

# Canadian Association for Health Services and Policy Research



Calgary, May 13<sup>th</sup>, 2009

# Objective

To compare population-based provincial rural newborn outcomes by local service catchments for three time periods: 1994-1999, 2000-2004, and 2005-2007

# Previous Research

<p>Black D, Fyfe I. (1984) The safety of obstetric services in small communities in northern Ontario. CMAJ 130: 571-576</p>	<ul style="list-style-type: none"> <li>• Northern Ontario populations served by small hospitals with limited facilities</li> <li>• Hospitals had perinatal mortality rates similar to populations served by larger secondary or tertiary facilities despite lower rates of interventions.</li> </ul>
<p>Rosenblatt RA, Reinken J, Shoemack P. (1985) Is obstetrics safe in small hospitals? Evidence from New Zealand's regionalized perinatal system. Lancet 2: 429-432</p>	<ul style="list-style-type: none"> <li>• New Zealand, nation-wide</li> <li>• For infants greater than 1500 g, the lowest levels of birthweight specific perinatal mortality were in Level 1 facilities.</li> </ul>
<p>Nesbitt TS, Connell FA, Hart LG, Rosenblatt RA. (1990) Access to obstetric care in rural areas: Effect on birth outcomes. Am J Public Health 80 (7): 814-818</p>	<ul style="list-style-type: none"> <li>• Rural Washington State</li> <li>• Communities which were high outflow had a greater proportion of complicated deliveries, higher rates of prematurity, and higher costs of neonatal care than low outflow communities.</li> </ul>
<p>Viisainen K, Gissler M, Hemminki E. (1994) Birth outcomes by level of obstetric care in Finland: a catchment area based analysis. J Epidemiol Community Health 48 (4):400-405.</p>	<ul style="list-style-type: none"> <li>• Finland, large, population-based survey</li> <li>• Compared birth outcomes for catchment areas of different levels of care provided in hospitals</li> <li>• Found no statistically significant difference in any outcomes between the different levels of care.</li> </ul>
<p>Moster D, Terje Lie R, Markestad T. (2001) Neonatal mortality rates in communities with small maternity units compared with those having larger maternity units. Br J ObGyn 108:904-909.</p>	<ul style="list-style-type: none"> <li>• Norway</li> <li>• Examined neonatal mortality in geographic areas served by different sized maternity units</li> <li>• Found statistically significant small increases in risk of neonatal death for smaller maternity units.</li> </ul>

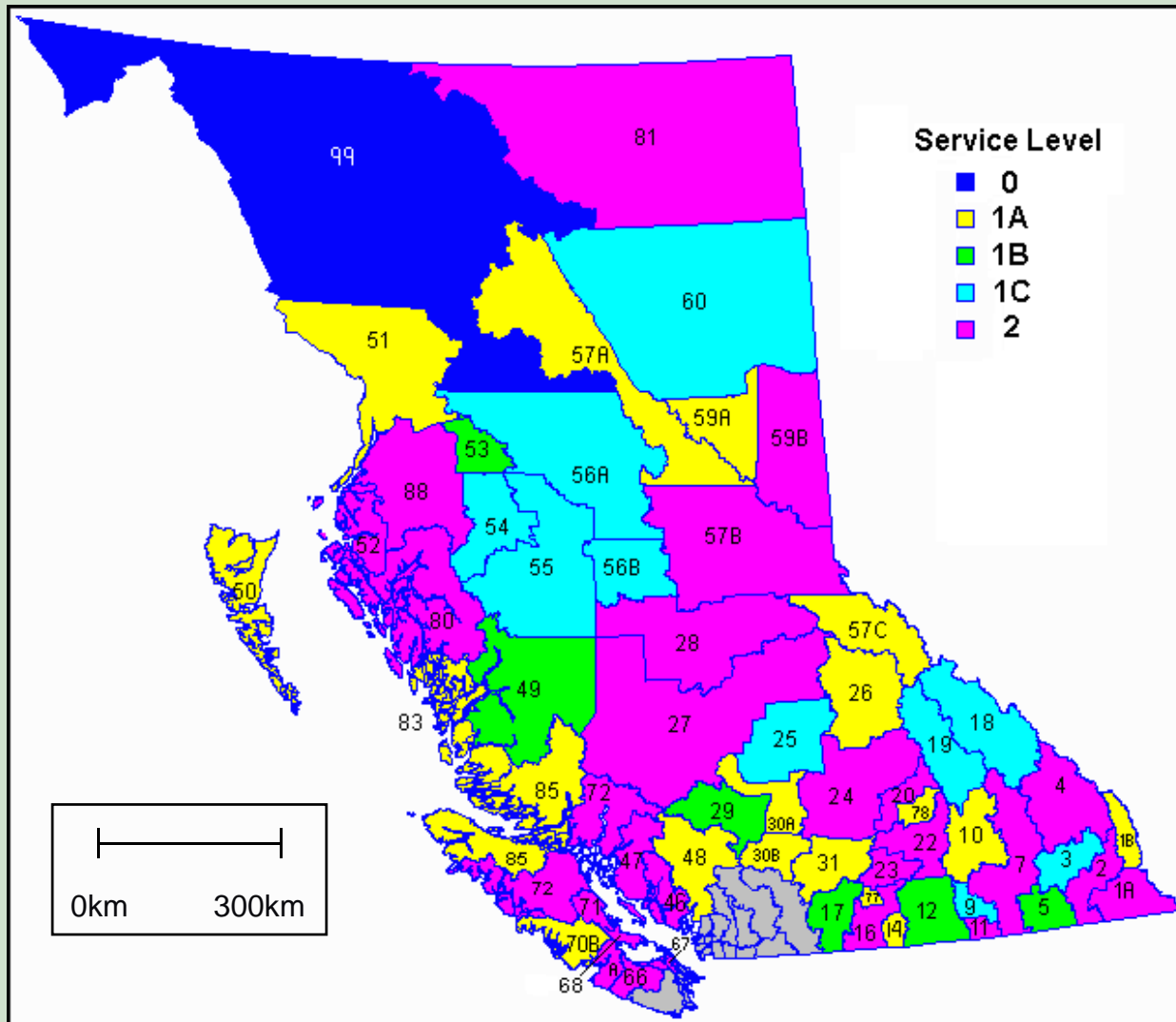
# Phase 1: 1994-1999

- British Columbia Linked Database cohort analysis of maternal/neonatal outcomes data from 1994-1999
- Link perinatal outcomes by residence of mother
- Unique catchment area for each rural hospital using postal codes was defined
- 5 obstetrical care service levels were defined, ranging from no local services to specialist services

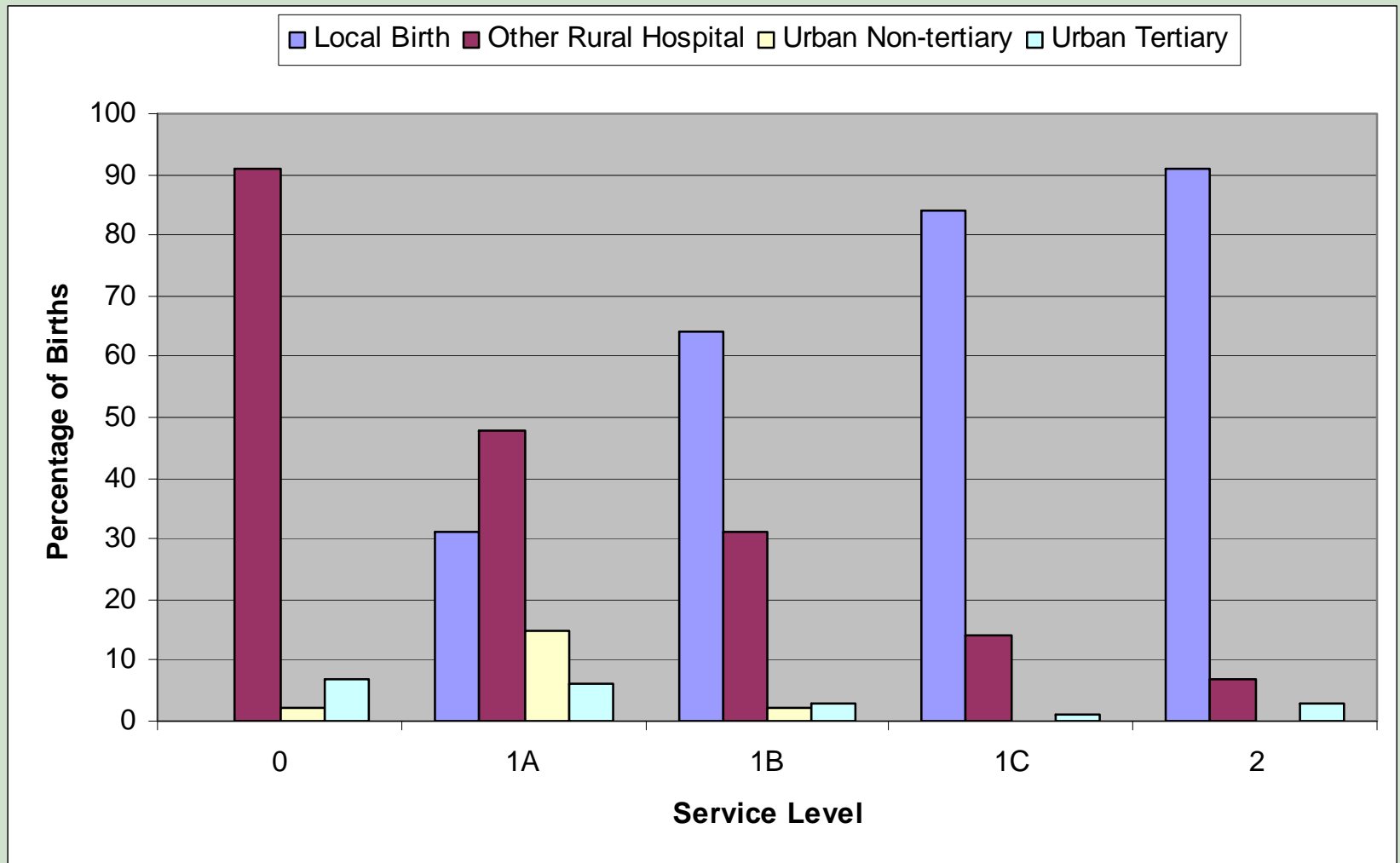
# Definition of Service Level (Phase 1)

Service Level	Definition of Service Level	# of Catchment Areas	# of Births
0	<b>No elective maternity service</b> • 0 births	1	172
1A	<b>No local C-section availability</b> • 0 C-sections	20	7,536
1B	<b>Limited C-section availability</b> • <10 C-sections per year • no obstetrician or gen surgeon living in community	6	2,174
1C	<b>24 Hour C-section availability provided by GP surgeons only</b> • $\geq 10$ C-sections per year • no obstetrician or gen surgeon living in community	10	7,440
2	<b>24 Hour C-section availability provided by specialists</b> • obstetricians and/or gen surgeons living in community	26	52,256
<b>Total</b>		<b>63</b>	<b>69,578</b>

# Definition of Service Level

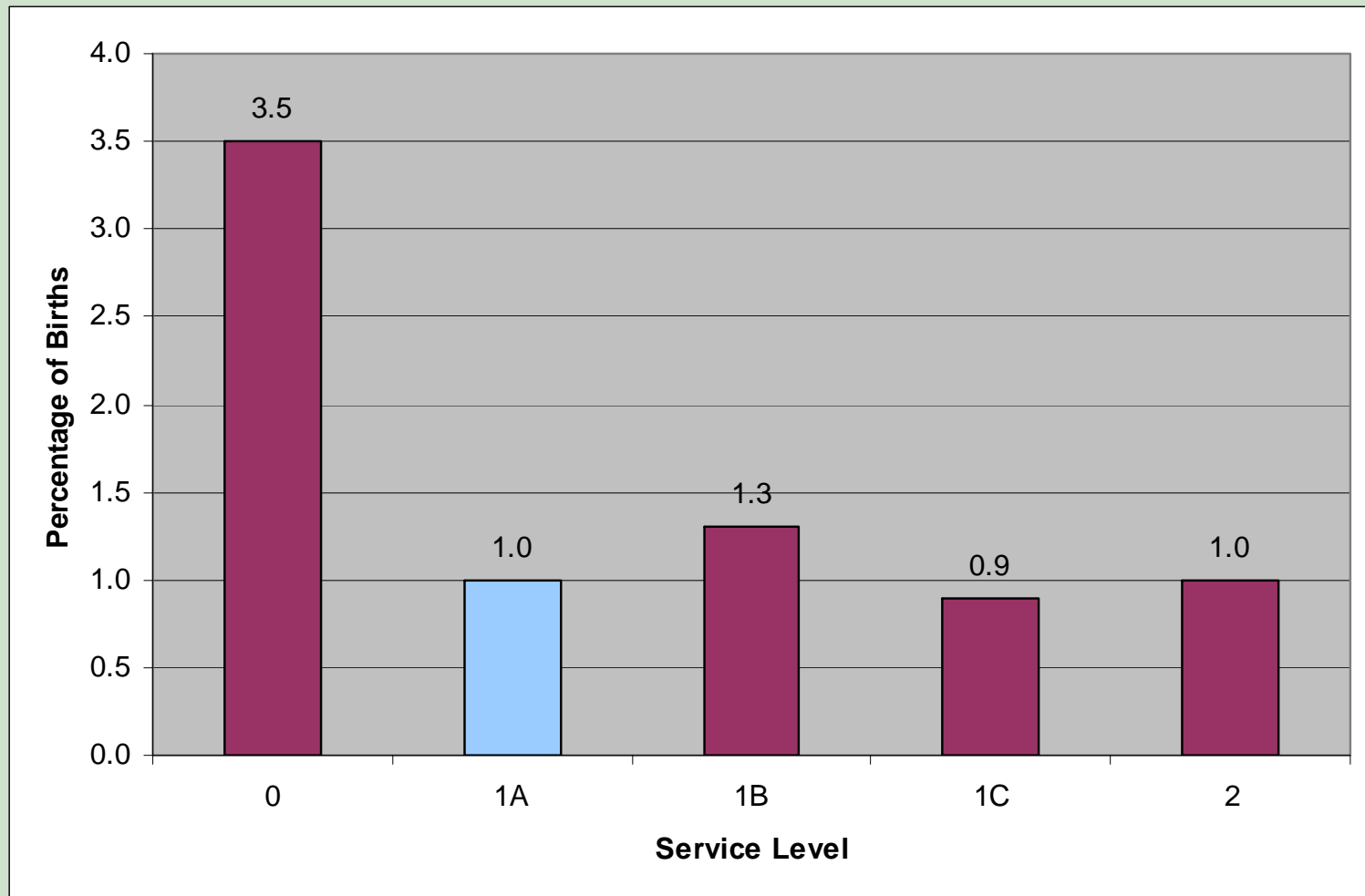


# Location of Birth by Service Level of Mother's Catchment Area (Phase 1)



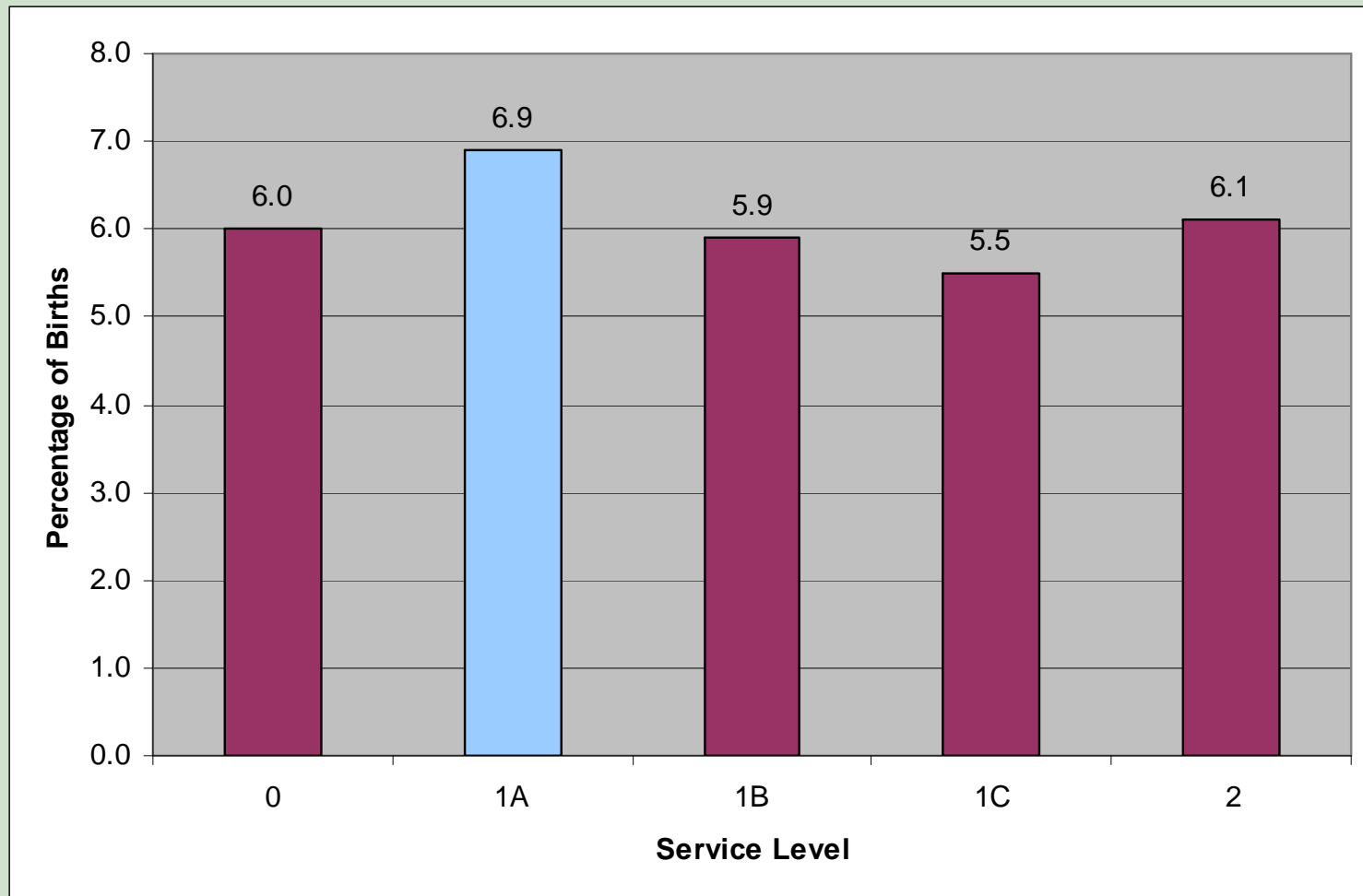
# Perinatal Deaths by Service Level of Mother's Catchment Area (Phase 1)

$p = 0.010$



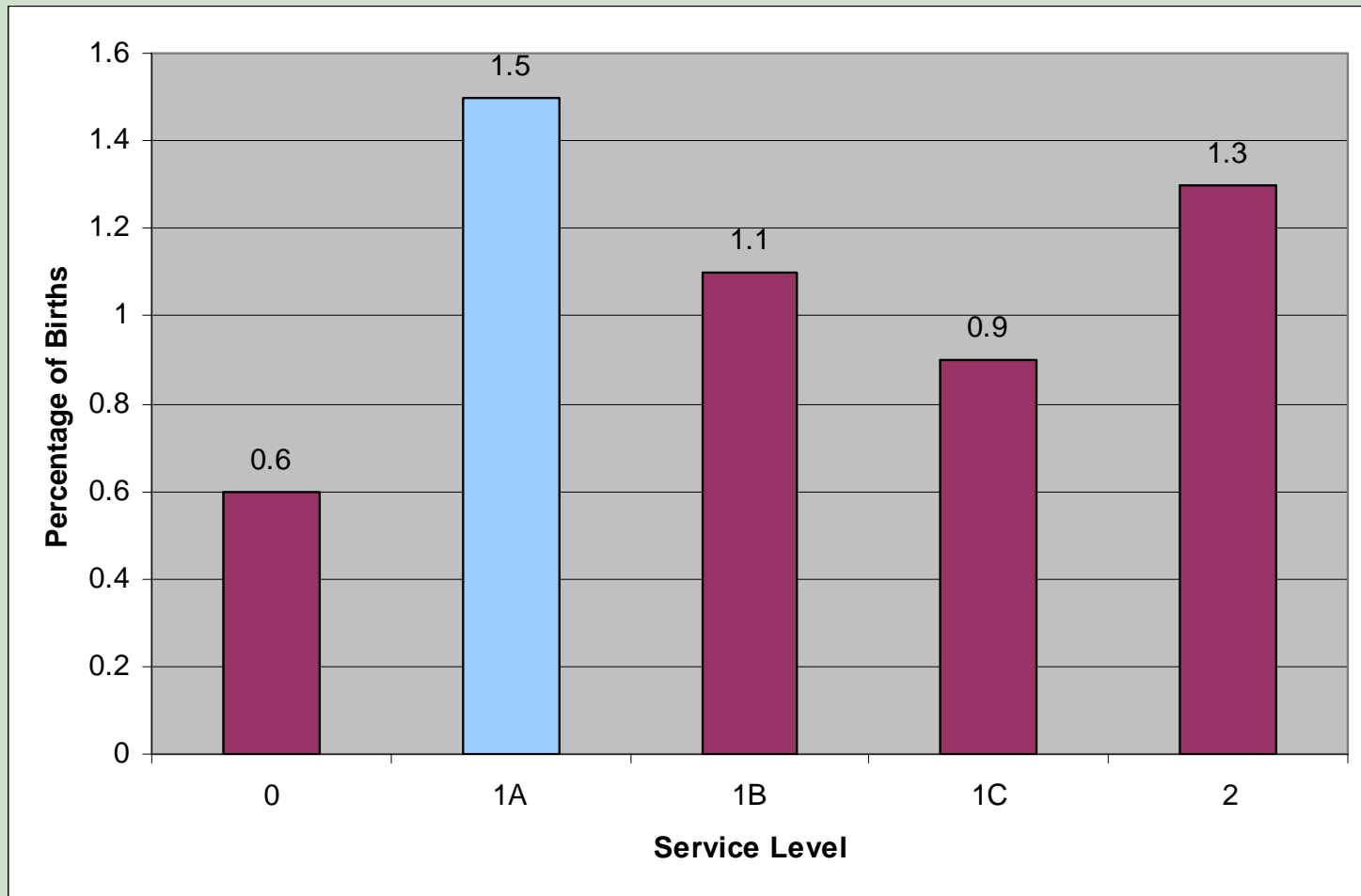
# Prematurity by Service Level of Mother's Catchment Area (Phase 1)

$p = 0.016$



# SCN Admissions by Service Level of Mother's Catchment Area (Phase 1)

$p = 0.022$



# Data Analysis (Phase 1)

- Logistic regression analysis
- Adjusted for Aboriginal ethnicity and socio-economic status.
- Comparisons made to Service Level 1A (no local c-section)
- Outcome Measures:
  - Perinatal Deaths
  - SCN Admissions (Tertiary or ICU)

# Phase 1 Results

- **Perinatal Mortality (Deaths + Stillbirths)**  
No statistically significant difference in perinatal mortality SCN Admissions
- **Level 1C babies are at decreased risk of being admitted to an SCN (OR = .634,  $p = .003$ )**
- **Prematurity**
  - Level 1B, 1C and 2 babies are at decreased risk for prematurity (OR = .774,  $p = .014$ ; OR = .798,  $p = .001$ ; OR = .875,  $p = .009$ )

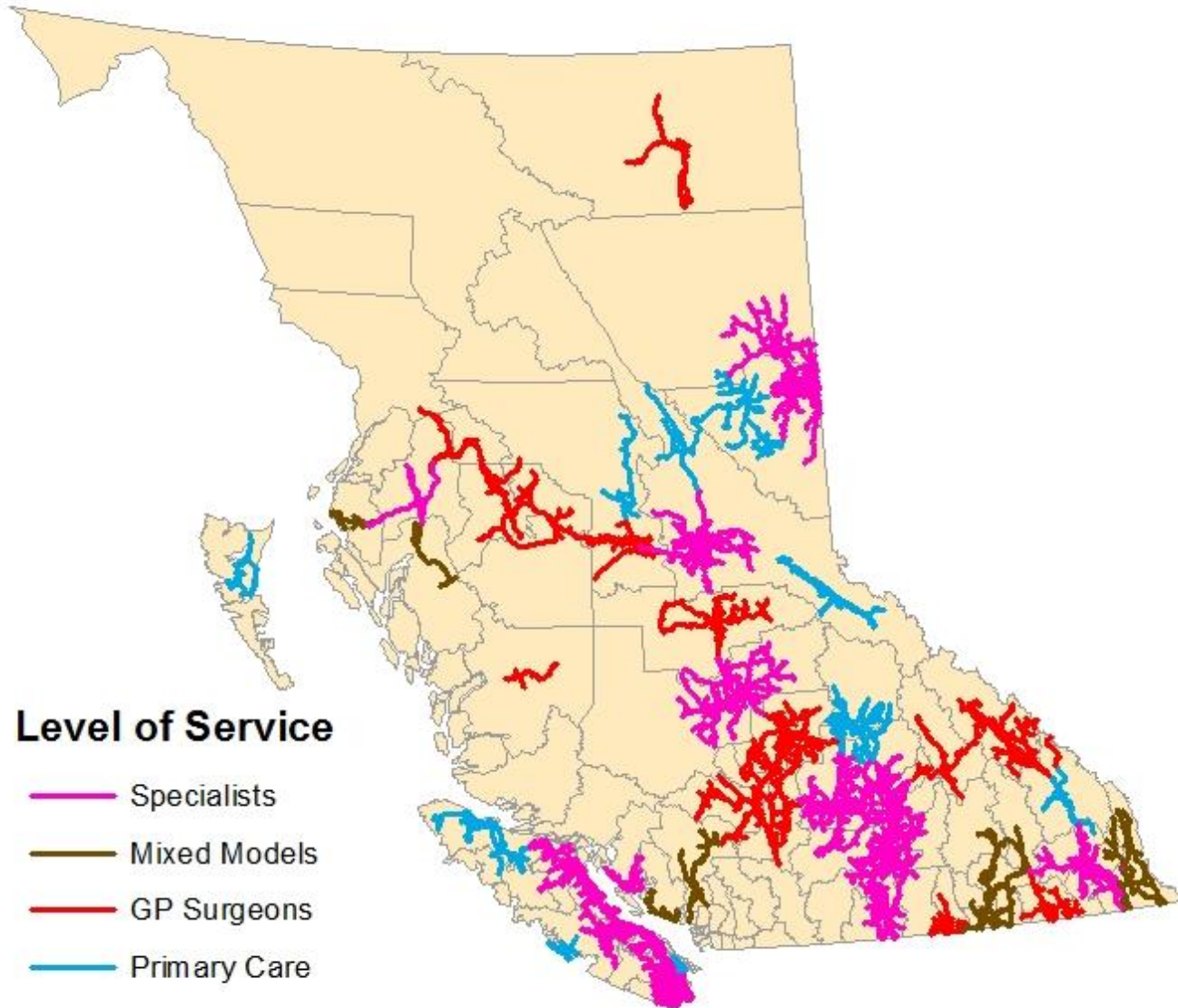
# Phase 1: Conclusions

- Having C-section capability is associated with a greater proportion of deliveries done locally (from 31% to 85%)
- No difference in perinatal mortality (stillbirths and deaths) across service level
- Babies born in Service Level 1 C facilities are at decreased risk of prematurity and SCN admission.

# Phase 2: 2000-2004

- British Columbia Perinatal Health Program Linked Database cohort analysis of maternal/neonatal outcomes for singleton births data from 2000-2004
- Link perinatal outcomes to geographic service catchment by residence of mother (postal code)
- Obstetrical service levels were expanded from 5 to 8, defined by level of service and distance to access services
- Congenital anomalies excluded.

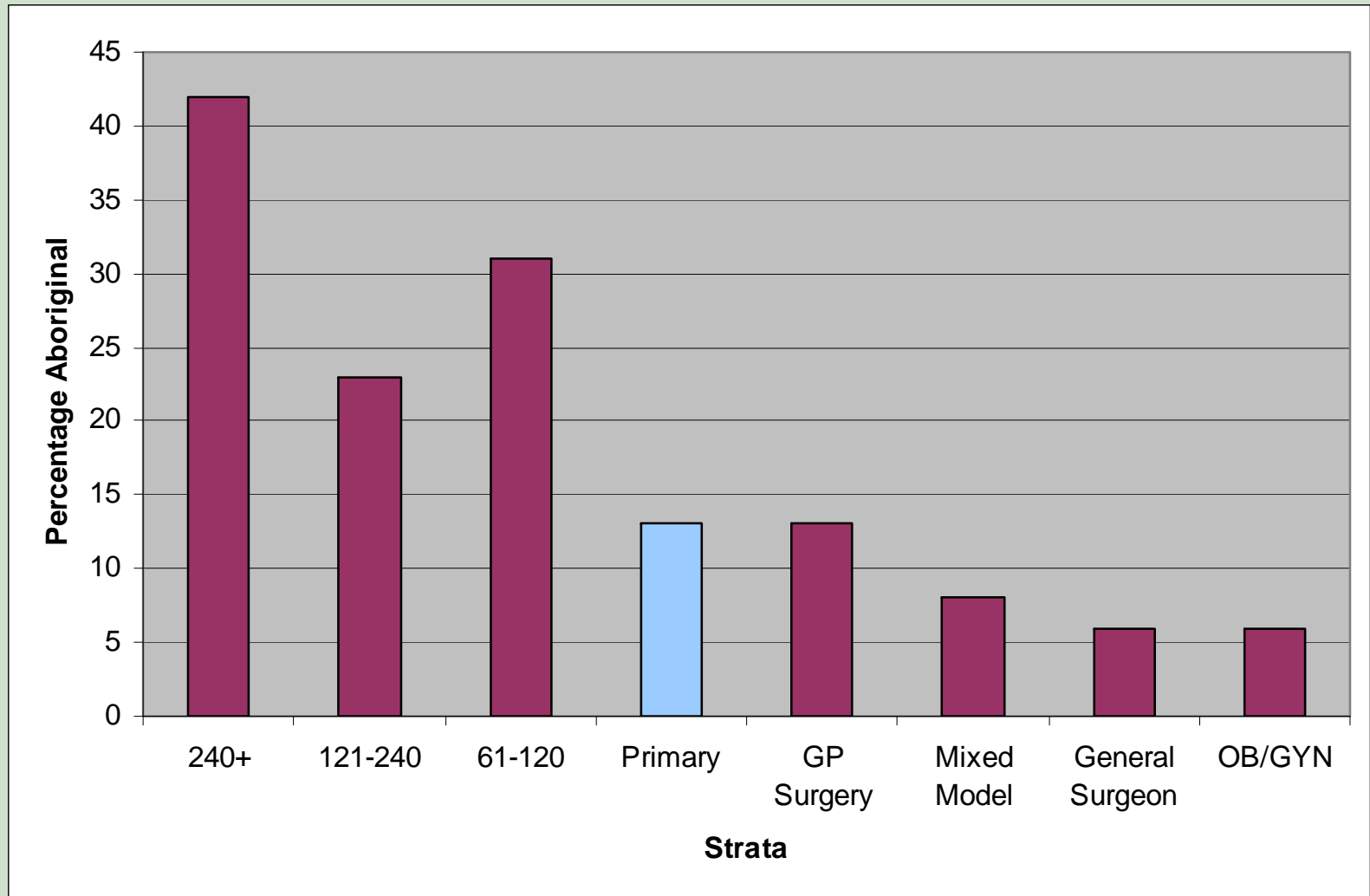
# Local Health Areas Overlayed by 1 Hour Hospital Catchments



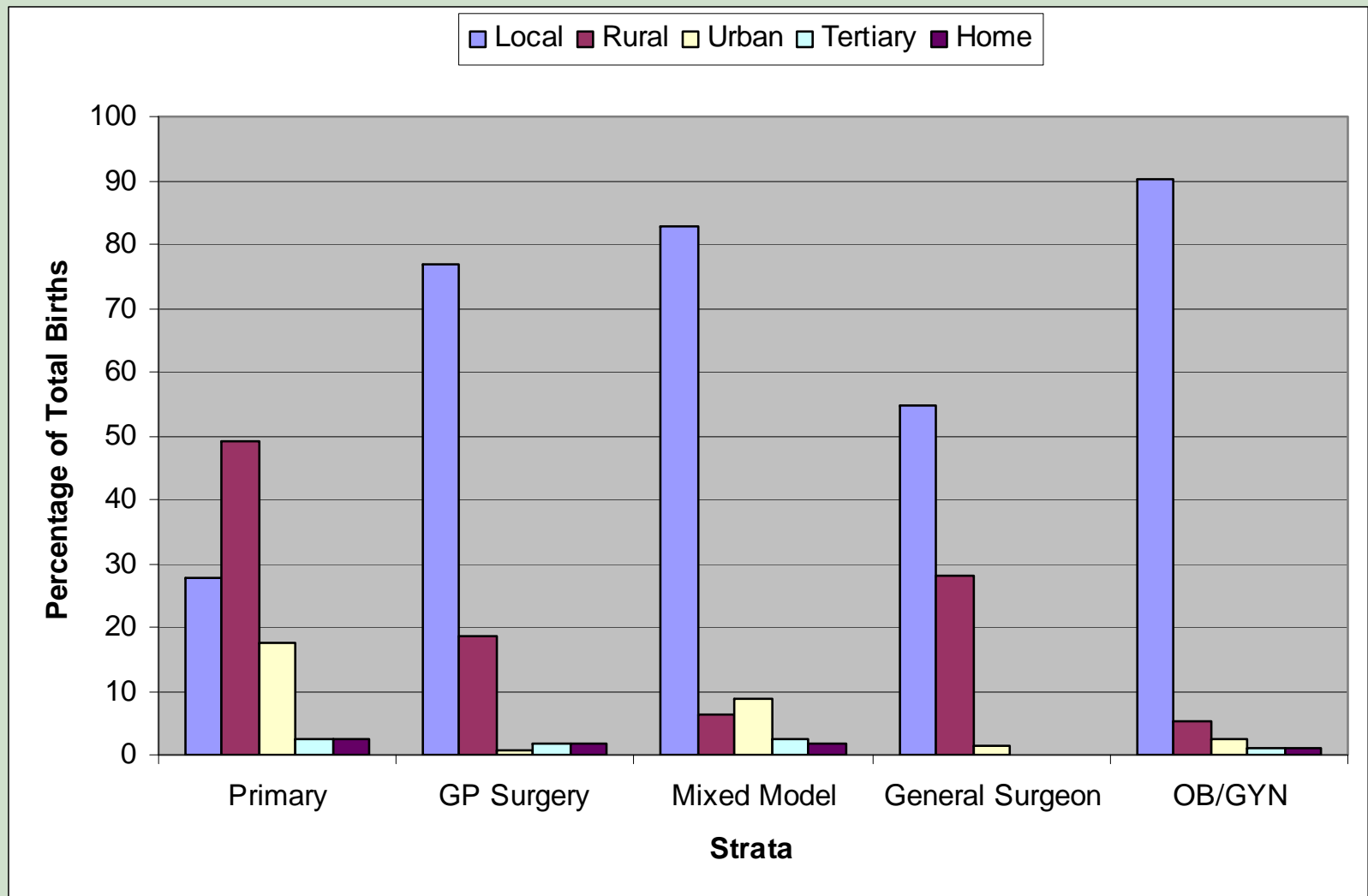
# Definition of Service Level (Phase 2)

Service Level	Definition of Service Level	# of Catchment Areas	# of Births
240+	Greater than 240 minutes (4 Hours) from maternity services	15	526
121-240	121-240 minutes (2-4 Hours) from maternity services	19	766
61-120	61-120 minutes (1-2 Hours) from maternity services	23	1,409
Primary	No local C-section availability (Mat Care Via Family Physician)	16	2,976
GP Surgery	C-section provided by GP surgeons only	20	5,277
Mixed Model	C-section provided by GP surgeon or Specialist	15	6,035
General Surgeon	C-section provided by General Surgeon	2	2,195
OB/GYN	C-section provided by Obstetrician	17	31,530
<b>Total</b>		<b>127</b>	<b>50,714</b>

# Percentage of the Catchment that is Aboriginal by Strata



# Location of Birth by Service Level of Mother's Catchment Area (Phase 2)

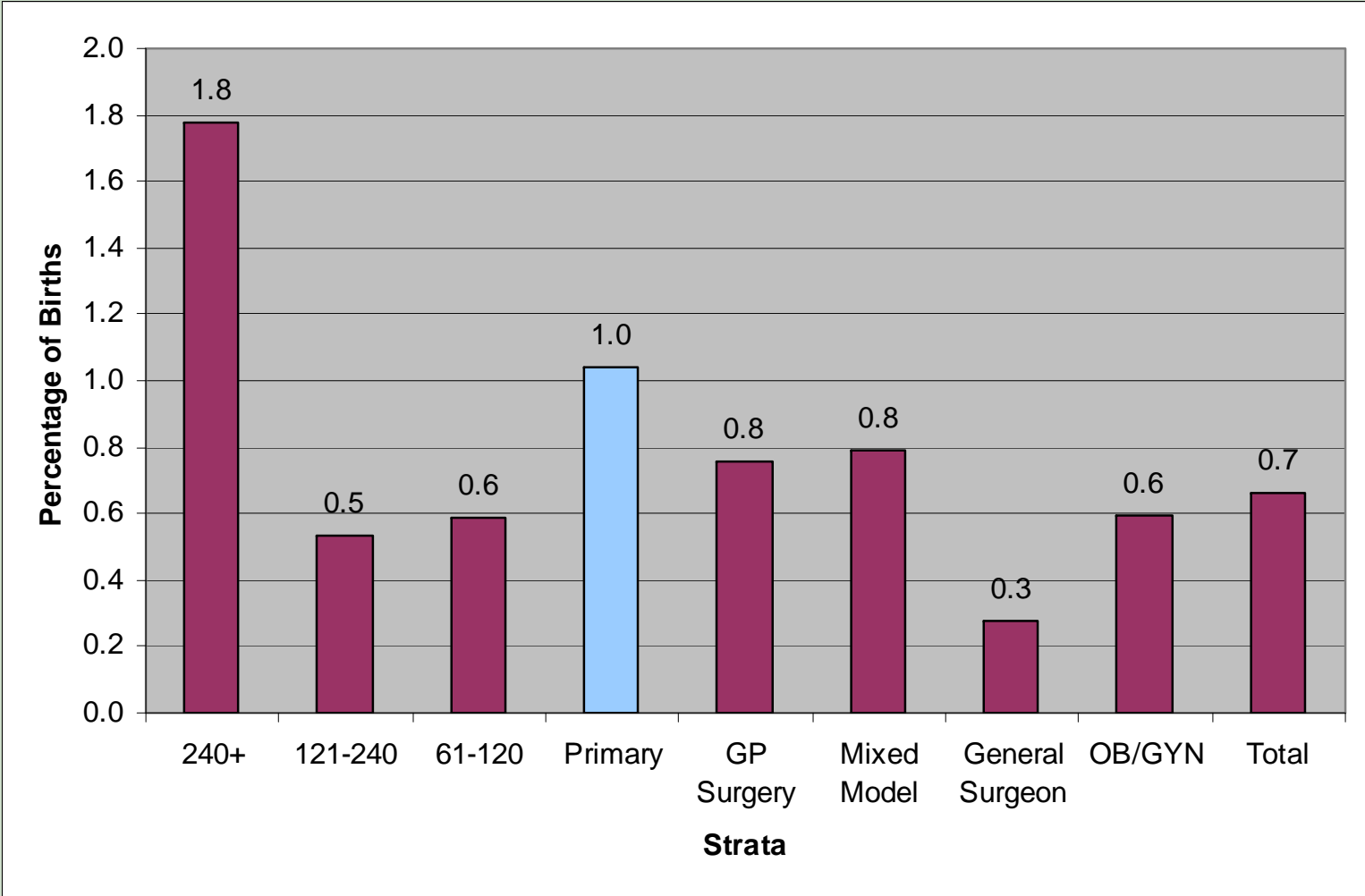


# Bi-Variate Analysis (2000-2004)

- Test for significant associations between service level and selected neonatal outcomes
  - Perinatal Mortality (Stillbirths, Early and Late Neonatal Deaths)
  - Term Death ( $\geq$  37 weeks, stillbirths excluded)
  - Prematurity ( $<$ 37 weeks gestation)
  - NICU II & NICU III Admission Rates
- Anova for continuous variables
- Chi-square for categorical variables

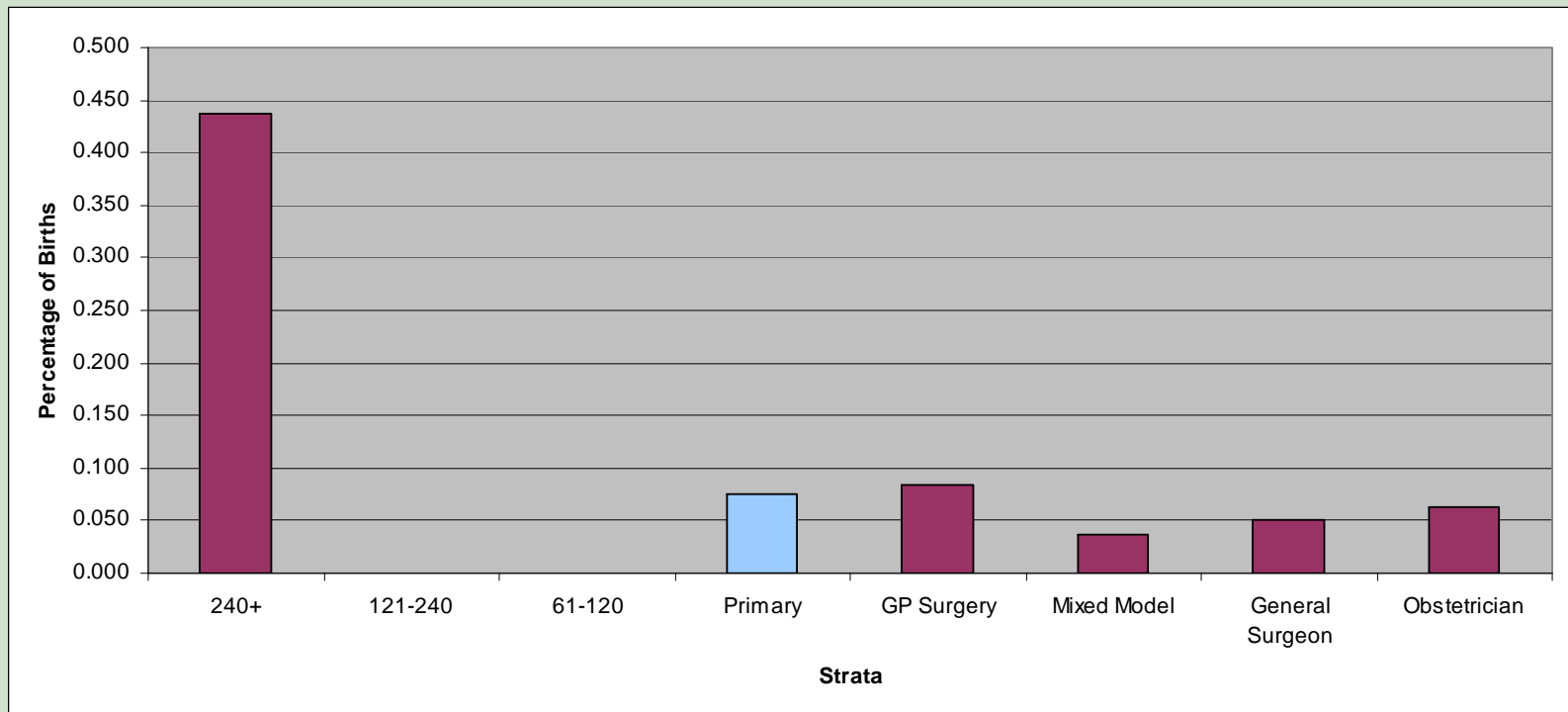
# Perinatal Deaths by Strata (Phase 2)

p = 0.001



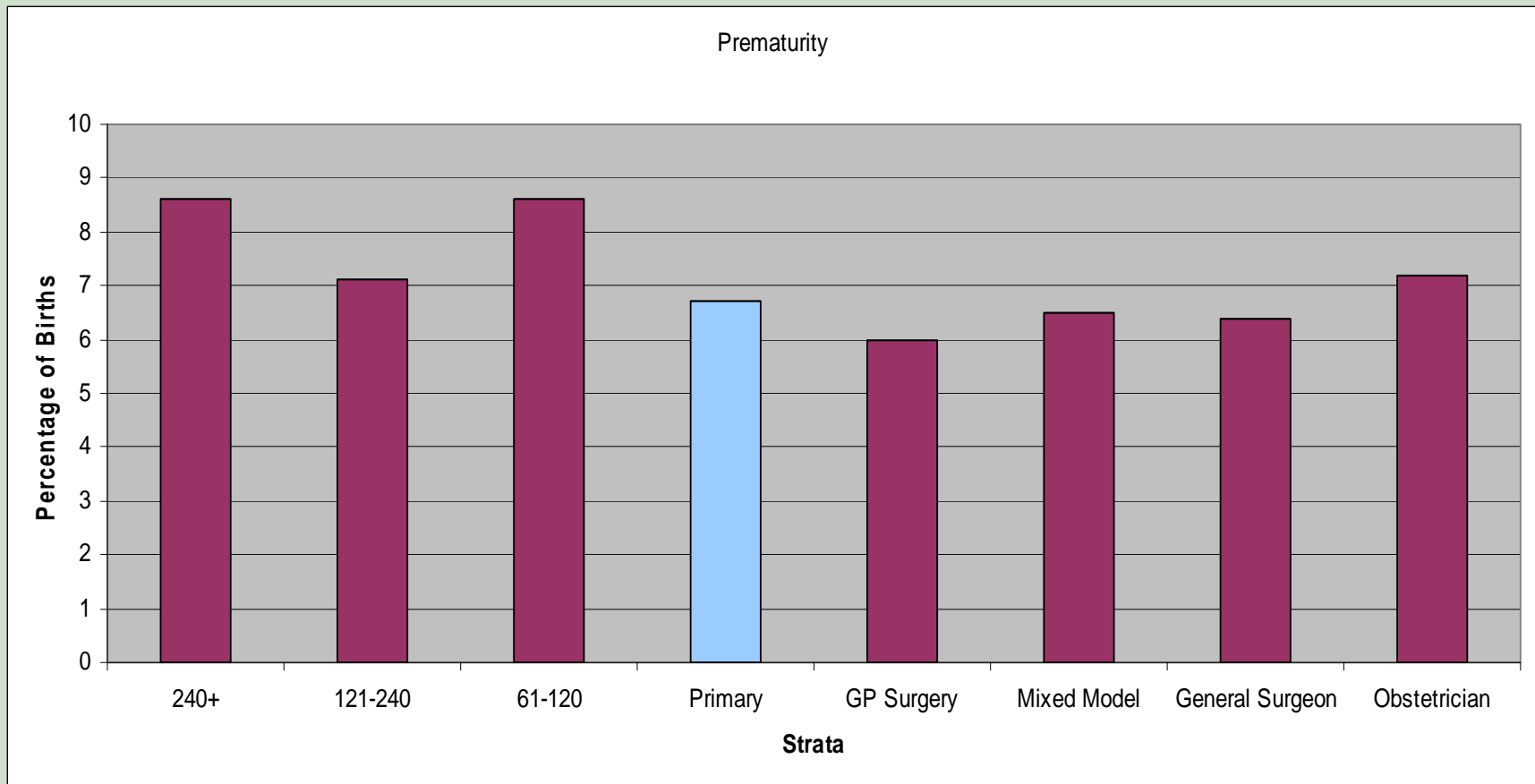
# Neonatal Deaths (= / > 37 wks)

p = N/S



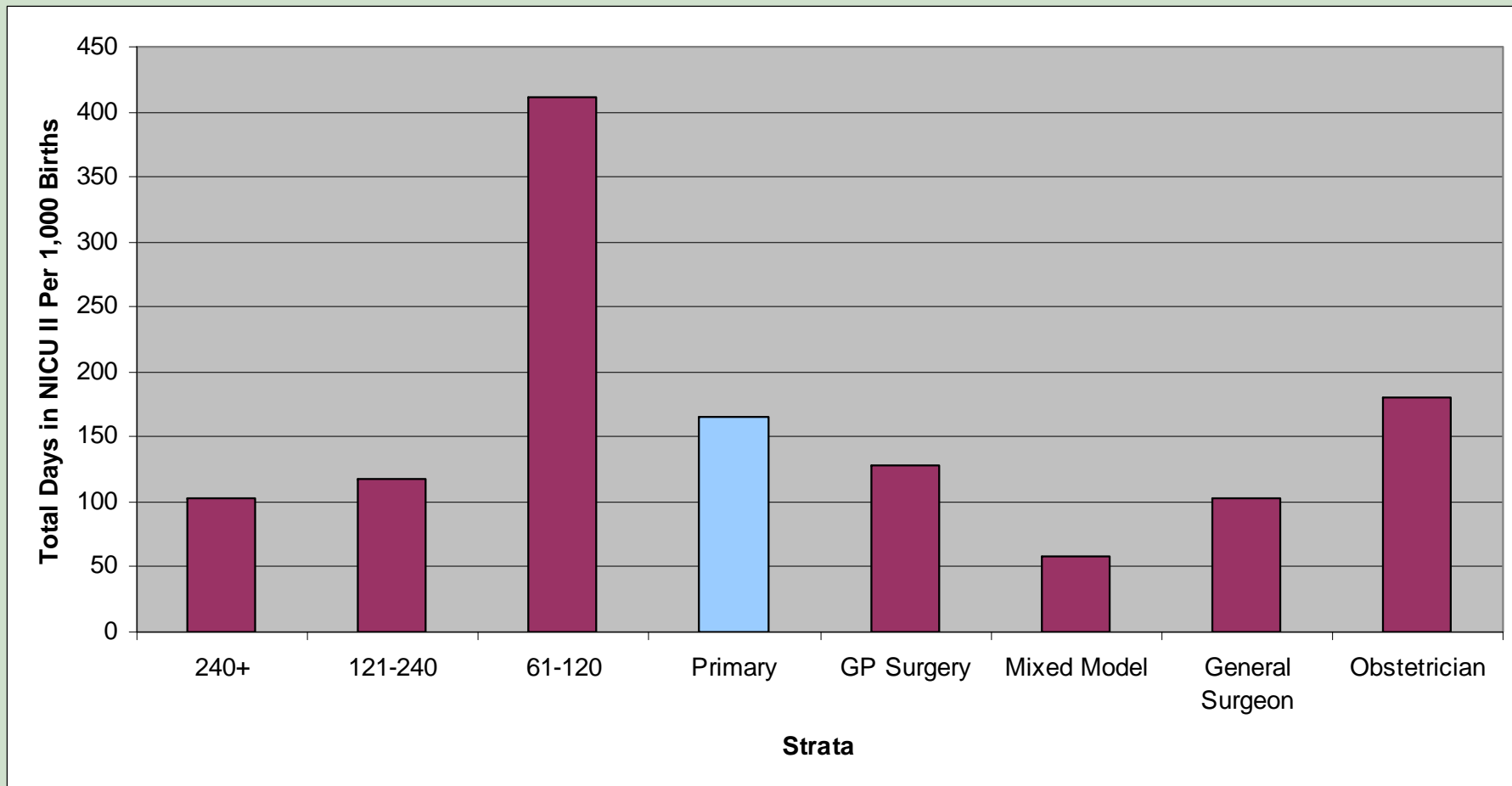
# Prematurity Rates (<37 wks) by Strata (Phase 2)

p = .004



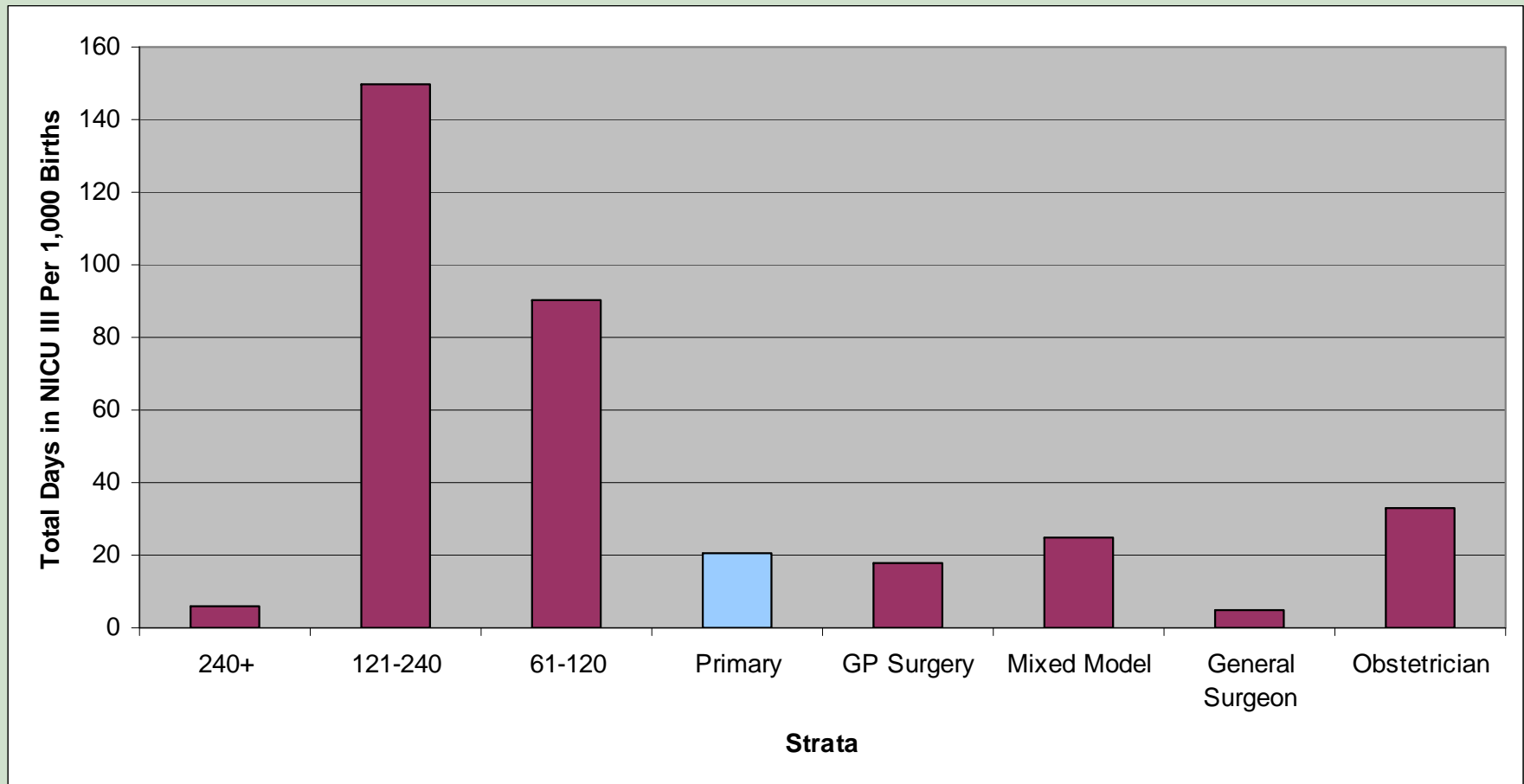
# Total Number of Days in NICU II Per 1,000 Births (Phase 2)

$p < .001$



# Total Number of Days in NICU III Per 1,000 Births (Phase 2)

p=.003



# Regression Analysis: Phase 2

- The primary aim of the regression analysis was to determine whether service level may explain variations in adverse neonatal outcomes, perinatal mortality in particular:

We wanted to control for two sets of variables:

- (1) Maternal characteristics such as age, parity, and BMI
- (2) Catchment social vulnerability and proportion of Aboriginal people residing within catchment

# Challenges

- The prevalence of adverse neonatal outcomes is very low
- Logistic regression analysis is not robust with outcome variables with a prevalence of  $< 10\%$
- Social vulnerability and aboriginal ethnicity variables were at the catchment, not the individual level

**More to Follow**

# Data Management

- We created two datasets to address these challenges:
- Dataset 1: Each case represents one of approx. 100 catchments.
- Neonatal outcomes were expressed as rates per 1000 live births
- Maternal characteristics were averaged for each catchment
- Social vulnerability and aboriginality are now analyzed at the catchment level

# Data Analysis

- We dummy coded obstetric level into 7 levels plus one reference category
- Included obstetric service levels, social vulnerability, aboriginality, maternal BMI > 25 and maternal age > 35 as predictors.
- When running the linear regression analyses, we weighted by size of catchment

# Results (Dataset 1)

Outcome variable: Perinatal mortality

Significant predictors:

- Mothers that were assigned obstetric level 1
- Mothers with a pre-pregnancy BMI > 25

# Results (Dataset 1)

Outcome variable: Term Deaths

Significant predictors:

- Mothers that were assigned obstetric level 1
- Mothers with a pre-pregnancy BMI > 25
- Mother older than 35

# Results (Dataset 1)

Outcome variable: LBW ( $< 2500$  grams)

No significant predictors

# Results (Dataset 1)

Outcome variable: Average number of days in NICU 2 (per catchment)

Significant predictors

- Mothers from a catchment deemed more socially vulnerable
- Mothers that were assigned obstetric level 3

# Results (Dataset 1)

Outcome variable: Average number of days in NICU 3 (per catchment)

- Mothers from a catchment deemed more socially vulnerable

# Limitations

## Bivariate Analysis:

Large number of cases = significance is easy to achieve

## Regression Analysis:

Some of the outcomes variables, such as NICU 2 and 3 admissions are not distributed normally, with severe outliers (e.g. some babes are in NICU 1 day, others over 50 days).

These results must be interpreted with caution

# Next Steps

- Analyze perinatal mortality stats for 2004-7 (Phase 3)
- Repeat logistic regression analysis after matching for all mortality cases, this time including TIME as a predictor:
  - 0 = 2000-2004
  - 1 = 2004-2007