A B S T R A C T

Purpose: To analyze spatio-temporal variations of neonatal length of in-hospital stay in Canada.

Method: The length of in-hospital stay of 1,469,761 newborns in Canadian hospitals from April 1, 1984 to March 31, 1995 recorded by the Canadian Institute for Health Information was analyzed.

Results: Neonatal length of in-hospital stay decreased from an average of 5.0 days in 1984 to 2.9 days in 1994. In 1994, the average neonatal length of in-hospital stay in Alberta was 2.5 days, which was 0.2 to 1.5 days shorter than other provinces. The spatio-temporal variations in neonatal length of in-hospital stay could not be explained by corresponding variations in birthweight and other neonatal disorders.

Conclusions: Neonatal length of in-hospital stay has been substantially reduced in Canada in recent years but there remain important inter-provincial variations. These variations are unlikely to be the results of changes or differences in patient-specific factors; policy played an important role.

A B R É G É

Objectif : Analyser les variations spatio-temporelles de la durée d'hospitalisation des nouveau-nés au Canada.

Méthode : On a analysé la durée des séjours hospitaliers de 1 469 761 nouveau-nés dans des établissements de soins canadiens entre le 1^{er} avril 1984 et le 31 mars 1995 enregistrés par l'Institut canadien d'information sur la santé.

Résultats : La durée des séjours hospitaliers des nouveau-nés est passée d'une moyenne de 5 jours en 1984 à 2,9 jours en 1994. En 1994, en Alberta, le séjour moyen d'un nouveau-né était de 2,5 jours, soit entre 0,2 et 1,5 jour de moins que dans les autres provinces. Les variations spatio-temporelles des hospitalisations des nouveau-nés n'ont pu être expliquées par les variations correspondantes en termes de poids à la naissance et d'autres troubles néonataux.

Conclusions : Ces dernières années, la durée d'hospitalisation néonatale a sensiblement diminué dans l'ensemble du Canada mais il demeure d'importantes variations entre les provinces. Il est peu probable que ces variations soient dues à des changements ou à des différences au niveau des facteurs propres aux patients; les politiques appliquées ont joué un rôle important.

Trends and Variations in Neonatal Length of In-hospital Stay in Canada

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The question of how long the newborn should stay in hospital remains controversial.¹⁻³ The main reason for shortening the length of in-hospital stay (LOS) for newborns is to reduce health care costs. However, there is increasing concern that the neonatal in-hospital stay will become, or already is, inappropriately short.¹⁻³ Potential risks and benefits of discharging newborns earlier have not been adequately assessed by randomized clinical trials.¹⁻³ Moreover, although the focus of the debate on early discharge is for uncomplicated cases,¹⁻³ it is unclear whether and to what extent hospital stay for complicated cases have been shortened as well in routine practice.

In an initial assessment of the potential and appropriate uses of existing data for perinatal surveillance, we found that hospital admission/separation records collected by the Canadian Institute for Health Information (CIHI, formerly Hospital Medical Records Institute (HMRI)) contain some of the information pertinent for perinatal surveillance, including neonatal LOS. Currently, most Canadian women give birth in hospitals, and about 78% of Canadian hospitals send their records to CIHI. Meticulous analysis of the temporal trends and geographic variations in neonatal length of in-hospital stay may generate results that could be used in the planning of neonatal care.

SUBJECTS AND METHODS

Eleven years of CIHI data (from fiscal 1984/85 to fiscal 1994/95) were utilized. To minimize the space required to describe the results, data are presented here for even years only.

Data on newborns were abstracted according to appropriate codes on "age unit". Neonatal length of stay and other administrative variables were coded by CIHI manual. Diagnoses were coded according to the Ninth Revision of International Classification of Disease (ICD-9).⁴ Procedures were coded according to the Canadian Classification of Surgical, Diagnostic, and Therapeutic Procedures (CCP).⁵ Both means and frequencies of short (< 2 days) and long (> 4 days) stays were analyzed. To limit the influence of a few excessively long in-hospital stays on the calculation of the mean, all infants with a length of in-hospital stay longer than 20 days (< 0.1% cases) were assigned a value of 20 days. Since no differences were observed between medians and means after trimming the neonatal LOS to 20 days (data available upon request), and since means are more convenient in statistical analysis, means have been used throughout the entire paper.

Temporal trends of LOS in all live births recorded by CIHI were analyzed first, followed by interprovincial variation for the most recent year (fiscal 1994). Since there were major differences in CIHI participation across provinces during the 11 years (Table I), temporal trends were analyzed at the national level only. Since infants with low birthweight or neonatal disorders may require prolonged in-hospital stay for needed care,^{6,7} temporal trends and interprovincial variations were also analyzed to assess

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whether changes in the distribution of birthweight and the occurrence of neonatal disorders over time and across provinces corresponded to changes in neonatal length of in-hospital stay. Stepwise multiple linear regression and logistic regression analyses were then performed to assess the independent effects of year of birth and province of residence on neonatal LOS. Since neonatal LOS is directly affected by birthweight, temporal trends and interprovincial variations were further analyzed for four birthweight groups: 500 - < 1500 g, 1500 - < 2500 g, 2500 - 4000 g, and > 4000 g. Because the registration of newborns < 500 grams as live births varied substantially over time and across provinces,⁸ and because the majority of these infants died in hospital shortly after birth, stratified analysis was not performed for this birthweight group. Since infants with low, and especially those with very low, birthweight frequently died in hospital or were transferred to other acute care institutions with intensive neonatal care facilities,⁹ the total length of in-hospital stay in the hospitals where the infants were born was reduced. To avoid misleading results, all infants who died in hospital or were transferred to other acute care institutions were excluded from the analysis stratified by birthweight groups. In order to determine whether excluding these subjects would alter the results and conclusions, a sensitivity analysis with these subjects included was performed.

RESULTS

During the six fiscal years of the study, a total of 1,469,761 infants born in Canadian hospitals were registered by CIHI, which represented 64% of all live births in Canada during the same period (Table I). Substantial interfiscal and interprovincial variations in CIHI registration were noted.

Neonatal length of in-hospital stay decreased during the decade, from an average of 5.0 days in 1984 to 2.9 days in 1994 (Table II). The decrease has been a combined effect of both an increasing rate of early discharge (< 2 days) and a decreasing rate of delayed discharge (> 4 days) in recent years. On the other hand, no obvious and consistent trends in the birthweight distribution and occurrence of

TABLE I
Number of Newborns (Live Births Only) Recorded by the Canadian Institute for Health Information and This Number as a Proportion (%) of All Newborns Registered by Statistics Canada*, by Province and Fiscal Year

Province	1984	1986	1988	1990	1992	1994
Newfoundland	8117 (NC)	7533 (NC)	6978 (NC)	7119 (100.0)	6482 (93.7)	5933 (93.6)
Prince Edward Island	1773 (90.7)	1750 (90.8)	1795 (90.8)	1810 (89.9)	1723 (93.1)	1600 (93.0)
Nova Scotia	1641 (13.3)	184 (1.5)	567 (4.7)	584 (4.5)	621 (5.3)	1629 (14.7)
New Brunswick	0 (0.0)	0 (0.0)	9759 (100.0)	9952 (100.0)	9490 (100.0)	9004 (100.0)
Quebec	0 (0.0)	10,409 (12.3)	13,203 (15.2)	14,548 (14.8)	11,923 (12.4)	0 (0.0)
Ontario	132,785 (100.0)	136,002 (100.0)	113,751 (82.4)	154,022 (100.0)	152,352 (100.0)	150,585 (100.0)
Manitoba	0 (0.0)	0 (0.0)	0 (0.0)	8573 (49.4)	11,919 (71.8)	11,682 (71.2)
Saskatchewan	15,113 (84.0)	15,048 (86.0)	33 (0.2)	14,406 (89.6)	13,851 (92.3)	13,287 (94.9)
Alberta	0 (0.0)	163 (0.4)	17,346 (41.3)	42,942 (99.9)	41,207 (98.1)	39,695 (100.0)
British Columbia	33,457 (76.3)	24,005 (57.2)	37,044 (86.3)	45,013 (98.7)	45,827 (99.3)	46,811 (99.0)
Northwest Territories & Yukon Territory	0 (0.0)	0 (0.0)	1412 (68.3)	1874 (87.6)	1752 (84.2)	1677 (83.9)
Canada	192,886 (52.4)	195,094 (53.5)	201,888 (55.2)	300,843 (74.4)	297,147 (74.5)	281,903 (73.2)

* Source: Health Statistics Division. Births and deaths, 1984-1994. Ottawa:Statistics Canada
NC: Not calculable because no corresponding figure from Statistics Canada is available

TABLE II
Temporal Trends of Neonatal Length of In-hospital Stay (LOS) and Associated Factors in All Live Births in Canada, 1984-1994

Variable Name	1984	1986	1988	1990	1992	1994
LOS in days, Mean (SD)	5.0 (2.7)	4.8 (2.7)	4.5 (2.6)	4.0 (2.7)	3.5 (2.6)	2.9 (2.6)
LOS < 2 days (%)	2.8	3.0	3.4	4.4	7.4	19.1
LOS > 4 days (%)	49.2	43.6	36.6	27.1	18.5	11.5
Transfer to another acute care facility (%)	2.3	2.3	2.2	2.3	2.3	2.3
Neonatal in-hospital death (per 1000)	3.3	3.3	2.9	3.5	2.9	3.1
Birthweight (g), Mean (SD)	3397 (589)	3398 (582)	3396 (577)	3395 (585)	3403 (582)	3395 (588)
Birthweight < 2500 g (%)	5.4	5.4	5.3	5.6	5.5	5.8
Birthweight > 4000 g (%)	12.2	12.2	12.1	12.5	12.9	12.7
Congenital anomalies (%)	4.2	3.9	4.2	4.6	4.5	4.2
Intracranial hemorrhage (per 1000)	0.5	0.6	0.5	0.7	0.7	0.6
Respiratory distress syndrome (%)	1.4	1.5	1.3	1.6	1.4	1.2
Meconium aspiration syndrome (%)	0.6	0.6	0.6	0.7	0.7	0.7

TABLE III
Results Obtained from Multiple Linear Regression and Logistic Regression for Temporal Trends in Neonatal Length of In-hospital Stay (LOS) in Canada, 1984-1994*

Year of Birth	β (95% CI) for Mean LOS	Odds Ratio (95% CI) for Short Stay (< 2 Days)	Odds Ratio (95% CI) for Long Stay (> 4 Days)
1986	-0.22 (-0.21, -0.23)	1.07 (1.03, 1.12)	0.78 (0.77, 0.79)
1988	-0.52 (-0.51, -0.53)	1.33 (1.28, 1.38)	0.58 (0.57, 0.59)
1990	-0.97 (-0.96, -0.98)	1.74 (1.68, 1.80)	0.37 (0.37, 0.37)
1992	-1.50 (-1.49, -1.51)	3.27 (3.16, 3.38)	0.22 (0.21, 0.22)
1994	-2.03 (-2.02, -2.04)	10.78 (10.45, 11.12)	0.12 (0.12, 0.12)

* All live births were included in the analyses. Potential confounding factors included in the initial models: province of residence, transfer to another acute care facility, neonatal in-hospital death, birthweight < 2500 g, birthweight > 4000 g, congenital anomaly, intracranial hemorrhage, respiratory distress syndrome, and meconium aspiration syndrome. Year of birth coded as dummy variable, and 1984 as the reference.

TABLE IV

Temporal Trends of Neonatal Length of In-hospital Stay (LOS) in Survived Live Births Who Were Not Transferred to Other Acute Care Facilities, by Birthweight Group, Canada, 1984-1994

Birthweight	LOS	1984	1986	1988	1990	1992	1994
500 - < 1500 g	Mean (SD)	17.3 (6.3)	18.6 (4.6)	17.8 (5.7)	18.4 (4.9)	18.8 (4.3)	18.0 (5.5)
	LOS < 2 d (%)	8.5	3.6	4.8	3.7	1.8	4.7
	LOS > 4 d (%)	88.5	93.9	89.6	93.1	94.5	90.5
1500 - < 2500 g	Mean (SD)	10.6 (6.0)	10.4 (6.1)	9.8 (6.1)	9.4 (6.2)	8.4 (6.2)	7.8 (6.3)
	LOS < 2 d (%)	1.4	0.8	1.2	1.2	2.0	6.1
	LOS > 4 d (%)	85.4	82.7	78.7	72.4	64.1	55.6
2500 - 4000 g	Mean (SD)	4.7 (1.9)	4.5 (1.8)	4.2 (1.8)	3.7 (1.8)	3.2 (1.7)	2.6 (1.6)
	LOS < 2 d (%)	1.1	1.3	1.7	3.0	6.3	19.0
	LOS > 4 d (%)	48.3	42.0	34.7	24.7	15.6	8.6
> 4000 g	Mean (SD)	4.8 (1.8)	4.6 (1.8)	4.4 (1.7)	3.9 (1.7)	3.4 (1.6)	2.8 (1.6)
	LOS < 2 d (%)	1.1	1.5	1.7	2.7	5.1	14.9
	LOS > 4 d (%)	50.7	45.7	39.2	29.4	19.8	11.0

in moderately low birthweight (1500 - 2499 g) infants and substantial in normal birthweight (2500 - 4000 g) or large birthweight (> 4000 g) infants (Table IV).

Neonatal length of in-hospital stay in 1994 varied substantially across provinces, with the shortest stay being in the province of Alberta (Table V). This interprovincial variation has resulted from variations in the rates of short and long stays. On the other hand, no corresponding and consistent interprovincial variation in the distribution of birthweight and the occurrence of major neonatal disorders was observed. Province of residence remained a significant explanatory factor for neonatal LOS after adjustment for birthweight and major neonatal disorders (Table VI). The

TABLE V

Interprovincial Variations in Neonatal Length of In-hospital Stay (LOS) and Associated Factors in All Live Births in Canada, 1994

Variable Name	NF N=5860	PEI N=1593	NS N=1611	NB N=8931	ON N=149,069	MB N=11,644	SK N=13,182	AB N=39,316	BC N=46,458	NWT & YT N=1645
LOS in days, Mean (SD)	3.6 (2.6)	4.0 (2.4)	3.5 (2.9)	3.9 (2.9)	2.9 (2.6)	3.1 (3.2)	3.4 (2.8)	2.5 (2.6)	3.0 (2.2)	2.7 (1.8)
LOS < 2 days (%)	6.8	2.6	10.9	3.5	19.6	13.4	10.2	33.5	14.5	22.2
LOS > 4 days (%)	19.5	26.0	15.9	19.9	11.1	12.2	16.3	7.6	11.1	10.6
Transfer to other acute care facility (%)	3.1	2.3	2.7	2.0	2.3	1.2	2.5	2.4	2.6	1.0
In-hospital death (per 1000)	2.0	1.9	1.8	2.3	3.1	4.8	5.0	3.2	2.2	1.2
Birthweight (g), Mean (SD)	3431 (626)	3481 (546)	3477 (579)	3433 (590)	3388 (593)	3400 (608)	3422 (588)	3367 (574)	3413 (572)	3491 (533)
Birthweight < 2500 g (%)	6.2	4.3	5.1	5.5	6.0	6.3	5.4	5.8	5.2	3.9
Birthweight > 4000 g (%)	15.4	15.9	16.0	14.5	12.5	13.5	13.6	10.9	13.0	16.4
Congenital anomalies (%)	5.3	2.2	3.9	3.0	3.8	4.3	4.9	4.6	4.7	3.6
Intracranial hemorrhage (per 1000)	1.0	0.6	1.5	0.8	0.5	0.6	1.3	1.1	0.3	0.0
Respiratory distress (%)	1.2	0.8	1.0	1.1	1.2	1.5	1.5	1.3	0.8	0.2
Meconium aspiration syndrome (%)	0.6	0.3	0.6	0.3	0.8	0.8	0.5	0.7	0.4	2.9

TABLE VI

Results Obtained from Stepwise Multiple Linear and Logistic Regression Analyses for Interprovincial Variations in Neonatal Length of In-hospital Stay (LOS) in Canada, 1994*

Province	β (95% CI) for Mean LOS	Odds Ratio (95% CI) for Short Stay (< 2 Days)	Odds Ratio (95% CI) for Long Stay (> 4 days)
Newfoundland	1.05 (0.99, 1.10)	0.13 (0.12, 0.14)	3.46 (3.19, 3.74)
Prince Edward Island	1.59 (1.49, 1.69)	0.04 (0.03, 0.06)	5.60 (4.95, 6.33)
Nova Scotia	1.01 (0.91, 1.11)	0.22 (0.19, 0.26)	2.70 (2.33, 3.13)
New Brunswick	1.36 (1.31, 1.41)	0.06 (0.06, 0.07)	3.63 (3.39, 3.88)
Ontario	0.33 (0.31, 0.35)	0.47 (0.46, 0.48)	1.62 (1.55, 1.69)
Manitoba	0.55 (0.51, 0.59)	0.30 (0.29, 0.32)	1.75 (1.63, 1.88)
Saskatchewan	0.93 (0.89, 0.97)	0.19 (0.18, 0.21)	2.78 (2.60, 2.96)
British Columbia	0.48 (0.46, 0.50)	0.32 (0.31, 0.33)	1.73 (1.65, 1.82)
NWT & Yukon	0.28 (0.18, 0.38)	0.57 (0.51, 0.64)	1.74 (1.47, 2.06)

* All live births were included in the analyses. Potential confounding factors included in the initial models: transfer to another acute care facility, neonatal in-hospital death, birthweight < 2500 g, birthweight > 4000 g, congenital anomaly, intracranial hemorrhage, respiratory distress syndrome, and meconium aspiration syndrome. Alberta as the reference.

major neonatal disorders were observed. Year of birth remained a significant explanatory factor for neonatal LOS after adjustment for province of residence,

birthweight, and major neonatal disorders (Table III). The change in neonatal LOS over time was trivial in very low birthweight (500 - 1499 g) infants, but evident

interprovincial variation in neonatal LOS was small for very low birthweight infants, and large for moderately low birthweight and normal or large birthweight infants (Table VII). Overall neonatal length of in-hospital stay based on all live births (i.e., including newborns who weighed < 500 grams or who died in hospital or were transferred to other acute care institutions) was somewhat different but did not alter the temporal trends and interprovincial variations observed by this study (data available upon request).

DISCUSSION

This study revealed a dramatic reduction in neonatal length of in-hospital stay in Canada, from a mean of 5.0 days in 1984 to 2.9 days in 1994. The study also revealed a substantial interprovincial variation in neonatal LOS. For example, in 1994 the mean LOS in Alberta was only 2.5 days,

TABLE VII

Interprovincial Variation in Neonatal Length of In-hospital Stay (LOS) in Survived Live Births Who Were Not Transferred to Other Acute Care Facilities by Birthweight Groups, Canada, 1994

Birthweight	LOS	NF N=5860	PEI N=1593	NS N=1611	NB N=8931	ON N=149,069	MB N=11,644	SK N=13,182	AB N=39,316	BC N=46,458	NWT & YT N=1645
500 - < 1500 g	Mean	16.1	NC	20.0	19.1	18.1	19.8	20.0	16.2	17.1	NC
	(SD)	(7.2)		(0.0)	(3.6)	(5.4)	(1.6)	(0.0)	(7.3)	(6.3)	
	LOS < 2 d (%)	6.7	NC	0.0	0.0	3.6	0.0	0.0	13.9	3.3	NC
1500 - < 2500 g	LOS > 4 d (%)	80.0	NC	100.0	98.0	90.9	99.0	100.0	80.7	88.3	NC
	Mean LOS	8.8	9.3	10.2	9.9	7.6	9.5	9.4	7.1	7.6	5.9
	(SD)	(6.2)	(6.1)	(6.5)	(6.7)	(6.2)	(6.9)	(6.9)	(6.4)	(5.9)	(4.6)
2500 - 4000 g	LOS < 2 d (%)	1.9	0.0	2.9	0.5	5.9	2.8	2.2	14.9	2.8	7.1
	LOS > 4 d (%)	63.8	72.4	72.1	69.4	54.2	62.7	69.5	47.4	56.0	53.6
	Mean LOS	3.3	3.8	3.1	3.5	2.5	2.7	3.1	2.2	2.8	2.5
> 4000 g	(SD)	(1.6)	(1.7)	(1.9)	(1.7)	(1.6)	(1.9)	(1.6)	(1.5)	(1.6)	(1.5)
	LOS < 2 d (%)	4.7	0.9	10.1	2.4	19.8	13.7	9.0	34.3	13.2	23.3
	LOS > 4 d (%)	17.0	22.8	12.3	16.6	8.0	8.7	13.0	5.0	9.2	8.5
> 4000 g	Mean LOS	3.4	4.1	3.6	3.7	2.7	2.7	3.3	2.4	2.8	2.8
	(SD)	(1.6)	(1.9)	(2.5)	(1.8)	(1.5)	(1.6)	(1.7)	(1.4)	(1.4)	(1.6)
	LOS < 2 d (%)	4.2	0.4	5.1	1.7	15.7	9.8	6.3	28.2	12.2	15.4
	LOS > 4 d (%)	20.2	34.3	19.5	20.0	10.4	9.5	18.2	5.6	10.0	12.1

NC: Not calculable because of small sample.

which was 0.2 to 1.5 days shorter than in other provinces. Determining the reasons for such a substantial temporal trend and geographic area variation in neonatal length of in-hospital stay may be helpful in planning policies that will ensure effective and efficient neonatal care in Canada.

Many factors can affect length of in-hospital stay.¹⁰⁻¹³ First, if patient-specific factors, such as severity of disease and general health status are not evenly distributed at the national level across different periods of time or at the provincial level during the same period of time, they may contribute to apparent temporal trends and interprovincial variations in neonatal LOS. Second, quality of care can affect neonatal LOS. For example, improved survival of infants can result in a decreased rate of less than two days' stay while better physiological understanding of the problems of high risk infants and better management can result in an increased rate of greater than four days' stay. Third, if organizational structures including the timely availability of necessary elements of care and post-hospitalization services (e.g., family care and community support programs) change at the national level across different periods of time or at the provincial level during the same period of time, they can result in corresponding temporal trends and interprovincial variations in neonatal LOS. Finally, differences in hospital practice can result in differences in neonatal LOS. Both organizational factors and hospital practice can be collectively influenced by policies at

national and provincial levels (e.g., guidelines, budget allocation, alternative services such as family care and community support programs) and lead to temporal trends and interprovincial variations in neonatal length of in-hospital stay.

The results of our assessment suggest that policy-related factors may be responsible for the reduced neonatal length of in-hospital stay in recent years and in certain Canadian provinces. This is supported by the following evidence. First, although patient-specific factors (e.g., birthweight distribution and neonatal mortality and morbidity) varied across time periods and provinces, the variations tended to be small and in different directions. For example, rates of low birthweight and major neonatal disorders changed little during the decade (Table II). Rates of transferring to other acute care facilities and in-hospital death can also serve as measures of disease severity in infants. These rates also remained constant across the 11 years examined (Table II). Although Alberta had the lowest average LOS, the highest rate of short stay and lowest rate of long stay, the rates of low birthweight and major neonatal disorders in this province were not near the lowest (Table V). Second, year of birth and province of residence remained significant explanatory factors for neonatal LOS, both statistically and clinically, after adjustment for low birthweight and major neonatal disorders by multiple linear and multiple logistic regression models. Moreover, improved survival of infants, better physiological understanding of the problems of high risk

infants and better management should have resulted in a decrease in the rate of less than two days' stay, an increase in the rate of greater than four days' stay, and an increase in the mean length of in-hospital stay over time. However, in the 11 years' CIHI data, we observed just the opposite.

The observation that the reduction of neonatal length of in-hospital stay in recent years and in certain provinces was trivial in infants with very low birthweight, evident in infants with moderately low birthweight, and substantial in infants with normal or large birthweight was consistent with the literature that early discharge may be safe for healthy infants,¹⁻³ but not for those at high risk, i.e., low and very low birthweight.^{6,7} This is contrary to our observation that maternal length of in-hospital stay in Canada was reduced substantially in recent years and in certain provinces, irrespective of the mode of delivery and clinical complexity.¹⁴ The differences between maternal and neonatal LOS may have reflected the different attitude of hospitals and health care providers regarding the safety of early discharge for mothers and infants, and a more cautious attitude may have been adopted in neonatal early discharge.

This study is limited by the incomplete registration of newborns by CIHI for some provinces, especially in earlier years (Table I). In particular, if the newborns registered in earlier years were those with systematically longer in-hospital stay, the observed trends of reduction in neonatal length of in-hospital stay could be an artefact. Fortunately, the

registration by CIHI for Ontario, the largest Canadian province, was consistent during the study period, with almost all newborns in Ontario being registered (which constitute more than two thirds in earlier years and more than half in recent years of the CIHI registered population). We believe that neonatal LOS has been reduced in Canada, because year of birth remained a significant explanatory factor for neonatal LOS after adjustment for many patient-specific factors (including province of residence), and because our findings are consistent with literature reports.¹⁵⁻¹⁷

This study is also limited by its inability to separate "acute day" from "nonacute day". Days that the patient is not receiving necessary hospital services and is not severely ill are often considered as "nonacute" days.¹⁰⁻¹³ A separation of "acute" from "nonacute" days is helpful in assessing the efficiency of hospital resource utilization. This issue underscores the fact that studies drawing on administrative data may suffer from a lack of clinical detail. Administrative data is also subject to coding errors.^{18,19} We have recently performed an assessment of the validity of information recorded by CIHI, and found that the codings for birthweight and administrative variables such as in-hospital death and in-hospital length of stay were valid.²⁰ However, we are concerned that there may be coding errors for diagnoses that may compromise the ability to adjust for neonatal disorders, so that residual confounding is possible. Fortunately, the registration of newborns by CIHI in 1994, the year for which interprovincial variation analysis was carried out, was quite complete for most provinces. The argument that our findings were biased thus assumes that there were dramatic interprovincial variations in population profile in 1994, with the healthiest newborns from the province of Alberta. Such an extreme scenario, while difficult to be disproven by given information, is highly unlikely.

Parents/guardians may well wish to reduce the neonatal length of in-hospital stay, especially for those considered excessively long (i.e., > 5 days). In addition to the potential benefit of reducing unnecessary hospital resource utilization,¹⁰ there are other potential benefits to newborns

attributed to early discharge after birth, including increased mother-infant bonding, increased breastfeeding and reduction in the risk of infection,¹⁻³ although there is debate on such claimed benefits as increased breastfeeding.²¹ However, the potential risks for early discharge should not be overlooked, especially if access to community care is limited, and the early discharge is largely the result of administrative pressure as opposed to patients' request. Recent studies both in the United States and in Canada have shown potential and real problems associated with early neonatal discharge.^{22,23}

We have not been able to directly examine the impact of policy-related factors. A recent report from Statistics Canada showed that during the period from 1986/87 to 1994/95, staffed beds in Canadian hospitals were reduced by 30%, and the reduction in Alberta was 54%, the largest among Canadian provinces.²⁴ The reduction in staffed beds in Canadian hospitals may have put pressure on hospitals to discharge patients earlier, including newborns. Given the dramatic nature of the recent reduction in neonatal length of in-hospital stay in certain Canadian provinces, and the fact that the reduction is likely the result of administrative pressure, systematic follow-up studies are warranted to examine the potential risks to newborns of shortened hospital stay.

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