

# Outcomes of Maternity Care Services in Alberta, 1999 and 2000: A Population-Based Analysis

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## Abstract

**Objective:** To evaluate the maternal and perinatal outcomes of Alberta's regionalized system of care. In particular, to compare the outcomes of communities with limited or no local intrapartum care with those of regional and tertiary care centres.

**Methods:** We conducted a population-based retrospective study of all Alberta deliveries in 1999 and 2000. Maternal outcome measures were rates of patient outflow, induction of labour, Caesarean section (CS), and participation in vaginal birth after Caesarean section (VBAC). The perinatal outcome measure was the perinatal loss rate (mortality rate plus stillbirth rate). Rural maternity care programs were categorized as follows: no elective local maternity care (level 0), local maternity care without local CS capabilities (level IA), and local maternity care with local CS capabilities (level IC).

**Results:** Communities offering intrapartum care without local CS capability delivered 22.1% of their maternity population. This proportion increased to 70.1% if the communities had local CS capabilities. Although patient outflow was associated with parity, risk, local services, and distance to an urban centre, there was a large unexplained outflow difference between communities with similar service levels. More limited local maternity care services and higher outflow rates were associated with higher rates of induction of labour. Rates for CS, participation in VBAC, and perinatal loss were not significantly different for different types of maternity care programs other than a lower CS rate for residents in type IA communities compared with other communities (18% vs. 20%).

**Conclusion:** The principal consequences of a limited scope of local maternity care services for rural women is an increased rate of induction of labour and, if they live in a community that delivers babies without local CS capability (IA), a lower CS rate. These category IA communities, with patient outflows of 78%, are largely unsuccessful in having women deliver locally, but women from these communities have a lower rate of CS wherever they deliver. The 18 rural Alberta maternity care programs where patient outflow is over 67% may not be sustainable.

**Key Words:** Maternity, perinatal, rural, induction, Caesarean section

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## Résumé

**Objectif :** Évaluer les issues maternelles et périnatales du système de soins régionalisé de l'Alberta. En particulier, comparer les issues que connaissent les communautés disposant de soins intra-partum locaux limités ou inexistantes à celles que connaissent les centres de soins régionaux et tertiaires.

**Méthodes :** Nous avons mené une étude rétrospective en population générale qui portait sur tous les accouchements ayant eu lieu en Alberta en 1999 et en 2000. Les critères d'évaluation maternels étaient les suivants : taux de patientes n'accouchant pas localement, déclenchement du travail, césarienne et participation à l'accouchement vaginal à la suite d'une césarienne (AVAC). Le critère d'évaluation périnatal était le taux de perte périnatal (taux de mortalité plus taux de mortinaissance). Les programmes ruraux de soins de maternité ont été classés comme suit : aucun soin de maternité facultatif local (niveau 0), soins de maternité locaux sans capacités locales d'effectuer une césarienne (niveau IA) et soins de maternité locaux avec capacités locales d'effectuer une césarienne (niveau IC).

**Résultats :** Les communautés offrant des soins intra-partum sans capacités locales d'effectuer une césarienne ont accouché 22,1 % de leur population de femmes enceintes. Cette proportion passait à 70,1 % pour les communautés disposant de capacités locales d'effectuer une césarienne. Bien que le taux de patientes n'accouchant pas localement ait été associé à la parité, au risque, aux services locaux et à la distance à parcourir pour atteindre un centre urbain, une importante différence inexplicée a été constatée, en ce qui concerne ce taux, entre des communautés disposant de niveaux de service semblables. Des services de soins de maternité locaux davantage limités et des taux de patientes n'accouchant pas localement accrues ont été associés à des taux accrues de déclenchement du travail. Le taux de césarienne, le taux de participation à l'AVAC et le taux de perte périnatal n'ont pas présenté de différences notables d'un type de programme de soins de maternité à l'autre, exception faite de la constatation d'un taux de césarienne moindre chez les citoyennes des communautés de niveau IA, par comparaison avec les autres communautés (18 % par comparaison avec 20 %).

**Conclusion :** Les principales conséquences de la limitation de la portée des services de soins de maternité locaux offerts aux femmes rurales sont un taux accru de déclenchement du travail et, dans le cas des femmes vivant au sein d'une communauté qui procède à des accouchements sans capacités locales d'effectuer une césarienne (IA), un taux de césarienne moindre. Ces communautés de niveau IA (qui présentent un taux de patientes n'accouchant pas localement de 78 %) ne parviennent largement

pas à faire accoucher leurs citoyennes localement; toutefois, les femmes de ces communautés présentent un taux de césarienne moindre, peu importe où elles accouchent. Il est possible que les 18 programmes ruraux de soins de maternité de l'Alberta qui présentent un taux de patientes n'accouchant pas localement supérieur à 67 % ne s'avèrent pas viables à long terme.

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## INTRODUCTION

Maternity care services in Alberta, as in most of Canada, are regionalized. Although women perceived to be at high risk of complications must often go to larger centres to deliver, those at low risk can be cared for in smaller rural hospitals. Regionalization of services in Canada has thus preserved an important role for small local maternity care services. In Northern Ontario,<sup>1</sup> communities without capability to perform Caesarean section (CS) delivered between 57% and 80% of women in their catchment area. This rose to almost 100% if local operative delivery was available.

There is considerable variation in the level of maternity care services provided by rural hospitals. Some communities with local surgical programs are able to offer extensive services, including CS. Others are restricted to offering a limited local maternity care program without CS. Still others have chosen to offer no elective local intrapartum maternity care and require women to travel elsewhere for care. Within these programs, women themselves are free to choose whether to seek care locally or to travel. Equally, their caregivers choose whether to recommend women travel for maternity care, depending on risk as well as the skills and comfort level of the care providers.

There is consensus, but limited published evidence, that outcomes for this regionalized system are good.<sup>2</sup> We conducted a search of Medline from 1980 to 2003 using the key words “rural” and “obstetrics” and cross-searched with MeSH headings of “maternity,” “perinatal,” “asphyxia,” and “Caesarean section.” We found only a few studies that were relevant to the Canadian context. The study by Black and Fyfe<sup>1</sup> of deliveries in Northern Ontario between 1980 and 1982 stands alone in Canada as a population-based evaluation of the outcomes of a regionalized care system. This study found little difference in the rate of perinatal loss in populations served by different levels of maternity care services.<sup>1</sup>

International studies that have documented the safety of rural maternity care with and without local CS have been based on delivery site rather than the mother's residence.<sup>3,4</sup> A small study in Washington State<sup>5</sup> showed that pregnant women living in high outflow areas (i.e., less than one-third of women deliver locally) were more likely to have complicated labour and premature deliveries, and their infants

were more likely to have longer and more expensive hospital stays.

The evaluation of both regionalized care and the outcomes of deliveries in small hospitals has been limited by the lack of appropriately organized databases. A proper evaluation requires that outcomes be attributed to the maternity service where the mother resides rather than where she ultimately delivers. The safety and performance of these small hospitals and the success of a risk identification, referral, and transportation system will be measured in the maternal and perinatal outcomes for all pregnant women who reside within a hospital's catchment area, regardless of where they deliver. Unfortunately, the administrative databases in Canada's perinatal programs and health records systems have generally been organized on the basis of where delivery occurs.

This study represents a collaborative effort by the principal stakeholders in Alberta's perinatal programs. We constructed a population-based database containing the maternal and perinatal outcomes of all deliveries in Alberta in 1999 and 2000. This allowed the following questions to be asked:

1. How do the perinatal outcomes for populations served by small community hospitals compare with those for regional and metropolitan centres?
2. How do the outcomes of maternity care services with no capacity for Caesarean section compare with programs that do have capacity? That is, does the availability of local Caesarean section services affect outcomes?
3. How do the outcomes of limited local maternity care programs compare with outcomes from communities without such programs (whose residents are obliged to travel for care)? That is, is it important to offer a limited local maternity care program?
4. Are outcomes different or comparable between high and low outflow communities?

## METHODS

### Data Sources

Through voluntary membership, the northern and southern Alberta perinatal outreach programs represent all of Alberta's maternity care programs. Each program maintains databases containing information abstracted from the provincial labour and delivery record. These databases are rigorously validated manually with the individual hospital sites. The labour and delivery record includes a numeric risk scoring system identifying each delivery as low, medium, or high risk. This score is derived from information about maternal health, past obstetric history, and the current pregnancy. The protocol for transcribing issues of risk into numerical

scores, adapted from a Manitoba protocol, was included in the Alberta labour and delivery record in the 1980s.<sup>6</sup>

The Alberta Medical Association Reproductive Care Committee, in collaboration with Alberta Health and Wellness, maintains a neonatal mortality and stillbirth database, which is validated by the Vital Statistics Office and the Office of the Chief Medical Examiner. For this study, the records from the neonatal mortality and stillbirth database for 1999 and 2000 were manually linked, using deterministic methodology, to each of the perinatal databases, using the birthdate, health number, and postal code of the mother and the delivery date and site. This allowed the calculation of a perinatal loss rate per 1000 births (neonatal mortality rate plus stillbirth rate).

Since the organization of the databases differs between the northern and southern Alberta perinatal outreach programs, a common set of variables was extracted from each database and merged for the study. These variables included data on parity, risk score, delivery site, and mother's residence by postal code, induction of labour (as defined on the labour and delivery record, including prostaglandin applications), CS, and vaginal birth after Caesarean section (VBAC). At the outset, all variables in our study that were drawn from the northern and southern Alberta databases were scrutinized to ensure identical definitions and specifications. Confidentiality was ensured by removing all patient identifiers. All births for 1999 and 2000 were included in the study database.

### Service Levels

The perinatal audit programs maintain information about the institutional and service characteristics of member hospitals. We used this information to create five service levels:

- Level 0: No elective deliveries
- Level IA: Elective deliveries without local CS capability  
No level II nursery
- Level IC: Elective deliveries with CS capability most of the time  
No level II nursery
- Level II: Regional centre, two or more specialist obstetricians on staff  
Level II nursery
- Level III: Hospital in large metropolitan area (Edmonton and Calgary)

### Hospital Catchment Areas

Several potential boundary sets were evaluated for use as definitions of hospital catchment areas. These included

municipal boundaries, current regional health authority and sub-regional boundaries, the boundaries of general hospital districts (GHDs) developed when each hospital was administered by a separate board before regionalization, and boundaries created by constructing a Voronoi constellation surrounding hospital geographical coordinates.<sup>7</sup>

Hospital coordinates were loaded into a geographic information system, and the different potential boundaries were overlaid with the hospital locations to determine their suitability. The GHD boundaries were chosen because almost all the GHDs contained at least one acute care facility, usually near the centre, and compared to the Voronoi boundaries, the GHD boundaries made allowances for the provincial road system. Hospitalization data during a 10-year period validated the choice of GHDs for defining catchment areas.

Our methodology required that all Alberta residents be mapped into a unique catchment area linked to either one (rural) acute care facility or a set (urban) of acute care facilities. This required some merging and splitting of the existing GHDs. In 15 GHDs, no acute care facilities existed. Hospitalization data for a 10-year period (1990–2000) were obtained from Alberta Health and Wellness files, and maternity data were extracted for the residents of these 15 GHDs. This information provided direction for merging each of these GHDs with one of its neighbours. There were several GHDs with more than one acute care facility where maternity services were provided. These GHDs were split.

A file assigning postal code to hospital catchment area was created using a geographic information system based on postal code locations valid during the study period and the GHD boundary files. A hospital catchment area was assigned to each birth based upon the postal code of residence of the mother.

### Rural Close and Rural Remote

Driving times were derived from a highway network file, using the driving times between postal code points and hospitals as a proxy for individual driving times. We defined "rural close" as a postal code within a 60-minute drive of Edmonton or Calgary or within a 30-minute drive of one of Alberta's regional centres. If more than 50% of the maternity care population within a catchment area met the definition of rural close, then the hospital catchment area itself was given a designation of rural close. Areas with greater driving times were defined as "rural remote."

All statistical analysis was performed using SPSS (version 12.0, SPSS Inc., Chicago, IL). Analyses consisted of logistic regressions of binary variables. Independent variables were generally categorical, and interactions between such categorical variables were included sequentially in blocks as

**Table 1. Deliveries by service level at residence versus delivery site, Alberta 1999 and 2000**

Service level at delivery site	Service level at residence					Total
	O %	IA %	IC %	II %	III %	
O	<b>16 (0.9)</b>	3 (0.1)				19
IA	57 (3.3)	<b>1 179 (22.1)</b>	45 (0.3)	26 (0.3)	25 (0.1)	1 332 (1.8)
IC	802 (46.0)	747 (14.0)	<b>10 350 (70.1)</b>	123 (1.4)	311 (0.7)	12 333 (16.8)
II	253 (14.5)	1 076 (20.2)	1 600 (10.8)	<b>8 659 (96.1)</b>	55 (0.1)	11 643 (15.8)
III	617 (35.4)	2 328 (43.7)	2 767 (18.7)	199 (2.2)	<b>42 295 (99.1)</b>	48 206 (65.6)
Total	1 745	5 333	14 762	9 007	42 686	73 533

The bold face figures show the proportion of women who did not travel outside their catchment area of residence to deliver.

O: no elective intrapartum care; IA: no local Caesarean section capacity; IC: local Caesarean section capacity; II: regional centre; III: tertiary centre.

allowed by the software. These interactions were retained in the final equations where significant. Tables were usually generated to enhance readability and to focus on important effects. Significant effects from the logistic regressions were always described whether included in the tabulations or not.

This research study was approved by the Health Research Ethics Board of the University of Alberta.

## RESULTS

The study database included 73 533 deliveries that occurred in 1999 and 2000. There were 1496 deliveries (2%) that could not be assigned to a catchment area because of missing or inaccurate postal codes.

There were 93 hospital catchment areas. Of these, 17 offered no local elective intrapartum maternity care (level 0, 1745 deliveries); 23 offered limited intrapartum care without local CS capacity (level IA, 5333 deliveries); 46 offered a rural maternity care program with local CS capacity but without specialists or level II nursery facilities (level IC, 14 762 deliveries); five were regional centres (level II, 9007 deliveries); and two (Edmonton and Calgary) offered full tertiary care maternity and neonatal services (level III, 42 686 deliveries) (Table 1).

Of the 86 rural maternity care programs, 14 were considered to be rural close (level 0: 2 programs; level IA: 6 programs; level IC: 6 programs).

### Outflow

The classification of deliveries in Alberta for the calendar years 1999 and 2000 is shown in Table 1, cross-classified by the type of obstetric service provided in the catchment area in which the mother lived and by the type of obstetric service in which the delivery occurred.

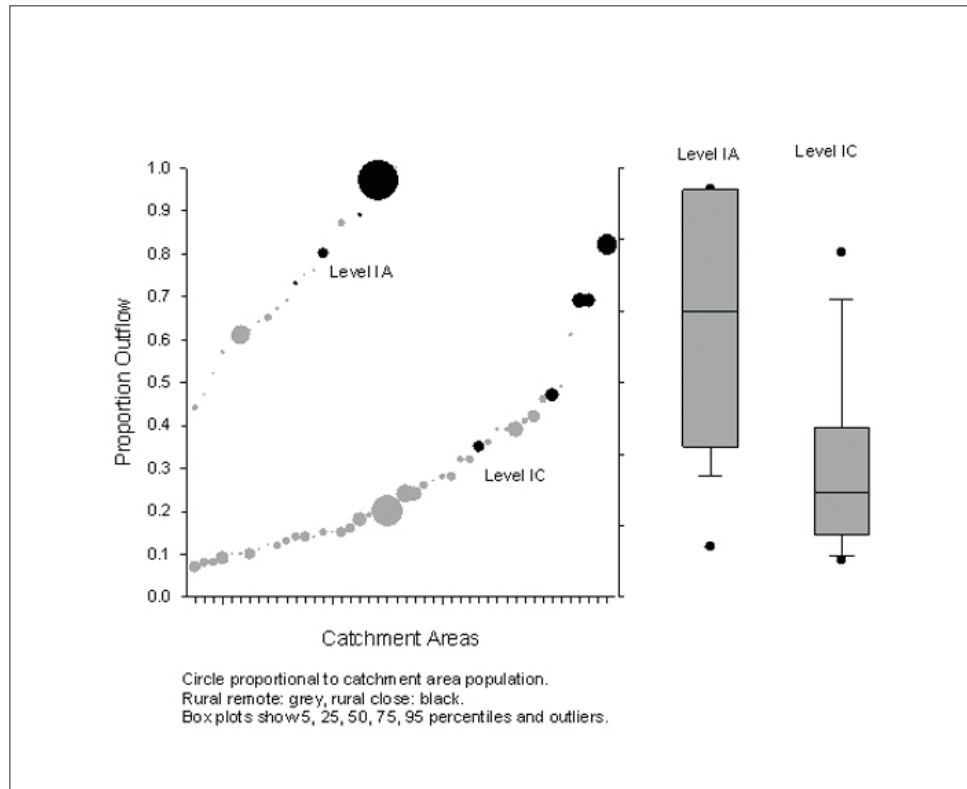
The distribution of outflow and the size of the population of pregnant women in each of the rural GHDs that offered

local maternity care services are shown in the Figure. Level IA catchment areas had outflows ranging from 45% to 97% with a median of 80%. The GHDs in close proximity to urban areas (rural close, shown in black), had higher outflow rates. Level IC catchment areas had outflows ranging from 8% to 80% with a median of 24%. The GHDs classified as rural close (also shown in black) tended to have higher outflow rates than those classified as rural remote. In 18 rural maternity care programs, more than two-thirds of local women had to travel outside their region for delivery. The proportion of patient outflow according to service and distance category and parity of the mother is shown in Table 2. On average, proportional outflow was much greater in level IA catchment areas (78%) than in level IC catchment areas (30%). The largest proportion of the outflow group was the nulliparous population residing in level IA catchment areas (87%).

A logistic regression for outflow tested for these variables, including the association between risk status and outflow. The significant findings ( $P < 0.05$ ) were as follows.

1. Level IA catchment areas had greater outflow than level IC (OR = 7.3).
2. Rural close areas had greater outflow than rural remote (OR = 4.9).
3. The difference between rural close and rural remote was greater for level IC catchment areas than level IA catchment areas.
4. Nulliparous women were more likely to deliver away from their community than were multiparous women (OR = 1.5).
5. Pregnant women at high risk were substantially more likely to deliver away from their community than were women at low risk (OR = 9.0).

**Maternity care outflow (%)**



6. Women at medium risk were more likely to deliver away from their community than were low-risk women (OR = 2.9).
7. Primiparous women from level IA catchment areas were more likely to be delivered elsewhere. This likelihood was greater than predicted by level of catchment area, risk category, and parity alone.

**Maternal Outcomes**

**Induction**

The rate of induction of labour cross-classified by the parity of the mother and by the type of obstetric service provided in the catchment area in which she lived is shown in Table 3. Nulliparous women had a higher rate of induction than multiparous women (30% vs. 25%). Pregnant women in rural communities had higher rates of induction than did urban women (note: the rates belong to the women who live in rural communities, not to their local service).

A logistic regression that tested for the effects of parity and risk level, service type, and percentage outflow in the catchment area of residence on rates of induction of labour showed the following significant effects ( $P < 0.05$ ).

1. Nulliparous women were more likely than multiparous women to have labour induced (OR = 1.25).

2. Pregnant women at medium or high risk were more likely than women at low risk to have labour induced (OR = 1.98 and 1.56, respectively). This difference was greater in nulliparous women, and there was a significant interaction between parity and risk in the regression analysis.
3. In general, residence in level 0, IA, or IC catchment areas was associated with a higher level of induction of labour than residence in level II or III catchment areas.
4. Higher outflows were associated with higher rates of induction (OR = 1.05 for each increase of 10% in outflow).

**Caesarean Section**

The rate of CS as a function of a woman's parity and the level of services in the catchment area in which she lived is shown in Table 4. The likelihood of delivering by CS was greater for nulliparous women (24%) than for multiparous women (17%). The lowest rates of CS were in women residing in level IA catchment areas (18%).

In a logistic regression that tested for the effects of parity and risk level, service type, and percentage outflow on the probability of delivery by CS, the following effects were significant ( $P < 0.05$ ).

**Table 2. Percentage outflow by parity category for rural close and rural remote level IA and level IC services**

	IA			IC			Table total
	Remote (n = 17)	Close (n = 6)	Total	Remote (n = 40)	Close (n = 6)	Total	
Nulliparity	77	97	87	26	61	31	47
Multiparity	61	90	74	24	57	30	42
Total	66	92	78	25	59	30	45

**Table 3. Rates of labour induction by parity and service level**

	Service level					Total
	0	IA	IC	II	III	
Nulliparity	0.34	0.33	0.31	0.29	0.30	0.30
Multiparity	0.28	0.25	0.27	0.25	0.24	0.25
Total	0.30	0.28	0.28	0.26	0.27	0.27

**Table 4. Caesarean section rates by parity and service level**

	Service level					Total
	0	IA	IC	II	III	
Nulliparity	0.24	0.21	0.25	0.24	0.24	0.24
Multiparity	0.18	0.16	0.17	0.17	0.17	0.17
Total	20	0.18	0.20	0.20	0.20	0.20

1. Nulliparous women were more likely to be delivered by CS than were multiparous women (OR = 2.5).
2. Pregnant women at medium and high risk were substantially more likely to be delivered by CS than were women at low risk (OR = 3.2 and 7.1, respectively). These effects of risk were greater in nulliparous women, as shown by a significant interaction between parity and risk in the regression analysis.
3. Level IA catchment areas were associated with lower CS rates (OR = 0.9).
4. When percentage outflow is added to the equation, there is no significant effect.

### **Vaginal Birth After Caesarean Section**

Of the women eligible for VBAC, 60.3% attempted a vaginal delivery and 75.8% of these were successful. When classified by service level of residence, women in regional programs (level II) had a lower rate of attempting VBAC (53.5%;  $P < 0.05$ ). There were no significant differences in rates of successful VBAC among service levels.

### **Perinatal Loss Rates**

The perinatal loss rate (neonatal mortality plus stillbirth) was 10.8 per 1000 births. There were no significant differences between service levels.

### **DISCUSSION**

Only 22.1% of women residing in communities with limited maternity care programs without local CS capabilities (level IA) actually deliver in their home communities. This outflow of patients is a combination of those women who choose to travel for care and those women who are referred out for care by the local medical staff. This finding contrasts with the findings of Black and Fyfe.<sup>1</sup> In Northern Ontario 20 years ago, 57% to 80% of women in communities with similar levels of service delivered locally. Although there are probably substantial differences between the rural maternity services in Alberta and those in Northern Ontario, this finding suggests that maternity care has become more centralized in the last two decades.

This proportion of women delivering in their home communities includes both women in the communities residing

adjacent to much larger regional and metropolitan centres and women in the communities further away from these larger centres. This distinction appears to matter. Within the rural remote level IA programs, 34.5% of women delivered in their community hospitals, compared to 7.9% in rural close programs. The majority of these deliveries in rural remote level IA centres involved multiparous women at low risk.

These level IA communities struggle with the intrapartum care of nulliparous women at low risk. Only 17% of these women (30% of those in rural remote communities, and 4% in rural close) actually deliver in their community hospital. This is, at least in part, due to an attitude among some rural care providers that these women should not deliver in communities without local CS capability because of the increased incidence of CS among nulliparous women. This practice contrasts with the published consensus recommending that, because these women do not have an increased incidence of emergency CS, they should not be discouraged from delivering in these level IA programs.<sup>8</sup>

The communities with local operative delivery capacity (level IC) deliver 70.1% of their maternity care population (77.1% in rural remote communities, 44.5% in rural close). Clearly, this operative delivery capability strongly affects outflow. These level IC programs do not have the problems with nulliparous women that are seen in the level IA programs. Rural remote level IC programs retain 82% of low-risk nulliparous women and 85% of low-risk multiparous women, and rural close programs retain 55% of low-risk nulliparous women and 49% of low-risk multiparous women.

Statistically, the interaction between distance (rural close vs. rural remote) and service level (IA vs. IC) demonstrates that distance is more important for service level IC. This underscores the importance of the surgical programs in these small rural Alberta hospitals. When there are no local operative delivery capabilities, many women in level IA communities still travel to larger centres, regardless of distance. These decisions are made both by the pregnant women, who seek a reassuring level of service, and by their caregivers, who are uncomfortable managing the range of maternity complications they might encounter. However, with local operative delivery, distance becomes a more powerful restriction to outflow.

Overall, outflow from rural maternity care programs in Alberta is much larger than reported in other populations. In a recent Canadian literature review,<sup>9</sup> 60% of women delivered within their own level IA communities. With local CS capabilities, reported rates were 90%.

The large variation in outflow between community hospitals with similar service levels is striking. In part, this is an

issue of distance to travel for care, as the rural close communities generate significantly higher outflow than the rural remote communities. In part, this variation in outflow reflects differences between communities in the energy, confidence, and commitment to maternity care of the local caregivers. Finally, there will be historical practice patterns and attitudinal variations among rural women in different communities who might choose to travel for care to larger centres. A separate study of outflow variation between community hospitals with similar service levels might better illuminate the relative importance of these issues.

In Nesbitt's study,<sup>3</sup> high-outflow communities were at high risk for losing local maternity care services, and eight of 13 high-outflow communities ultimately closed these programs. Perinatal outcomes were poorer in these high-outflow communities. In our study, there were 18 rural maternity care programs in Alberta where more than two-thirds of local women delivered outside the community.

The decision to induce labour is influenced by the actual or anticipated obligation to travel for care and is driven by the caregiver, the pregnant woman, or both. Regardless of risk and parity, women who lived in rural communities served by level O or level I care programs were more likely to have labour induced. Additionally, if they lived in high outflow communities, they were more likely to have labour induced.

Why should travel matter? First, because of the fear of an unplanned delivery on the way to the referral centre, the obligation to travel for care is an accepted indication for induction of labour in the Alberta guideline.<sup>10</sup> Second, because of distances travelled, it is possible that women who present with symptoms but who are not in labour will undergo induction rather than being sent home. Third, without local surveillance technology such as ultrasound, it is possible that pregnant women at term with concerns such as apparently diminished fetal movement, a lower amniotic fluid index, or fetal measurements and growth that are below normal might require induction of labour.

An associated issue in small rural maternity care programs is the irregular interruption of service. For example, small programs might lose their CS capability when the surgeon or anaesthetist is away. Faced with these interruptions of service, rural women and their caregivers might choose induction of labour rather than risk women having to travel for care if labour begins during one of these interruptions.

Although we use outflow from local catchment area as a measured outcome in this study, we also use it as an independent variable when we study the other outcomes of induction and CS. Clearly, some patient outflow is appropriate in a regionalized program where pregnant women deliver in a hospital with resources sufficient to meet their

needs. However, in the outflow data, we have seen large variations that are unexplained by parity, risk, or local service availability. This unexplained variation is an inexact measure of local attitudes, the intensity of the local maternity care program, and other unknown factors. For these reasons, we sought to establish whether these variations in outflow were associated with variations in rates of induction of labour or CS.

Nulliparous women were more likely to have labour induced than were multiparous women (30% vs. 25%). After adjusting for risk status and local service level, we found the difference was statistically significant. This finding is counterintuitive because multiparous women are perceived to be exposed to fewer risks with induction of labour; in particular, they are less likely to require CS. Differences between nulliparous and multiparous women with respect to the other indications for induction of labour should be accounted for by risk assessment. It is notable that the British Columbia Reproductive Care Program, in its 2003 Report, identified and highlighted this same finding of a higher induction rate in the nulliparous population.<sup>11</sup>

Women who were considered to be at high risk for adverse pregnancy outcomes had labour induced less frequently than those at medium risk. We presume that a significant proportion of these high-risk pregnancies proceed directly to delivery by CS (for example, for very early premature births, for malpresentations, and for multiple gestations).

Only the level IA communities, served by a limited maternity care program without local CS services, had CS rates significantly different from the provincial rates (18% vs. 20%). Residents of these rural communities have lower rates of CS, even though only 22% of these women actually deliver in their own communities. We surmise that the presence of local maternity caregivers, with skills and experience in maternity care but without the opportunity to provide local operative delivery, stabilizes the vaginal birth rates. This reduced CS rate is seen in women from type IA communities wherever they deliver.

The CS rates were identical for all other service levels. This represents a striking standardization of outcomes in a very large province with a marked variation in the availability of local maternity care services between communities. It can be seen as a confirmation of the effectiveness of regionalization.

Over the past decade, the Alberta perinatal programs have encouraged eligible women to undergo a trial of labour rather than an elective repeat CS. Although success rates for VBAC vary little, higher participation rates are important because these translate into fewer Caesarean sections without diminishing the success rates. We thought that the obligation to travel for care might impede women's

participation in VBAC in rural Alberta, since only maternity care programs that offer immediate CS capability can offer VBAC. Consequently, many rural women living in communities with limited or no local maternity care services face a requirement to travel in labour for VBAC. As the alternative is a planned elective CS, we expected that participation in VBAC in rural Alberta would be significantly below that of the regional and urban centres.

It is not surprising that the eligibility rate and the success rate of VBAC show no variation across service levels. However, we did find it surprising that the rate of attempted VBAC in the small rural programs was not significantly different from the rate in metropolitan centres (57.5% vs. 63.2%;  $P = 0.10$ ). This standardization of care and outcome can, we believe, be attributed to the energy and enthusiasm with which Alberta's perinatal programs have promoted participation in VBAC. Equally surprising is the significantly lower rate of attempted VBAC in Alberta's regional centres (53.5%).

The perinatal loss rate (neonatal deaths plus stillbirths) was similar at all service levels (10.8 per 1000 births). This echoed the findings of Black and Fyfe,<sup>1</sup> who found that perinatal loss in Northern Ontario (12.27 per 1000 births in 1980–1982) was identical for communities with different levels of service.

This is a positive evaluation of a regionalized perinatal system of care. Across rural Alberta, women live in communities that differ widely in local maternity care services. Despite this large variation in service level and practice patterns, the outcomes for the infant are identical. A regionalized perinatal case system designed to match resources to needs has been proven effective, at least with regard to perinatal loss rate.

A corollary is the documented safety of the limited level IA maternity care programs. Providing intrapartum maternity care services without local operative delivery capability, the level IA communities have a perinatal loss rate as good as communities where no services are offered and women travel to larger centres for care (level O) and communities that are able to offer local operative delivery (level IC).

A caution is in order. These data provide a positive evaluation of a system of care, and the conclusions about individual components of that system should be interpreted only within the context of the entire system of care. That is, because perinatal outcomes are similar for service levels O, IA, and IC, we should not be tempted to conclude that this would still be true if local maternity care services were withdrawn (centralization rather than regionalization) and all women travelled for care (i.e., every community becomes a level 0 service community). We believe that it is likely that the level 0 programs have good outcomes precisely because



IA and IC programs support them. Thus, towns that are distant from regional or urban programs can justify having no local maternity care services because a relatively close community offers a local program, often complete with CS capability. In a similar fashion, it is likely that the close proximity of IC programs contribute to the outcomes of the women residing in IA communities.

We believe that the evidence supports the efficacy of a provincial regionalized care system as it is presently constituted. However, changing service levels could diminish outcomes.

### **Limitations**

Any study on the outcomes of maternity care programs is limited by the available data on perinatal outcomes. Although the perinatal loss rate is an effective measure of mortality, it is difficult to find equally effective measures of neonatal morbidity. This reflects the limitations of the hospitalization databases. There are no standardized criteria for admissions to secondary and tertiary care nurseries. Variations in case definitions and coding preclude comparisons between nurseries. We are unable to measure and code for the severity of neonatal morbidity.

A second limitation is the risk scoring system. While risk identification is recognized as an important triage tool in a regionalized perinatal program, risk scoring is controversial. In general, risk scoring systems, including Alberta's, have not been validated. Where the measurement of true risk is captured imperfectly by our scoring system, we must qualify our conclusions.

A third limitation is the high correlation between outflow rates, service type, and rural close or remote. Communities with high patient outflow tended to be closer to urban centres and were less likely to have local CS capability. Because of this interdependence, the strength of our conclusions about their relative importance is limited.

Other clinical parameters that might influence perinatal outcomes, such as maternal age, maternal weight, and socio-economic status, were not included in our study.

Finally, it would have been helpful to have a significantly larger sample size. Our analysis indicates that travel and distance to care matter. Our ability to examine the differences between the rural remote and rural close maternity care programs was restricted, in part, by the smaller numbers in these databases.

### **CONCLUSION**

For women, the principal obstetric outcome associated with living in rural Alberta is the increased rate of induction

of labour that results from limited services and increased outflow. Despite this difference, rates of perinatal loss, Caesarean section, and participation in VBAC are similar for women living within the catchment area of all but one of the maternity care programs. The rural communities that have maternity care programs without local CS capability (level IA) have a lower CS rate.

Although this study indicates that the current provincial system of maternity care provides uniform outcomes at different service levels, it does not promise that this would remain the case if individual components were to change because of a public policy or because of a failure of local resources.

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