostic, therapeutic and surgical interventions (up to nine, classified according to the Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures [CCP])
- date of admission
- date of discharge
- age
- gestational age in completed weeks
- birth weight of the infant

The mother's and infant's files are routinely linked, year by year, using the institutional code and the mother's hospital admission number. The match rate is about 98%. Unsuccessful linkage may be due to error in transcription of mother's hospital number on newborn's file, early neonatal admission of babies born outside the hospital, hospital admission of mothers without corresponding neonatal admission (fetal death), or mother and newborn not discharged in the same fiscal year.

Data Quality

Med-Écho data share many of the features and limitations of the data in the Discharge Abstract Database (DAD). However, Med-Écho includes more variables than the DAD (e.g., gestational age).

Canadian Congenital Anomalies Surveillance System (CCASS)

Overview

CCASS data are largely culled from the Discharge Abstract Database (DAD) of the Canadian Institute for Health Information. Additional data sources are also used, particularly to provide better information for provinces inadequately covered by the DAD. The Manitoba hospitalization database is used to obtain complete data for Manitoba, and Québec data are obtained from Med-Écho; these two systems are similar to the DAD. Alberta uses its own reporting system, the Alberta Congenital Anomalies Surveillance System (ACASS).

Perinatal Health Relevant Content

The data items that are used in compiling the CCASS statistics are all live births, stillbirths and infants born with a diagnosis of congenital anomaly corresponding to one or more codes that fall within 740-759 of the International Classification of Diseases, Ninth Revision (ICD-9). Variables such as birth date, sex, vital status, other demographic details and the absence/presence of congenital anomaly are recorded in CCASS. To identify cases diagnosed after newborn discharge, CCASS follows infants for one year (through record linkage within the hospitalization databases). Since the personal identifiers are removed from the records, CCASS identifies and combines duplicate readmission records (diagnosed congenital anomalies occurring in the same infant) using scrambled health insurance number, sex, date of birth, province, postal code, geographic code and ICD-9 codes.

Data Quality

The definition, interpretation and diagnosis of an anomaly can differ from one physician to another. Certain anomalies can be excluded or included, and others are not always evaluated against the same criteria, which can make reporting varied

and inaccurate. Some anomalies may be reported as part of a syndrome or reported separately. All these circumstances can produce variations in rates nationally, provincially or even locally. Other factors contributing to geographic variations in rates include trends and variations in use of prenatal diagnosis and pregnancy termination and in hospitalization practices. Prenatally diagnosed fetuses with congenital anomalies that are aborted are not included in CCASS because they are not captured by the DAD. Hospitalization practices directly influence the potential for identifying and recording new cases of congenital anomalies within the DAD data.

The data provided by Alberta, Manitoba and Québec are not from the same source and therefore are subject to their own limitations, including the ones mentioned above. Another limitation of CCASS DAD-based data arises because of the inclusion of duplicate information due to separate hospital admissions of the same infant. Despite the fact that the records for the same infant are linked together, this process is successful only if the variables for linkage are present and accurate. The accuracy and completeness of these variables can vary and lead to erroneously high rates of congenital anomalies for some areas. DAD data only cover births that occur in hospitals and not all hospitals participate in the DAD. Additional limitations include the lack of information on periconceptional and early pregnancy exposures, behavioural risk factors and the mother's past and current pregnancy history. Other factors, such as coding, transcription and classification errors, can also contribute to discrepancies in regional rates of congenital anomalies.

CHAPTER

3

National Health Surveys

National Population Health Survey (NPHS)[1]

Overview

The NPHS is designed to measure the health status of Canadians periodically and to expand knowledge of health determinants. It focuses on behaviours or conditions that are amenable to prevention, treatment or intervention.[2] The survey collects cross-sectional information as well as longitudinal data from a panel of individuals every two years. In the first data collection cycle in 1994-1995, the survey covered about 26,000 respondents. The survey is conducted by Statistics Canada.

The NPHS target population includes household residents in all provinces and territories, except persons living on Indian reserves, on Canadian Armed Forces Bases and in some remote areas. The survey collects information from a single household member, but also limited health information for all household members. An institutional component of the survey covers long-term residents of hospitals and residential facilities. In all provinces except Québec, the NPHS sample was selected using a multistage stratified sample design developed for the Labour Force Survey (LFS).[3] In Québec, the NPHS sample was selected from dwellings participating in a health survey organized by Santé Québec, the Enquête sociale et de santé (ESS). In the territories, the sample was selected randomly.

Perinatal Health Relevant Content

General and supplementary variables related to reproductive health that are covered by the survey include:

- maternal age and marital status
- maternal country of birth
- mother's highest level of education
- total household income
- current pregnancy status
- number of children less than five years of age who were breastfed
- alcohol consumption during pregnancy
- cigarette smoking during pregnancy
- use of illicit drugs and prescription medications during pregnancy

Data Quality

The survey is primarily designed for national-, regional- and some provincial/territorial-level analysis. Studies of rates in population subgroups may be limited by insufficient sample size. Attrition may further reduce the longitudinal sample in subsequent data collection cycles. Perinatal health variables are underrepresented and are not detailed enough to provide sufficient information for in-depth analysis of reproductive health issues. Perinatal health information may be subject to incorrect recall because it is collected retrospectively up to five years after the birth of the child. The information may also be subject to a small selection bias because it is collected only from mothers whose child is still living at the time the sample is selected.

References

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National Longitudinal Survey of Children and Youth (NLSCY)[1]

Overview

The primary objective of the NLSCY is to develop a national database on the characteristics and life experiences of Canadian children as they grow from infancy to adulthood. The survey collects cross-sectional information as well as longitudinal data. Data collection began in 1994-1995 and will be repeated every two years to follow the children surveyed in 1994-1995. In subsequent years, a cross-sectional sample will be added for age groups no longer covered by the longitudinal sample. In the first data collection cycle in 1994-1995, the survey targeted approximately 27,300 children ranging in age from newborn to 11 years inclusive. The survey is conducted by Statistics Canada.

The NLSCY target population includes children in all provinces and territories, except children living in institutions, on Indian reserves, on Canadian Armed Forces Bases and in some remote areas. The survey collects information on the child from the household member most knowledgeable about the child. Up to four children are chosen randomly per household. In all provinces except Québec, the entire NLSCY sample was selected using a multistage stratified sample design developed for the Labour Force Survey (LFS).[2] In Québec, part of the NLSCY sample was selected from dwellings participating in a Santé Québec health survey, the Enquête sociale et de santé (ESS). In the territories, the NLSCY used a modified version of the survey instrument and sampling methodology used in the provinces.

Perinatal Health Relevant Content

Perinatal health relevant information collected by the NLSCY includes:

- maternal prenatal practices: use of prenatal care, alcohol consumption, smoking and drug use
- delivery details: method of delivery, child's gestational age and weight at birth
- mother's and child's postnatal health: occurrence of infections, length of hospitalization following birth
- breastfeeding: initiation and duration

Additional information relevant to the child's health includes data on recent infections, asthma and frequency of contact with health professionals. The survey also covers demographic and socioeconomic information on the person most knowledgeable about the child, such as age, years since immigrating to Canada, highest level of education, income and single parent versus two parent status.

Data Quality

The survey is primarily designed for national-, regional- and some provincial/territorial-level analysis. Analysis of subpopulations is limited by insufficient sample sizes. Attrition may further reduce the sample size in subsequent data collection cycles. Perinatal health information is often not detailed enough to be used for in-depth analysis, and it may be subject to incorrect recall because it is collected retrospectively up to three years after the birth of the child. Perinatal health information may be subject to a small selection bias because it is collected only for children still living at the time the sample is selected.

References

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Selected Indicators of Maternal, Fetal and Infant Health

Section B

CHAPTER

4

Behaviours and Practices

Prevalence of Prenatal Smoking

Indicator Definition

The number of pregnant women who smoked cigarettes during pregnancy expressed as a proportion of all pregnant women (in a given place and time).

Since it is difficult to acquire data on prenatal smoking for all pregnancies, this indicator may be estimated by the number of women delivering a live-born child and who smoked cigarettes during pregnancy expressed as a proportion of all women delivering a live-born child. The indicator can be refined by specification of the trimester of cigarette use and the number of cigarettes smoked per day.

Relevance

Cigarette smoking during pregnancy can have adverse health effects on the mother, fetus and child. Monitoring the rate of prenatal smoking is important for the development and evaluation of smoking prevention and cessation programs.

Background Information

- Prenatal smoking increases the risk of intrauterine growth restriction (IUGR), preterm birth, spontaneous abortion and stillbirth.[1-4] Prenatal smoking is related to increased risk of infant mortality, in part due to increases in the incidence of low birth weight and prematurity. Cigarette smoking during pregnancy also increases the risk of sudden infant death syndrome and has been associated with impaired physical and intellectual development of the child.[1-4]
- The relationship between maternal smoking and adverse pregnancy outcomes is linked to the amount and duration of smoking. For example, the risk of IUGR increases with the length of time the mother smokes during pregnancy.
- Smoking cessation before pregnancy or in the first trimester reduces the risk of certain adverse pregnancy outcomes. Women who stop smoking before becoming pregnant or during the first trimester of pregnancy are at reduced risk of having a low birth weight baby compared with women who smoke throughout pregnancy.[4]
- The prevalence of prenatal smoking differs among population subgroups. It is more prevalent among women who are young, unmarried and have low levels of education and income.[1] It is also more prevalent among nonimmigrant women, particularly francophones and Aboriginals.[1,5]
- Prenatal smoking is often correlated with other lifestyle variables that affect pregnancy outcome. For example, women who smoke during pregnancy also tend to have a higher prevalence of alcohol consumption during pregnancy.[6] When studying the effects of prenatal smoking, it is important to control for these other variables.

Table 4.1 **Smoking during pregnancy by maternal age (years), Nova Scotia, 1996**

Maternal age	Number (percentage) of mothers*							
	Nonsmoker		1-12 cigarettes/day		≥ 13 cigarettes/day		Amount smoked unknown	
< 15	5	(50.0)	2	(20.0)	3	(30.0)	0	(0.0)
15-19	462	(54.2)	203	(23.8)	169	(19.8)	19	(2.2)
20-24	1,410	(62.0)	364	(16.0)	453	(19.9)	46	(2.0)
25-29	2,376	(74.4)	297	(9.3)	467	(14.6)	54	(1.7)
30-34	2,217	(78.5)	217	(7.7)	343	(12.2)	46	(1.6)
35-39	751	(79.1)	65	(6.9)	116	(12.2)	17	(1.8)
≥ 40	98	(79.7)	8	(6.5)	14	(11.4)	3	(2.4)
Total	**7,319**	**(71.6)**	**1,156**	**(11.3)**	**1,565**	**(15.3)**	**185**	**(1.8)**

* 210 women with unknown smoking status not included.

Background Data[7]

Information on maternal smoking in Canada is available from the National Longitudinal Survey of Children and Youth (NLSCY), the National Population Health Survey (NPHS) and regional studies. Table 4.1 shows the prevalence of smoking during pregnancy by maternal age in Nova Scotia. In 1996 in Nova Scotia, prenatal smoking prevalence generally decreased with age. However, among smokers, the proportion smoking heavily (≥ 13 cigarettes/day) increased with age.

Data Limitations

- Some of the information from the NPHS and the NLSCY on prenatal smoking may be incorrect, because information is collected retrospectively up to five years after the birth of the child. Data from the NPHS and the NLSCY may also be subject to a small selection bias, as prenatal smoking information is collected only on children who are alive.
- The knowledge that smoking during pregnancy can adversely affect the outcome of the pregnancy may lead pregnant women and mothers to under-report their smoking behaviour. Biochemical measures of tobacco exposure, such as maternal urine cotinine (the primary metabolite of nicotine) concentrations, are more accurate.[8]

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Prevalence of Prenatal Alcohol Consumption

Indicator Definition

The number of pregnant women who consumed alcoholic beverages during pregnancy expressed as a proportion of all pregnant women (in a given place and time).

Since it is difficult to acquire data on prenatal alcohol use for all pregnancies, this indicator may be estimated by the number of women delivering a live-born child who drank alcohol during pregnancy expressed as a proportion of all women delivering a live-born child. The indicator can be refined by specification of the trimester of alcohol consumption and by the number of alcoholic drinks consumed per day or per occasion.

Relevance

Prenatal alcohol consumption can have adverse health effects on the mother, fetus and child. Owing to the preventable nature of these adverse health effects and the significant burden they impose on individuals and society, prenatal alcohol use is an important public health issue.

Background Information

- The effects of prenatal alcohol consumption vary and are thought to depend on a number of factors, including the quantity of alcohol consumed, the stage(s) during pregnancy when the alcohol is consumed, the mother's ability to metabolize alcohol and the genetic makeup of the fetus.[1,2]
- Alcohol-related birth defects exhibit a continuum of severity, with spontaneous abortion, intrauterine growth restriction and fetal alcohol syndrome (FAS) being among the more severe effects.[1-3] Other effects include cognitive and behavioural abnormalities, which may extend to adulthood.
- FAS is a medical diagnosis characterized by three traits: prenatal and/or postnatal growth restriction, characteristic facial features and central nervous system dysfunction.[1] Subjective interpretation of diagnostic criteria, differences in study methodology and failure to recognize FAS make it difficult to accurately measure the incidence of this condition.
- Fetal effects are likely related to chronic, heavy alcohol exposure, rather than low, steady rates of drinking.[4,5] However, as a safe level of alcohol consumption during pregnancy has not been determined, Health Canada recommends that women abstain from alcohol consumption if they are pregnant or planning to become pregnant.[3]
- The prevalence of prenatal alcohol consumption differs among population subgroups. Prenatal alcohol use is more prevalent among single women and women who have low levels of income and education. It is also more prevalent among older women, but binge drinking (consumption of five or more drinks per occasion) may be more prevalent among younger women.[6,7]
- Studying the effects of prenatal alcohol consumption is complicated by difficulties in separating alcohol effects from those of other aspects of maternal lifestyle. For example, a study in Toronto associated binge drinking among pregnant women with tobacco smoking and cocaine and other illicit drug use.[7] When studying the effects of prenatal alcohol consumption, it is important to control for these other aspects of maternal lifestyle.

Background Data

Information on prenatal alcohol consumption in Canada can be obtained from the National Longitudinal Survey of Children and Youth (NLSCY), the National Population Health Survey (NPHS) and regional studies. Table 4.2 presents results of analysis from the NLSCY. In 1994-1995 in Canada, maternal alcohol consumption was most prevalent in Québec and among older women.

Table 4.2 **Prenatal alcohol consumption by geographic region and age (years), Canada excluding the territories, 1994-1995**

	Percentage of children less than two years old whose mother reported drinking some alcohol during pregnancy
Canada	**17.5**
Region	
British Columbia	15.9
Prairies	16.9
Ontario	14.5
Québec	26.3
Atlantic	8.2
Mother's age group	
< 25	14.4
25-29	14.1
30-34	19.0
≥ 35	24.6

Data Limitations

- Some of the information from the NPHS and the NLSCY on prenatal alcohol consumption may be incorrect because data are collected retrospectively up to five years after the birth of the child. These data may also be subject to a small selection bias because information is collected only on children who are alive.
- There may be systematic underreporting of maternal alcohol consumption in surveys, because alcohol consumption during pregnancy is considered socially undesirable and known to incur risk to the fetus.[8]

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Prevalence of Breastfeeding

Indicator Definition

The number of women who delivered and ever breastfed a live-born child expressed as a proportion of all women who delivered a live-born child (in a given place and time).

The indicator can be refined by specification of the duration of breastfeeding.

Relevance

There is compelling evidence that breastfeeding is beneficial to infants and mothers. Breastfeeding rates measure how frequently this beneficial form of infant feeding is practised. Monitoring breastfeeding rates provides useful information for breastfeeding promotion and education.

Background Information

- Human milk is uniquely superior for infant feeding and is species-specific; all other substitute feeding options differ markedly from it.[1]
- Human milk protects the infant from gastrointestinal and respiratory infections and otitis media and has also been associated with enhanced cognitive development.[1-3]
- Beneficial effects for mothers associated with breastfeeding include reduced postpartum bleeding and delayed resumption of ovulation, which increases the spacing between pregnancies.[1,2] There is evidence that lactating women have improved postpartum bone remineralization and a reduced risk of ovarian and breast cancers.[1,2]
- In addition to the health benefits, breastfeeding is socially and economically advantageous. It is an ecologically sound, efficient and self-reliant food source. Furthermore, the lower incidence of illnesses in breastfed babies results in reduced health care costs.
- The Canadian Paediatric Society (CPS), Dietitians of Canada (DC) and Health Canada recommend exclusive breastfeeding for at least the first four months of life and continuing breastfeeding and complementary foods for up to two years of age and beyond.[2] This recommendation is consistent with that made by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF).[4]
- Breastfeeding rates differ among population subgroups. Rates are higher among women who are married, are older and have higher levels of income and education.[5]

Background Data[5]

Information on breastfeeding in Canada can be obtained from the National Longitudinal Survey of Children and Youth (NLSCY), the National Population Health Survey (NPHS) and regional studies. Table 4.3 presents results of analysis from the NLSCY. Lower rates of breastfeeding were reported among younger mothers. There were also regional differences in rates, indicating an increasing east-to-west gradient.

Table 4.3 **Breastfeeding rates (%) by geographic region and age (years), Canada excluding the territories, 1994-1995**

	Percentage of children less than two years old ever breastfed
Canada	**73**
Region	
British Columbia	85
Prairies	83
Ontario	80
Québec	56
Atlantic	60
Mother's age group	
< 25	66
25-29	73
≥ 30	77

Data Limitations

- The NPHS and NLSCY surveys did not ask mothers if breastfeeding was exclusive. Exclusive breastfeeding for at least the first four months of life is a key component of the CPS/DC/Health Canada and WHO/UNICEF infant feeding recommendations.[3,4]

References

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Rate of Live Births to Teenage Mothers

Indicator Definition

The number of live births to mothers aged 10-14 or 15-19 years expressed as a proportion of all live births (in a given place and time).

A related indicator is the age-specific live birth rate (ASBR), which refers to the number of live births to mothers aged 10-14 or 15-19 years per 1,000 females in the same age category (in a given place and time).

Relevance

Various adverse maternal and infant effects of teenage pregnancy have been documented in the scientific literature, including biological and social effects.

Background Information

- Typically, teen pregnancies are characterized by delayed entry into prenatal care and lower rates of prenatal care.
- Tobacco, alcohol and other substance abuse is reported to be higher among pregnant adolescents.[1]
- A relatively higher proportion of teenagers report physical and sexual abuse during pregnancy.
- Compared with mothers aged 20-24 years, mothers aged 17 years or less have increased risks for delivering babies who are low birth weight (relative risk [RR] = 1.7, 95% confidence interval [CI] = 1.5-2.0), preterm (RR = 1.9, 95% CI = 1.7-2.1) or small for gestational age (RR = 1.3, 95% CI = 1.2-1.4).[2]
- Other adverse associations include preeclampsia, anemia, urinary tract infection, very low birth weight, very preterm birth and primary postpartum hemorrhage.[3]
- Infants of adolescent mothers have higher rates of neonatal group B streptococcal infection and non-chromosomal congenital anomalies. Adolescent mothers are at greater risk for maternal death in settings of high maternal mortality. Although adolescents are at lower risk of ectopic pregnancy, case fatality rates in this age category are higher.
- Explanations for the increased rate of adverse obstetric outcomes among adolescent mothers include hypotheses related to (a) "biological immaturity" (of the uterine and cervical vasculature), and (b) competition for nutrients between mother and fetus. Related mechanisms proposed include incomplete maternal growth, reproductive immaturity, smaller maternal body size, nutritional deficiencies, socioeconomic and behavioural factors and maternal emotional stress.[4]
- Some studies have demonstrated beneficial associations, such as lower rates of labour induction/augmentation and cesarean section.[5] Various other studies have shown no association between the above-mentioned adverse outcomes and teen pregnancy. Studies showing adverse associations have been criticized for failing to adequately control for environmental influences.
- There is some controversy as to whether the adverse outcomes that attend teen pregnancy are a consequence of biology or secondary to environmental factors linked to socioeconomic status. The robust nature of the crude associations means that teen pregnancies are of public health concern, however.
- Infants of teen mothers tend to have higher rates of neonatal and postneonatal mortality and morbidity. Differences in birth weight, gestational age, race, prenatal care, multiparity and socioeconomic factors appear responsible for most of the excess neonatal mortality.[6]
- Higher rates of handicap, child abuse, low intelligence quotient (IQ) and delinquent behaviour have been observed among children of adolescent mothers. Some of the increase is a consequence of the fact that adolescent mothers are less experienced, demonstrate less adaptive child-rearing practices and are more likely to suffer episodes of postpartum depression.

Background Data[7,8]

Table 4.4 **Live births to teenage mothers, age-specific live birth rates (per 1,000) and teen live births as a proportion of all live births (%), Canada, 1995**

Age	Number	ASBR	Percent
10-15 years	1,147	1.0	0.3
16-17 years	6,940	18.2	1.8
18-19 years	15,570	40.1	4.1

Data Limitations

- Canadian data on maternal age are obtained from birth certificates and are unstated in a small fraction of records. Some transcribing errors are also likely.
- Late-registered births may not be included in the above statistics.

References

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Rate of Live Births to Older Mothers

Indicator Definition

The number of live births to mothers aged 30-34, 35-39 or 40-44 years expressed as a proportion of all live births (in a given place and time).

A related indicator is the age-specific live birth rate (ASBR), which refers to the number of live births to mothers aged 30-34, 35-39 or 40-44 years per 1,000 women in the same age category (in a given place and time).

Relevance

The proportion of women who are delaying childbearing to later years has increased drastically in Canada in recent years. There is some evidence that this may be associated with adverse outcomes to both mother and infant.

Background Information

- Fertility rates in women decrease steadily up to about the mid-thirties and fall dramatically thereafter.
- The frequency of Down's syndrome increases with advancing maternal age from less than 1 per 1,000 births at age 20 years to 2.5-3.9 per 1,000 births at age 35, 8.5-13.7 per 1,000 births at age 40 and 28.7-52.3 per 1,000 births at age 45.[1]
- Rates of other cytogenetic abnormalities (trisomy 18, trisomy 13, XXY, etc.) also increase with advancing maternal age.[1] Significant negative associations have been observed with congenital anomalies such as patent ductus arteriosus, hypertrophic pyloric stenosis and congenital dislocation of the hip. There is conflicting evidence on the age relation of other non-chromosomal anomalies.
- Antepartum complications shown to be associated with delayed childbearing include increased risks for early pregnancy loss, gestational diabetes, diabetes mellitus, hypertension, other chronic medical conditions,[2] preeclampsia, placenta previa and prenatal hospital admission.[3]
- Labour complications shown to increase with advanced maternal age include malpresentation, cephalopelvic disproportion, protraction and arrest disorders, intrapartum decelerations, prolonged second stage,[2] operative deliveries[3] and postpartum hemorrhage.
- Studies have shown that babies of older mothers are at increased risk for very low/low birth weight, very preterm/preterm birth, small for gestational age, macrosomia, low one-minute Apgar scores and admission to newborn intensive care.
- An increased risk of more serious outcomes, such as late fetal death,[3,4] early neonatal death and perinatal death, has also been demonstrated.
- The deleterious effect of maternal smoking (on outcomes such as birth weight and fetal growth) has been shown to be disproportionately stronger among older mothers.
- Older mothers also have a higher risk of maternal mortality.
- Some recent evidence suggests, however, that older women with prudent health behaviours (e.g., smoking abstinence) who receive good quality obstetric care are not at elevated risk for complications such as low birth weight, preterm birth, small for gestational age, late fetal death and perinatal death.[2,5]

Background Data [6-8]

Table 4.5 **Live births to mothers over 30 years of age, age-specific live birth rates (per 1,000) and live births in older maternal age categories as a proportion of all live births (%), Canada, 1970-1995**

	1970	1980	1990	1992	1995
30-34 years					
Number	50,547	65,304	103,352	111,291	114,513
ASBR	80.1	65.2	81.8	86.0	86.8
Percent	13.6	17.6	25.5	27.9	30.3
35-39 years					
Number	23,681	14,617	31,064	34,953	40,419
ASBR	38.2	18.6	27.2	29.1	31.3
Percent	6.4	3.9	7.7	8.8	10.7
40-44 years					
Number	6,964	1,946	3,856	4,538	5,625
ASBR	11.1	3.0	3.8	4.2	4.8
Percent	1.9	0.5	1.0	1.1	1.5

Data Limitations

- Canadian data on maternal age are obtained from birth certificates. Maternal age is unstated in a small fraction of records. Some transcribing errors are also likely.
- Late-registered births may not be included in the above statistics.

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CHAPTER

5

Health Services

Labour Induction Rate

Indicator Definition

The number of delivering women whose labour was induced by medical or surgical means (prior to the onset of labour) expressed as a proportion of all delivering women (in a given place and time).

Induction refers to the initiation of uterine contractions by medical or surgical means prior to the spontaneous onset of labour (among pregnant women at or over 20 weeks of gestation).

Relevance

Induction is an active intervention with associated risks for both mother and fetus. In certain situations, the risks of continuing pregnancy for either mother or fetus will outweigh the risks associated with induction. Induction should not be confused with augmentation, which is the use of various manoeuvres designed to enhance the progress of labour that is already established.[1]

Background Information

- Fetal risks of induction include the risk of neonatal immaturity if the fetus is preterm and the risk of fetal compromise as a result of uterine hyperstimulation. Both of these risks are small.[2]
- Another fetal/neonatal risk arises because induction can sometimes lead to prolonged labour. Prolonged labour may, in turn, lead to chorioamnionitis and congenital infection.[2]
- Maternal risks of induction in first-time mothers (primigravida) relate to the complications of prolonged labour or failed induction — namely, chorioamnionitis or operative delivery. For highly parous women (more than three previous deliveries), there is a risk of uterine hyperstimulation, which can rarely be associated with uterine rupture.[2]
- Fetal indications for induction focus upon a compromising intrauterine environment, most commonly seen in association with placental insufficiency (intrauterine growth restriction), preeclampsia, poorly controlled diabetes, prolonged rupture of membranes and postdatism.[2]
- Induction may be indicated for maternal reasons when continuation of the pregnancy poses a significant risk to the health of the mother, as, for example, in severe preeclampsia.[2]
- Control issues with respect to the timing of delivery and the presence of particular support personnel, compounded by the discomforts and anxieties of late pregnancy, have led to a gradual increase in requests for elective induction. In such a situation, the benefits of induction are unlikely to outweigh the risks.
- The most effective method of induction involves artificial rupture of the membranes (surgical induction), usually with the concomitant use of intravenous oxytocin to stimulate uterine activity. Medical induction using prostaglandins to stimulate uterine activity is increasingly popular. There is insufficient evidence to indicate a preference for prostaglandin over oxytocin stimulation.[3-5]

- Induction is most likely to fail when the cervix is unfavourable. The use of prostaglandins has been shown to be effective in ripening the cervix.

Background Data[6,7]

There is a paucity of good data on the number of inductions in Canada. Results of a postal questionnaire of major teaching centres across Canada conducted by the Maternal and Fetal Medicine Committee of the Society of Obstetricians and Gynaecologists of Canada (SOGC) suggest that induction rates ranged from 10% to 25% in 1995.[6] Rates of labour induction among women at 40 weeks' gestation in specific hospitals and regions in Canada are presented in Table 5.1.

Table 5.1 **Temporal changes in the rates of labour induction among women at 40 completed weeks of gestation in specific hospitals/regions of Canada**[7]

Hospital/region	Year	Rate of labour induction (%)
B.C. Women's Hospital	1986	3.8
	1992	15.5
	1995	16.0
Southern Alberta	1991	13.2
	1992	12.7
	1995	14.5
Northern/Central Alberta	1992	23.5
	1995	27.1
McMaster University Health Science Centre	1982	12.8
	1992	13.5
Québec	1981	9.9
	1992	16.0
	1994	18.7
Nova Scotia	1988	9.1
	1992	12.4
	1995	17.1
Halifax County	1980	8.3
	1992	11.3
	1995	16.5
Newfoundland	1990	18.0
	1992	19.1
	1995	19.4

Data Limitations

- Limitations in identifying the proportion of women induced relate to errors in identifying whether a woman was induced or whether existing labour was augmented. Augmentation would imply that spontaneous labour had already commenced when medical or surgical means were used to enhance that labour. The administration of oxytocin agents or artificial rupture of the membranes prior to the establishment of the active phase of labour (cervix fully effaced and 3-4 cm dilated at least) constitutes an induction.

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Cesarean Section Rate

Indicator Definition

The number of deliveries by cesarean section expressed as a percentage of the total number of deliveries (in a given place and time).

This rate is often subdivided into:

- The primary cesarean section rate: the number of cesarean deliveries to women who have not previously had a cesarean delivery expressed as a percentage of all deliveries to women who have not had a cesarean delivery previously.
- The repeat cesarean section rate: the number of cesarean deliveries to women who have had a cesarean delivery previously expressed as a percentage of all deliveries to women who have had a previous cesarean delivery.
- The vaginal birth after cesarean (VBAC) rate: the number of vaginal deliveries to women who have had a previous cesarean delivery expressed as a percentage of all deliveries to women who have had a previous cesarean delivery.

Although information with which to calculate the rates below is not available nationally, the following rates are more appropriate when comparisons are being made across regions or health care settings:

- Age- and parity-specific cesarean section rates: rates of cesarean delivery stratified by both maternal age group and parity (primiparous, multiparous with no previous cesarean delivery, multiparous with previous cesarean delivery).
- Risk-specific cesarean section rates: rates stratified by risk factors such as birth weight, presentation (vertex vs. non-vertex presentation), gestation (preterm vs. term) and plurality (multiple vs. singleton births).

Relevance

Determination of what constitutes an "appropriate" rate of cesarean delivery is complex[1] and varies according to several characteristics of the childbearing population. Rates of cesarean delivery have increased dramatically in many countries since the 1960s, when approximately 5% of births in Canada were delivered by cesarean section. By the mid-1980s, nearly 20% were delivered by cesarean section.[2] The proportion of the increase attributable to simultaneous increases in the proportion of first births and in maternal age at first birth (both of which occurred during this period) is unclear. Although it is known that perinatal mortality rates have decreased and the safety of this method of delivery for the mother has improved,[3] the very rapid and pronounced increase in cesarean section rates has led to speculation that the balance between the risks to the mother and the benefits to the infant has shifted too far.[4] Moreover, rates of cesarean delivery often differ, sometimes greatly, by place and among health care providers, raising concerns that many cesarean sections may be unnecessary — that is, not in the interests of either the mother or the child.[5]

Background Information

- Avoidance of unnecessary cesarean delivery is important, because cesarean delivery is associated with a greater risk of adverse outcomes, such as psychological trauma to the mother and a potentially increased risk of abnormalities of placentation and spontaneous abortion in subsequent pregnancies.[6-8]
- Following a National Consensus Conference on Aspects of Cesarean Birth, Canadian guidelines were developed in an attempt to lower cesarean section rates in three categories: repeat cesarean section, breech presentation and failure to progress.[9] Guidelines have also been developed by the Society of Obstetricians and Gynaecologists of Canada (SOGC) that address specific topics in the management of labour, including dystocia,[10] vaginal birth after previous cesarean birth,[11] breech presentation at term[12] and surveillance of fetal health during labour.[13,14]
- Factors that affect cesarean section rates include the following:[1]
  (a) Demographic profile of the population (proportion of primiparas, maternal age distribution, birth weight distribution, proportion of women with other obstetric risks). Women having their first baby are at higher risk of a cesarean delivery, particularly women having a first baby at later ages.
  (b) Availability of obstetrical services (e.g., the presence and number of tertiary care facilities in the region, availability of 24-hour blood banking and anaesthesia services). For example, women who have had a previous cesarean delivery who live in areas where tertiary care is not available for the management of a trial

of labour may prefer to have a scheduled elective repeat cesarean delivery so that they can remain in their home community.

(c) Practice habits of health care workers. Practices such as allowing ambulation in labour and various positions during delivery and less use of epidural anesthesia are believed to result in lower cesarean section rates.

(d) Patient and public input and expectations. For example, whether women who have had a previous cesarean delivery are willing to undergo a trial of labour can affect the cesarean section rate.

(e) Compliance with national recommendations developed by the SOGC.[10-14] It is hoped that continuing compliance with these guidelines will result in a lower cesarean section rate.

Background Data[15,16]

Table 5.2 **Cesarean section rates in Canada, by year**

Year	Rate (%)
1970	6
1975	10
1980	16
1985	19
1990	19
1993	18

Data Limitations

- Caution should be used in comparing cesarean section rates between provinces/territories and across health care settings. At present, data are not available with which to adjust for population differences in demographic patterns, particularly parity and related risk factors. Furthermore, hospital-specific rates are not comparable because the population of women delivering at specific institutions may include disproportionate numbers of high- or low-risk patients, depending on the availability of specialized services within the setting. Similarly, the risk profile of women delivering at community facilities is affected by distances to facilities where more specialized care is available.

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Rate of Operative Vaginal Deliveries

Indicator Definition

The number of vaginal births assisted by means of forceps or vacuum extraction expressed as a proportion of all vaginal births (in a given place and time).

Relevance

Appropriate operative vaginal delivery provides health benefits for the mother and baby. Inappropriate or improper forceps or vacuum delivery can be harmful.

Background Information

- Operative vaginal deliveries can be carried out safely.
- It is believed that perinatal outcomes may be compromised below some minimum level of operative delivery, including operative vaginal delivery. Since operative delivery rates have far exceeded the minimum level in most industrialized countries, a number of studies have failed to detect any relation between crude perinatal mortality rates and the level of operative deliveries.[1-4]
- There are marked international variations in operative delivery rates.[5] Countries with a higher rate of cesarean delivery usually also have a higher rate of operative vaginal deliveries. On the other hand, countries with a relatively higher rate of forceps utilization usually have a relatively lower vacuum extraction rate.[5]
- Non-medical reasons for operative vaginal delivery (e.g., influence of malpractice litigation, convenience, etc.)[1] may explain, to a large extent, the substantial international and intranational variations in operative vaginal delivery rates.[5]
- The choice between using forceps or vacuum extraction for assisting a delivery is largely based on tradition and training.[6,7] Forceps deliveries are favoured in North America, whereas vacuum extractions are often used in European countries.[5]
- Several studies have compared perinatal outcomes following vacuum extraction and forceps delivery.[7,8] Some authorities recommend the use of vacuum extraction rather than forceps as a means of delivering infants with an instrument.[7]

Background Data[5]

Table 5.3 **Operative vaginal deliveries as a proportion (%) of all vaginal births, cross-national comparison***

Country	Year	Forceps	Vacuum	Either
Canada	1980	21.2	0.6	21.8
United States	1980	22.0	0.6	22.6
Netherlands	1980	1.8	3.8	5.6
Sweden	1979	0.3	7.8	8.1
Denmark	1979	0.8	9.6	10.4
Norway	1979	3.5	3.7	7.2
Finland	1979	0.3	3.9	4.2
Czechoslovakia	1981	1.4	1.0	2.4

* All rates calculated using total vaginal births as the denominator.

- Clinical trials comparing forceps and vacuum extraction have been too small to allow comparisons with regard to rare yet important infant outcomes such as intracranial hemorrhage and mortality. There is a need to study the rates of such infant outcomes following forceps and vacuum deliveries using population-based surveillance information.

Data Limitations

- Operative vaginal delivery rates are usually calculated from hospitalization data. Since instrumental deliveries are considered minor procedures, coding of these procedures may not be as complete as it is for major procedures (e.g., cesarean delivery).

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Rate of Trauma to the Perineum

Indicator Definition

The number of women who had an episiotomy or a delivery resulting in a first-, second-, third- or fourth-degree tear of the perineum expressed as a proportion of all women who had a vaginal delivery (in a given place and time).

In specific analyses, this indicator may be restricted to episiotomies or tears (lacerations), including analyses of total lacerations or of lacerations of a particular severity (e.g., fourth degree).

Relevance

Episiotomy is one of the most common surgical procedures in Western medicine, yet there is no evidence to support its liberal or routine use. Trauma to the perineum can result in short-term and long-term morbidity.

Background Information

- Trauma to the perineum commonly accompanies vaginal births, particularly first births and births involving instrumental delivery.[1] Typically, between 42% and 96% of all women having a vaginal birth undergo repair of an episiotomy or a laceration. Perineal trauma can result in short-term morbidity, such as pain and hemorrhage. Potential long-term morbidity includes protracted pain and difficulties in bowel, urinary and sexual function.[1]
- The rationale supporting the use of episiotomies has been that a precise surgical incision (a) allows more satisfactory repair and healing as compared with an irregular perineal laceration, (b) prevents long-term pelvic relaxation and associated complications, and (c) leads to a controlled enlargement of the delivery outlet, which reduces trauma to the infant.[2,3] However, randomized trials have shown that routine use of episiotomy does not have a beneficial effect, and there is evidence that this procedure may cause harm, such as greater need for surgical repair of the perineum, increased perineal pain and more frequent wound dehiscence.[4] Overall, evidence suggests that the use of an episiotomy should be reserved for specific fetal and maternal indications.
- Spontaneous lacerations of the perineum range from minor lacerations that do not require repair with sutures to fourth-degree tears that extend through the rectal mucosa to expose the lumen of the rectum. Perineal lacerations caused by childbirth are classified into four categories/degrees:

  First: involves the fourchette, perineal skin and vaginal membrane.

  Second: in addition to skin and mucous membrane, the fascia and muscles of the perineal body are involved.

  Third: laceration that extends through the skin, mucous membrane and perineal body and involves the anal sphincter (muscle).

  Fourth: extends through the rectal mucosa to expose the lumen of the rectum.[5]
- For spontaneous deliveries, risk factors for perineal lacerations include nulliparity, macrosomia, second-stage arrest, Asian race, midline episiotomy, delivery in lithotomy position and delivery by residents.[6]

Background Data[7]

Table 5.4 **Episiotomy rates in Canada, 1981-1982 to 1993-1994***

Year	Episiotomy rate per 100 vaginal births
1981-1982	66.8
1982-1983	65.3
1983-1984	65.6
1984-1985	64.5
1985-1986	62.9
1986-1987	60.5
1987-1988	57.5
1988-1989	56.1
1989-1990	55.0
1990-1991	51.5
1991-1992	47.8
1992-1993	42.6
1993-1994	37.7

* Includes Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures (CCP) codes: 84.1 (low forceps with episiotomy), 84.21 (midforceps with episiotomy), 84.31 (high forceps with episiotomy), 84.71 (vacuum extraction with episiotomy), 85.7 (episiotomy).

Data Limitations

- Routine reports typically underestimate the number of episiotomies performed in Canada each year because of issues related to data coding and presentation (use of abridged Canadian Procedure Short List codes rather than the more extensive Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures codes). Underreporting also results from failing to count episiotomies that are generally not the principal procedure on the hospital separation form.[8]
- Published rates of laceration are difficult to interpret due to the variation that likely exists in the reporting of this outcome. For example, spontaneous lacerations that are minor and do not require suturing may not be enumerated.[1]

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Rate of Early Maternal Discharge from Hospital after Childbirth

Indicator Definition

The number of women discharged from hospital early (within 24 or 48 hours after childbirth) expressed as a proportion of all women discharged from hospital after childbirth (in a given place and time).

Relevance

Early postpartum discharge, while increasing hospital efficiency and conferring health and other benefits to mothers and babies, may sometimes pose a risk to the health of mothers or their infants. Monitoring the rate of early postpartum discharge can help to assess the quality, efficiency and accessibility of hospital services for childbirth.

Background Information

- The length of time that mothers should stay in the hospital for childbirth remains controversial.[1-5] An immediate incentive for shortening the length of postpartum hospital stay is reduced hospital costs. However, increasing concern has been expressed that hospital stays are becoming inappropriately short.[1-3]
- Studies evaluating early postpartum discharge policies in terms of maternal outcomes have yielded controversial results.[4,5]
- Early postpartum discharge for uncomplicated vaginal deliveries has been assumed to be safe.[1,2] However, a recent Canadian study has shown that early discharge is also quite frequent in complicated deliveries.[6]
- Maternal hospital stay is often linked to infant length of stay and may affect neonatal health.
- Length of hospital stay after childbirth can be influenced by patient-specific factors: type and severity of maternal complications, age and general health status, distance between residence and hospital, and other social and family factors.
- The duration of maternal hospital stay after childbirth can also be affected by organizational factors, including the timely availability of necessary elements of care and pre- and post-hospitalization services (e.g., availability of pre- and postpartum family care and community support programs).
- Differences in hospital practice can also lead to differences in length of hospital stay after childbirth.
- Both organizational factors and hospital practice can be collectively influenced by policies at the national and provincial/territorial level (such as guidelines, budget allocation, alternative services such as family care and community support programs). Such policies can affect temporal trends and lead to interprovincial/territorial variations in the rates of early postpartum discharge.
- The Canadian Paediatric Society and the Society of Obstetricians and Gynaecologists of Canada have published a joint statement, "Facilitating discharge home following a normal term birth."[7] This document reiterates the importance of individualized and family-centred care for mothers and babies and contains maternal and newborn criteria for discharge from hospital within 48 hours after birth.
- When analyzing temporal trends or regional differences in rates of early postpartum discharge, it is important to first consider variation in patient-specific factors, especially severity of maternal pregnancy complications.
- If the temporal trends and regional variations in the rates of early postpartum discharge cannot be explained by patient-specific factors, the potential impact of organizational and other factors operating at the national, regional and hospital levels should be considered.
- Assessment of differences in early postpartum discharge rates should include analyses of variations in postpartum morbidity and mortality, initiation and duration of breastfeeding and other outcomes likely to be affected by length of maternal hospital stay.

Background Data[6]

Information on early postpartum discharge can be obtained from hospitalization data. Table 5.5 shows that the rates of short hospital stay for childbirth (< 2 days) increased substantially in the past decade in Canada, from 1.6% in 1984-1985 to 13.5% in 1994-1995.

Table 5.5 **Temporal trends in the rate of short hospital stay (< 2 days) for childbirth in Canada,* 1984-1994**

Fiscal year	Length of stay < 2 days (%)
1984-1985	1.6
1986-1987	1.9
1988-1989	2.3
1990-1991	2.9
1992-1993	4.9
1994-1995	13.5

* The data source is the Discharge Abstract Database (DAD), which does not contain information on all acute care hospitalizations in Canada. For the years presented, Manitoba, Nova Scotia and Québec were not covered completely in the database.

Data Limitations

- Administrative data such as the DAD do not allow a distinction to be made between antepartum, intrapartum and postpartum hospital stay. The inability to identify the duration of postpartum stay (within a hospital admission for childbirth) limits the utility of administrative data.
- Administrative data are also limited by an inability to separate "acute days" from "nonacute days."[8-10] Separation of acute from nonacute days may help to assess the efficiency of the use of hospital resources.
- Administrative data may suffer from coding errors.[11]

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Rate of Early Neonatal Discharge from Hospital after Birth

Indicator Definition

The number of newborns discharged from hospital early (within 24 or 48 hours of birth) expressed as a proportion of all newborns discharged from hospital after birth (in a given place and time).

Relevance

Appropriate early discharge of newborns increases the efficiency of hospital care services and brings other benefits to the newborns and their families. Inappropriate early discharge of newborns, however, may pose risks to the newborn's health. Systematically monitoring the rate of early neonatal discharge can help to assess the quality, efficiency and accessibility of hospital care services for newborns.

Background Information[1,2]

- The question of how long a newborn should stay in hospital at birth remains controversial. One incentive for shortening the length of neonatal hospital stay is reduced hospital costs. However, increasing concern has been expressed that neonatal hospital stay will become, or already is, inappropriately short.
- Potential risks (e.g., neonatal readmission) and benefits (e.g., increased breastfeeding) of discharging newborns earlier have not been adequately examined by randomized clinical trials.
- The focus of the debate is on early neonatal discharge for uncomplicated births. There is some evidence that neonatal hospital stay for complicated births has not been reduced over time.[3]
- Length of neonatal hospital stay at birth can be influenced by the health status of the newborns, distance between residence and hospital, and other social and family factors.
- As with maternal length of hospital stay, the neonatal length of hospital stay at birth can be affected by organizational factors (e.g., availability of postpartum family care and community support programs).
- Differences in hospital practice can also lead to differences in length of neonatal hospital stay at birth.
- Both organizational factors and hospital practice can be influenced by policies at the national and provincial/territorial level (e.g., guidelines, budget allocation, alternative services such as family care and community support programs). Such policies can affect temporal trends and lead to interprovincial/territorial variations in the rates of early neonatal discharge.
- The Canadian Paediatric Society and the Society of Obstetricians and Gynaecologists of Canada have published a joint statement, "Facilitating discharge home following a normal term birth."[4] This document reiterates the importance of individualized and family-centred care for mothers and babies and contains maternal and newborn criteria for discharge from hospital within 48 hours after birth.
- When comparing rates of early neonatal discharge, it is important to consider the variation of patient-specific factors, especially gestational age, birth weight, diagnosis and treatment of neonatal jaundice, other morbidity, etc.
- If the temporal trends and regional variations in the rates of early neonatal discharge cannot be explained by patient-specific factors, the potential impact of organizational factors at national, regional and hospital levels should be considered.
- In the assessment of temporal trends and regional variations in the rates of early neonatal discharge, it is important to study the relevant outcomes, such as neonatal mortality and morbidity.

Background Data[3]

Information on early neonatal discharge can be obtained from hospitalization databases, such as the Discharge Abstract Database (DAD), the Hospital Morbidity Database and Québec's Med-Écho. Table 5.6 shows that the rate of early neonatal discharge from hospital after birth (within 48 hours) has increased substantially in Canada, from 2.8% in 1984 to 19.1% in 1994, according to analysis of the DAD.

Table 5.6 **Temporal trends in the rates of early neonatal discharge from hospital (within 48 hours) after birth in Canada,* 1984-1994**

Year	Length of stay < 48 hours (%)
1984	2.8
1986	3.0
1988	3.4
1990	4.4
1992	7.4
1994	19.1

* The DAD does not contain information on all acute care hospitalizations in Canada. For the years presented, Manitoba, Nova Scotia and Québec were not covered completely in the database.

Data Limitations

- Administrative data such as the DAD cannot be used to distinguish between "acute" and "nonacute" days of hospital stay.[5-8] Separation of acute from nonacute days can help in assessing the efficiency of use of hospital resources.
- Administrative data may suffer from coding errors.[9,10]

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CHAPTER

6

Maternal Health Outcomes

Maternal Mortality Ratio

Indicator Definition

The number of maternal deaths per 100,000 live births (in a given place and time).

Relevance

Maternal mortality has been considered a key public health issue for many decades.[1] Comparisons of maternal mortality ratios over time and between countries provide a "report card" indicating trends and differences in the general level of health of a population, the adequacy of medical care on a population level, as well as the economic and social status of women within the population.[2] The maternal mortality ratio and other pregnancy risk statistics are important indicators of obstetric care and women's health and societal status in general.

Background Information

- The International Classification of Diseases, Ninth Revision (ICD-9), definition of maternal death is as follows: the death of a woman while pregnant or within 42 days of the termination of the pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.[3]
- Maternal deaths are subdivided into two groups:
  (a) *Direct obstetric deaths:* those resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium); from interventions, omissions or incorrect treatment; or from a chain of events resulting from any of the above.
  (b) *Indirect obstetric deaths:* those resulting from previous existing disease or that developed during pregnancy and were not due to direct obstetric causes, but were aggravated by physiological effects of pregnancy.
- The ICD-10 definition of maternal death is the same as the ICD-9 definition. However, there are some new definitions included under ICD-10. These are:
  (a) *Late maternal deaths:* deaths from direct or indirect obstetric causes more than 42 days but less than one year after the termination of pregnancy.
  (b) *Pregnancy-related deaths:* deaths while pregnant or within 42 days of the termination of pregnancy, irrespective of the cause.[4]
- In the last half of the 20th century, risks to women associated with childbirth in developed countries have been dramatically reduced as a result of many factors, including technological advancements in obstetrical care, greater access to health services and fewer births occurring at the extremes of women's reproductive age span.
- Although Canada has one of the lowest reported maternal mortality ratios in the world, it is nevertheless important to monitor patterns of mortality and be sensitive to what observed patterns or changes may tell us.

Background Data[2]

Table 6.1 shows maternal mortality ratios observed in several countries in 1990.

Table 6.1 **Maternal mortality ratios in selected countries, 1990**

Country	Maternal deaths per 100,000 live births
Mexico	110
Ukraine	50
Japan	18
United States	12
Italy	12
Norway	6
Canada	6

Data Limitations

- Several studies in the United States and France have found maternal deaths to be underreported by vital records systems.[5-9] The Canadian Perinatal Surveillance System is completing a study to determine whether maternal mortality is similarly underreported in Canada.

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Induced Abortion Ratio

Indicator Definition

The number of induced abortions per 100 live births (in a given place and time).

A related indicator is the age-specific induced abortion rate (ASAR), which refers to the number of induced abortions per 1,000 females in the same age category (in a given place and time).

Relevance

In many countries, abortion is a significant or leading cause of maternal mortality. Access to safe legalized abortion has been a significant factor in decreasing maternal morbidity and mortality in some nations.[1-2] Access to induced abortion is viewed as an indicator of society's attitude towards women and their right to reproductive choice.

Background Information

- The complication rate from abortions in Canada from 1990 to 1995 was 1.1%. Genital tract and pelvic infections (42.9%), delayed or excessive hemorrhage (17.4%) and damage to pelvic organs and tissues (12.5%) were the most commonly reported complications. There were no reported abortion-related deaths.[3]
- In 1995, 106,658 abortions were obtained by Canadian women, making abortions approximately 22% of reported pregnancy outcomes.[3]
- Of reported abortions, 66.2% were performed in hospitals, 33.4% in clinics and 0.4% in the United States.[3]
- In 1969, a law was passed to regulate abortion under the *Criminal Code*. This law permitted a qualified medical practitioner to perform an abortion if prior approval was obtained by a Therapeutic Abortion Committee. A 1988 Supreme Court of Canada decision found this process unconstitutional. The 1969 law was rendered unenforceable, and abortion was effectively decriminalized.
- Complications, and therefore morbidity, related to abortions may be underreported due to delay between the event and the outcome or the use of a different facility. Complication rates are often calculated without regard for the severity of the complication. Hence, true morbidity may not be accurately reflected in a combined complication rate.

Data Limitations

- Limitations include lack of reporting of some abortions, primarily from three sources: abortions provided in physicians' offices that have not been designated as abortion facilities, medically/pharmacologically induced abortions and abortions provided to Canadian women in the United States.[3,5]

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Background Data[3,4]

Table 6.2 **Number of induced abortions, induced abortion ratios and age-specific induced abortion rates (ASAR, per 1,000), by maternal age, Canada, 1995**

	< 15	15-17	18-19	20-24	25-29	30-34	35-39	≥ 40
Number	576	7,978	12,520	31,812	23,209	17,017	10,283	3,263
Ratio	239.0	101.7	80.4	44.7	19.0	14.9	25.4	56.0
ASAR	2.9	13.8	32.2	31.5	20.9	12.9	7.9	2.8

Ectopic Pregnancy Rate

Indicator Definition

The number of ectopic pregnancies per 1,000 reported pregnancies (in a given place and time).

Ectopic pregnancy is defined as the implantation of the blastocyst anywhere other than the endometrial lining of the uterine cavity.[1] Reported pregnancies include ectopic pregnancies, spontaneous and induced abortions occurring within health care settings, live births and stillbirths.

Relevance

Ectopic pregnancy is a significant cause of maternal morbidity and mortality. In industrialized countries, ectopic pregnancy is the leading cause of maternal death during the first trimester of pregnancy and accounts for about 10% of all maternal mortality. Furthermore, ectopic pregnancy leads to permanent sterility in 20%-60% of cases.[2]

Background Information

- During the past two decades, the incidence of ectopic pregnancy has doubled or tripled in many parts of the world.[2] In Canada, as in many other industrialized countries, the ectopic pregnancy rate increased in the 1980s and early 1990s.[3]
- Although the annual maternal mortality ratio from ectopic pregnancies has declined over time, maternal mortality ratios from other causes have fallen more rapidly. Thus, ectopic pregnancy has emerged as the leading cause of maternal death during the first trimester.[4]
- It is estimated that 50% of ectopic pregnancies occur in women who have had a previous fallopian tube infection with a sexually transmitted disease agent.[3]
- Additional established risk factors for ectopic pregnancies include pelvic inflammatory disease, older maternal age, low parity, low gravidity, prior tubal surgery, history of infertility, intrauterine contraceptive device use and prior ectopic pregnancy.[5]
- The recurrence risk of ectopic pregnancy is reported to range from 4% to 27%.[6]

Background Data[7]

Table 6.3 **Temporal trends in rate of ectopic pregnancy in Manitoba, Canada, 1981-1990**

Year	Number per 1,000 reported pregnancies*†
1981	10
1982	11
1983	10
1984	11
1985	13
1986	14
1987	14
1988	15
1989	16
1990	16

* Reported pregnancies include live births, stillbirths, legally induced abortions and ectopic pregnancies.
† Test for linear trend: $p < 0.001$.

Data Limitations

- The management of ectopic pregnancy is changing from inpatient surgical treatment to outpatient management using pharmacological methods. This shift to more conservative treatment of unruptured tubal pregnancies outside the hospital may result in a lower reported rate of ectopic pregnancies if the data source is hospital admissions/separations.
- Underestimates or overestimates of incidence may be the result of problems in clinical diagnosis, especially in very early gestation. The frequency of subclinical ectopic pregnancy is unknown.[7]
- Understanding rates of risk factors and the contribution of each to the incidence of ectopic pregnancy is difficult. All risk factors are not always coded systematically in hospitalization data.

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Severe Maternal Morbidity Ratio

Indicator Definition

The number of women who experience severe (life-threatening) maternal morbidity per 100,000 live births (in a given time and place).

This indicator may be refined by specifying cause.

Relevance

As maternal mortality ratios have declined to very low levels and many maternal mortality review committees have disbanded for lack of deaths to review, the question of whether to reinstitute these committees to periodically review cases of life-threatening pregnancy-related morbidity has arisen. Of interest is the extent to which such events are preventable and the extent to which they are associated with lengthened hospital stays and long-term adverse physical or psychological sequelae.

Background Information

- Very few women in Canada today — between 15 and 20 per year — die from disorders directly resulting from pregnancy.[1] We do not know, however, the number of women who experience severe life-threatening events attributable to pregnancy. Determining the magnitude of the problem depends on how we define "life-threatening" and whether we include only disorders directly related to pregnancy. It is possible that severe morbidity directly related to pregnancy may be too rare in Canada to allow meaningful secular and regional comparisons.
- Quantification of life-threatening maternal morbidity has been approached primarily in two ways. The first has been to report the number of admissions to intensive care units (ICUs) during pregnancy or within a defined time period following the termination of pregnancy.[2-8] The purpose of the majority of these investigations has been to describe the utilization patterns of obstetric care facilities or the use of general intensive care facilities for critically ill pregnant and postpartum women rather than to determine the rate of occurrence of life-threatening events related to pregnancy. The patient populations described in these investigations have typically included women whose illnesses were not directly related to pregnancy; that is, they included women who were critically ill who also happened to have been pregnant, such as women with asthma, underlying cardiac disease, carcinomas and drug overdose. Most of these studies were limited to single tertiary referral centres with intensive care units having varying capacities and admission criteria. Most studies were not population-based, although in some cases the number of births in the surrounding region was given, enabling the calculation of illness-to-live birth ratios for ICU admission. For example, a population-based ICU admission rate of 3.1 per 1,000 live births was reported from a region of France, although approximately one-quarter of the "obstetric" ICU admissions were for conditions not directly related to pregnancy.[3]
- Another approach is the critical incident approach.[9,10] Critical incidents are not limited to ICU admissions but require a subjective judgment of which conditions to include. Moreover, judgments of severity must often be made in individual cases for conditions such as hypertensive disorders that are not necessarily life-threatening. The advantage of using the critical incident approach to defining life-threatening maternal morbidity is that there is less likelihood of missing events where admission to an ICU was not possible or of including events that were not directly related to pregnancy.

Background Data

Table 6.4 below lists causes of life-threatening morbidity chosen as potentially reportable nationally. These specific causes of life-threatening morbidity were chosen by members of the Maternal Mortality and Morbidity Study Group of the Canadian Perinatal Surveillance System (CPSS) because they are — in most cases — avoidable; an increased incidence or case fatality rate would, therefore, be a warning signal requiring further investigation. Definitions are given along with incidence and case fatality rates where available. It should be noted that these rates are taken from studies undertaken in various settings — usually tertiary facilities — at different points in time.

Table 6.4 **Selected reportable causes of severe maternal morbidity**

Disorder and definition	Reported incidence/births	Reported case fatality rate	Sequelae
Amniotic fluid embolism: A type of pulmonary embolism in which amniotic fluid enters into maternal blood circulation, resulting in severe disturbance of cardiorespiratory function and blood clotting.[11] Amniotic fluid embolism is difficult to diagnose and to distinguish from other types of pulmonary emboli.	1/80,000[12]	60% to 80%[13]	neurological sequelae, severe coagulopathy in 50% of survivors[13]
Other obstetrical pulmonary embolism: Includes air embolism, venous thromboembolism (blood clots) and other pulmonary emboli in pregnancy, childbirth and the puerperium.	3/1,000 to 1/10,000[14,15]	3% treated, 30% untreated	possible pulmonary hypertension
Eclampsia: A severe form of preeclampsia (pregnancy-induced hypertension) in which seizures occur.[16]	0.5-2/1,000[16]	5.8%[17] to 14%[18]	increased risk of cerebrovascular accident
Septic shock: May accompany bacteremia and in obstetrics is most commonly associated with septic abortion, chorioamnionitis, pyelonephritis and endometritis.[19]	"low incidence"	< 3% to 50%[12]	increased risk of end organ failure
Cerebrovascular disorders: Disorders of blood vessels of the brain such as stroke or ruptured cerebral aneurysm, resulting in neurological injury.[15]	1/10,000[15] to 2/10,000[18]	2.2% for in-hospital stroke[18]	40% residual neurological impairment reported[20]
Anesthesia complications: Definition very problematic. One solution has been to define a critical incident as "any occurrence that could have or which has harmed a patient," with case-by-case review required.[21]	unknown	overall fatality rates/ administration of anesthesia in obstetrics: 32/million (general) 1.9/million (regional)[22]	19/10,000 neurological complications following epidural[23]
Hemorrhage requiring transfusion: Blood loss during either the antepartum or postpartum period so severe as to require transfusion. Criteria for transfusions known to differ, however.	< 1% if vaginal delivery, 2% to 12% if cesarean[16]	low mortality in Canadian hospital settings	possible progression to end organ failure
Hemorrhage requiring hysterectomy: As above, but requiring hysterectomy.	unknown	low mortality in Canadian hospital settings	loss of fertility and possible psychological effects
Catastrophic rupture of the uterus: A rupture where there is a through-and-through tear of the uterine wall accompanied by bleeding.	approximately 1% during a trial of labour[24]	low mortality in Canadian hospital settings	hysterectomy 5%-10%, risk of subsequent rupture

Data Limitations

- Currently, information about adverse pregnancy events is available from hospitalization data. The reliability of this information as a means of determining frequency of serious events related to pregnancy is unknown. Preliminary assessments have shown that such databases may overcount some events, such as uterine rupture, and undercount others, such as cerebrovascular disorders. CPSS and the Canadian Institute for Health Information are undertaking an assessment of the reliability of reporting of the causes of severe maternal morbidity listed here using the Discharge Abstract Database. Because of the rarity of these events, however, it is possible to assess only whether events reported occurred; it would not be possible to determine the number that occurred that were not reported.

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Rate of Maternal Readmission after Discharge following Childbirth

Indicator Definition

The number of mothers readmitted to hospital within three months of initial hospital discharge (following childbirth) expressed as a proportion of the total number of women discharged from hospital following childbirth (in a given place and time).

A mother being transferred from one hospital to another is not considered a readmission. The definition can be varied, and estimates of maternal readmission within one month or within six months following initial discharge may also be calculated. A related indicator is the proportion of childbirth-related diagnoses at maternal readmission (i.e., the number of mothers with a diagnosis related to childbirth as a proportion of all readmitted mothers).

Relevance

Maternal readmission rates serve as a proxy for complications related to childbirth. Many factors influence maternal readmission, including the severity of illness, availability of hospital resources, distance to hospital, physician practice patterns, hospital admission policy and accessibility of outpatient services.

Background Information

- Maternal readmission following childbirth is an under-researched topic, and the impact of maternal readmission on maternal and child health has not been well documented in the scientific literature.[1,2] Comprehensive data on maternal readmission are lacking for both Canada and other countries.
- Studies have failed to establish an association between a shorter length of hospital stay at childbirth and an increased maternal readmission rate.[3] In recent years, maternal length of hospital stay at childbirth has decreased steadily in Canada.[4]

Table 6.5 **Three-month maternal readmission rate by province/territory, Canada (excluding Québec and Yukon), 1995-1997**

Province/territory*	Hospital deliveries			Readmission rate (%)		
	Total	Cesarean	Vaginal	Total	Cesarean	Vaginal
Newfoundland	16,210	3,533	12,677	4.0	4.9	3.7
Prince Edward Island	4,724	996	3,728	2.4	4.2	2.0
Nova Scotia	27,592	5,244	22,348	3.1	5.0	2.7
New Brunswick	23,874	5,019	18,855	3.5	5.3	3.1
Ontario	408,084	74,630	333,454	2.3	3.3	2.0
Manitoba	48,936	7,990	40,946	2.8	3.8	2.6
Saskatchewan‡	26,246	4,302	21,944	2.6	3.9	2.5
Alberta	107,902	17,229	90,673	4.0	5.5	3.7
British Columbia	132,070	27,721	104,349	3.0	4.0	2.7
Northwest Territories	3,632	381	3,251	4.1	4.9	4.0
Canada†	**799,270**	**147,045**	**652,225**	**2.8**	**3.9**	**2.5**

* Province/territory where the original hospital admission occurred.
‡ Not all hospital deliveries were recorded in the DAD.
† Data for Québec were not available in the DAD. Data for the Yukon were excluded because very few events were captured in the DAD.

- A survey of 1,249 mothers showed that 87% of the subjects reported health problems or maternal morbidity after delivery. Three percent of subjects were readmitted to hospital within eight weeks of hospital delivery. Of the readmitted women, 79% were admitted to a gynecology ward, 12% to a maternity hospital for parentcraft or respite and 9% elsewhere.[1]

Background Data

Information on maternal readmission may be obtained from hospitalization data through internal record linkage.

Table 6.5 summarizes information on the three-month maternal readmission rates by province/territory using the Discharge Abstract Database (DAD) for 1995-1997. Less than 3% of women in Canada (excluding Québec and Yukon) were readmitted during the three months after discharge following hospital delivery. The overall maternal readmission rate varied by province/territory, from 2.3 per 100 hospital deliveries in Ontario to 4.1 per 100 hospital deliveries in the Northwest Territories. In general, women who underwent cesarean section were more likely to be rehospitalized than those who had vaginal deliveries.

Data Limitations

- The readmission calculation by linkage between the obstetric delivery file and the readmission file in the DAD was achieved by matching the provincial/territorial scrambled health insurance number on both records. If the number was missing or not accurately recorded, linkage was not possible.
- The data provided above pertain only to hospital delivery/readmission. Hospital admissions for women who had given birth outside hospital were not included.

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CHAPTER

7

Fetal and Infant Health Outcomes

Preterm Birth Rate

Indicator Definition

The number of live births with a gestational age at birth of less than 37 completed weeks (< 259 days) expressed as a proportion of all live births (in a given place and time).

Relevance

Preterm birth is the most important determinant of perinatal and infant mortality, and preterm birth prevention is considered the most important perinatal challenge facing industrialized countries.[1,2]

Background Information

- Although preterm births generally constitute less than 10% of all live births, over 80% of all neonatal deaths occur among infants less than 37 weeks of gestational age.[3,4] Mortality rates increase drastically with decreasing gestational age: compared with infants born at 36 weeks of gestation, those born at 24, 28 and 32 weeks of gestational age have neonatal mortality rates that are about 180-fold, 45-fold and 7-fold higher, respectively.[3]
- Neonatal and infant morbidity associated with preterm birth includes neurodevelopmental handicaps, chronic respiratory problems, intraventricular hemorrhage, infection, retrolental fibroplasia and necrotizing enterocolitis.[1] Among preterm survivors, long-term rates of impairment, disability and handicap are several-fold higher than among term infants.[5]
- The rates of preterm birth are much higher and the mean gestational age is much lower among multiple births than among singleton births. Of singleton live births in Canada in 1993-1995, 5.9% were preterm, compared with 50.6% of multiple live births. Within multiple births, differences in preterm birth rates and mean gestational age are also pronounced; twin births are associated with lower rates of preterm birth as compared with triplet or higher-order multiple births. Although multiple births are highly associated with preterm birth, their frequency is low (about 2% of all live births). Fourteen percent of all preterm births in Canada in 1993-1995 were due to multiple births (etiologic fraction).[6]
- The health care costs associated with preterm birth are substantial.[1]
- Preterm birth rates have increased slightly in Canada in recent years, from 6.3% in 1981-1983 to 6.8% in 1992-1994. This increase has been attributed to increases in the frequency of multiple births and obstetric intervention (which is reducing stillbirth rates).[7] Hospital-based studies have shown that the recent increase in preterm birth in Canada is largely attributable to increasing preterm induction and cesarean section, increasing use of early ultrasound (for gestational age ascertainment) and changes in sociodemographic and behavioural factors.[8]
- Rates of preterm birth in Canada are much lower than in the United States (7.1% in Canada excluding Ontario vs. 11.0% in the United States in 1995, Table 7.1), although between 1990 and 1995 the rates of increase in preterm birth are similar (4% increase in the United States vs. a 6% increase in Canada excluding Ontario). Rates of preterm birth in other countries such as Sweden and Finland are lower than those in Canada,

Background Data[6,10]

Table 7.1 **Rates of preterm birth (per 100 live births with known gestational age) in Canada (excluding Ontario) and the United States, 1990-1995**

Year	Canada (excluding Ontario)†	United States		
		All races	White	Black
1990*	6.6	10.6	8.9	18.8
1991	6.6	10.8	9.1	18.9
1992	6.7	10.7	9.1	18.4
1993	6.6	11.0	9.5	18.5
1994	6.8	11.0	9.6	18.1
1995	7.1	11.0	9.7	17.7

* Data for 1990 exclude Newfoundland.
† Ontario data excluded because of data quality concerns.

while those in countries such as Australia are similar. France and Finland are perhaps the only countries where a decrease in preterm birth is reported to have occurred in recent years.[9,11]

Data Limitations

- Data on the gestational age of births in Canada are obtained from birth certificates. The information is provided by the mother or, in the case of Québec, by the physician attending the birth. A small fraction of gestational ages are unstated. Some transcribing errors are also likely.

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Postterm Birth Rate

Indicator Definition

The number of total births (stillbirths and live births) that occur at a gestational age of 42 or more completed weeks (≥ 294 days) of pregnancy expressed as a proportion of total births (in a given place and time).

Relevance

Postterm birth is associated with an increased rate of fetal, neonatal and postneonatal mortality.[1] Antenatal surveillance and intervention (by induction of labour) are likely to reduce the risk of fetal and neonatal mortality.

Background Information

- The World Health Organization and the International Federation of Gynecology and Obstetrics define postterm birth as births that occur at a gestational age of 42 (294 days) or more weeks. A birth that occurs more than two weeks beyond the expected date of delivery is the definition used by the American College of Obstetrics and Gynecology.[2]
- Risk factors that may have a causal association with prolonged gestation include season, heredity, race, primigravidity, use of iron supplementation, hormonal influences and genetic abnormalities.[3]
- The existing evidence concerning the role of a variety of maternal demographic factors including parity, prior postterm birth, socioeconomic status and maternal age as risk factors for postterm birth is conflicting.[4] The tendency for postterm birth to recur in subsequent pregnancies raises the issue that postterm birth may be genetically or biologically determined.[2]
- Postterm birth is associated with increased risk of perinatal mortality. The risk associated with postterm birth also extends to infant deaths.[1,5]
- Methods employed to calculate gestational age-specific fetal, neonatal and infant mortality are partly responsible for the observed discrepancies in reported outcomes associated with postterm birth. For example, some of the studies[6-8] have calculated gestational age-specific stillbirth rates per 1,000 total births at each week of gestation, while others[1] estimated the risk of stillbirth as a proportion of the ongoing pregnancies at each gestational week. Theoretically, the latter approach appears more attractive and appropriate, as all women who are pregnant (at any particular gestational age) are at risk of stillbirth. These two approaches lead to very different results.
- Studies from Sweden and Spain have reported a slightly increased risk of fetal, neonatal and postneonatal mortality associated with post-term birth. Subsequent reports from the United Kingdom and Sweden revealed a stronger association between postterm birth and all components of perinatal mortality (intrapartum and postpartum), however.[1,9]
- Data obtained from randomized controlled trials have provided evidence that elective labour induction results in reduced perinatal mortality, without an increase in the rates of cesarean deliveries.[10,11] Based on results of these trials, the Society of Obstetricians and Gynaecologists of Canada has recommended elective induction of labour for women at 41-42 weeks of gestation.[12]
- The major causes of increased perinatal mortality among postterm births are macrosomia, pregnancy hypertension, cephalopelvic disproportion, shoulder dystocia, prolonged labour, maternal trauma, postpartum hemorrhage, unexplained anoxia and neonatal seizures.[13]
- It has been suggested that placental senescence is the underlying mechanism behind the consequences of postterm birth. Histological, morphological and quantitative changes in the placenta of babies born postterm (which could suggest placental degeneration) have not been demonstrated, however.[14] The fact that the postterm fetus can continue to gain weight and become unusually large (at birth) also argues against placental insufficiency.[2]

Background Data [15,16]

Table 7.2 **Numbers and rates (per 100 total births) of postterm birth, Canada and the provinces/territories, 1990-1994**

Province/territory*	Total births	≥ 42 weeks	
		Number	Rate
Newfoundland	27,028	861	3.19
Prince Edward Island	9,279	237	2.55
Nova Scotia	59,739	4,940	8.27
New Brunswick	46,997	2,273	4.84
Québec	476,535	11,768	2.47
Manitoba	84,972	5,636	6.63
Saskatchewan	75,135	3,581	4.77
Alberta	209,301	6,382	3.05
British Columbia	231,356	11,642	5.03
Yukon	2,612	212	8.12
Northwest Territories	7,972	218	2.73
Canada	**1,230,926**	**47,750**	**3.88**

* Ontario data excluded because of data quality concerns.

Data Limitations

- Birth certificates are the source of gestational age data in Canada. Some transcription errors are likely, and gestational age information is missing in a small fraction of records.

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Fetal Growth: Small-for-Gestational-Age Rate, Large-for-Gestational-Age Rate

Indicator Definition

1) Small-for-gestational-age rate: The number of live births whose birth weights are below the standard 10th percentile of birth weight for gestational age expressed as a proportion of all live births (in a given place and time).

2) Large-for-gestational-age rate: The number of live births whose birth weights are above the standard 90th percentile of birth weight for gestational age expressed as a proportion of all live births (in a given place and time).

Alternative cut-offs to determine small for gestational age and large for gestational age can also be used, including the 5th percentile and the 95th percentile of birth weight for gestational age.

Mean fetal growth ratios (FGR) are an alternative to percentiles based on reference populations for identifying small- or large-for-gestational-age babies. The FGR is the ratio of the observed birth weight to the mean birth weight for gestational age of the standard population.[1-3] An FGR below 0.85[2,3] can be used to determine small for gestational age, while an FGR above 1.15[3] can be used to identify large for gestational age. A particular feature of FGR is that it can be treated as a continuous variable in statistical analysis.

Relevance

Fetal growth restriction is associated with increased perinatal morbidity and mortality,[4] whereas accelerated fetal growth can result in macrosomia with associated birth complications.[4] Surveillance of fetal growth indicators can be helpful in identifying populations at high risk of fetal growth restriction and/or macrosomia and planning public health programs aimed at reducing risks of fetal growth restriction and macrosomia.

Background Information

- Since it is difficult to measure fetal growth *in utero*, birth weight for gestational age is widely used as a measure of fetal growth in both clinical and public health practice.[4,5]
- Since health risks to infants are increased at both extremes of fetal growth, the ultimate goal of public health programs should be optimizing the fetal growth distribution, with reduced numbers of births at both extremes.
- Ultrasound-based estimation of gestational age tends to reduce numbers at the left and (especially) right extremes of the gestational age distribution, with an overall reduction in mean gestational age.[6] Therefore, FGRs and birth weight for gestational age tend to increase when ultrasound-based gestational ages are used.
- To reduce errors in determining FGR and birth weight for gestational age categories (e.g., small-for-gestational-age) a standard growth curve with minimum misclassification of gestational age is preferred. The ideal standard growth curve should be based on a population with a high percentage of ultrasound-assisted dating and should perhaps be further smoothed by statistical modelling. The Canadian Perinatal Surveillance System is developing a new standard growth curve for Canada.
- Comparisons of fetal growth distribution across time periods, geographic regions and population groups should first distinguish true differences in fetal growth from those resulting from the above-mentioned artifacts.
- The mean birth weight at almost all gestational ages and the rate of macrosomia are substantially higher among North American native populations than among non-natives.[7] Higher rates of glucose intolerance during pregnancy among natives have been proposed as the explanation.
- Maternal nutrition supplementation programs, such as the Women, Infants, and Children Program in the United States and the Canada Prenatal Nutrition Program, may have limited impact on fetal growth restriction rates in industrialized countries such as Canada.[8]
- Because birth weight for gestational age is not a direct measure of *in utero* growth, caution should be exercised in interpretation of this indicator.

Background Data[9]

Table 7.3 **Small-for-gestational-age and large-for-gestational-age rates in Canada and the provinces/territories,† 1992-1994***

Province/territory	Small for gestational age (%)	Large for gestational age (%)
Newfoundland	9.0	13.7
Prince Edward Island	7.5	14.7
Nova Scotia	9.2	11.9
New Brunswick	9.1	12.4
Québec	9.7	9.1
Manitoba	8.5	12.7
Saskatchewan	8.3	12.0
Alberta	9.5	10.0
British Columbia	8.2	11.3
Yukon and Northwest Territories	6.8	12.9
Canada	**9.1**	**10.6**

† Ontario excluded because of data quality concerns.
* The standard developed by Arbuckle et al.[5] is used in these calculations.

Data Limitations

- Birth weight for gestational age is an index derived from the two underlying measures. Measurement errors in birth weight and (especially) gestational age can result in erroneous estimation of fetal growth.
- Gestational age estimation is often based on women's recall of the date of last normal menstrual period, which is subject to error. The accuracy of gestational age estimation can be substantially improved by ultrasound-assisted dating early in the second trimester.[6]

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Fetal and Infant Mortality Rates

Indicator Definition

1) Fetal mortality rate: The number of still-births (≥ 500 g or ≥ 20 weeks of gestation) per 1,000 total births (live births and still-births), in a given place and time.

2) Infant mortality rate: The number of deaths of live-born babies prior to the 364th completed day of life per 1,000 live births (in a given place and time).

Fetal mortality can be divided into two components: early fetal deaths (at < 28 completed weeks of gestation) and late fetal deaths (at ≥ 28 completed weeks of gestation).

Infant mortality can be divided into three components: early neonatal deaths (0-6 days), late neonatal deaths (7-27 days) and postneonatal deaths (28-364 days).

Fetal and infant mortality rates can be refined by calculation of birth weight- and age at death-specific mortality rates and gestational age- and age at death-specific mortality rates. Fetal and infant mortality rates can also be refined by calculation of cause-specific mortality rates.

The estimation of preventable feto-infant mortality has been advocated as an important component of perinatal health surveillance. Under this approach, birth weight- and age at death-specific mortality rates for specific population subgroups are calculated and compared with rates for a reference population. The purpose of this approach is to estimate the number of fetal and infant deaths that may be prevented by improvements in various health determinants.

Relevance

Together, fetal and infant mortality are considered to be a key measure of health in a society. In almost all countries, fetal and infant mortality rates have declined dramatically over the last century. Nevertheless, disparities remain. Estimates of preventable feto-infant mortality enable us to better understand the nature of the disparities between population subgroups and the factors that may be responsible. They help to direct interventions towards areas where improvement is possible.

Background Information

- In almost all countries throughout the world, fetal and infant mortality have decreased dramatically over the last century with improvements in sanitation, nutrition, infant feeding and maternal and child health care, although the decline has been slower in recent years.
- Disparities in the risk of infant mortality remain, however, including in developed countries such as Canada.
- Interpretation of secular trends in infant mortality rates should take into account the increasing tendency to register extremely small live births (< 500 g).[1] As well, there are differences among jurisdictions in approach to registering these very small babies. For these reasons, the World Health Organization has recommended that international comparisons of infant mortality be restricted to live births ≥ 1,000 g.[2]
- A conceptual framework for perinatal surveillance that focuses on preventable feto-infant mortality was described by Dr. Brian McCarthy, Centers for Disease Control and Prevention, Atlanta, Georgia.
- Estimates of preventable feto-infant mortality are based on a cross-tabulation of birth weight and age at death that results in a 16-cell table. Each of the 16 cells represents two aspects of perinatal health: (a) perinatal outcomes (age at death- and birth weight-specific mortality); and (b) determinants of these outcomes (maternal health, maternal care, newborn care and infant care).
- The Canadian Perinatal Surveillance System has adapted this framework by using the term “infant environment” rather than “infant care.” Infant environment is to be considered in the broad sense, including but not limited to infant health care. The 16-cell table is shown below.
- Preventable feto-infant mortality is estimated by comparing the mortality rates in the population under surveillance with mortality rates for a defined reference population with good health outcomes — for example, one that is socioeconomically affluent.[3] Mortality rate differences between the two populations (in any cell) represent excess/preventable mortality.

Table 7.4 **Framework for the estimation of preventable feto-infant mortality according to birth weight and age at death**

Birth weight (g)	Late fetal (≥ 28 weeks)	Early neonatal (0-6 days)	Late neonatal (7-27 days)	Postneonatal (28-364 days)
< 1,000	Maternal health			
1,000-1,499				
1,500-2,499	Maternal care	Newborn care		Infant environment
≥ 2,500				

- According to this model, late fetal, neonatal and postneonatal deaths among babies less than 1,500 g may be largely attributable to factors affecting maternal health. Late fetal deaths among babies weighing ≥ 1,500 g may result from suboptimal maternal care. For example, regions characterized by relatively high rates of late fetal death among babies with normal birth weight may benefit from better access to cesarean delivery. Suboptimal newborn care or lack of access to neonatal intensive care is likely to contribute to early neonatal deaths among babies with birth weight ≥ 1,500 g and late neonatal deaths among babies with intermediate birth weight (between 1,500 and 2,499 g). Infant deaths during the late neonatal period for birth weight ≥ 2,500 g and postneonatal deaths for birth weight ≥ 1,500 g may be largely attributable to factors in the infant environment (e.g., access to immunization, injury prevention and control).
- The 16-cell feto-infant mortality table can be extended, and cause-specific excess or preventable deaths can be calculated.
- This conceptual approach has some limitations.[1,2,4-6] For example, classifying fetal and infant deaths under such a scheme may not be entirely appropriate for some deaths (e.g., those due to congenital anomalies). In addition, the framework does not take into account differences in gestational age[3] and other confounding variables. Also, the framework does not account for potential differences in birth weight distributions between the compared populations. Such differences should be addressed in other analyses.

Background Data[7,8]

Table 7.5 **Fetal mortality (rate per 1,000 total births) and infant mortality (rate per 1,000 live births) in Canada, 1993-1997***

Year	Fetal mortality rate	Infant mortality rate
1993	6.0	6.3
1994	5.9	6.3
1995	6.1	6.1
1996	5.8	5.6
1997	6.1	5.5

* Includes stillbirths of unknown gestational period. Newfoundland, New Brunswick and Québec do not report fetal death of less than 500 g.

Table 7.6 **Feto-infant mortality rates in a Winnipeg benchmark population and for all Manitoba, and the mortality rate differences (preventable mortality), per 1,000 births***

Intervention opportunities	Benchmark Winnipeg women, high income, aged 20-34, 1985-1996	All Manitoba women, 1994-1996	Preventable (excess) deaths
Maternal health	3.00	3.93	0.93
Maternal care	1.96	2.28	0.32
Newborn care	1.21	1.38	0.15
Infant environment	1.32	2.36	1.04

* Adapted from *Manitoba Perinatal Surveillance Report 1985-1996*.[8]

Data Limitations

- Birth weight- and age at death-specific mortality rates and gestational age- and age at death-specific mortality rates are calculated from linked birth and death files. Linkage of birth and death databases is likely to result in some deaths remaining unlinked, especially if the linkage process is probabilistic (i.e., no unique identifier).
- Measurement and coding errors may occur in vital statistics data.

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Severe Neonatal Morbidity Rate

Indicator Definition

The number of infants identified as having severe neonatal morbidity in the first month of life expressed as a proportion of all live-born infants (in a given place and time).

Conditions included under severe neonatal morbidity include severe respiratory distress syndrome (RDS), sepsis, seizures, severe intraventricular hemorrhage (IVH), persistent fetal circulation (PFC), multi-system congenital malformations and very low birth weight.[1]

Relevance

Severe morbidity during the neonatal period is an important predictor of subsequent mortality and disability.[2] Intervention programs targeted towards neonates with severe morbidity may help to reduce long-term disability.

Background Information

- The first 24 hours after birth represent the period of highest risk for infant death, and the rates of morbidity and mortality remain high during the first 28 days of postnatal life.[1]
- Advances in neonatal intensive care have significantly improved the survival of infants with severe morbidity during the neonatal period. The increased survival of these neonates may have resulted in a higher proportion of infants with long-term disabilities.
- Neonatal morbidity that is likely to predict long-term disability includes severe RDS, sepsis, seizures, IVH, PFC, multisystem congenital anomalies and very low birth weight.
- RDS is significantly associated with neonatal mortality and accounts for about 30% of all neonatal deaths.[3] Efforts to reduce preterm birth (by preventing unnecessary or poorly timed cesarean section, appropriate management of high-risk pregnancy and labour, etc.), use of antenatal corticosteroids and surfactant therapy may help to prevent the occurrence of RDS.[4-6]
- Neonatal sepsis is significantly associated with neonatal mortality, with a case fatality rate of 50%-75%.[7] Neonatal sepsis may lead to meningitis in 20%-30% of cases, and surviving children frequently have neurological deficits.[8-9] Early recognition and treatment can minimize the severity of the illness and its long-term consequences.
- Neonatal seizures are the most common neurological emergency in the newborn infant and are clinically important because very few are idiopathic.[10] Neonatal seizures require specific treatments depending on etiology. Better outcomes are observed when neonatal seizures are treated early and appropriately.[11]
- IVH is more common among preterm births and is an important cause of neonatal mortality and morbidity.[12] A dramatic decline in the incidence of IVH has been observed during the last decade. In spite of this decline, about 21% of infants weighing less than 1,000 g at birth and 12% of those weighing less than 1,500 g at birth suffered IVH in 1995.[13] IVH is predictive of later neurodevelopmental and seizure disorders.[14-17] Efforts to prevent preterm birth, transfer of high-risk mothers to tertiary care centres, antenatal maternal steroid use, optimal resuscitation and postnatal pharmacotherapy are likely to reduce the burden of morbidity and long-term disability associated with IVH.[18]
- PFC is mostly idiopathic. The occurrence of PFC is also linked with birth asphyxia, meconium aspiration pneumonia, neonatal sepsis and RDS. PFC is reported to occur in 1 in 500 live births. The treatment outcomes and long-term consequences for infants with PFC are dependent on the underlying insult.[5]
- Very low birth weight (< 1,500 g) infants are at increased risk of mortality during infancy or disability later in life. A recent Canadian study and a meta-analysis of published studies on the subject showed that the median incidence of cerebral palsy among very low birth weight infants was about 7.7%, and disability was about 25%.[2,19]

Background Data[20,21]

Table 7.7 **Rates of selected neonatal morbidity, Canada, 1984-1994***

	1984	1986	1988	1990	1992	1994
Respiratory distress syndrome (per 100 live births)	1.4	1.5	1.3	1.6	1.4	1.2
Very low birth weight (per 1,000 live births)	—	—	8.32	8.58	8.41	—

* Rates of respiratory distress syndrome are by fiscal year. Rates of very low birth weight are by calendar year.

Data Limitations

- Hospitalization databases and birth certificate data are the usual source of information on severe neonatal morbidity. Coding errors and incomplete recording may lead to an underestimation of severe neonatal morbidity when these administrative databases are the sole source of information.[22-24]

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Multiple Birth Rate

Indicator Definition

The number of live births and stillbirths following a multiple gestation pregnancy expressed as a proportion of all live births and stillbirths (in a given place and time).

A related indicator that is of increasing interest is the proportion of multiple births that result from assisted conception.

Relevance

Multiple pregnancies are at higher risk of poor outcome (including fetal death and infant morbidity and mortality) than singleton pregnancies and hence require more intensive monitoring and follow-up.[1]

Background Information

- In the last 15-20 years, there has been an increase in the occurrence of multiple births. Rates in England and Wales increased from 9.9 per 1,000 live births (1975) to 13.4 per 1,000 live births (1994); the largest increase appears to have occurred among triplet births.[2] In France, a similar increase in multiple births has also been observed.[3] In Canada, multiple births increased from 1.9% of all live births in 1981-1983 to 2.1% in 1992-1994.[4]
- Preterm birth is common among multiple births,[4] and this high rate of preterm birth has increased in recent years. In Canada, 40% of multiple live births were born preterm in 1981-1983, and this figure increased to 50% in 1992-1994.[4] Discordant growth and twin to twin transfusion may occur *in utero*. Stillbirth rates following multiple pregnancies are much higher than those following a singleton pregnancy.
- It is estimated that 22% of triplets, 17% of quadruplets and 11% of quintuplets are a result of assisted conception.[5]

Background Data[6]

Table 7.8 **Numbers and rates of twin and triplet births (live births and stillbirths), by province/territory, 1995**

Province/territory	Twin and triplet births	All births	Multiple birth rate (%)
Newfoundland	142	5,892	2.4
Prince Edward Island	32	1,767	1.8
Nova Scotia	232	10,804	2.1
New Brunswick	160	8,595	1.9
Québec	1,968	87,794	2.2
Ontario	3,594	147,247	2.4
Manitoba	374	16,241	2.3
Saskatchewan	301	13,579	2.2
Alberta	917	39,164	2.3
British Columbia	1,018	47,161	2.2
Yukon	14	473	3.0
Northwest Territories	42	1,625	2.6
Canada	**8,794**	**380,342**	**2.3**

- Multifetal pregnancy reduction may be offered at centres offering assisted conception. This option is intended to reduce the risks associated with multiple pregnancy. However, there is no consensus in the literature on whether risks can be lowered by reducing a higher-order gestation to a twin pregnancy. There is more agreement that selective termination before 20 weeks is safer than that after 20 weeks.[7] In one Scandinavian study, selective termination was successful (at least one infant discharged home) in 79% of cases.[8]

Data Limitations

- Measurement and coding errors may occur in vital statistics data.
- Currently, there are no national Canadian data on rates of assisted conception and associated outcomes.

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Prevalence of Congenital Anomalies

Indicator Definition

The number of individual live-born or stillborn infants with at least one congenital anomaly expressed as a proportion of the total number of live births and stillbirths (in a given place and time).

A related indicator is the congenital anomaly birth prevalence, which refers to the total number of congenital anomalies identified among live births and stillbirths divided by the total number of live births and stillbirths. Congenital anomalies that are diagnosed in the prenatal period and result in the termination of an affected pregnancy should ideally be identified and enumerated in the congenital anomaly rate.

Relevance

Congenital anomalies, particularly major congenital anomalies, are one of the leading causes of fetal and infant death and long-term morbidity. Surveillance of congenital anomalies can help detect new teratogens and evaluate interventions aimed at reducing the burden of congenital anomalies.

Background Information

- Congenital anomalies are structural or metabolic imperfections present at birth, which may or may not be diagnosable at birth.[1,2] In response to the rubella epidemic of the 1950s and the thalidomide tragedy of the 1960s, congenital anomaly surveillance systems were introduced and maintained in many countries worldwide, and an International Clearinghouse for Birth Defects Monitoring Systems was established in 1974.[2]
- Congenital anomalies, especially specific types of congenital anomalies, are relatively rare events. Studying congenital anomalies by specific type (rather than in total) is a necessary step for surveillance, since a specific environmental agent is likely to cause a specific form of a congenital anomaly. Large populations — for example, those at a provincial/territorial, national or international level — are usually required for meaningful monitoring.
- Routine monitoring of the occurrence of congenital anomalies in a large population base can lead to rapid detection of abnormal disease patterns (e.g., sudden increase in certain congenital anomalies), so that appropriate prevention/control strategies can be initiated.
- Comparisons of congenital anomaly rates across geographic regions may identify regions with higher rates of particular anomalies and lead to the identification of environmental teratogens.
- There are currently two congenital anomaly surveillance systems in Canada: the Canadian Congenital Anomalies Surveillance System (CCASS)[3] and the Alberta Congenital Anomalies Surveillance System (ACASS).[4] CCASS is hospital discharge diagnosis-based, national and efficient, with limited ability to review quality of diagnosis, while ACASS is based on voluntary reports from multiple sources, is more labour intensive and costly, but allows for a more detailed and timely review of the diagnosis.
- To be able to detect new teratogens, efforts should be made to collect detailed clinical case information to allow both a classification beyond the International Classification of Diseases (ICD) system and the collection of maternal exposure information.[5]
- Advances in diagnostic techniques, such as amniocentesis, chorionic villus sampling, maternal serum screening and ultrasonography, have improved the early and accurate diagnosis of congenital anomalies, sometimes leading to the termination of an affected pregnancy.[6,7] For example, Down's syndrome can be prenatally detected in 45%-75% of cases, while nearly 100% of the cases of anencephaly can be detected prenatally with ultrasonography.[6] Congenital anomaly surveillance systems need to adapt to these changes. Case surveillance among live births and stillbirths remains the key effort in the surveillance of defects that are less likely to be detected through prenatal diagnosis.

- There is evidence suggesting that folic acid and other vitamin supplementation prevent neural tube defects.[8-10] Congenital anomaly surveillance systems should be able to evaluate folic acid fortification and supplementation interventions.

Background Data[3]

Table 7.9 **Rates of selected congenital anomalies in Canada, 1985-1988**

Anomaly	Rate per 10,000 births
Anencephalus and similar anomalies	2.4
Spina bifida	7.8
Encephalocele	1.5
Congenital hydrocephalus	7.7
Transposition of great vessels	4.8
Hypoplastic left heart syndrome	3.4
Cleft palate with cleft lip	8.2
Cleft palate	7.3
Tracheo-esophageal fistula, esophageal atresia and stenosis	3.8
Intestinal, anorectal atresia and stenosis	5.8
Renal agenesis and dysgenesis	5.0
Limb reduction anomalies	4.6
Anomalies of abdominal wall	4.7
Down's syndrome	14.3

Data Limitations

- CCASS is based on hospitalization data, therefore cases diagnosed and seen only in outpatient settings are not captured.
- Anomalies captured by CCASS are limited to those occurring among live births and stillbirths, therefore anomalies resulting in spontaneous or induced abortions are missed.
- CCASS is coded by the ICD system, which may not discriminate sufficiently in certain complicated cases, resulting in coding errors.

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Rate of Neonatal Hospital Readmission after Discharge at Birth

Indicator Definition

The number of newborns who are readmitted to hospital within 28 days of birth expressed as a proportion of all newborns discharged from hospital after birth (in a given place and time).

This indicator can also be specified as the rate of readmission within seven days of birth.

Relevance

Newborn readmission rates have been used as one outcome to evaluate the quality of perinatal health care.[1-3] Newborn readmission rates are related to the length of hospital stay after birth.[4,5] Policies of early hospital discharge after birth are primarily motivated by economic considerations, and it is necessary to continuously monitor the relative benefits and risks of such policies.[1,5]

Background Information

- Increased newborn readmission rates are associated with shorter hospital stay at birth. The common reasons for readmission are neonatal jaundice, dehydration with weight loss, feeding problems and infection.[1,4,6,7]
- Some studies have suggested that early hospital discharge of full-term births (37-41 weeks' gestation) is likely to be safe for selected populations, particularly those deemed to be suitable in terms of psychosocial, socioeconomic and medical factors. Careful antenatal screening and preparation and postpartum home visits are necessary aspects of a program of early neonatal discharge after birth.[3,7,8]
- Early discharge of newborns has been motivated partly by parental preference for the home environment, but the psychosocial burden on parents resulting from possible rehospitalization needs to be considered as well.[1,3,5]
- The cost of care for infants rehospitalized after earlier discharge, or the cost of care for infants with irreversible morbidity resulting from delayed diagnosis or treatment, may be much higher than the marginal cost of increased newborn length of stay at birth. On the other hand, it is argued that increased newborn rehospitalization does not necessarily increase overall costs to the health care system, since early hospital discharge involves most births, whereas readmissions occur much less frequently. Although several published studies have evaluated the impact of early hospital discharge after birth, some concerns remain because of issues related to the validity and generalizability of the studies.[3,5] Comprehensive evaluation, including economic evaluation, of early hospital discharge programs is needed.[1,5]
- Nevertheless, hospitals with early discharge programs should work with community health agencies to ensure that guidelines for early discharge are followed.[4,9,10]
- The Canadian Paediatric Society and the Society of Obstetricians and Gynaecologists of Canada have published a joint statement, "Facilitating discharge home following a normal term birth."[9] This document reiterates the importance of individualized and family-centred care for mothers and babies and contains maternal and newborn criteria for discharge from hospital within 48 hours after birth.[9]

Background Data[6]

Information on newborn readmission may be obtained from internal record linkage of hospitalization data.

Table 7.10 presents the neonatal readmission rates in Canada from 1989 through 1996 (based on the Discharge Abstract Database [DAD]). Neonatal readmission rates increased steadily from 2.7% in 1989 to 3.8% in 1996.

Table 7.10 **Temporal trends in the rate of neonatal hospital readmission within 28 days of birth, Canada,* 1989-1996**

Year	Readmission rate (%)
1989	2.7
1990	2.9
1991	2.9
1992	3.1
1993	3.2
1994	3.4
1995	3.7
1996	3.8

* Data for Nova Scotia, Québec and Manitoba were not included, because only a small proportion of their hospital discharge data was available in the DAD.

Data Limitations

- The DAD does not contain information on gestational age of births, so the currently available neonatal readmission rate is calculated based on live births that weighed more than 1,499 g at birth instead of stratifying live births by gestational age.
- The absence of unique identifiers for infant records in the DAD makes it difficult to link neonatal readmission records with the record of hospital stay at birth.
- Details of the severity of illness of rehospitalized infants (i.e., detailed clinical and laboratory information) are usually unavailable in hospitalization databases. Also, newborn deaths that occur outside hospital and data on health care needs that are met in the community are not contained in these databases.

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Appendices

Appendix A

List of Perinatal Health Indicators

Rank	Indicator	Location in Section B
1	Fetal and Infant Mortality Rates	57
2	Fetal Growth: Small-for-Gestational-Age Rate, Large-for-Gestational-Age Rate	55
3	Preterm Birth Rate	51
4	Postterm Birth Rate	53
5	Maternal Mortality Ratio	41
6	Rate of Live Births to Teenage Mothers	25
7	Prevalence of Congenital Anomalies	65
8	Prevalence of Prenatal Smoking	19
9	Severe Maternal Morbidity Ratio	46
10	Cesarean Section Rate	31
11	Prevalence of Breastfeeding	23
12	Prevalence of Prenatal Alcohol Consumption	21
13	Multiple Birth Rate	63
14	Rate of Neonatal Hospital Readmission after Discharge at Birth	67
15	Ectopic Pregnancy Rate	44
16	Severe Neonatal Morbidity Rate	60
17	Use of Antenatal Steroids in < 34 Weeks	
18	Induced Abortion Ratio	43
19	Labour Induction Rate	29
20	Rate of Maternal Readmission after Discharge following Childbirth	49
21	Proportion of Mothers with Low Weight Gain Rate	
22	Rate of Operative Vaginal Deliveries	33
23	Rate of Early Neonatal Discharge from Hospital after Birth	39
24	Spontaneous Abortion Rate	
25	Proportion of Births in Women with No First Trimester Prenatal Visit	
26	Rate of Mother/Infant Separation	
27	Proportion of Mothers with a Low Pre-pregnancy Body Mass Index (BMI)	

28	Rate of Early Maternal Discharge from Hospital after Childbirth	37
29	Proportion of Pregnant Women with a Low Educational Level	
30	Prevalence of Exposure to Environmental Tobacco Smoke during Pregnancy	
31	Proportion of Pregnant Women Living without a Partner	
32	Proportion of Pregnant Women Reporting No Social Support	
33	Rate of General Anesthesia Use in Cesarean Deliveries	
34	Rate of Regional Anesthesia Use in Deliveries	
35	Use of Surfactant in Pregnancies of < 34 Weeks of Gestation	
36	Resuscitation Rate in Low Birth Weight Neonates	
37	Rate of Trauma to the Perineum	35
38	Proportion of Low Birth Weight Neonates with Low Five-Minute Apgar Score	
39	Proportion of Pregnant Women Reporting Physical Abuse	
40	Proportion of Pregnant Women Reporting High Psychosocial Stress	
41	Proportion of Low Birth Weight Neonates with Low Cord Blood pH	
42	Proportion of Low Birth Weight Neonates with Abnormal Cord Blood Base Deficit	
43	Circumcision Rate	

Additional Perinatal Health Indicators

Rate of Live Births to Older Mothers	27
Prevalence of Folic Acid Use in the Periconceptional Period	
Rate of Prenatal Obstetrical Ultrasound Utilization	
Rate of Assisted Conception	
Prevalence of Group B Streptococcal Infection	
Prevalence of Illicit Drug Use during Pregnancy	
Prevalence of Postpartum Depression	
Rate of Electronic Fetal Monitoring	
Rate of Client Satisfaction with Services	

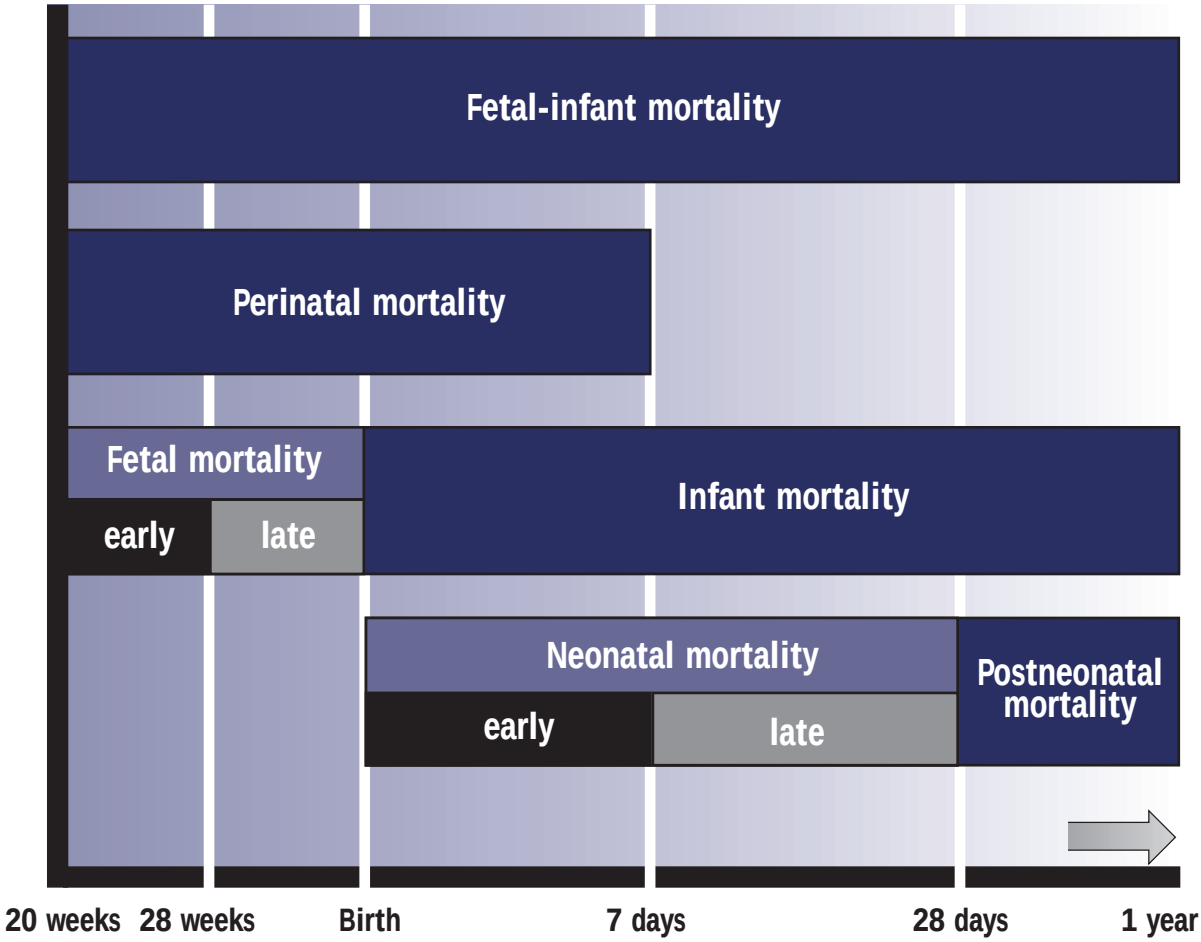
Appendix B

List of Acronyms

ACASS	Alberta Congenital Anomalies Surveillance System
ACOG	American College of Obstetricians and Gynecologists
ARBD	alcohol-related birth defect
ASAR	age-specific induced abortion rate
ASBR	age-specific birth rate
CCASS	Canadian Congenital Anomalies Surveillance System
CCP	Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures
CI	confidence interval
CIHI	Canadian Institute for Health Information
CMG	case mix group
CPS	Canadian Paediatric Society
CPSS	Canadian Perinatal Surveillance System
DAD	Discharge Abstract Database
DC	Dieticians of Canada
ESS	Enquête sociale et de santé
FAS	fetal alcohol syndrome
FGR	fetal growth ratio
ICD-9	International Classification of Diseases, Ninth Revision
ICU	intensive care unit
IQ	Intelligence Quotient
IUGR	intrauterine growth restriction
IVH	intraventricular hemorrhage
LCDC	Laboratory Centre for Disease Control
LFS	Labour Force Survey
Med-Écho	Système de maintenance et d'exploitation des données pour l'étude de la clientèle hospitalière
PFC	persistent fetal circulation
NLSCY	National Longitudinal Survey of Children and Youth
NPHS	National Population Health Survey
RDS	respiratory distress syndrome
RR	relative risk
SOGC	Society of Obstetricians and Gynaecologists of Canada
UNICEF	United Nations Children's Fund
VBAC	vaginal birth after cesarean
WHO	World Health Organization

Appendix C

Components of Fetal-Infant Mortality*



* Adapted from Péron Y, Strohmenger C. *Demographic and Health Indicators: Presentation and Interpretation.* Ottawa: Minister of Supply and Services Canada, 1985 (Catalogue No. 82-543E); and Monnier A. Les méthodes d'analyse de la mortalité infantile. In: *Manuel d'analyse de la mortalité.* Paris: INED, 1985: 52-55.

In calculating the fetal-infant mortality rate, perinatal mortality rate and stillbirth rate, the denominator includes total births (live births and stillbirths), whereas in calculating the infant mortality rate, neonatal mortality rate (early and late) and postneonatal mortality rate, the denominator includes live births only.