

Epidemiology of obstetrical outcomes for rural women:

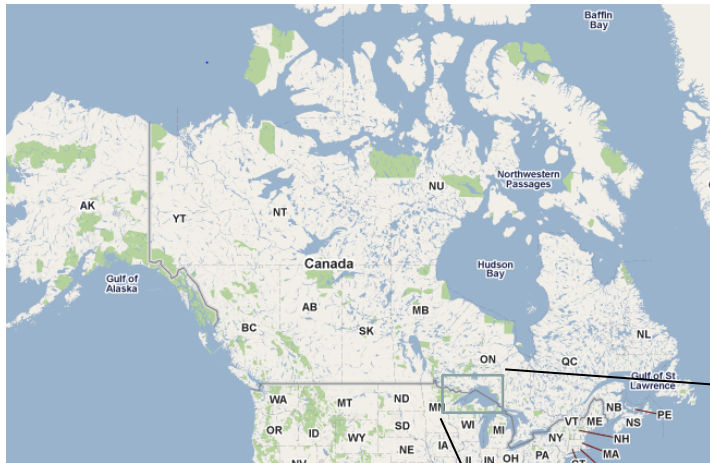
An examination of residential proximity and
hospital level of service

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Conflict Disclosure



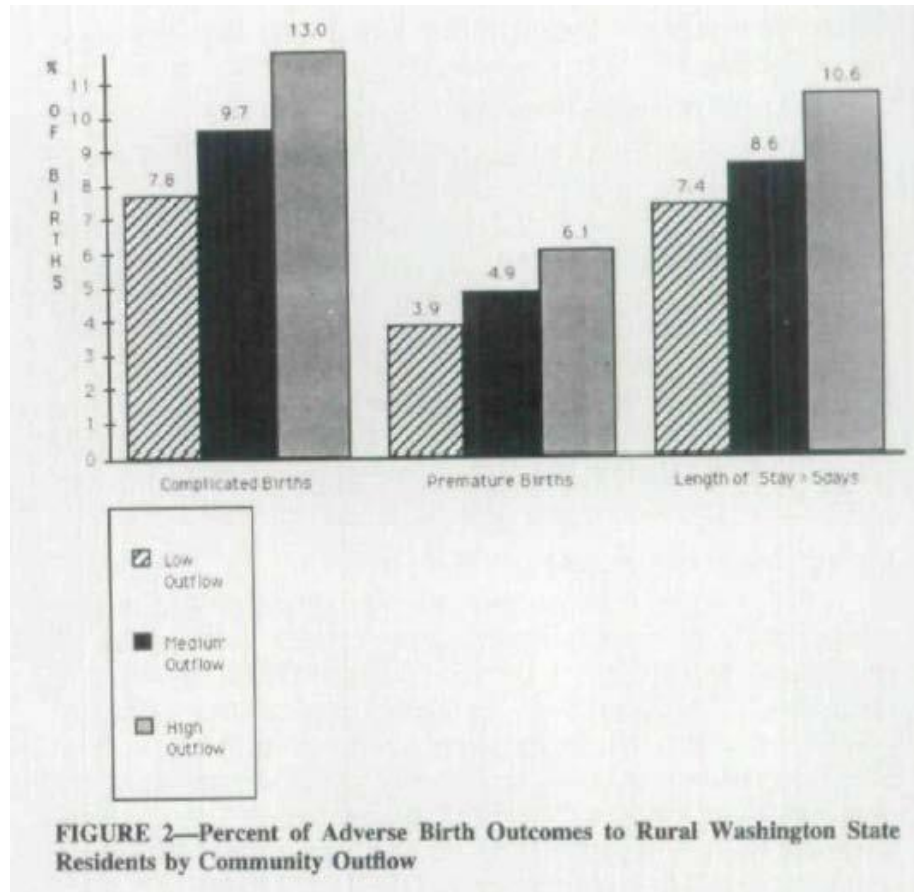


Rural obs programs closing



- **Northern Ontario**
 - ❖ 1981 – 3 hospitals without services
 - ❖ 1999 – 15 hospitals without services
- **British Columbia**
 - ❖ 30 program closures in recent years
- **Newfoundland**
 - ❖ Port-Aux-Basques, others

Neonatal outcomes worse



Nesbitt Am J Public Health 80: 814-8, 1990

Neonatal Outcomes Worse

TABLE 4—Logistic Regression Results for Various Birth Outcomes for Privately and Medicaid Insured Residents of High- vs Low-Outflow Communities in Rural Washington State, 1987 to 1989

	Non-Normal Neonate (DRGs 386, 387, 388, 390)		Infant Charges >\$1500		Infant Charges >\$3000		Infant Stay >5 Days	
	Insured	Medicaid	Insured	Medicaid	Insured	Medicaid	Insured	Medicaid
Independent variable of interest: high outflow (95% CI)	1.30*	1.22*	2.34*	1.28	2.28*	1.57**	2.01*	1.15
	(1.17, 1.44)	(1.05, 1.40)	(1.89, 2.92)	(.96, 1.69)	(1.68, 3.11)	(1.07, 2.32)	(1.52, 2.67)	(.80, 1.66)

Nesbitt, Am J Public Health 87: 85-90, 1997



Travel time/outcomes

Table 4 Hierarchical logistic regression results for newborn outcomes

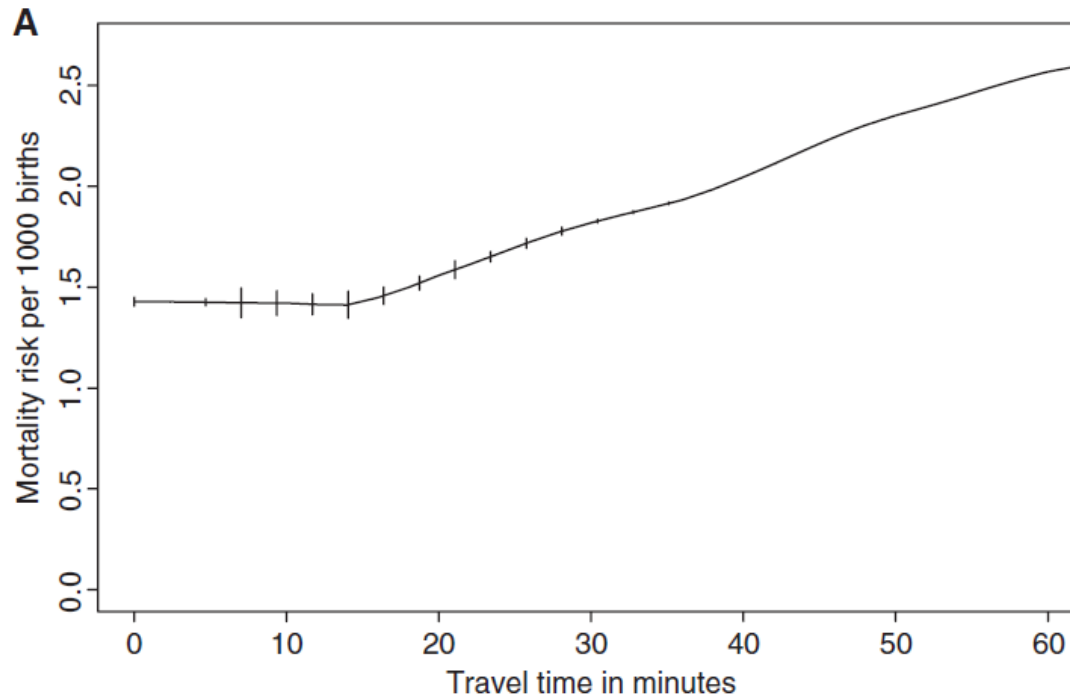
		Perinatal Mortality N = 49,402	
		OR	95% CI
Step 3: Obstetric Service Level			
Level 1	>240 minutes	3.17	(1.45, 6.95) **
Level 2	120-240 minutes	0.92	(0.33, 2.53)
Level 3	60-120 minutes	1.04	(0.48, 2.22)
Level 4	GP only obstetrics	1.44	(1.08, 1.93)*
Level 5	GP surgeon or specialist	1.46	(1.05, 2.03)*

* P-value < .05 ** P-value < .01 *** P-value < .001

Reference is specialist centre

Grzybowski et al. *BMC Health Services Research* 2011, **11**:147

Travel time/outcomes



Please cite this paper as: Ravelli A, Jager K, de Groot M, Erwich J, Rijninks-van Driel G, Tromp M, Eskes M, Abu-Hanna A, Mol B. Travel time from home to hospital and adverse perinatal outcomes in women at term in the Netherlands. BJOG 2011;118:457–465.

Volume/Outcome - VLBW

Table 3. Odds Ratios for Mortality among Very-Low-Birth-Weight Infants, According to NICU Level of Care and Annual Patient Volume.*

Level of Care and No. of Infants	Odds Ratio (95% CI)	P Value
Level 1		
≤10	2.72 (2.37–3.13)	<0.001
>10	2.39 (1.91–3.00)	<0.001
Level 2		
≤10	2.53 (2.02–3.18)	<0.001
11–25	1.88 (1.56–2.26)	<0.001
>25	1.22 (0.98–1.52)	0.08
Level 3A		
≤25	1.69 (1.28–2.24)	<0.001
26–50	1.78 (1.35–2.34)	<0.001
>50	1.08 (0.96–1.21)	0.22
Level 3B or 3C		
≤25	1.51 (1.17–1.95)	<0.002
26–50	1.30 (1.12–1.50)	<0.001
Level 3B, 3C, or 3D		
51–100	1.19 (1.04–1.37)	0.01
>100	1.00	

* The area under the receiver-operating-characteristic curve was 0.86. The reference group was hospitals with a level 3B, 3C, or 3D NICU that treat at least 100 very-low-birth-weight infants per year. Standard errors were corrected for clustering of patients within hospitals. The model included birth weight, gestational age, sex, multiple gestation, black race, maternal educational level, type of insurance, year (2000 was the reference variable), several obstetrical conditions (premature rupture of the membranes, fetal distress, placental complications, polyhydramnios, and oligohydramnios), and fetal and neonatal conditions (small for gestational age, exceptionally large for gestational age, hydrops, and hemolytic disorders). Infants with major congenital anomalies or a birth weight below 500 g were excluded.

Phibbs, NEJM 356:2165-2175, 2007

Volume/Outcome

Table III—Perinatal loss rates in communities of northern Ontario

Community type	No. of newborns from community	No. of perinatal deaths			
		Stillbirths	Neonatal deaths		Total per 1000 newborn admissions* (and 95% confidence limits)
			< 8 days after birth	8–28 days after birth	
0	216	1	2	0	13.89 (2.87; 40.60)
IA	1 165	8	6	2	13.73 (7.85; 22.30)
IB	2 115	20	10	1	14.66 (9.58; 20.80)
IC	4 313	31	14	0	10.43 (7.61; 13.96)
ID	1 808	14	9	0	12.72 (8.06; 19.09)
II	14 836	111	68	1	12.13 (10.37; 13.89)
Unassigned	71	3	0	0	42.25 (8.71; 123.52)
Total	24 524	188	109	4	12.27 (10.89; 13.65)

Black, CMAJ 130 (5): 571, 1984

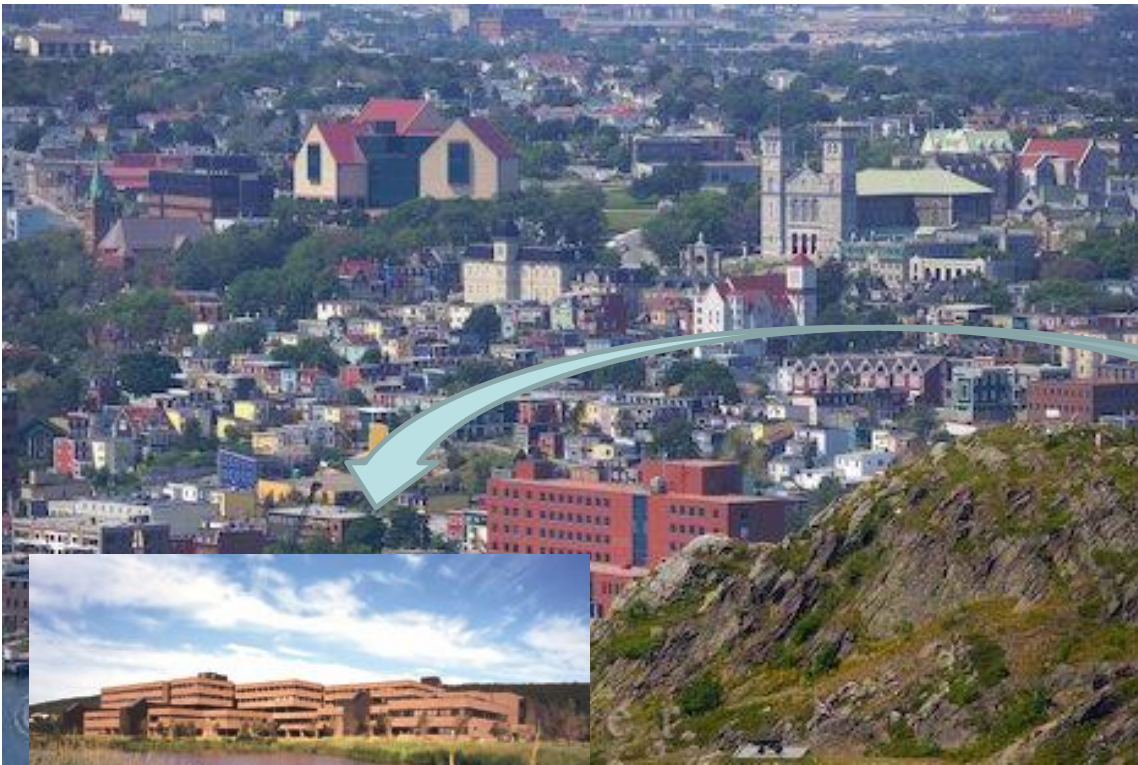
Volume/Outcome – Low Risk

Study population Dependent variable	Babies born in Hesse (1990–1999)	
	Early-neonatal death Normal birthweight ^b Odds ratio (95% CI)	Normal birthweight born at term ^c Odds ratio (95% CI)
Size of birth clinic (births/year)		
Very small (≤ 500)	3.48 (2.62–4.62)	3.48 (2.50–4.84)
Small (501–1000)	1.84 (1.45–2.35)	1.87 (1.38–2.55)
Intermediate (1001–1500)	1.43 (1.00–2.03)	1.41 (1.01–1.97)
Large (> 1500)	Ref.	Ref.

Heller Int. J. Epidemiol. 31(5): 1061, 2002

Heller et al.

- **Dramatic RR = 3.48**
- **Baseline Risk Large = 0.016%**
- **Baseline Risk Small = 0.052%**
- **NNH = 2778**



Conflicting Information

- **Communities with no obstetrics
– worse outcomes (Nesbitt)**
- **Smaller hospitals – worse
outcomes (Heller)**

Methods



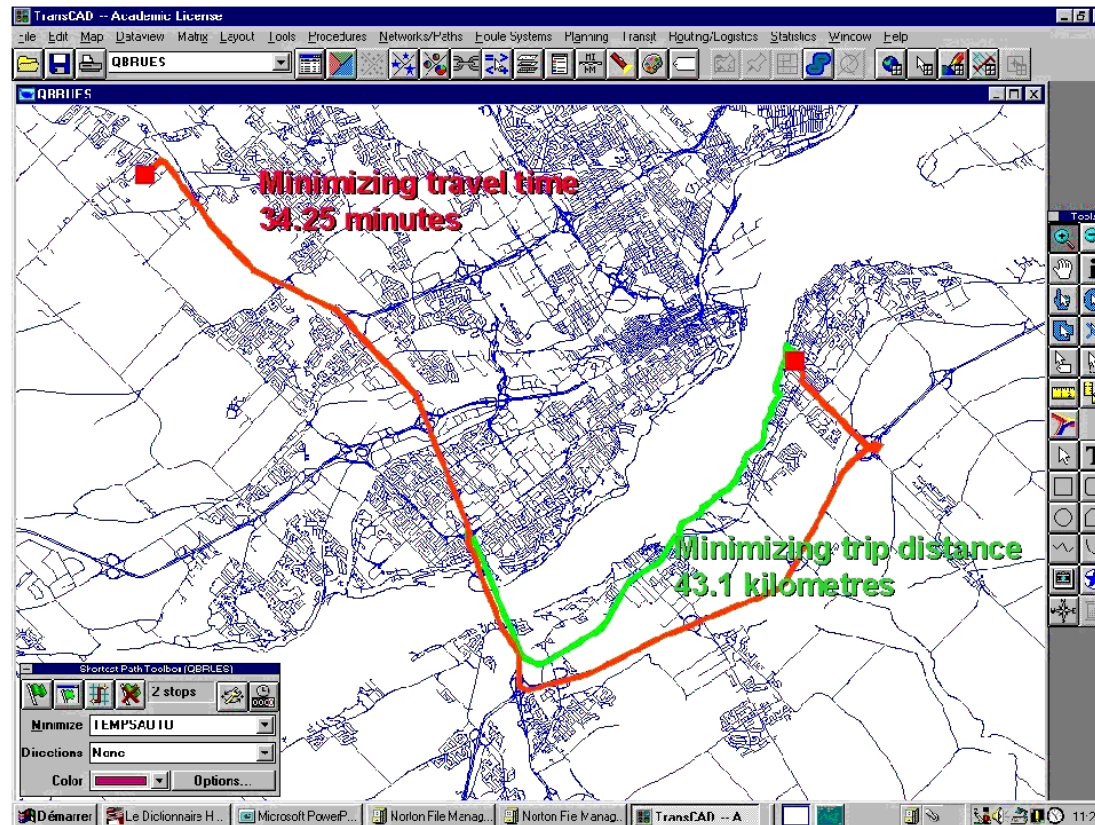
- **Retrospective Cohort**
- **CIHI Administrative Data**
- **Maternal and Neonatal Records**
- **Multi-level Regression**

Co-primary Outcomes

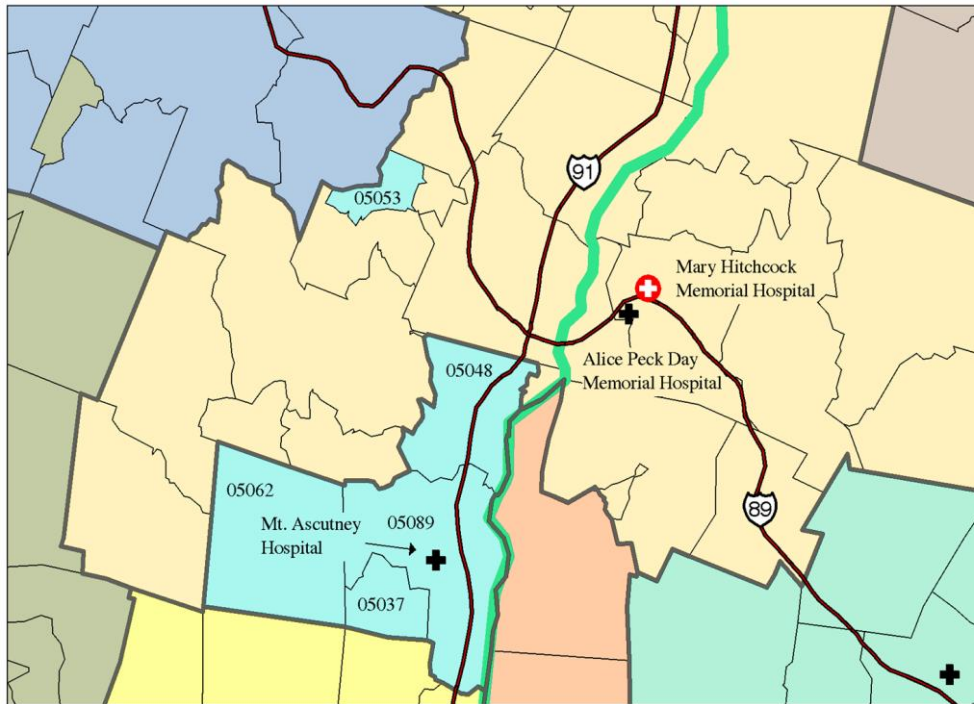


- **In-hospital perinatal mortality (before 7 days of life or if continuously hospitalized)**
- **Maternal morbidity and mortality**

Geospatial Travel Times



Hospital Catchments



Reference # 2

Small Area Analysis

Wennberg, 1996

Hospital Levels



Level 0

- : <10% of deliveries



Level 1

- A: <5 csections/year
- B: GP Surgeon
- C: General Surgeon
- D: Obstetrician



Level 2

- >20 deliveries 32-34 wks



Level 3

- A: No major surgery
- B: Major surgery, no cardiac
- C: Cardiac surgery



Level 3 subtypes



Procedure	Diagnosis
For Level 3b	
Repair of omphalocele	Omphalocele
Repair of gastroschisis	Gastroschisis
Repair of Tracheoesophageal fistula	Tracheoesophageal fistula
Esophageal anastomosis	Esophageal atresia
Small bowel resection/repair	Necrotizing Enterocolitis
Large bowel resection	Necrotizing Enterocolitis
Total colectomy	Necrotizing Enterocolitis
Ligation of PDA	Patent Ductus Arteriosus
Repair of myelomeningocele	Myelomeningocele
Insertion of VP Shunt	Congenital hydrocephalus
For Level 3c	
Cardio pulmonary bypass	Congenital anomalies of heart
ECMO	Congenital anomalies of heart

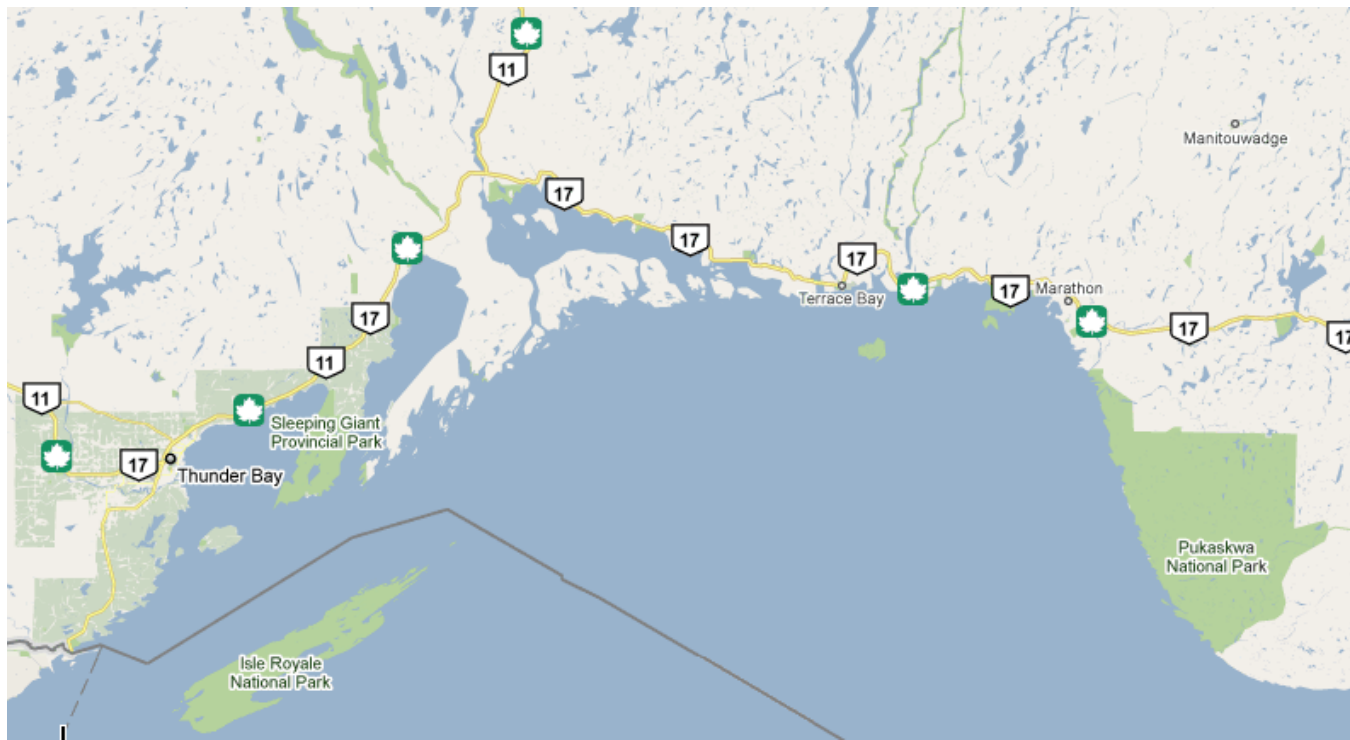
Other Variables



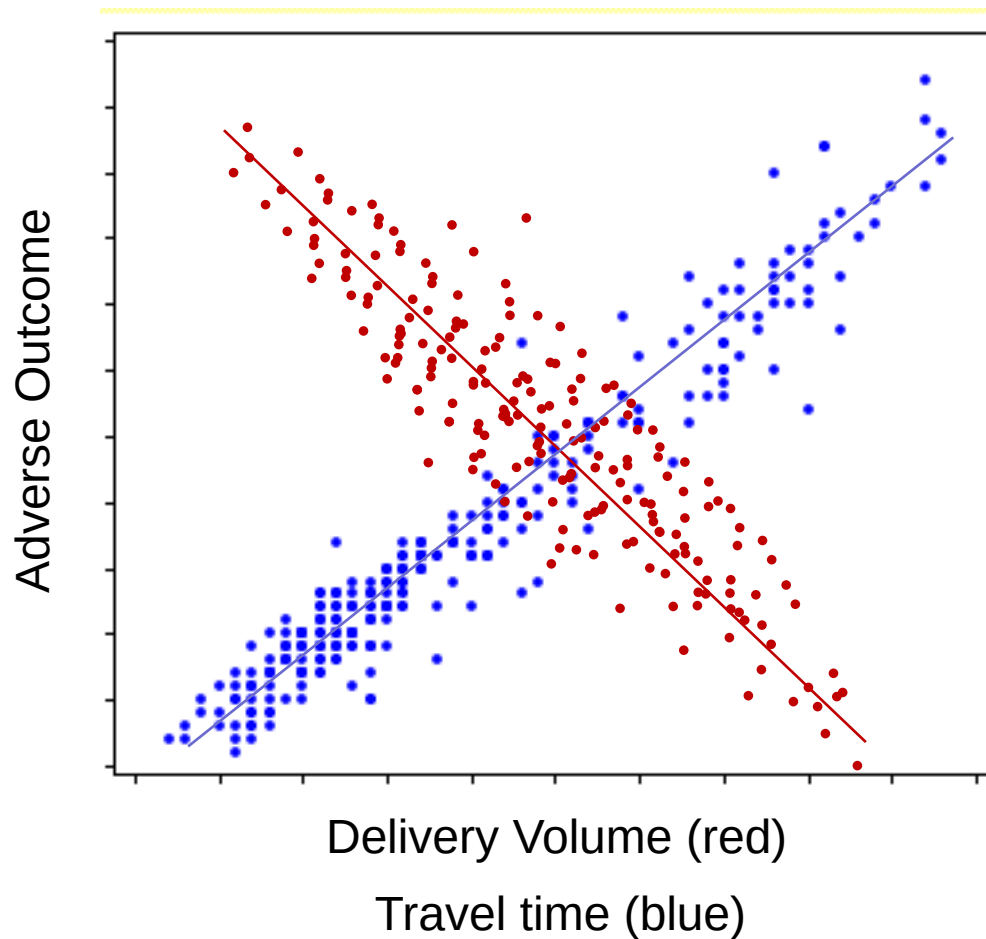
- **Socioeconomic**
- **Hospital Volume**
- **Provider Volume**
- **Specialty of Provider**

Analyses

- Distance /Hospital Level Interaction



Distance/Volume Relationship



Planning Tool

Regression Equation

$$Y = \beta_1 X_1 + \beta_2 X_1 + \beta_3 X_1 + \beta_4 X_1 + \epsilon_1$$

Where:

Y = *Hospital Level of Service*

X_1 = *Community obstetrical volume*

X_2 = *Road distance to higher hospital*

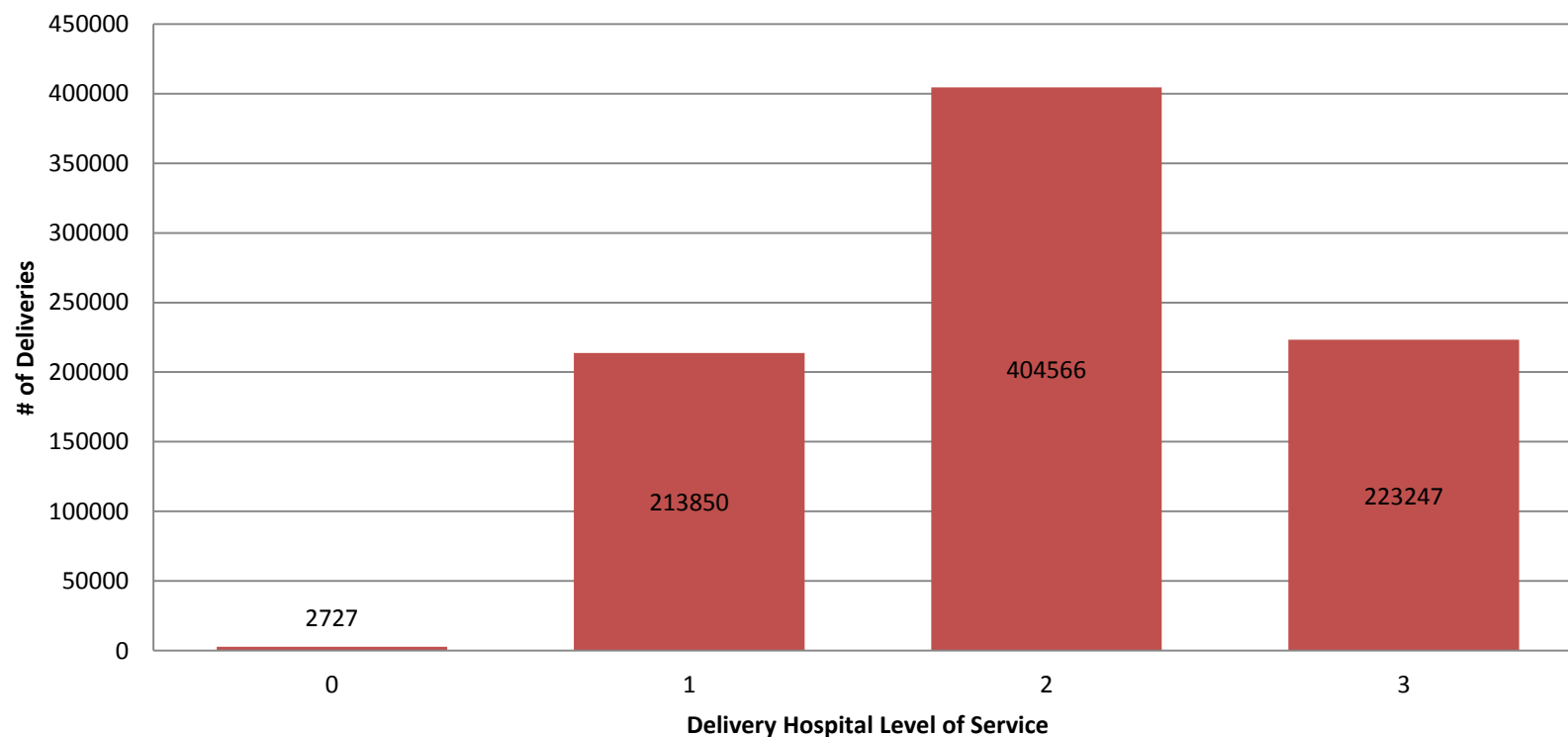
X_3 = *Socioeconomic status*

X_4 = *Cultural makeup*

β_i = *Regression coefficients*

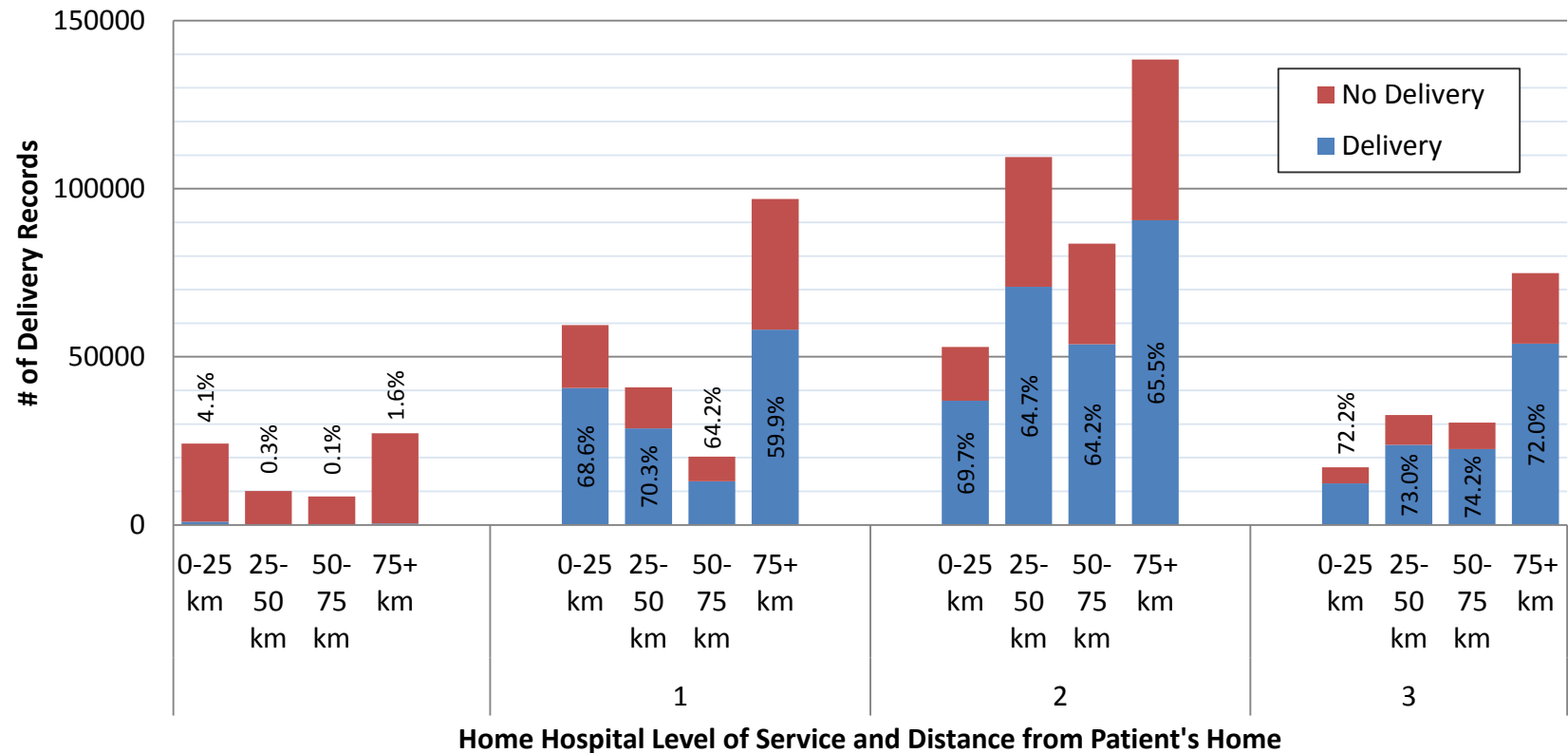
Results:

Delivery Volumes



Results:

Distance to Patients' Home Hospitals by Level of Service



Outcomes

- **3365 perinatal deaths**
 - ❖ 4.0/1000 births
- **18,160 cases of maternal morbidity**
 - ❖ 21.5/1000 mothers

Limitations



Acknowledgements



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- **Marshall Godwin**
- **Peter Wang**
- **Joan Crane**
- **Bruce Weaver**
- **Richard Cullen**

References



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2. Nesbitt TS, et al. Access to obstetric care in rural areas: Effect on birth outcomes. *Am J Public Health* 80(7):814-8, 1990.
3. Nesbitt TS, et al. Access to maternity care in rural Washington: Its effect on neonatal outcomes and resource use. *Am J Public Health* 87(1):85-90, 1997.
4. Wennberg *et al.* *The Dartmouth Atlas of Health Care in the United States*. American Hospital Publishing: Chicago, 1996.