



Comparison of Maternity Care Outcomes Among Rural Colorado Hospitals Using Birth Certificate Data

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Abstract

Purpose:

- To compare maternity care outcomes between urban, rural, and frontier facilities
- To investigate population, facility, or clinical care intervention variations that could account for differences among rural hospitals' maternity care outcomes

Methods: Colorado Birth Certificate Data from 2016-2018 was used to compare average percentages of adverse maternity care outcomes at urban, rural, and frontier facilities. High and low performing quartiles of facilities were identified by heat mapping. Facility, population, and clinical care intervention differences were compared between high and low performing rural facilities.

Results: Rural facilities in Colorado reported worse average percentages of adverse maternity care outcomes compared to urban facilities. Variation in adverse maternity care outcomes among rural facilities also existed. When compared to high performing rural hospitals, low performing rural hospitals averaged fewer augmented labors, and more vaginal forceps use, clinical chorioamnionitis, unplanned hysterectomies, admissions of the mother to the intensive care unit, meconium aspiration, and hypoglycemia in the infant. Mothers who delivered babies at low performing rural hospitals tended to live at higher elevation, more often identified as non-white race, reported consuming more alcohol during the 2nd and 3rd trimesters, and were more often diagnosed with eclampsia and HELLP Syndrome.

Conclusions: This hypothesis-generating study suggests there were worse maternity care outcomes at rural facilities compared to urban facilities in Colorado and some rural Colorado hospitals may perform better than others. However, due to numerous limitations this cannot be definitively concluded without additional research.

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Background

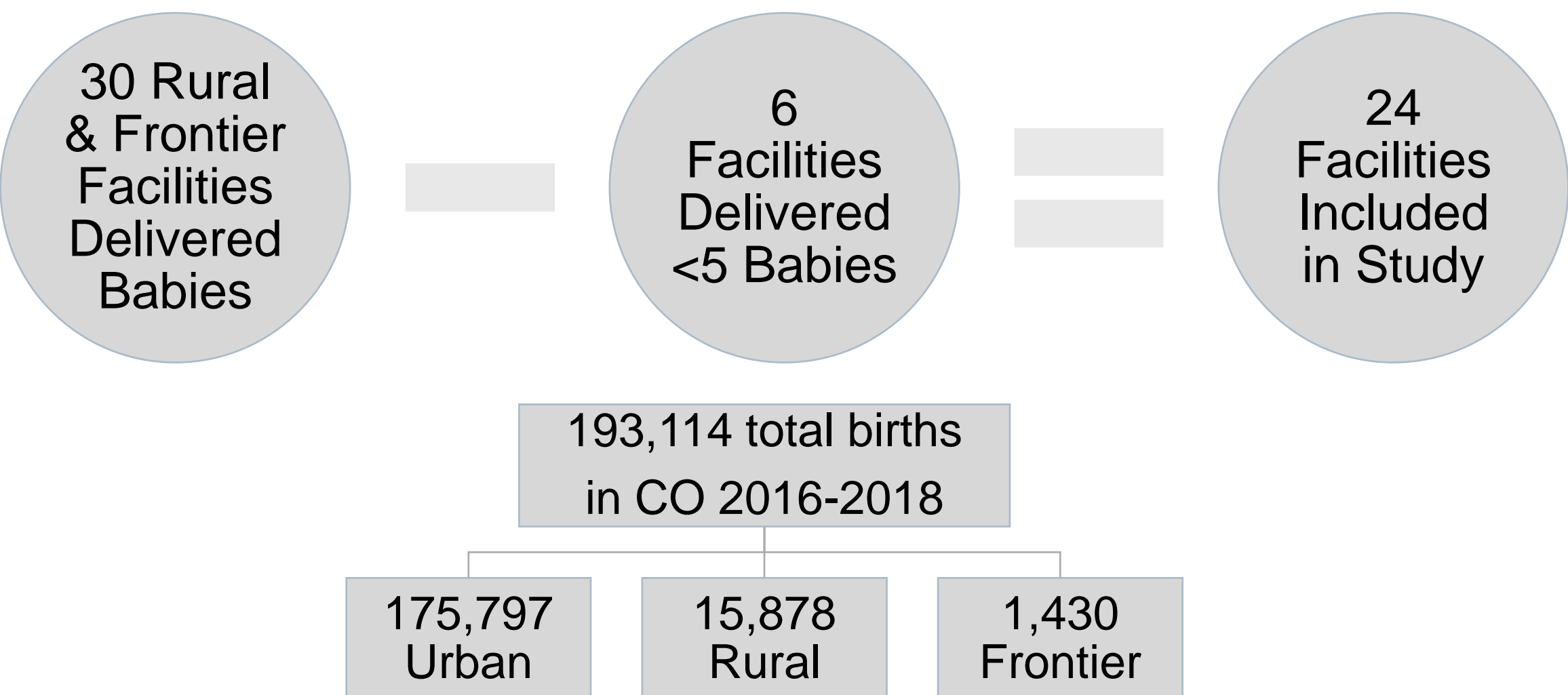
- 1 in 5 US citizens lives rurally and nearly 500,000 babies are born in rural hospitals annually
- From 2007 to 2015 rural residents had a 9% greater probability of severe maternal morbidity and mortality, compared with urban residents
- Challenges to rural communities in overcoming these health disparities include
 - keeping rural hospitals open
 - greater distances to travel for care with limited access to reliable transportation
 - lower socioeconomic population in rural areas
- Rural areas, like urban areas, have disparities in maternity care outcomes by race and ethnicity
- Rural communities across the United States are quite heterogeneous
- Not all rural communities have worse maternity care outcomes than their urban counterparts, but previous research has not clearly identified why



- Colorado is a largely rural state: Forty-seven of its 64 counties (73%) are designated as rural or frontier
- Colorado is home to 43 rural or critical access hospitals: 23 intentionally deliver babies
- No previous research studies investigated differences among the maternity care at these rural Colorado hospitals and possible explanations

Methods

- Deemed exempt by the University of Colorado Institutional Review Board
- Used de-identified Colorado Birth Certificate Data from 2016-2018
- Low volume facilities (<5 deliveries) were excluded as unintentional deliveries



- Variables from the Colorado Birth Certificate data were categorized as either adverse birth outcomes or population and facility characteristics, and clinical care interventions
- Adverse birth outcomes included: maternal transfusions, 3rd or 4th degree perineal lacerations, ruptured uterus, unplanned hysterectomy, maternal admission to ICU, c-section, cord prolapse, assisted ventilation of newborn following delivery, assisted ventilation of newborn over 6 hours, NICU admission, surfactant replacement therapy, antibiotics for suspected neonatal sepsis, seizure, hyaline membrane disease, meconium aspiration, and hypoglycemia of the newborn

Part 1

- Calculated average percentages of birth outcomes for frontier, rural, and urban facilities in aggregate and by facility using SAS statistical software
- Compared urban average percentage adverse birth outcomes to rural and frontier

Part 2

- Used urban average percent for each adverse birth outcomes to create a "heat map" that sorted the rural and frontier facility rates into equal or better than, and worse care
- Each adverse outcome was weighted equally
- "High" performing rural/frontier facilities represented the top quartile while "Low" performing rural/frontier facilities represented the bottom quartile

Part 3

- Facility and population characteristics were then compared across the High, Middle, and Low performing hospitals
- A difference was defined as greater than or equal to 1 standard deviation

Results

Table 1: Percent of Births with Adverse Maternity Care Outcomes Among Urban, Rural, and Frontier Facilities in Colorado from 2016-2018*

Adverse Maternity Care Outcomes	Urban Facilities	Rural Facilities	Frontier Facilities	Urban v Rural Chi-Square Test	Urban v Frontier Chi-Square Test	Rural v Frontier Chi-Square Test
Maternal Transfusions (% of births)	0.27%	0.83%	0.70%	140.68 p<0.05	9.44 p<0.05	0.26 p=0.61
Unplanned Hysterectomy (% of births)	0.07%	0.13%	0.07%	6.29 p<0.05	0.003 p=0.96	0.40 p=0.53
Cesarean Section (% of births)	26.17%	26.40%	32.87%	0.38 p=0.54	32.87 p<0.05	27.93 p<0.05
Cephalopelvic Disproportion (% of births)	0.07%	0.21%	1.47%	35.57 p<0.05	349.86 p<0.05	67.04 p<0.05
Assisted Ventilation of Newborn (% of births)	5.13%	6.74%	5.94%	75.5 p<0.05	1.92 p=0.17	1.33 p=0.25
Assisted Ventilation of Newborn for > 6 hours (% of births)	1.16%	0.79%	0.49%	17.83 p<0.05	5.55 p<0.05	1.54 p=0.22
Admission to Neonatal Intensive Care Unit (% of births)	11.22%	5.45%	1.61%	506.34 p<0.05	132.39 p<0.05	39.73 p<0.05
Surfactant Administration (% of births)	0.62%	0.84%	0.14%	11.34 p<0.05	5.29 p<0.05	8.25 p<0.05
Administration of Antibiotics to Newborn (% of births)	1.83%	2.25%	0.84%	14.1 p<0.05	7.76 p<0.05	12.49 p<0.05
Hyaline Membrane Disease (% of births)	0.82%	0.11%	0.21%	97.88 p<0.05	6.52 p<0.05	1.20 p=0.27
Meconium Aspiration (% of births)	0.15%	0.35%	0.35%	33.45 p<0.05	3.69 p=0.055	0.0004 p=0.98
Hypoglycemia of Newborn (% of births)	2.02%	2.90%	2.17%	55.63 p<0.05	0.16 p=0.69	2.57 p=0.11

*Only includes Adverse Maternity Care Outcomes with significant Chi-Square values of p < 0.05 included in this abbreviated table

Table 2: Comparison of Facility Characteristics of High, Mid, and Low Performing Rural and Frontier Facilities in Colorado from 2016-2018

	High Performing Facilities	Mid Performing Facilities	Low Performing Facilities
Facility Type			
Hospital	4	13	5
Home Birth	1	0	0
Other	1	0	0
Location			
Rural	4	11	4
Frontier	2	2	1
Average Delivery Volume	315	953	606
Attendant Type (% MD/DO Provider)	61%	77%	81%

Table 3: Comparison of Population Characteristics at High and Low Performing Rural and Frontier Hospitals in Colorado from 2016-2018 with a ≥ 1 Standard Deviation Difference*

Population Characteristic	High Performing Hospitals Average	Low Performing Hospitals Average
Mother's Residence Elevation (m)	1166.53	1712.44
Mother's Race (% white)	92.46	81.53
Mother's Alcohol Use 2nd Trimester (drinks/week)	0	0.02
Mother's Alcohol Use 3rd Trimester (drinks/week)	0	0.02
Eclampsia (%)	0.17	1.2
HELLP Syndrome (%)	0	0.2

*Greater than or equal to 1 standard deviation of difference based on average of all rural and frontier hospitals

Table 4: Comparison of Maternity Care Interventions at High and Low Performing Rural and Frontier Hospitals in Colorado from 2016-2018 with a ≥ 1 Standard Deviation Difference*

Maternity Care Interventions (% of births)	High Performing Hospitals Average	Low Performing Hospitals Average
Augmentation of Labor (%)	16.84	14.73
Clinical Chorioamnionitis (%)	0.05	1.14
Vaginal Forceps Assisted Delivery (%)	0	0.47
Unplanned Hysterectomy (%)	0.04	0.13
Admission to Intensive Care Unit (%)	0.16	0.34
Meconium Aspiration (%)	0.21	0.37
Hypoglycemia (%)	1.36	3.43

*Greater than or equal to 1 standard deviation of difference based on average of all rural and frontier hospitals

Conclusions

Urban versus Rural and Frontier Facility Maternity Care Outcomes

- Rural facilities generally had a higher average percentage of births with adverse maternal and neonatal outcomes than urban facilities
- Both frontier and rural facilities appear to be sending higher risk pregnancies to urban areas to be delivered

Facility Characteristics of High versus Low Performing Rural Maternity Care Facilities

- Tended to be frontier rather than rural
- Lower volumes of births
- More likely to have a nurse midwife attendant (likely lower risk pregnancies)

Population Characteristics of High and Low Performing Rural Maternity Care Facilities

- Facilities with more patients who lived at a higher elevation had more complications (established risk of pre-term births and neonatal respiratory distress at higher elevations)
- High performing facilities tended to have a whiter population (92.46% vs 81.53%) suggesting there are racial disparities in care
- Alcohol use was reported slightly higher in the 2nd and 3rd trimesters among mothers at the low performing facilities, but the same pre-pregnancy and in the 1st trimester
- Eclampsia and HELLP syndrome were higher among the low performing facilities' patient populations despite no difference in risk factors such as hypertension/gestational hypertension, diabetes/gestational diabetes, age, or weight gain in the low and high performing facilities

Clinical Interventions of High versus Low Performing Rural Maternity Care Facilities

- Higher performing facilities were more likely to augment labor and thus likely reduce further complications

Limitations

- Prior studies have shown that birth certificate data is not always reliable
- Are urban hospitals the best standard of care to compare against?
- Reported adverse maternity care outcomes were very rare at rural and frontier facilities which may skew the size of differences
- Adverse maternity care outcomes were weighted equally which could lead to a facility ranking lower based on one birth causing 2-3 related adverse outcomes

Key Takeaways

1

Colorado has large rural and frontier locations and the women who live there need access to maternity care since prior studies show that significant travel for care is associated with worse outcomes

2

There are differences between urban, rural, and frontier maternity care outcomes in Colorado and some possible facility, population, and clinical care characteristics to explain those differences

3

It is complex and difficult to compare maternity care outcomes across facilities with so many potential variables to control for and therefore more research is needed to fully understand this issue

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