Rural-Urban Differences in Obstetric Care, 2002–2010, and Implications for the Future

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Background: Approximately 15% of the 4 million annual US births occur in rural hospitals.

Objective: To (1) measure differences in obstetric care in rural and urban hospitals, and to (2) examine whether trends over time differ by rural-urban hospital location.

Research Design and Subjects: This was a retrospective analysis of hospital discharge records for all births in the 2002–2010 Nationwide Inpatient Sample, which constitutes 20% sample of US hospitals (N = 7,188,972 births: 6,316,743 in urban hospitals, 837,772 in rural hospitals).

Measures: Rates of low-risk cesarean (full-term, singleton, vertex pregnancies; no prior cesarean), vaginal birth after cesarean (VBAC), nonindicated cesarean, and nonindicated labor induction were estimated.

Results: In 2010, low-risk cesarean rates in rural and urban hospitals were 15.5% and 16.1%, respectively, and nonindicated cesarean rates were 16.9% and 17.8%, respectively. VBAC rates were 5.0% in rural and 10.0% in urban hospitals in 2010. Between 2002 and 2010, rates of low-risk cesarean and nonindicated cesarean increased, and VBAC rates decreased in both rural and urban hospitals. Nonindicated labor induction was less frequent in rural versus urban hospitals in 2002 [adjusted odds ratio = 0.79 (0.78–0.81)], but increased more rapidly in rural hospitals from 2002 to 2010 [adjusted odds ratio = 1.05 (1.05–1.06)]. In 2010, 16.5% of rural births were induced without indication (12.0% of urban births).

Conclusions: From 2002 to 2010, cesarean rates rose and VBAC rates fell in both rural and urban hospitals. Nonindicated labor induction rates rose disproportionately faster in rural versus urban settings. Tailored clinical and policy tools are required to address differences between rural and urban hospitals.

Key Words: rural health, urban health, obstetrics, cesarean, labor induction

(*Med Care* 2014;52: 4–9)

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Supported by the Rural Health Research Center Grant Program Cooperative Agreement from the Health Resources and Services Administration (U1CRH03717-09-00). This work was also supported by the Building Interdisciplinary Research Careers in Women's Health Grant (K12HD055887) from the Eunice Kennedy Shriver National Institutes of Child Health and Human Development (NICHD), the Office of Research on Women's Health, and the National Institute on Aging, at the National Institutes of Health, administered by the University of Minnesota Deborah E. Powell Center for Women's Health.

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Health Resources and Services Administration.

The authors declare no conflict of interest.

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Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Website, www.lww-medicalcare.com.

ISSN: 0025-7079/14/5201-0004

Approximately 15% of the 4 million US mothers who give birth each year deliver their babies in rural hospitals.[1,2] Rural-urban differences in obstetric care are important for financial and policy reasons, as well clinical and public health reasons. Small absolute differences in childbirth care can affect the health of thousands of women and infants every year, with such differences growing even larger, if they are driven by disparate trends.[3]

In 2009, childbirth-related hospitalizations accounted for 7.6% of all inpatient costs, totaling $27.6 billion, and nearly half of births were paid for by the state Medicaid programs.[4] Rising costs are driven in part by greater use of obstetric procedures nationally,[5,6] including increases in labor induction, first-time cesareans, and repeat cesareans.[7–10] A rise in the prevalence of conditions that necessitate cesarean delivery, a changing medico-legal environment, and local clinical practice patterns may all contribute to the recent rise in cesarean rates and variation in the use of cesarean delivery across hospitals and geographic regions.[11–15] These same factors differ between rural and urban settings.[16,17]

The use and appropriateness of obstetric care in rural and urban hospitals impacts the health of women and infants in these settings.[17–20] Cesarean delivery is an important and potentially life-saving intervention, but it is associated with certain risks, compared with vaginal delivery (eg, infection, surgical injury, rehospitalization, breastfeeding challenges, pain, placentation disorders in future pregnancies, and infant respiratory illness), and labor induction and cesarean without medical indication, especially between 37 and 39 weeks gestation, may adversely affect maternal and infant health (eg, postpartum hemorrhage, infant morbidity and mortality, and prolonged length of stay).[14,21–26] Clinical guidelines and measurement protocols have been developed to guide maternity care quality improvement.[11,21,27–30] These efforts are generally being implemented without particular regard for rural-urban differences. We document current obstetric practices, changes over time, and relevant differences between rural and urban settings.

METHODS

Data

Obstetric deliveries in both rural and urban hospitals were identified from the Nationwide Inpatient Sample[31] (NIS) datasets 2002–2010 (N = 7,188,972 total births: 6,316,743 urban and 837,772 rural). The NIS uses a stratified, single-stage cluster sampling design, with region, urban or rural location, teaching status, ownership, and bed size to identify strata. After stratification, a 20% random sample of hospitals from the target population (US community hospitals) is taken. The NIS, with 100% of discharges from sampled hospitals, has been a uniform database to support comparative health services research since 1998.[31]

Measurement

Primary outcomes for this analysis use International Classification of Diseases—9th revision (ICD-9) codes and reflect measures appropriate for assessing quality in rural hospitals[32]; outcomes include low-risk cesarean, vaginal birth after cesarean (VBAC), cesarean without medical indication, and labor induction without medical indication. Low risk is defined as a woman with a pregnancy that is not preterm (≥ 37 wk gestation), singleton, vertex position, and with no prior cesarean delivery. Medical indications are defined based on the Specifications Manual for Joint Commission National Quality Measures (v2011A, appendix A). Medical indications possibly justifying labor induction included premature or prolonged rupture of membranes, HIV infection, placenta previa, vasa previa, antepartum hemorrhage, hypertensive disorders, postdates, liver, renal or cardiovascular disease, abnormal blood glucose, coagulation defects, multiple gestation, unstable lie, fetal malformation, poor fetal growth, fetal chromosomal abnormality, fetal-maternal hemorrhage, Rh/ABO isoimmunization, fetal distress, intrauterine death, stillbirth, polyhydramnios, oligohydramnios, abnormal fetal heart rates, amniotic infection, and pregnancy with poor obstetric history. Contraindications for vaginal delivery included complications related to preterm labor or multiple gestation, long or obstructed labor with multiple gestation, malpresentation (eg, breech), complications from prior cesareans, and other serious fetal or placental problems.

Hospital urban-rural status was based on US Census Core-Based Statistical Area codes. Patient-level covariates were maternal age, race/ethnicity, primary payer, and maternal medical conditions, including the following complications of pregnancy, labor, and delivery: diabetes, hypertension, preeclampsia, eclampsia, postterm pregnancy, multiple gestation, placental complications, malpresentation, fetal disproportion, fetal distress, prior cesarean delivery, and preterm delivery.

Analysis

We used generalized estimating equations with a log link and adjusted SEs to account for hospital-level clustering. Models were controlled for age, race, and payer and included interaction terms between year and rural location to evaluate whether annual trends in outcomes differed by hospital location. We also calculated unadjusted odds with models controlling for age alone, age and race, and clinical covariates. These results confirm main analyses and are presented as Supplemental Digital Content (http://links.lww.com/MLR/A609).

To illustrate rural and urban time trends, we also calculated predicted probabilities using mean covariate values (Table 1), to represent a typical childbirth-related hospitalization and coefficients generated by the generalized estimating equations models described above (Table 3). All analyses were performed using SAS, version 9.3.

This research was approved by the University of Minnesota Institutional Review Board (ID 1209S20781).

RESULTS

Differences Between Births in Rural and Urban Hospitals and Trends Over Time

Women giving birth in rural hospitals were younger than those giving birth in urban hospitals (52.9% vs. 37.5% below the age of 25 years), were less diverse (46.9% white vs. 38.5% white), and were more likely to have Medicaid coverage (50.9% vs. 39.3%; Table 1). In addition, there were lower rates of pregnancy complication in rural versus urban hospitals. From 2002 to 2010, obstetric trends were similar across settings (Table 2). In rural hospitals, unadjusted cesarean rates for low-risk women grew from 12.9% to 15.5% versus 12.7% to 16.1% in urban hospitals. VBAC rates declined from 13.1% to 5% in rural hospitals and from 18.8% to 10.0% in urban hospitals. Nonindicated labor induction increased from 9.3% to 16.5% in rural hospitals and from 10.3% to 12.0% in urban hospitals. This represents a 17.3% relative increase among urban hospitals versus a 77.7% increase in rural hospitals. Nonindicated cesarean rates grew from 14.3% to 16.9% in rural hospitals and 14.3% to 17.8% in urban hospitals.

Differential Time Trends Between Rural and Urban Hospitals

Controlling for sociodemographic factors, low-risk women had 6% higher odds of cesarean delivery in a rural (vs. urban) hospital in 2002 [adjusted odds ratio (AOR) = 1.06 (1.04–1.07); Table 3], but the odds of cesarean delivery among low-risk women grew slightly more quickly in urban hospitals, with an annual increase of 4% across the study period [annual AOR = 1.04 (1.03–1.04)]. Rural hospitals were also more likely to perform a cesarean without medical indication in 2002 [AOR = 1.03 (1.02–1.05)], and the pattern of increase over time in rural and urban hospitals was similar to that for low-risk cesareans. In addition, odds of VBAC were 38% lower in rural versus urban hospitals in 2002 [AOR = 0.62 (0.60–0.65)]. VBAC odds declined 10% each year in urban hospitals from 2002 to 2010 [annual AOR = 0.90 (0.90–0.91)] and less rapidly among rural hospitals [annual AOR = 0.96

TABLE 1. Maternal Descriptive Statistics for Childbirth Hospitalizations in Rural and Urban Hospitals, 2002–2010

	Number of Childbirth-related Hospitalizations 2002–2010 (%)*			
	All (n = 7,188,972)†	Rural (n = 837,772)	Urban (n = 6,316,743)	*P*
Demographics				
Age category, n (%)				
<20	1,018,434 (14.2)	169,366 (20.2)	842,300 (13.3)	<0.001
21–25	1,813,878 (25.2)	273,732 (32.7)	1,529,501 (24.2)	<0.001
26–30	1,977,568 (27.5)	216,462 (25.8)	1,751,672 (27.7)	<0.001
31–35	1,556,359 (21.7)	123,456 (14.7)	1,427,640 (22.6)	<0.001
35+	816,654 (11.4)	54,587 (6.5)	759,720 (12)	<0.001
Race/ethnicity, n (%)				
White	2,841,802 (39.5)	392,855 (46.9)	2,433,821 (38.5)	<0.001
Black	727,915 (10.1)	49,684 (5.9)	672,006 (10.6)	<0.001
Hispanic	1,248,800 (17.4)	50,176 (6.0)	1,194,171 (18.9)	<0.001
Other	580,839 (8.1)	44,931 (5.4)	532,932 (8.4)	<0.001
Missing	1,789,616 (24.9)	300,126 (35.8)	1,483,813 (23.5)	<0.001
Primary payer, n (%)				
Medicaid	2,928,166 (40.7)	425,967 (50.8)	2,483,937 (39.3)	<0.001
Private insurance	3,774,089 (52.5)	340,842 (40.7)	3,420,363 (54.1)	<0.001
Self	238,194 (3.3)	26,736 (3.2)	210,050 (3.3)	<0.001
Other	237,559 (3.3)	41,846 (5)	193,959 (3.1)	<0.001
Clinical conditions, n (%)				
Diabetes	422,205 (5.9)	38,768 (4.6)	381,351 (6)	<0.001
Hypertension	615,460 (8.6)	71,575 (8.5)	540,253 (8.6)	<0.001
Preeclampsia/eclampsia	250,683 (3.5)	27,281 (3.3)	221,895 (3.5)	<0.001
Postdates (>40 wk)	784,838 (10.9)	73,985 (8.8)	707,413 (11.2)	<0.001
Multiple gestation	95,884 (1.3)	6,927 (0.8)	88,513 (1.4)	<0.001
Placenta problems	134,025 (1.9)	13,451 (1.6)	119,937 (1.9)	<0.001
Malpresentation	544,806 (7.6)	54,816 (6.5)	487,532 (7.7)	<0.001
Disproportion	373,610 (5.2)	51,970 (6.2)	320,007 (5.1)	<0.001
Prior cesarean	1,066,758 (14.8)	120,346 (14.4)	940,838 (14.9)	<0.001
Preterm delivery (<37 wk)	542,020 (7.5)	46,603 (5.6)	492,331 (7.8)	<0.001

P-values were derived from χ^2 tests of significance for differences in the distribution of demographic and clinical characteristics between rural and urban settings.
*Percentages may not total 100 because of rounding.
†34,457 observations (0.5%) did not have hospital location indicator.

(0.95–0.97)]. Finally, nonindicated labor induction was less frequent in rural versus urban hospitals in 2002 [AOR = 0.79 (0.78–0.81)]. In urban hospitals, the odds of nonindicated labor induction increased 4% per year from 2002 to 2010 [annual AOR = 1.04 (1.04–1.04)], but odds of nonindicated labor induction increased more rapidly in rural hospitals from 2002 to 2010 [annual AOR = 1.05 (1.05–1.06)]. All noted trends and comparisons were significant at $P<0.001$.

TABLE 2. Changes Over Time in Obstetric Procedures, 2002–2010, in Rural and Urban Hospitals

	Numerator/Denominator (%)			
	All, 2002–2010 n = 7,188,972	2002 n = 735,322	2010 n = 776,191	% Change 2002–2010
Rural hospitals (n = 837,772)				
Cesarean delivery among low-risk women*	94,369/631,901 (14.9)	10,245/79,131 (12.9)	10,547/68,254 (15.5)	19.4
Vaginal birth after cesarean (VBAC)	8101/120,346 (6.7)	1689/12,940 (13.1)	726/14,577 (5.0)	−61.8
Labor induction without indication†	63,249/511,658 (12.4)	5877/63,370 (9.3)	8880/53,875 (16.5)	77.7
Cesarean delivery without indication‡	106,024/649,919 (16.3)	11,583/80,977 (14.3)	11,845/70,274 (16.9)	17.8
Urban hospitals (n = 6,316,743)				
Cesarean delivery among low-risk women*	708,248/4,588,462 (15.4)	60,322/473,569 (12.7)	77,031/477,666 (16.1)	26.6
VBAC	105,850/940,838 (11.3)	15,181/80,889 (18.8)	11,107/111,373 (10.0)	−46.9
Labor induction without indication†	405,000/3,502,914 (11.6)	37,362/363,786 (10.3)	42,771/355,168 (12.0)	17.3
Cesarean delivery without indication‡	813,017/4,734,953 (17.2)	69,723/486,995 (14.3)	87,674/492,575 (17.8)	24.3

Numerators are hospitalizations with the corresponding outcome.
Denominators are total hospitalizations among women eligible to experience the outcome (ie, low-risk women, women with prior cesarean deliveries; and women without medical indications for induction or cesarean).
Percent change between 2002 and 2009 highlights the time trend for each outcome in rural and urban hospitals.
*Low-risk women refer to women with full-term, singleton, vertex pregnancies, and no prior history of cesarean delivery.
†Pregnancies without medical indication to hasten delivery.
‡Pregnancies without contraindication to vaginal delivery (ie, with no medical indication for cesarean delivery).

TABLE 3. Adjusted Odds Ratios (AOR) of Differences by Rural Status, Annual Time Trends, and Differential Time Trends by Rural for Obstetric Procedures, N = 7,188,972

	N*	AOR (95% CI)		
		Rural (vs. Urban)	Time Trend	Differential Annual Time Trend for Rural (vs. Urban)
Cesarean delivery among low-risk women	5,244,898	1.06 (1.04–1.07)	1.04 (1.04–1.04)	0.99 (0.99–0.99)
Vaginal birth after cesarean (VBAC)	1,066,758	0.62 (0.60–0.65)	0.90 (0.90–0.91)	0.96 (0.95–0.97)
Labor induction without medical indication	4,014,572	0.79 (0.78–0.81)	1.04 (1.04–1.04)	1.05 (1.05–1.06)
Cesarean delivery without medical indication	5,384,872	1.03 (1.02–1.05)	1.03 (1.03–1.04)	0.99 (0.99–0.99)

All models use SEs adjusted for hospital clustering and control for age, race/ethnicity, and primary payer.

Results are all statistically significant at $P<0.05$.

*N—total hospitalizations among women eligible to experience the outcome (ie, low-risk women, women with prior cesarean deliveries; and women without medical indications for induction or cesarean).

CI indicates confidence interval.

Figure 1 shows predicted probabilities for labor induction for a woman with population average characteristics (Table 1, age 28 years, white, privately insured, and without medical indications necessitating labor induction), giving birth in either a rural or an urban hospital in the years 2002–2010. Although the predicted probability of nonindicated labor induction for a typical low-risk woman was lower in 2002 in a rural hospital (11.0%) compared with an urban hospital (13.4%), chances of nonindicated induction increased more rapidly in rural hospitals. By 2010, a low-risk woman had a higher probability of nonindicated labor induction if she gave birth in a rural hospital compared with an urban hospital, with predicted probabilities of 20.7% and 17.8%, respectively.

DISCUSSION

Rising cesarean rates are a challenge faced in both rural and urban locations. Nonindicated labor induction is increasingly common for births in rural hospitals. This analysis indicates that women giving birth in rural and urban hospitals may experience different childbirth-related benefits and risks. Whether these trends continue will depend in part on the implementation of current policy recommendations and health reform efforts.

Financial and Policy Implications

Medicaid pays hospitals about 50% less than private insurers for childbirth-related services.[4] A higher proportion of rural (vs. urban) residents are enrolled in Medicaid, and rural hospitals receive 14% of their revenue from Medicaid.[33] Rural hospital administrators often cite a high percentage of Medicaid patients as a financial concern in their obstetric services line.[3]

Because of Medicaid's important role in financing childbirth care, particularly in rural hospitals, Medicaid payment policy has great potential to inform and catalyze quality improvement in obstetric care,[34] for example, by adjusting payment to discourage nonindicated deliveries before 39 weeks gestation.[35] However, rural-urban differences should be

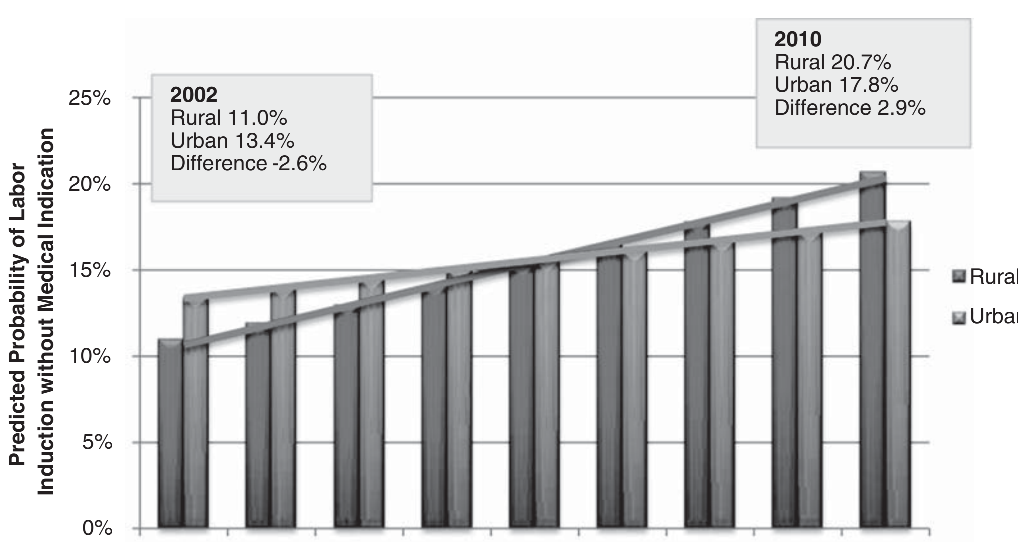

FIGURE 1. Predicted probability of labor induction without medical indication over time (2002–2010) for a 28-year-old, white, and privately insured, low-risk women, by hospital location. Predicted probabilities were calculated using coefficients generating using the model presented in Table 3.

considered in implementation of payment policies. Hospitals that struggle to comply with requirements or recommendations to reduce the use of this procedure may experience revenue reductions and may hamper efforts (eg, educational trainings, protocol development, or staffing increases) that may be required for effective implementation of quality improvement efforts. The medico-legal environment may also influence rural obstetric practice by liability insurance rate surcharges for low-volume and family physician obstetric providers.[36]

New and emerging models of health care delivery including the establishment of Accountable Care Organizations (ACOs) may provide opportunities for shared resources and shared savings to facilitate the implementation of evidence-based care,[37,38] but rural-urban differences in ACO implementation may impact obstetric care. One consequence of perinatal regionalization has been reduced availability of obstetric services in some rural areas,[23,39] and ACO implementation may further decrease the availability of rural obstetric care through hospital consolidations. It may, however, also catalyze new maternity care practice models, including collaborative practice between obstetricians, nurse-midwives, and family physicians, as well as ACO collaborations across rural and urban sites.[40,41]

Health and Clinical Practice Implications

Small differences in annual trends between rural and urban hospitals constitute large cumulative effects over time. Our findings have important implications for the adoption of quality improvement programs and clinical management protocols in both rural and urban hospitals. A recent NIH consensus panel issued recommendations for reducing the rate of first-time cesareans.[21] These recommendations, although not yet universally agreed upon, may be helpful to clinicians and administrators and are clinically valid in both rural and urban hospitals; however, implementation and logistical barriers may delay or prevent adoption of the recommendations in rural settings, which face staffing shortages and resource limitations.[3,16,17,42]

The goal of any hospital—rural or urban—should be to provide evidence-based care consistently to all maternity care patients. Although the means may differ across settings, policy efforts should enable rural and urban hospitals to achieve the same level quality of care. Future research should assess the appropriateness and effectiveness of these and other obstetric care guidelines in both rural and urban settings. Efforts underway to narrow the rural-urban gap in quality of maternity care specifically, and health care generally, should be rigorously evaluated.

Limitations

NIS data do not contain information to distinguish nulliparous women or identify nonindicated procedures performed between 37 and 39 weeks of gestation. Clinical notes and information on the number of obstetric providers within hospital catchment areas are also unavailable. We construct outcome measures based on ICD-9 codes. Therefore, some diagnoses or procedures (eg, labor induction) may be underreported; we do not, however, expect this to differentially affect births in rural and urban hospitals. Our final regression models controlled for individual demographic characteristics, but we also used alternative model specifications based on hospital characteristics and clinical conditions; results were robust to these specifications (Supplemental Digital Content, http://links.lww.com/MLR/A609).

CONCLUSIONS

This analysis offers important insight into obstetric care trends in rural and urban hospitals. Rising cesarean rates for low-risk pregnancies and nonindicated cesareans are challenges for both rural and urban hospitals. National trends toward greater use of nonindicated labor induction were especially pronounced in rural hospitals. Maternal and child health promotion policies, including payment reforms for nonindicated interventions and labor management practices, may face different implementation challenges in both rural and urban hospitals. These findings provide clinicians, hospital administrators, and policymakers an opportunity to address disparate trends between rural and urban settings and to improve maternity care quality.

ACKNOWLEDGMENTS

The authors thank for research assistance provided by Maeve McClellan, BS, and for editorial input provided by Alex McEllistrem-Evenson, MA, and Ezra Golberstein, PhD.

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