Babies Admitted to NICU/ICU: Province of Birth and Mode of Delivery Matter

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Abstract

Neonatal intensive care units (NICUs) and intensive care units (ICUs) provide care for newborns in need of specialized medical attention. Across Canada, rates of NICU/ICU admission vary. Due to the high cost of monitoring and interventions these admissions cost more than general newborn stays – whether the newborn is in a specialized NICU or in an ICU in those facilities without specialized units for newborns. This study explores the variation in NICU/ICU admissions and the characteristics of mothers and newborns associated with an increased likelihood of NICU/ICU admission. We focus further on the association between NICU/ICU admission and Caesarean section (C-section). After excluding multiple births, preterm births, small for gestational age births and those delivered by women with select complications, we find an increased risk for NICU/ICU admission for babies born by C-section as their only indication. NICU/ICU admission following C-section alone may not represent the most desirable pathway of care for these newborns.

The neonatal intensive care unit (NICU) is a specialized care unit in a hospital that provides a high-level of intensive care for premature babies and those with medical problems. In facilities without specialized NICU care, newborns requiring specialized care may be admitted to an intensive care unit (ICU). Overall, the main reasons for NICU/ICU admission are low-birth weight, preterm birth and respiratory conditions; length of stay depends on the severity of the newborn's condition. Previous analyses by the Canadian Institute for Health Information (CIHI) found that in 2001–2002, 14.4% of newborns in Canada (excluding Quebec, rural Manitoba and the territories) were admitted to a NICU. The median length of stay in a NICU was two days for low-birth-weight babies and 23 days for very-low-birth-weight babies (Canadian Institute for Health Information 2004). Lee et al. (2000) reported significant jurisdictional variation in NICU practices and outcomes in Canada and recently the Canadian Neonatal Network (2009) suggested that variation in NICU practice and outcomes are associated.

Births involving NICU admissions are more costly compared to typical newborn stays without NICU admissions. In 2002–2003, the average cost for Canadian hospitals per NICU admission was $9,700 (Canadian Institute for Health Information 2006). In that same year, the average cost per newborn stay was $795 for babies of normal birth weight delivered vaginally without a NICU admission. Given the associated costs with NICU admissions, it is important to know the factors affecting the likelihood of a NICU admission following birth.

A study by Liston et al. (2008) on term singleton live-birth deliveries with no congenital anomalies found that NICU admission rates were higher for babies delivered by C-section. Fogelson et al. (2005) and Kamath et al. (2009) also observed more elective repeat C-section babies were admitted to the advanced care nurseries. Tita et al. (2009) reported early delivery (before 39 weeks) for elective C-section in the United States was associated with an increase in admission to NICU.

In this study, we consider the factors associated with an increased likelihood of NICU/ICU admission including jurisdictional variations in these admissions. In addition we look specifically at the association between NICU/ICU admissions and mode of delivery by comparing babies born by C-section with those born by vaginal delivery.

Data Sources and Methods

All records of live births discharged from Canadian acute care facilities between fiscal year 2006–2007 and 2008–2009 were included. Data are from CIHI's Discharge Abstract Database (DAD) and Fichier des hospitalisations MED-ÉCHO, Ministère de la Santé et des Services sociaux du Québec. All birth records were selected based on the newborn's discharge date.

For record linkage to create a matched cohort within a facility, we first linked the mother's hospitalization record with their newborn's birth record using the maternal chart number recorded in the newborn's record. For those without matching chart numbers, we attempted the linkage by using the newborn chart number recorded in the mother's hospitalization record. Approximately 99% of newborns delivered in acute care hospitals were successfully linked with maternal hospitalization

record. Direct linking between the mother's record and the newborn's record was the only methodology used for Quebec records. Second, newborns within a facility were linked with their NICU/ICU admission using their chart number whether in the same admission or a readmission. Admissions to NICU or ICU were included if the admission was within 28 days after birth. Finally transferred cases (4.3% of all admissions) for which we had the NICU or ICU admission record were linked to the birth record from the transferring hospital using province code and health card number; approximately 14.6% of transfer records were not captured due to missing health card numbers.

For adjusted odds ratio calculations, hospitals were categorized as a teaching hospital, large hospital or a small hospital based on annual volumes of deliveries for the latter two classifications (small hospitals ≤500 and large hospitals >500). Teaching hospital status was based on full membership in the Association of Canadian Academic Healthcare Organizations (ACAHO); for Quebec the teaching hospital was provided by AQESSS (L'Association québécoise d'établissements de santé et de services sociaux). The Postal Code Conversion File (PCCF) from Statistics Canada was used to assign mothers to income quintile based on the 2001 census. Forceps and vacuum deliveries and augmentation are classified as delivery interventions.

Findings

Between 2006–2007 and 2008–2009, 11.1% of our matched cohort of live births in Canadian hospitals was admitted to a NICU or an ICU in their first 28 days of life. The babies admitted to NICU/ICU had a median gestational age of 38 weeks and median birth weight of 2,974 grams. The median NICU/ICU stay was two days (excluding Quebec). There were provincial variations in the proportion of newborns admitted to NICU/ICU, with the highest rate in New Brunswick (24.5%) and the lowest rate in Quebec (5.3%). Among newborns admitted to NICU/ICU, the proportion of NICU/ICU stays of less than 24 hours (excluding Quebec and babies that died in the NICU within 24 hours of birth) varied from 10 to 40% by province; the average across jurisdictions was 33.5% (Table 1).

After adjusting for several factors (hospital peer group, maternal age, mother's neighbourhood income quintile and delivery interventions) multiple births (adjusted OR 6.7, 95% CI 6.5–6.8), preterm births (adjusted OR 13.7, 95% CI

TABLE 1.
Proportion of newborns admitted to NICU or ICU by Canadian provinces, 2006–2007 to 2008–2009*

Province of Hospital	Number of Live Births in Matched Cohort	Number of Newborns Admitted to NICU/ICU within 28 Days after Birth	Proportion Admitted to NICU/ICU (%)	Proportion of NICU/ICU Stays of Less Than 24 Hours (%)
NL	13,780	991	7.2	12.3
PEI	4,198	406	9.7	9.8
NS	26,496	3,489	13.2	28.4
NB	21,806	5,352	24.5	37.2
QC	245,819	13,127	5.3	NA
ON	414,252	54,995	13.3	35.6
MB	46,091	4,891	10.6	17.3
SK	39,951	4,197	10.5	19.3
AB	143,791	20,924	14.6	39.7
BC	127,469	11,973	9.4	26.6
Total	1,083,653	120,345	11.1	33.5

NA = no data available; NICU/ICU = neonatal intensive care unit/intensive care unit.

*The analysis was limited to live births discharged from an acute care facility in Canadian provinces. There are no NICUs in the territories. Cohort includes newborns whose charts could be linked to their mothers' charts and to their NICU/ICU admission records.

Sources: Discharge Abstract Database 2006–2007 to 2008–2009, Canadian Institute for Health Information; Fichier des hospitalisations MED-ÉCHO, 2006–2007 to 2008–2009, Ministère de la Santé et des Services sociaux du Québec.

13.5–13.9), low birth weight (adjusted OR 16.5, 95% CI 16.2–16.8) and small for gestational age births (adjusted OR 1.6, 95% CI 1.59–1.64) were each associated with increased risk of NICU/ICU admission (Table 2).

In addition, newborns delivered by C-section were more likely to be admitted to the NICU/ICU than those delivered vaginally (adjusted OR 2.6, 95% CI: 2.58–2.65). To explore this further, and to control for confounders, we restricted the analysis to full-term singletons without select maternal and newborn conditions. We found that C-section delivery was still significantly associated with increased risk of NICU/ICU admission (8.5% of C-section babies compared to 3.3% of non-C-section babies). In addition, the proportion of short stays of less than 24 hours among newborns admitted to NICU/ICU also was higher among those delivered by C-section (adjusted OR 1.4, 95% CI: 1.3–1.4), suggesting that many newborns delivered by C-section are admitted to N/ICU for short term medical observation (Table 3).

Discussion

Across the provinces NICU/ICU admission rates for our matched cohort varied for all NICU/ICU admissions and for those with NICU/ICU stays of less than 24 hours. After excluding multiple births, preterm births, small for gestational age births and those delivered by women with select complications we found that newborns delivered by C-section were more likely to be admitted to an NICU/ICU within 28 days of birth than those delivered vaginally.

TABLE 2.
Proportion of newborns admitted to NICU or ICU by newborn characteristics, 2006–2007 to 2008–2009*

Neonatal Characteristics	Number of Live Births in Matched Cohort	Number of Newborn Admitted to NICU/ICU (%)	Adjusted OR (95% CI)	*p* Value
Plurality				
Multiple birth	32,930	14,736 (44.8)	6.7 (6.5, 6.8)	< .0001
Singleton birth	1,050,723	105,609 (10.1)	Reference	
Gestational age				
<37 weeks	91,339	48,302 (52.9)	13.7 (13.5, 13.9)	< .0001
≥37 weeks	991,793	71,925 (7.3)	Reference	
Birth weight				
<2,500 grams	65,812	39,635 (60.2)	16.5 (16.2, 16.8)	< .0001
≥2500 grams	1,017,694	80,654 (7.9)	Reference	
Birth weight percentiles for gestational age				
<10th percentile	123,210	19,818 (16.1)	1.6 (1.59, 1.64)	< .0001
≥10th percentile	959,780	100,354 (10.5)	Reference	

CI = confidence intervals; NICU/ICU = neonatal intensive care unit/intensive care unit; OR = odds ratio.

*The analysis was limited to live births discharged from an acute care facility located in Canadian provinces. There are no NICUs in the territories. Cohort includes newborns whose charts could be linked to their mothers' charts and to their NICU/ICU admission records.

The analysis for birth weight percentiles for gestational age was limited to singleton births of known birth weight and sex with a gestational age between 22 and 42 weeks, and twin births of known birth weight and sex with gestational age between 22 and 40 weeks.

Odds ratios and 95% confidence intervals were calculated with adjustment for hospital peer group, maternal age, mothers' neighbourhood income quintiles, and delivery interventions (forceps, vacuum and augmentation).

Sources: Discharge Abstract Database 2006–2007 to 2008–2009, Canadian Institute for Health Information; Fichier des hospitalisations MED-ÉCHO, 2006–2007 to 2008–2009, Ministère de la Santé et des Services sociaux du Québec.

TABLE 3.
Proportion of newborns admitted to NICU or ICU by mode of delivery, 2006–2007 to 2008–2009*

Mode of Delivery	Number of Live Births in Matched Cohort	Number of Newborn Cohort Admitted to NICU/ICU (%)	Adjusted OR (95% CI)	*p* Value
All births				
By C-section	296,426	56,358 (19.0)	2.6 (2.58-2.65)	<0.0001
By vaginal delivery	786,650	63,922 (8.1)	Reference	
Full-term singleton pregnancies without select complications				
By C-section	58,025	4,931 (8.5)	2.7 (2.7, 2.9)	<0.0001
By vaginal delivery	283,111	9,305 (3.3)	Reference	

C-section = Caesarean section; CI = confidence intervals; HIV = human immunodeficiency virus; NICU/ICU = neonatal intensive care unit/intensive care unit; OR = odds ratio.

*The analysis was limited to live births discharged from an acute care facility located in Canadian provinces. There are no NICUs in the territories. Cohort includes newborns whose charts could be linked to their mothers' charts and to their N/ICU admission records.

Full term was defined as delivery between 37 and 41 complete weeks.

Select complications included chronic hypertension, diabetes insulin dependent, diabetes non-insulin dependent, asthma, HIV, hepatitis B, lupus, thrombophilia, heart disease, renal disease, liver disease, gestational hypertension, preeclampsia and eclampsia, gestational diabetes, placenta abruption, placenta previa, premature rupture of membranes, small-for-gestational-age birth, large-for-gestational-age birth, breech/malpresentation, cephalopelvic disproportion, cord prolapsed, fetal distress, non-progressive labour/descent/dystocia, oligohydramnios, non-reassuring fetal status.

Odds ratios and 95% confidence intervals were calculated with adjustment for hospital peer group, maternal age, maternal neighbourhood income quintiles, and delivery interventions (forceps, vacuum and augmentation).

Sources: Discharge Abstract Database 2006–2007 to 2008–2009, Canadian Institute for Health Information; Fichier des hospitalisations MED-ÉCHO, 2006–2007 to 2008–2009, Ministère de la Santé et des Services sociaux du Québec.

There are limitations associated with this analysis. The principal limitations are the lack of uniform definition of neonatal and intensive care units across Canada; non-matching health card numbers resulting in decreased record linkage success for transferred cases; and our inability to adjust for all the clinical indicators that may necessitate a NICU/ICU admission.

Despite these limitations, our findings suggest that in some cases C-section delivery could be the sole reason for admitting newborns to NICU/ICU, including for observation with low risk births. Canada, like many developed countries is engaged in conversations that reflect both patient centered care and cost containment. Additional information at the facility level could further inform NICU/ICU admission policy review to ensure that newborns are getting both patient centred and cost-effective care. HQ

References

Canadian Institute for Health Information. 2004. *Giving Birth in Canada: A Regional Profile.* Ottawa, ON: Author.

Canadian Institute for Health Information. 2006. *Giving Birth in Canada: The Costs.* Ottawa, ON: Author.

Canadian Neonatal Network. 2009. *Annual Report 2009.* Toronto, ON: Author. Retrieved December 10, 2010. <http://www.canadian-neonatalnetwork.org/portal/>.

Fogelson, N.S., M.K. Menard, T. Hulsey and M. Ebeling. 2005. "Neonatal Impact of Elective Repeat Cesarean Delivery at Term: A Comment on Patient Choice Cesarean Delivery." *American Journal of Obstetrics and Gynecology* 192: 1433–36.

Kamath, B.D., J.K. Todd, J.E. Glazner, D. Lezotte and A.M. Lynch. 2009. "Neonatal Outcomes after Elective Cesarean Delivery." *American Journal of Obstetrics and Gynecology* 113(6): 1231–38.

Lee, S.K., D.D. McMillan, A. Ohlsson, M. Pendray, A. Synnes, R. Whyte et al. and the Canadian NICU Network. 2000. "Variations in Practice and Outcomes in the Canadian NICU Network: 1996–1997." *Pediatrics* 106: 1070–79.

Liston, F.A., V.M. Allen, C.M. O'Connell and K.A. Jangard. 2008. "Neonatal Outcomes with Caesarean Delivery at Term." *Archives of Diseases in Childhood: Fetal and Neonatal Education* 93: F176–82.

Tita, A.T.N., M.B. Landon, C.Y. Spong, Y. Lai, K.J. Leveno, M.W. Varner et al. 2009. "Timing of Elective Repeat Cesarean Delivery at Term and Neonatal Outcomes." *New England Journal of Medicine* 360(2): 111–20.

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