

Neonatal and Infant Mortality Rates

Indicator Type: Core Indicator

Description

- Neonatal mortality rate: The ratio of the number of deaths of live born infants 27 days or younger during a calendar year per 1,000 live births in the same calendar year.
- Post-neonatal mortality rate: The ratio of the number of deaths of live born infants 28-364 days old during a calendar year per 1,000 live births in the same calendar year.
- Infant mortality rate (IMR): The ratio of the number of deaths of live born infants 364 days or younger during a calendar year per 1,000 live births in the same calendar year.

Related OPHS Topics

Reproductive Outcomes

Method of Calculation

Neonatal Mortality Rate

$$\frac{\text{total number of deaths for live born infants (27 days or younger)}}{\text{total number of live births}} \times 1,000$$

Post-Neonatal Mortality Rate

$$\frac{\text{total number of deaths for live born infants (28-364 days)}}{\text{total number of live births}} \times 1,000$$



Infant Mortality Rate

$$\frac{\text{total number of deaths for live born infants (364 days or younger)}}{\text{total number of live births}} \times 1,000$$

Recommended Subset Analysis Categories

- Geographic areas of patient residence:
 - Ontario
 - Public health unit
 - Municipality
 - Smaller areas of geography based on aggregated postal code
- Age of mother, gestational age, birth weight, sex of infant
- Age of infant (early neonatal: 0-6, late neonatal: 7-27, or post-neonatal: 28-364 days)
- Specific cause of death

Data Source(s) Table

Numerator:	Denominator:
 Ontario Mortality Database	 Ontario Live Birth Database
Original Source: Vital Statistics, Ontario Office of the Registrar General (ORG)	Original Source: Vital Statistics, Ontario Office of the Registrar General (ORG)
Distributed by: Ontario Ministry of Health: IntelliHEALTH ONTARIO (IntelliHEALTH)	Distributed by: Ontario Ministry of Health: IntelliHEALTH ONTARIO (IntelliHEALTH)
<i>Suggested Citation:</i> Ontario Mortality Database [years], Ontario Registrar General, Ontario Ministry of Health, IntelliHEALTH ONTARIO, Date Extracted: [date].	<i>Suggested Citation:</i> Ontario Vital Statistics Live Birth Database [years], Ontario Registrar General, Ontario Ministry of Health, IntelliHEALTH ONTARIO, Date Extracted: [date].

Analysis Checklist

General Checklist

- For information related to the data sources, refer to the Data Source resources and the [Reproductive Health Core Indicators Documentation Report](#).
- The IntelliHEALTH licensing agreement does not require suppression of small cells, but caution should be used when reporting at a level that could identify individuals, (e.g. reporting at the postal code level by age and sex). Please note that privacy policies may vary by organization. Prior to releasing data, ensure adherence to the privacy policy of your organization.
- Aggregation (e.g. combining years, age groups, categories) should also be considered when small numbers result in unstable rates.
- Analyze mortality and live birth data by infant residence, not place of death.

- For detailed information about live birth and mortality data provided by the Ontario Registrar General, refer to [Vital Statistics Live Births](#) and [Vital Statistics Stillbirths](#) resources.

Vital Statistics - Mortality Data:

- Use Vital Stats Deaths data package from the IH Reports / Packages folder in IntelliHEALTH, select “#Dths (ON Res)” measure (number of deaths for Ontario residents who died in Ontario). Note: deaths for Ontario residents who died outside the province are not captured in Vital Statistics.
- Filter by ‘Infant Age (Days)’ <= 364 for infant mortality or <= 27 for neonatal mortality from the Deceased Information data items.
- Select appropriate geography from Deceased Information data items (PHU of Deceased). Include other items, depending on your requirements (ICD10 Chapter, Lead Cause Group, age group, sex, etc.) from the Death Information data items.
- Filter of calendar year(s) (CYear) of death from the Time Period data items.

Vital Statistics - Live Birth Data:

- To use IntelliHEALTH package:
 - Use Vital Stats Birth data package from the IH Reports / Packages folder in IntelliHEALTH, select “# Livebirth (ON Res)” measure (number of live births to Ontario mothers who gave birth in ON excluding ON mothers who gave birth outside ON).
 - Filter by ‘Type of Birth’ from Birth Information to select whether the birth is singleton, twin, or other.
 - Filter on calendar year(s) (CYear) of birth from the Timer Period data items.
- To use Standard Reports:
 - In IntelliHEALTH under Standard Reports, folder "01 Vital Stats", open " Birth Summary v3". This report summarizes information on births by age group and mother's residence (Ontario, PHU and LHIN). IntelliHEALTH also provides population data (total population, female population aged 15-49 years) for the calculation of rates. Refer to the Notes tab for information. Open tab "1.2 Births x PHU x Type x Age" to obtain public health unit data and tab "1.1 ON Births x Type x Age" to obtain Ontario data. The report can be modified, renamed and saved under your own folder or can be exported into Excel.
 - The predefined report provides live birth and population data from the last 5 years ending with the last year.
 - The data contained in the Birth Summary v3 report includes birth to Ontario mothers in Ontario only.
 - The notes section of the report provides important data caveats and background information on data sources and should be reviewed.

Indicator Comments

General Comments

- Infant mortality rates are considered an indicator of social and economic conditions within a country, community or subpopulation (1, 2). High rates may reflect inadequate nutrition, low levels of education, exposure to environmental hazards, or limited utilization of or access to adequate health care services (2).
- Infant mortality rates may vary by country due to the definition of a live birth.
- Disparities in the risk of infant death between indigenous and non-indigenous populations have been reported previously in Canada (3, 4, 5, 6).
- The denominator used for post-neonatal mortality is not consistent between sources. The Public Health Agency of Canada (PHAC) uses neonatal survivors (live births still alive at 28 days) as the denominator (6). All live births is used as the denominator in other sources including Statistics Canada (7), United States Center for Disease Control (8), United Kingdom Office for National Statistics (9), and *A Dictionary of Epidemiology 6th ed.*(10). The PHAC definition examines the risk for death within the postneonatal period without placing it in the context of mortality across the fetal/infant age range. The indicator definition used by the other sources listed above, examines postneonatal mortality in the context of mortality across the fetal/infant age. In other words, examining all infant deaths, at what age did the deaths occur and how was the mortality rate distributed across the fetal/infant age groups. The recommendation is to use all live births as the denominator. If neonatal survivors is used as the denominator, it should be clearly stated.
- Determining the true cause of death is not always clear resulting in a somewhat subjective primary cause of death being listed on the death certificate. The reported cause of death may also be influenced by the social or legal conditions surrounding the death and by the level of medical investigation (1). ICD code groupings provided in the Canadian Perinatal Health Report, appendix A.2, may be useful if choosing to examine infant mortality by cause (6). The infant mortality tables have been reproduced in Appendix A, below.
- Registration fees initiated in some Census Subdivisions (CSDs) in 1996 may have reduced the number of infants registered, subsequently reducing the number of live births counted, especially for low income and/or adolescent parents (11, 12); however, it is worth noting that registration fees have since been discontinued in Ontario. Please refer to the [Timeline of changes in Live Birth Registration in Ontario](#) document for details.
- Data used in the updated 2017 Perinatal Health Indicators Report are from birth and death registries as well as linked birth data and the Canadian Institution for Health Information (CIHI) Discharge Abstract Database (DAD), which may differ as the databases are updated (6).
- In all provinces except Ontario, Statistics Canada linkages of live birth and infant death registration are successful for all but 1.1% of cases (2003); in Ontario 42.3% were

unlinked (13). The unlinked cases vary from linked cases by time of death and cause of death (13). This linkage issue precludes the reliable calculation of certain figures, such as gestational age-specific infant mortality rates. Even the 2017 Perinatal Health Indicators Report indicates that Ontario was excluded from statistics on Infant mortality because of data quality concerns (6). Fell et al. were able to link 96.4% of Vital Statistics infant death registrations from 2010 and 2011 with birth records from the hospital inpatient discharge data indicating the missing live birth data is specific to Vital Statistics (14).

- Infant mortality rates are higher among multiple births (15) and births to mothers over 35 (16). The changing pattern of registration of live births with a birth weight less than 500 grams in Canada has shown to have significantly increased infant mortality rates as such infants have very high rates of mortality (17).
- It is recommended to exclude births weighing <500 g from neonatal, post-neonatal, and infant mortality rates. Doing so may reduce fluctuations in estimates and facilitate comparisons across jurisdictions. However, it is not possible to examine neonatal and infant mortality among births ≥ 500 g due to data limitations in Ontario. Please refer to the [Reproductive Health Core Indicators Documentation Report](#) for recommendations on excluding live births <500 g from reproductive health indicators.
- Given the small number of stillbirths/perinatal/infant deaths, stillbirth rate, perinatal/infant mortality rates may fluctuate from year to year. It may be of beneficial to group years when reporting stillbirth rate/perinatal mortality/infant mortality and/or calculate a three-year moving average (Refer to Document: [Methods for Calculating Moving Averages](#))
- Hospitalization birth records cannot be linked to vital statistics mortality data at this time. Therefore, hospitalization data sources cannot be used to determine neonatal or infant mortality.

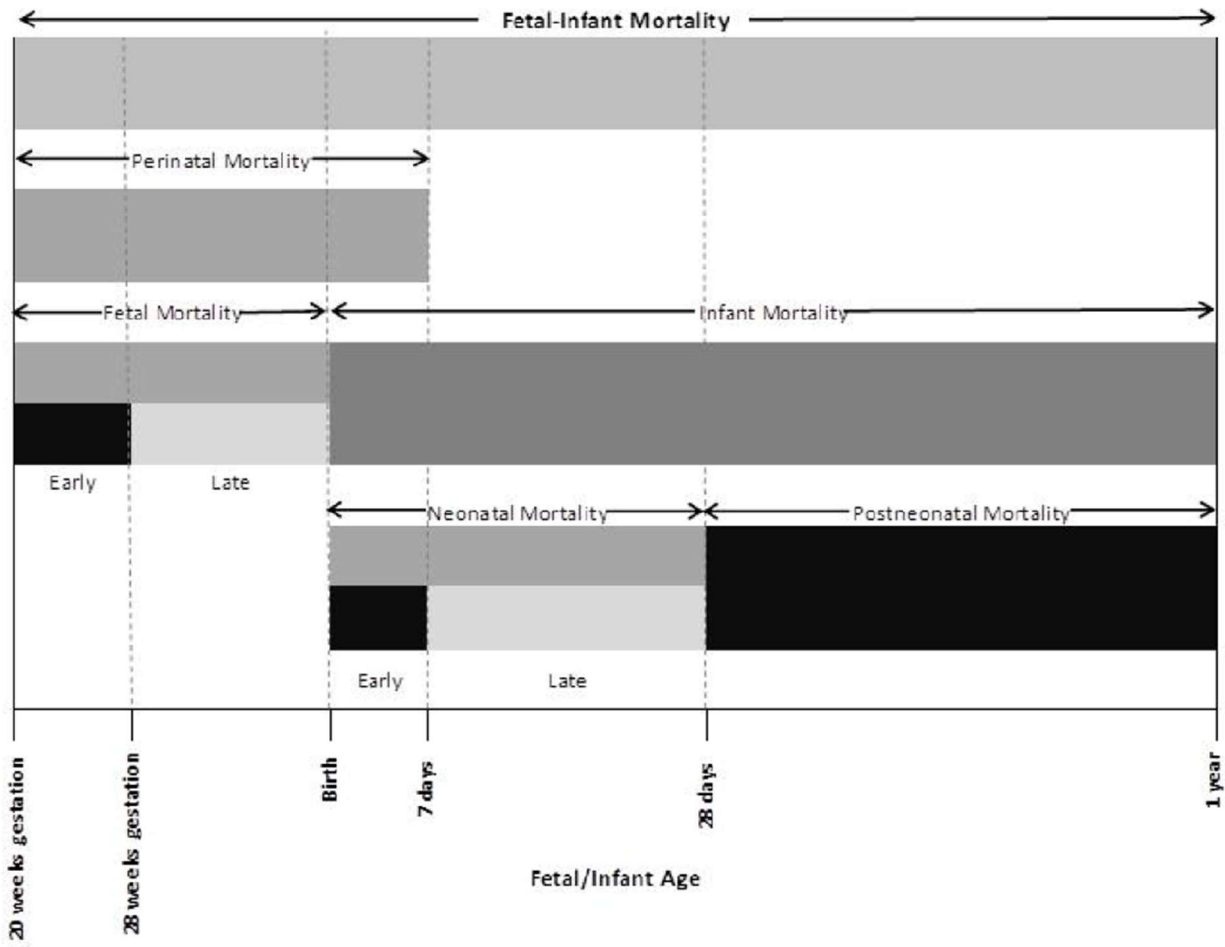
Glossary

Components of Fetal-Infant Mortality

- **Live birth** - the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life (such as a heartbeat, umbilical cord pulsation, or definite movement of voluntary muscles), whether the umbilical cord has been cut or the placenta is attached. A live birth is not necessarily a viable birth.
- **Mortality rates** based on deaths during the following specified periods:
 - **Infant mortality** - death of a live born infant before the 365th day of life.
 - **Neonatal mortality** - death of a live born infant before the 28th day of life (0 - 27 days of age).
 - **Early neonatal mortality** - death of a live born infant before the 7th day of life (0 - 6 days of age).
 - **Late neonatal mortality** - death of a live born infant during the period between the 7th and 28th day of life (7 - 27 days of age).
 - **Postneonatal mortality** - death of a live born infant between the 28th and 364th day of life.
- **Sudden infant death syndrome (SIDS)** - the unexpected and sudden death of an apparently healthy infant. It is more often reported in infants between two weeks and one

year of age, in preterm infants, and males. Also called crib death. ICD-9 code: 798.0. Note that some researchers use ICD-9 codes: 798.0-798.9.

- **Respiratory Distress Syndrome (RDS)** - a respiratory disorder that occurs in newborn premature infants and is characterized by deficiency of the surfactant coating the inner surface of the lungs, failure of the lungs to expand and contract properly during breathing resulting in collapse; and by the accumulation of a protein-containing film lining the alveoli and their ducts. Also called hyaline membrane disease.
- **Congenital Anomaly** - a condition that results from an abnormality of structure, function or metabolism in one or more parts of the body, with potential to adversely affect health, development or function. Anomalies are present at birth and may be inherited genetically, acquired during gestation, or inflicted during birth. Also called a birth defect.
- **Intrauterine Hypoxia (IH)** - occurs when the fetus is deprived of an adequate supply of oxygen. IH is used to describe inadequate oxygen availability during the gestation period.
- **Birth Asphyxia** - (also referred to as perinatal asphyxia or Asphyxia neonatorum) can result from inadequate supply of oxygen immediately prior to, during or just after delivery.



Adapted from: Canadian Perinatal Health Report 2008, Public Health Agency of Canada

Cited References

- (1) World Health Organization. Neonatal and Perinatal Mortality: Country, Regional and Global Estimates. 2006. Available at: https://iris.who.int/bitstream/handle/10665/43444/9241563206_eng.pdf, Accessed prior to February 22, 2013.
- (2) Spong CY, Iams J, Goldenberg R, Hauck FR, Willinger M. Disparities in perinatal medicine: preterm birth, stillbirth and infant mortality. *Obstet Gynecol.* 2011;117(4):948-55.
- (3) Kleinman JC. The slowdown in the infant mortality decline. *Paediatric Perinatal Epidemiology.* 1990; 4(4):373-381.
- (4) Luo ZC, Senecal S, Simonet F, Guimond E, Penney C, Wilkins, R. Birth outcomes in the Inuit-inhabited areas of Canada. *Canadian Medical Association Journal* 2010, 182(3): 235-42
- (5) Chen L, Xiao L, Auger N, Torrie J, McHugh NG-L, Zoungrana H, Luo ZC (2015) Disparities and Trends in Birth Outcomes, Perinatal and Infant Mortality in Aboriginal vs. Non-Aboriginal Populations: A Population-Based Study in Quebec, Canada 1996–2010. *PLoS ONE* 10(9): e0138562. <https://doi.org/10.1371/journal.pone.0138562>
- (6) Public Health Agency of Canada. Perinatal Health Indicators for Canada 2017. Available at: http://publications.gc.ca/collections/collection_2018/aspc-phac/HP7-1-2017-eng.pdf. Accessed prior to June 21, 2019.
- (7) Statistics Canada. [Table 13-10-0712-01 Infant deaths and mortality rates, by sex](https://doi.org/10.25318/1310071201-eng) DOI: <https://doi.org/10.25318/1310071201-eng>
- (8) Ely, D.M. and Driscoll, A.K. (2023). Infant mortality in the United States, 2021: Data from the period linked birth/infant death file. *National Vital Statistics Reports* 72(11). <https://www.cdc.gov/nchs/data/nvsr/nvsr72/nvsr72-11.pdf>
- (9) Office for National Statistics (ONS), published 1 March 2023, ONS website, methodology, [User guide to child and infant mortality statistics](#)
- (10) International Epidemiological Association. (2014). M. Porta (Ed). *A Dictionary of Epidemiology 6th ed.* Oxford University Press.
- (11) Bienefeld M, Woodward GL, Ardal S. Underreporting of live births in Ontario: 1991-1997. Central East Health Information Partnership, February 2001.
- (12) Woodward GL, Ardal S. Data Quality Report: Effect of Residence Code Errors on Fertility Rates. Central East Health Information Partnership, July 2000.
- (13) Public Health Agency of Canada. Canadian Perinatal Health Report, 2008. Available at: <https://www.canada.ca/content/dam/phac-aspc/migration/phac-aspc/publicat/2008/cph-rspsc/pdf/cph-rspsc08-eng.pdf>. Accessed prior to June 21, 2019.

(14) Fell DB, Park AL, Sprague AE, Islam N, Ray JG. A new record linkage for assessing infant mortality rates in Ontario, Canada. *Can J Public Health*. 2020; 111(2): 278-285.

(15) Mathews TJ, MacDorman MF. Infant mortality statistics from the 2007 period linked birth/infant death data set. *National Vital Statistics Report (US)*. 2011 June 29; 59(6):1-31.

(16) Gage TB, Fang F, O'Neill E, Stratton H. Maternal age and infant mortality: a test of the Wilcoxon-Russell hypothesis. *American Journal of Epidemiology* 2009; 169(3):294-303.

(17) Joseph KS, Kramer MS. Recent trends in Canadian infant mortality rates: the effect of changes in registration of live newborns weighing less than 500g. *Can Med Assoc J* 1996; 155:1047-52.

(18) Statistics Canada. Data quality, concepts and methodology: definitions. Available at: https://www.statcan.gc.ca/eng/statistical-programs/document/3231_D5_T9_V1. Date modified: 2017-11-24. Accessed August 28, 2019.

(19) Statistics Canada. Fetal deaths (20 weeks or more of gestation) and late fetal deaths (28 weeks or more of gestation). Available at: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310042701>. Date modified: 2019-08-28. Accessed August 28, 2019.

Acknowledgements

<p>Lead Authors Jessica Deming, Region of Waterloo Public Health Sandy Dupuis, Niagara Region Public Health Natalie Greenidge, Public Health Ontario Adam Stevens, Brant County Health Unit Sarah Ahmed, Toronto Public Health Emily Chemnitz, Niagara Region Public Health Erica Clark, Huron Perth Public Health</p>	<p>Reviewers</p>
<p>Contributing Authors Reproductive Health Sub-Group</p>	<p>Other Acknowledgements</p>

Revision History

Date	Review Type	Author	Changes	PDF
May 30, 2025			<ul style="list-style-type: none"> ➤ Indicator created 	
January 2012	Formal review	Reproductive Health Sub-Group	<ul style="list-style-type: none"> ➤ All sections updated in alignment with the Guide to Creating or Editing Core Indicator pages ➤ Significant changes made to many aspects of indicator, including: Specific Indicators, Corresponding Indicators from Other Sources, Data Sources, Method of Calculation, Indicator Comments, Cited References, Other References. 	
June, 2019	Formal review	Reproductive Health Sub-Group	<ul style="list-style-type: none"> ➤ <ul style="list-style-type: none"> ● All sections reviewed and updated as a first step to fitting into Core Indicator Re-Design. 	
April 2024	Formal review	Reproductive Health Sub-Group	<ul style="list-style-type: none"> ➤ Full update of indicator document including: Indicator definitions, corresponding indicators and analysis checklist accordingly. 	

Appendix A

Table 1: Infant mortality causes

Causes	ICD-9	ICD-10
Congenital anomalies	740–759.9	Q00–Q99
Asphyxia-related conditions	761.6; 761.7; 762.0–762.2; 762.6; 763;766– 768; 770.1; 772.2; 779.0; 779.2	O43.8; O83.4; P01.6–P01.7; P02.0–P02.2; P02.6; P03.0–P04.0; P08.0–P08.2; P10.0–P10.1; P10.3–P21.9; P24.0–P24.9; P52.4–P52.5; P52.8; P90–P91.0; P91.4–P91.5; P91.9
Immaturity-related conditions	761.3–761.5; 761.8; 761.9; 762.7; 764.0– 765.1; 769; 770.2–770.9; 772.1; 774.0– 774.7; 777.5; 777.6; 778.2; 779.6; 779.8	D58.9; P01.3–P01.5; P01.8–P01.9; P02.7; P05.0–P05.9; P07.0–P07.3; P10.2; P22.0–P22.9; P25.0–P29.2; P29.4–P29.9; P52.0–P52.3; P57.8–P59.9; P77; P78.0; P80.0; P91.1–P91.2; P91.8; P94.1–P94.9; P96.0; P96.3–P96.5
Infections	001–139; 320– 326; 382; 420– 422; 460–466; 475–477; 480– 491; 510; 511; 513; 540; 541; 566; 567; 570; 590; 591; 770.0; 771; 790	A00.0–B19.9; B25.0–B99; D86.0–D86.9; E79.0; G00.0–G09; G36.1; G37.3–G37.4; G92; G93.3– G93.4; G94.8; G96.1; H66.0–H67.8; H75.0; I30.0– I30.9; I32.0–I33.9; I39.8–I41.2; I42.3; I43.0; I52.0– I52.1; I72.9; I88.8; J00–J30.4; J36–J37.1; J39.9– J42; J44.1–J44.8; J65; J85.0–J92.9; J94.0–J94.9; J98.0; J98.4; J99.8; K35.0–K35.9; K37; K52.9; K61.0–K61.4; K65.0–K65.9; K67.0–K67.8; K72.0; K72.9; K76.2; K90.8; K93.0; L08.1; L44.8; L94.6; M02.1; M02.3; M35.2; N10–N13.3; N13.6; N15.1– N16.8; N17.2; N28.8; N29.1; N34.1; O98.0–O98.1; P23.0–P23.9; P35.0–P39.9; R06.5; R09.1; R29.1; R70.0–R71; R73.0–R74.9; R77.0–R78.0; R78.7– R79.9; R89.7; T62.9
Sudden infant death syndrome (SIDS)	798.0	R95

Other unexplained infant death	798.1; 798.2; 798.9; E913; 799	J96.0–J96.9; R09.0; R09.2; R41.8; R45.0; R45.2– R45.6; R45.8–R46.3; R46.5–R46.7; R53; R64; R68.1; R68.8; R69; R96.0–R99; Z71.1; W75–W77; W81–W84
External causes	260–263; 507; E800–E912; E914–E999	E40–E46; E64.0; J69.0–J69.8; J95.8; V01–Y98 (except W75–W77; W81–W84)
Others	Any code not mentioned above	Any code not mentioned above

Source: Public Health Agency of Canada. Canadian Perinatal Health Report, 2008 Edition. Ottawa, 2008. Retrieved from: <https://www.phac-aspc.gc.ca/publicat/2008/cphr-rspc/pdf/cphr-rspc08-eng.pdf>