Location of Childbirth For Rural Women: Implications For Maternal Levels Of Care

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Abstract

BACKGROUND—A recent American College of Obstetricians and Gynecologists and Society for Maternal Fetal Medicine consensus statement on levels of maternity care lays out designations that correspond to specific capacities available in facilities that provide obstetric care. Pregnant women in rural and remote areas receive particular attention in discussions of regionalization and levels of care, owing to the challenges in assuring local access to high-acuity services when necessary. Currently, approximately half a million rural women give birth each year in US hospitals, and whether and which of these women give birth locally is crucial for successfully operationalizing maternal levels of care.

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OBJECTIVES—To characterize rural women who give birth in non-local hospitals and measure local hospital characteristics and maternal diagnoses present at childbirth that are associated with non-local childbirth.

STUDY DESIGN—This was a repeat cross-sectional analysis of administrative hospital discharge data for all births to rural women in nine states in 2010 and 2012. Multivariate logistic regression models were used to predict the odds of childbirth in a non-local hospital (at least 30 road miles from the patient's residence). We examined patient age, race/ethnicity, payer, rurality, clinical diagnoses (diabetes, hypertension, hemorrhage during pregnancy, placental abnormalities, malpresentation, multiple gestation, preterm delivery, prior cesarean delivery, and a composite of diagnoses that may require maternal-fetal medicine consultation), as well as local hospital characteristics (birth volume, neonatal care level, ownership, accreditation, and system affiliation).

RESULTS—The rate of non-local childbirth among 216,076 rural women was 25.4%. It varied significantly by primary payer (Adjusted Odds Ratio [95% Confidence Interval]=0.76 [0.68,0.86] for Medicaid vs. private insurance) and by clinical conditions including multiple gestation (1.82 [1.58,2.1]), preterm deliveries (2.41 [2.17,2.67]), and conditions which may require maternal fetal medicine services or consultation (1.28 [1.22,1.35]). Rural women whose local hospital did not have a neonatal intensive or intermediate care unit had nearly double the odds of giving birth at a non-local hospital (1.94 [1.64,2.31]).

CONCLUSION—Approximately 75% of rural women gave birth at local hospitals; rural women with preterm births and clinical complications, as well as those without local access to higher-acuity neonatal care, were more likely to give birth in non-local hospitals. However, after controlling for clinical complications, rural Medicaid beneficiaries were less likely to give birth at non-local hospitals, implying a potential access challenge for this population.

Introduction

The movement toward regionalization of perinatal care began in the 1970s, with a focus on developing coordinated referral systems to ensure access to facilities with adequate levels of care.[1,2] Pregnant women in rural and remote areas receive particular attention in discussions of regionalization, owing to the challenges in assuring local access to high-acuity services when necessary.[3–6]

Currently, approximately half a million rural women give birth in each year in US hospitals. Compared with women in urban areas, rural women experience poorer health outcomes and have less access to health care, both generally and with respect to obstetric services.[7] ln rural areas, women must travel greater distances to access hospitals with perinatal care - particularly those offering higher acuity neonatal care services, than in urban areas.[8] Many rural women with low-risk pregnancies can safely give birth at local hospitals, a choice that helps to minimize the additional perinatal morbidity risk of increased travel distance;[8,9] however, complications that necessitate higher-acuity care (for example, placenta previa, pre-eclampsia/eclampsia, cardiac conditions, etc.) happen frequently in obstetrics, even

among low-risk pregnancies.[10] The challenge of ensuring that appropriate maternity services are available to meet clinical needs tops the list of concerns among rural obstetric unit managers, medical directors, and clinicians.[11]

The recent Consensus Statement from the American College of Obstetricians and Gynecologists and the Society for Maternal Fetal Medicine,[12] documenting uniform designations for levels of maternity care, begins to address this challenge by encouraging clarity around the specific capacities available in different facilities that provide obstetric care. This consensus statement marks the first coordinated effort to address the need for appropriate triage of pregnant women, with particular health conditions, to settings where their clinical needs can be met and the best possible outcomes achieved. However, the extent to which rural pregnant women give birth locally or at non-local hospitals is not well-characterized in the current context. Clinicians and hospital administrators need basic information about the rural women who give birth at non-local hospitals, as well as the hospitals they leave behind, in order to effectively operationalize maternity care level designations in both rural and urban areas.[13] The goal of this study was to measure whether local hospital characteristics or maternal diagnoses present at childbirth were associated with delivery in a non-local hospital among rural women.

Materials and Methods

Data sources

We used 2010 and 2012 hospital discharge data from the Statewide Inpatient Databases (SID) of the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality, for nine states (Colorado, Iowa, Kentucky, New York, North Carolina, Oregon, Vermont, Washington, and Wisconsin).[14,15] The SID contains 100% of hospital discharge records for all payers within the state in a given year. These states were chosen based on the size of their rural populations, US regional distribution, and because they permit use of patient ZIP codes and linkage with data on hospital characteristics from the American Hospital Association (AHA) Annual Surveys.[16] Patient-level variables in this analysis were defined by International Classification of Diseases—9th revision (ICD-9) diagnosis and procedure codes or by Clinical Classification Software codes, based on ICD-9 codes and developed and designed for use with HCUP data.

For this study we examined the hospital discharge records of maternal childbirth hospitalizations for rural residents. We identified maternal childbirth hospitalizations using a validated methodology based on ICD-9 diagnosis and procedure codes as well as Diagnosis-Related Group codes.[17,18] Using federal Office of Management and Budget definitions of rurality, we identified rural women based on their residence ZIP code location in a micropolitan county with at least 10,000 but less than 50,000 population or a noncore county that is not part of a metropolitan or micropolitan area.[19] All rural women who lived in these nine states, had a childbirth hospitalization in the same states during 2010 or 2012, and were not transferred from a hospital to another hospital, were included in the analysis. Women who were transferred from one hospital to another for their childbirth hospitalization (n=2,931) were excluded because transfers generally occur due to emergent clinical needs that occur in the course of clinical care and do not reflect planned decisions on the part of

the mother and her clinician (Appendix 1). The final analysis included 111,764 births in 581 hospitals (2010), and 104,312 births in 565 hospitals (2012).

Measurement

Several studies of rural maternity care have used a specific list of high-risk maternal conditions for which consultation with or referral to a maternal-fetal medicine specialist (MFM) is recommended; this list was based on clinical guidelines developed for the Arkansas Antenatal and Neonatal Guidelines, Education and Learning System (ANGELS) program.[20–24] We replicated this list as closely as possible, using ICD-9 diagnosis and procedure codes, and defined a patient as high-risk if the discharge record for her childbirth hospitalization contained a diagnosis for a condition for which MFM consultation or referral was recommended.

Maternal medical conditions defined by ICD-9 diagnosis and procedure codes included in this analysis were gestational diabetes, diabetes mellitus, hypertension, placental complications (placenta previa, placenta accreta), multiple gestation, malpresentation, preterm delivery (delivery before 37 weeks completed gestation), and prior cesarean delivery.

We defined a "local" hospital as any hospital in the nine study states that was either a) the nearest hospital to the patient's residential ZIP code that provides obstetric services (at least 10 births in a given year), regardless of distance; or b) any hospital within 30 road miles of the patient's ZIP code that provides obstetric services. The 30 mile distance criterion was selected based on prior research on access to perinatal services,[8] and sensitivity analyses were robust to alternate specifications using a range of distance cut-off values (15-60 miles). We calculated the driving distance from the rural patient's residential ZIP code to the ZIP code of the hospital where she gave birth, and compared it to the distance between the patient's ZIP code and each local hospital(s). Driving distances were calculated based on ZIP code centroids using SAS 9.3 URL access method linked to Google Maps; in mountainous areas where Google Maps could not calculate distances, they were calculated using latitude and longitude estimates.[25,26]

Hospital ownership, accreditation by the Joint Commission or American Osteopathic Association, system affiliation, and the presence of a neonatal intensive care unit (NICU) or neonatal intermediate care unit (NINT) were from the AHA Annual Survey. In this survey, a NICU is defined as a unit that must be separate from the newborn nursery providing intensive care to all sick infants including those with the very lowest birth weights (less than 1500 grams). NICUs must also have potential for providing mechanical ventilation, neonatal surgery, and special care for the sickest infants born in the hospital or transferred from another institution, and a full-time neonatologist must serve as medical director. NINT units must be separate from the normal newborn nursery and provide intermediate and/or recovery care and some specialized services, including immediate resuscitation, intravenous therapy, and capacity for prolonged oxygen therapy and monitoring. Using the complete records of hospital discharge data, we calculated annual hospital-level birth volume for each hospital in the analysis.

Analysis

This study used descriptive statistics and multivariate logistic regression models to analyze the chances that a rural woman would give birth in a non-local hospital, by maternal socio-demographic characteristics (age, primary payer, race/ethnicity, and rurality of residence), patient clinical diagnoses, and local hospital characteristics. These analyses were conducted with the childbirth hospitalization as the unit of analysis. We examined the differences in non-local childbirth by maternal demographics, primary payer, and maternal clinical conditions, using Pearson's chi square tests. We also employed generalized estimation equations to analyze the relationship between these factors and non-local delivery status, accounting for year of childbirth, maternal residence state, and the fact that patients within hospitals are not fully independent observations.

Delta-method marginal effects were calculated to identify individual contributions of each factor to the change in the rates of childbirth hospitalization in non-local hospitals.[27] Marginal effects demonstrate a change in the predicted probability of non-local childbirth for rural women in one category relative to the referent category.

Recognizing the importance of transfers for perinatal regionalization of care, we conducted a sensitivity analysis including transferred women. Main results were largely unchanged, but women who were transferred had significantly higher odds of non-local childbirth (Appendix 2). Previous analysis found that the state-level proportion of rural women with non-local childbirth varied from 18.9% in Vermont to 32.4% in Kentucky.[28] Recognizing that state policies may affect non-local childbirth, we included state-level fixed effects in main models.

The analysis was conducted using SAS, version 9.3 (SAS Institute Inc., Cary, North Carolina) for descriptive analysis and Stata (version 13; Stata Corp, College Station, TX) for multivariate analysis. This research was approved by the University of Minnesota Institutional Review Board (ID 1409E53644).

Results

Of the 216,076 rural women who gave birth in the nine states included in our analysis, 54,858 (25.4%) gave birth at a non-local hospital (Table 1). The rate of non-local childbirth increased slightly from 24.2% in 2010 to 26.6% in 2012. Table 1 provides descriptive characteristics for all rural women and the unadjusted rates of non-local childbirth for each characteristic. Giving birth in a non-local hospital occurred more frequently with increased maternal age, and was more common among privately-insured rural women, compared with publicly-insured women (28.6% vs. 22.5%). White rural women were more likely to give birth in non-local hospitals (26.5%) than rural racial/ethnic minority women, including Black (17.5%), Hispanic (19.2%), and Asian (16.5%) women. Rural women without local hospitals capable of providing neonatal intensive or intermediate care were more inclined to deliver in non-local hospitals (29.9%), compared to those in areas with NICU (17.1%) or NINT only (24.8%) capacity. These differences are all significant at P<.001.

Table 2 shows the number and percent of rural women who gave birth in non-local hospitals, by maternal clinical diagnoses present at the childbirth hospitalization. Rural women with conditions that may require MFM consultation had higher rates of non-local childbirth than those without these conditions (28.6% vs. 23.1%, *P*<.001). All maternal clinical diagnoses we studied were associated with higher chances of giving birth in a non-local hospital (*P*<.001). Among these clinical conditions, women with multiple gestation (47%) and preterm deliveries (44%) had the highest rates of childbirth in a non-local hospital.

Table 3 shows the characteristics of the hospitals where rural women gave birth, based on whether or not the birth occurred in a local or non-local hospital. Almost two-thirds (64.4%) of rural women who gave birth in non-local hospitals went to urban hospitals, while 68% of those who gave birth locally went to a rural hospital that was not a Critical Access Hospital. Non-local births were much more likely than local births to occur in a hospital with a NICU or NINT (71.7% vs 31.7%).

Table 4 shows the adjusted odds ratios and average marginal effects that the presence of specific maternal diagnoses and local hospital characteristics have on the chances of childbirth in a non-local hospital. On average, a rural woman had significantly increased odds of giving birth in a non-local hospital if she was diagnosed with one or more conditions that may require MFM consultation (AOR [95% CI]=1.28 [1.22, 1.35]), malposition (1.16 [1.08, 1.24]), multiple gestation (1.82 [1.58, 2.1]), preterm delivery (2.41 [2.17, 2.67]), and/or prior cesarean (1.25 [1.17, 1.34]). Compared to privately-insured rural women, those with Medicaid coverage had 24% lower (0.76 [0.68, 0.86]) odds of non-local childbirth. This translates to a 5 percentage point difference in the chances of giving birth in a non-local hospital (26.3% for privately-insured vs. 21.4% for Medicaid women, *P*<.001). Women who were older, white, privately-insured, and lived in rural noncore areas adjacent to metro areas were more likely to give birth in non-local hospitals than their counterparts, after controlling for measured covariates.

The neonatal care capacity at a rural woman's local hospital had a large and significant effect on her odds of giving birth in a non-local hospital (Table 4). Rural women living in an area without any NICU or NINT units had almost double the odds of non-local childbirth (1.94 [1.64, 2.31]) than those living in an area with NICU units. This results in a rate of non-local childbirth that is 11 percentage points higher for rural women without local access to a hospital with higher-acuity neonatal care capacity (30% vs. 18.7% of rural women in areas with NICU units, *P*<.001).

Comment

Our study found that one-quarter of rural women give birth in non-local hospitals, and that non-local childbirth is significantly related to maternal clinical diagnoses and socio-demographic factors, insurance status, and local hospital characteristics. Rural women with preterm births and clinical complications, as well as those without local access to higher-acuity neonatal care, were more likely to give birth in non-local hospitals.

The extent to which rural residents receive care at their local hospital or a non-local hospital has long been a topic of interest to both rural and urban clinicians, health policy researchers, and policymakers.[29–32] Prior research indicates that 23-60% of rural women give birth in non-local hospitals; however, most of these studies were limited to a single state or metropolitan area.[29,31,32] Our 25.4% non-local delivery rate for rural women in the nine study states was consistent with a 2003 study using data from seven states,[30] but updates prior estimates and improves upon the accuracy of measurement of non-local childbirth by allowing for more than one local hospital and using driving distances rather than straight-line distances.

The same 2003 study found that rural patients with general medical or obstetrical diagnoses were less likely to give birth in a non-local hospital than those with a diagnosis related to complex medical, general surgery, or specialty surgery services.[30] An additional contribution of our research is to report the relationship between maternal clinical diagnoses and childbirth at a non-local hospital. Limited prior research has explored the role of primary payer, but a 1993 study concluded that high-risk urban women covered by Medicaid were less likely than those covered by private insurance to deliver in hospitals with NICUs.[31] Our findings update and extend this research by showing rural women with preterm births and clinical complications have a higher likelihood of giving birth in non-local hospitals, and that Medicaid-covered women are less likely to give birth non-locally or in hospitals with neonatal intensive or intermediate level care.

The higher likelihood of non-local childbirth for rural women with more complex pregnancies implies potentially appropriate referral patterns, which may characterize a functioning perinatal regionalization system. However, after controlling for clinical complications, rural Medicaid beneficiaries were less likely to give birth at non-local hospitals, implying a potential access challenge for this population. This finding also raises the possibility of over-triage; that is, privately-insured women may give birth at non-local hospital when they could have been appropriately cared for at a local facility.

Previous research has shown that average travel distance for childbirth among rural women was lower if their closest hospital had a NICU,[33] implying that giving birth locally is more frequent among rural women with nearby access to higher-acuity neonatal services. More recent research has analyzed the extent to which all U.S. women of reproductive age are within 30-minute and 60-minute driving times to a hospital offering Level I-III perinatal services.[8] Our study builds on these results by examining the potential role of the characteristics of multiple local hospitals, and showing that rural women whose local hospitals did not have a neonatal intensive or intermediate care unit were more likely to give birth at a non-local hospital.

This analysis contributes to the extant literature by using recent all-payer data from nine geographically-diverse states with significant rural populations, and examining whether the roles of maternal demographics, clinical conditions, and insurance status affect childbirth in non-local hospitals, as well as characteristics of local and delivery hospitals. However, use of administrative data and other aspects of this study impose limitations on interpretation of results. The results from these nine states may not be generalizable nationally. We controlled

for state-level fixed effects, but rates of non-local childbirth differ dramatically across states, indicating an important future area of study, especially with respect to effects of state-level policies on patterns of non-local childbirth. Hospital discharge data do not contain clinical notes or information on prenatal care, parity, or gestational age at birth. We did not have information about whether local providers had referred women for obstetric care at a non-local hospital, or about the quality of local providers. More research should be done on this topic, preferably with data that allows for clinical diagnosis data, linkages between mothers and infants, and detailed information on referral and transfers; no such nationwide data currently exist.

Even with access to data on all recorded maternal clinical diagnoses and local and delivery hospital characteristics, we were only able to predict a small percentage of the variability in the odds of non-local childbirth. Although we examined the role of several factors that were potentially associated with non-local delivery, other factors that may be important were not observable in our data, including maternal education, income, and willingness to travel; rural women's perceptions regarding the quality of local and non-local providers; hospital management characteristics; health care marketplace influences; and the influence of friends and family.

Our results highlight the need for greater clarity concerning the levels of maternity care available at hospitals across the U.S., which will help rural clinicians and patients determine whether local hospitals have the capacity to address specific clinical needs.[13] Traveling greater distances for obstetric care may put women and infants at increased risk for morbidity, but such a decision may be advisable when clinical conditions warrant services that are not available locally.[9,20,34] Additionally, prior research indicating greater risk of maternal morbidity (such as postpartum hemorrhage) and postpartum complications in low-volume rural settings may influence clinical recommendations or personal decisions regarding delivery location.[35–37] Indeed, our findings show higher rates of non-local childbirth among rural women whose local hospital has 460 births or fewer each year (Table 3). Future research on personal and clinical decision-making around delivery location may elucidate both medical and non-medical reasons for these patterns.

Our finding that Medicaid beneficiaries have lower rates of non-local childbirth, even after controlling for clinical diagnoses, raises several potential concerns regarding access to appropriate clinical services for Medicaid beneficiaries who have complicated pregnancies or risk factors that may necessitate higher-acuity care. Lower-income women may have fewer economic and social resources at their disposal to allow for non-local childbirth, which may require that women incur costs related to travel, transportation, food, lodging, and child care, in addition to medical care.

While our data do not allow us to examine clinical decision-making that underlies non-local childbirth, they do illuminate the fact that many rural women with clinical complications do not give birth at local hospitals with limited neonatal care capacity, instead traveling to more distant hospitals with higher-acuity care available. Our data also highlight the need for greater systems-level support for regional perinatal care networks to ensure access to high quality obstetric care for all rural women.

Acknowledgment

Appendix

Appendix 1

Maternal Clinical Conditions for Rural Women by Whether or Not Being Transferred In From Another Hospital (N=219,007)

	% of Rural Women with A Medical Condition	
	Transferred In From Another Hospital (N=2,931)	Non-Transfers (N=216,076)
MATERNAL CLINICAL CONDITION		
Conditions Which May Require Maternal Fetal Medicine Services or Consultation	75.7%	41.1%
Malposition, Malpresentation	18.3%	7.6%
Multiple Gestation	6.8%	1.4%
Pregnancy Delivered Before 37 Weeks Gestation	53.6%	6.1%
Previous Cesarean Section	14.8%	16.3%

Appendix 2

Determinants of Rural Women Giving Birth in a Non-Local Hospital (N=219,007, Including Transferred Women)

	Adjusted Odds Ratio (95% Confidence Interval)	Average Marginal Effects (%)	P-value
MATERNAL CLINICAL CONDITION			
Conditions Which May Require Maternal Fetal Medicine Services or Consultation	1.31 (1.2, 1.43)	5.8%	<.001
Malposition, Malpresentation	1.22 (1.16, 1.29)	4.1%	<.001
Multiple Gestation	1.94 (1.76, 2.15)	14.3%	<.001
Pregnancy Delivered Before 37 Weeks Gestation	2.58 (2.26, 2.96)	21.0%	<.001
Previous Cesarean Section	1.25 (1.2, 1.31)	4.5%	<.001
MATERNAL CHARACTERISTICS			

	Adjusted Odds Ratio (95% Confidence Interval)	Average Marginal Effects (%)	P-value
Age			
Age 20	**0.77 (0.73, 0.83)**	**−4.3%**	**<.001**
21 Age 25	**0.89 (0.86, 0.93)**	**−2.0%**	**<.001**
26 Age 30	Ref	-	-
31 Age 35	**1.06 (1.02, 1.09)**	**1.0%**	**0.002**
Age 36	**1.14 (1.08, 1.2)**	**2.4%**	**<.001**
Primary Payer			
Medicaid	**0.73 (0.66, 0.8)**	**−5.6%**	**<.001**
Private	Ref	-	-
Self	0.89 (0.68, 1.15)	−2.2%	0.357
Other	0.92 (0.76, 1.11)	−1.5%	0.404
Race/Ethnicity			
White	Ref	-	-
Black	**0.64 (0.45, 0.91)**	**−7.1%**	**0.012**
Hispanic	**0.71 (0.58, 0.88)**	**−5.5%**	**0.002**
Native American, Asian, Other	1.22 (0.95, 1.57)	3.7%	0.117
Patient Residence Rurality			
Micropolitan area	Ref	-	-
Noncore adjacent to a metro area	**2.24 (1.68, 2.97)**	**13.9%**	**<.001**
Noncore not adjacent to a metro area	**1.58 (1.12, 2.24)**	**7.9%**	**0.01**
LOCAL HOSPITAL CHARACTERISTICS			
Neonatal Care Capacity			
Any Neonatal Intensive Care Units	Ref	-	-
Neonatal Intermediate Care Units Only	**1.98 (1.33, 3.09)**	**4.6%**	**0.005**
No NICU or NINT	**2.65 (1.96, 3.64)**	**20.6%**	**<.001**
Local Hospital(s) with:			
Accreditation	0.8 (0.52, 1.24)	−4.0%	0.317
System Affiliation	0.94 (0.68, 1.31)	−1.0%	0.732

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Table 1

Maternal and Local Hospital Characteristics By Rural Women's Delivery Hospital Location (Local or Non-Local)

	Number (%) of all rural women in each category	% of women in each category who delivered in non-local hospitals[a]	P-Value[b]
All Rural Women	**216,076 (100%)**	**25.4%**	
Age			
Age 20	35,447 (16.4%)	20.8%	<.001
21 Age 25	65,231 (30.2%)	23.8%	<.001
26 Age 30	62,352 (28.9%)	26.8%	<.001
31 Age 35	37,171 (17.2%)	28.2%	<.001
Age 36	15,875 (7.3%)	30.1%	<.001
Primary Payer			
Unknown	332 (0.2%)	29.2%	<.001
Medicaid	109,800 (50.8%)	22.5%	<.001
Private	94,489 (43.7%)	28.6%	<.001
Self	4,145 (1.9%)	28%	<.001
Other Payment	7,310 (3.4%)	25.5%	0.858
Race			
Unknown	8,960 (4.1%)	34%	<.001
White	163,277 (75.6%)	26.5%	<.001
Black	13,203 (6.1%)	17.5%	<.001
Hispanic	19,425 (9%)	19.2%	<.001
Asian	1,904 (0.9%)	16.5%	<.001
Native	5,005 (2.3%)	20.2%	<.001
Other	4,302 (2%)	27.7%	<.001
Local Hospital(s) with			
Neonatal Intensive Care Unit (NICU)	66,419 (30.7%)	17.1%	<.001
Neonatal Intermediate Care (NINT) only	28,234 (13.1%)	24.8%	<.001
No NICU or NINT	121,423 (56.2%)	29.9%	<.001

	Number (%) of all rural women in each category	% of women in each category who delivered in non-local hospitals[a]	P-Value[b]
Accreditation[c]			<.001
Yes	182,491 (84.5%)	23.9%	
No	33,585 (15.5%)	32.7%	
System Affiliation			<.001
Yes	149,378 (69.1%)	24.3%	
No	66,698 (30.9%)	27.5%	

[a] A rural woman's local hospital refers to either her nearest hospital or any hospital within 30 miles driving distance and having 10 or more births in a year.

[b] P-value refers to a significant difference in proportion of rural women delivering in non-local hospitals for each maternal characteristic, based on Pearson Chi-square tests.

[c] Accreditation by either the American Osteopathic Association Council or the Joint Commission

Table 2

Maternal Clinical Conditions for Rural Women Giving Birth in Non-Local Hospitals

		Number (%) of All Rural Women In Each Category	% of Rural Women in Each Category Who Delivered in Non-Local Hospitals
All Rural Women		216,076 (100%)	25.4%
Conditions Which May Require Maternal Fetal Medicine Services or Consultation[a]	Yes	89,528 (41.4%)	28.6%
	No	126,548 (58.6%)	23.1%
Diabetes Gestational Hypertension Hemorrhage During Pregnancy Or Placenta Problems Malposition, Malpresentation	Yes	14,180 (6.6%)	32.3%
	No	201,896 (93.4%)	24.9%
	Yes	19,242 (8.9%)	32.7%
	No	196,834 (91.1%)	24.7%
	Yes	4,083 (1.9%)	36.5%
	No	211,993 (98.1%)	25.2%
	Yes	16,654 (7.7%)	31.1%
	No	199,422 (92.3%)	24.9%
Multiple Gestation	Yes	3,080 (1.4%)	47.1%
	No	212,993 (98.6%)	25.1%
Pregnancy Delivered Before 37 Weeks Gestation Previous Cesarean Section	Yes	14,540 (6.7%)	43.5%
	No	201,536 (93.3%)	24.1%
	Yes	35,168 (16.3%)	29.4%
	No	180,908 (83.7%)	24.6%

Note: p <.001 for all comparisons in the proportion of rural women delivering in non-local hospitals by maternal clinical conditions, based on Pearson Chi-square tests.

[a] Definitions from Appendix A. in Wingate, M. S., Bronstein, J., Hall, R. W., Nugent, R. R., & Lowery, C. L. (2011). Quantifying risks of preterm birth in the Arkansas Medicaid population, 2001–2005. Journal of Perinatology, 32(3), 176-193.

Table 3

Distribution of Delivery Hospital Characteristics by Rural Women's Delivery Hospital (Local or Non-Local)

Delivery Hospital Characteristics:	Number (%) of All Rural Women Who Delivered in Each Category of Hospitals (N=216,076)	% of Rural Women Who Delivered in Non-Local Hospitals (N=54,858)	% of Rural Women Who Delivered in Local Hospitals (N=161,218)
Hospital Type			
Critical Access Hospital	36,462 (16.9%)	7.2	20.2
Other Rural Hospital	125,160 (57.9%)	28.4	68
Urban Hospital	54,454 (25.2%)	64.4	11.9
Hospital Ownership			
Public Hospital	39,586 (18.3%)	14.7	19.6
Private, Not-for-profit	163,390 (75.6%)	79.4	74.3
Private, For-Profit	13,100 (6.1%)	5.9	6.1
Accredited Hospital	176,715 (81.8%)	87.5	79.8
System-Affiliated Hospital	126,605 (58.6%)	69.3	55
Annual Birth Volume			
461+	138,487 (64.1%)	84.8	57.1
241-460	46,052 (21.3%)	10.2	25.1
111-240	24,993 (11.6%)	3.9	14.2
1-110	6,544 (3%)	1.1	3.7
Neonatal Care Capacity			
Neonatal Intensive Care Unit (NICU)	67,504 (31.2%)	60.6	21.3
Neonatal Intermediate Care (NINT) Only	22,827 (10.6%)	11.1	10.4
No NICU or NINT	125,745 (58.2%)	28.4	68.3

Table 4

Determinants of Rural Women Giving Birth in a Non-Local Hospital (N=216,076)

	Adjusted Odds Ratio (95% Confidence Interval)	Average Marginal Effects (%)	P-value
MATERNAL CLINICAL CONDITION			
Conditions Which May Require Maternal Fetal Medicine Services or Consultation	**1.28 (1.22, 1.35)**	**4.5%**	**<.001**
Malposition, Malpresentation	**1.16 (1.08, 1.24)**	**2.7%**	**<.001**
Multiple Gestation	**1.82 (1.58, 2.1)**	**12.3%**	**<.001**
Pregnancy Delivered Before 37 Weeks Gestation	**2.41 (2.17, 2.67)**	**18.7%**	**<.001**
Previous Cesarean Section	**1.25 (1.17, 1.34)**	**4.2%**	**<.001**
MATERNAL CHARACTERISTICS			
Age			
Age 20	**0.82 (0.74, 0.9)**	**−3.5%**	**<.001**
21 Age 25	**0.91 (0.86, 0.97)**	**−1.6%**	**<.001**
26 Age 30	Ref	-	-
31 Age 35	**1.04 (1.01, 1.07)**	**0.8%**	**<.001**
Age 36	**1.12 (1.04, 1.21)**	**2.2%**	**<.001**
Primary Payer			
Medicaid	**0.76 (0.68, 0.86)**	**−4.9%**	**<.001**
Private	Ref	-	-
Self	0.96 (0.77, 1.18)	−0.8%	0.681
Other	0.91 (0.82, 1.02)	−1.8%	0.093
Race/Ethnicity			
White	Ref	-	-
Black	**0.67 (0.60, 0.76)**	**−6.5%**	**<.001**
Hispanic	**0.70 (0.56, 0.88)**	**−5.9%**	**<.001**
Native American, Asian, Other	1.14 (0.84, 1.57)	2.6%	0.401
Patient Residence Rurality			
Micropolitan area	Ref	-	-
Noncore adjacent to a metro area	**2.29 (1.77, 2.96)**	**15.9%**	**<.001**
Noncore not adjacent to a metro area	**1.88 (1.13, 3.16)**	**11.6%**	**0.016**
LOCAL HOSPITAL CHARACTERISTICS			
Neonatal Care Capacity			
Any Neonatal Intensive Care Units	Ref	-	-
Neonatal Intermediate Care Units Only	**1.77 (1.25, 2.51)**	**9.4%**	**<.001**
No NICU or NINT	**1.94 (1.64, 2.31)**	**11.3%**	**<.001**
Local Hospital(s) with:			
Accreditation	0.92 (0.67, 1.26)	−1.5%	0.602

	Adjusted Odds Ratio (95% Confidence Interval)	Average Marginal Effects (%)	P-value
System Affiliation	1.02 (0.81, 1.3)	0.4%	0.859

Note: Model also controlled for year of birth and maternal residence of state. Average marginal effects demonstrate a change in the predicted probability of non-local delivery for an average rural woman in one category relative to the referents.