Access to Maternity Care in Rural Washington: Its Effect on Neonatal Outcomes and Resource Use

ABSTRACT

Objectives. This study sought to ascertain the effects of poor local access to obstetric care on the risks of having a neonate diagnosed as non-normal, a long hospital stay, and/or high hospital charges.

Methods. Washington State birth certificates linked with hospital discharge abstracts of mothers and neonates were used to study 29 809 births to residents of rural areas. Births to women from rural areas where more than two thirds of the women left for care were compared with births to women from rural areas where fewer than one third left for care.

Results. Poor local access to providers of obstetric care was associated with a significantly greater risk of having a non-normal neonate for both Medicaid and privately insured patients. However, poor local access to care was consistently associated with higher charges and increased hospital length of stay only if the patient was privately insured.

Conclusions. These results indicate that local maternity services may help prevent non-normal births to rural women and, among privately insured women, might decrease use of neonatal resources.

Thomas S. Nesbitt, MD, MPH, Eric H. Larson, PhD, Roger A. Rosenblatt, MD, MPH, and L. Gary Hart, PhD

Introduction

Ensuring optimal neonatal outcomes for rural populations poses unique problems. Between 1984 and 1989 alone, there was a 20% decrease in the number of rural obstetric providers in the United States.[1] This decrease has continued; the proportion of rural family physicians providing obstetric care was 43% in 1988 and only 37% in 1992.[2–4] Provision of newborn services has also begun to decline among rural family physicians, who have stopped delivering babies; the proportion of family physicians providing normal newborn care decreased from 73% in 1988 to 65% in 1992.[2,4] This declining access to local maternity and neonatal services in the rural United States over the past decade[1,5] raises significant health policy issues. Namely, to what degree should health policy and educational resources be directed at ensuring local access to maternity services instead of simply allowing an increasing number of women to travel to larger communities for care?

To address this important issue, one must look at the consequences for neonates born to women with adequate local access compared with those born to women without this access. Traditional measures of system performance in this area have included neonatal mortality, prematurity, and birthweight. However, to fully appreciate the impact from a health policy standpoint, resource usage must be evaluated. The opportunity arose to study the relationship between neonatal outcomes and the availability of local maternity services within a rural population through a natural experiment. Because some, but not all, rural hospitals in Washington State experienced significant losses of access to maternity services in the mid to late 1980s, those rural communities had vastly differing levels of access to maternity care. This allowed for neonatal outcomes in areas with poor local access to be compared with outcomes in areas with adequate local access. Specifically, this study explores how local availability of maternity services in rural areas is associated with neonatal outcomes and the use of health care resources for publicly and privately insured patients.

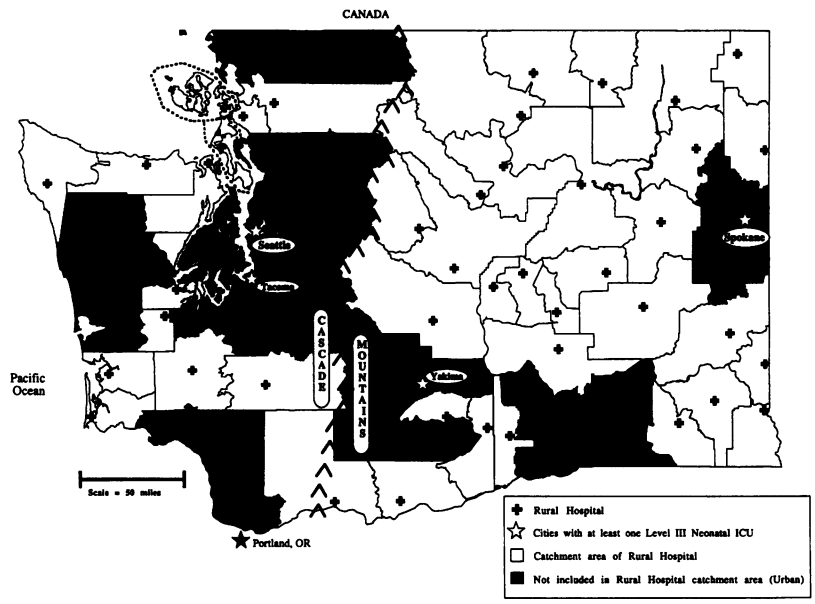
Methods

This study was based on all deliveries of women whose primary residence was in Washington State and who gave birth during calendar years 1987, 1988, or 1989. Rural residents were defined as those individuals living within the primary service areas of one of the 43 hospitals designated as rural by the Washington State Department of Health. A rural primary service area was defined as all the five-digit ZIP code areas whose population centers were closer by public roadway to a specific rural hospital than to any other hospital facility. These primary service areas should be thought of as the normative areas from which primary obstetric care would generally be expected to be provided. These areas are not based on utilization data because utilization behavior is, in part, a direct function of the local availability of services.

Thomas S. Nesbitt is with the Department of Family Practice, University of California–Davis, Sacramento. Eric H. Larson, Roger A. Rosenblatt, and L. Gary Hart are with WAMI Rural Health Research Center, Department of Family Medicine, University of Seattle, Wash.

Requests for reprints should be sent to Thomas S. Nesbitt, MD, MPH, University of California–Davis, Department of Family Practice, 2221 Stockton Blvd, Sacramento, CA 95817.

This paper was accepted May 17, 1996.



Source. This map was produced by the University of Washington, Rural Health Research Center, 1996.

FIGURE 1—Rural hospitals and their primary service areas, Washington State, 1987 to 1989.

TABLE 1—Community and Hospital Characteristics by Obstetric-Patient Outflow Group, Rural Washington State, 1987 to 1989

	Low-Outflow Communities (n = 15)	High-Outflow Communities (n = 16)
Total no. hospital births to residents of services areas, 1987–1989	16 248	3736
Births occurring outside community, %	16.7	86.4
Physicians per 100 births per years, no.	2.8	1.1
Mean beds in local hospital, no.	66	23

A data file maintained by the state of Washington, which includes linked data from birth certificates and all nonfederal hospital discharge abstracts for both mother and neonate, was used as the main data source. The match rate between the birth certificates and the hospital discharge abstracts was 95%. The linked file allowed traditional birth certificate data (such as birthweight, gestational age, adequacy of prenatal care visits, and maternal demographic data) to be supplemented with hospital abstract information, including ZIP code of residence, hospital charges, length of stay, diagnosis-related group (DRG), and *International Classification of Diseases,* 9th edition (ICD-9) diagnostic codes.

Availability of Local Obstetric Services

Comparing the place of residence with the location of the hospital of delivery made it possible to determine the proportion of all deliveries that occurred in facilities outside a woman's local primary service area. Communities in which more than two thirds of the deliveries occurred at a hospital other than a local one were designated as "high-outflow" communities. "Low-outflow" communities were those in which fewer than one third of deliveries to local women occurred at a nonlocal hospital. Communities that fell between these two extremes were excluded from the analysis because the focus of this study was on the contrast in outcomes for residents of communities with clearly good vs poor access to care. Using the two extremes also helped guard against the potential problem of misclassification of communities caused by population differences in underlying obstetric risk and subsequent higher rates of appropriate referral out of the community. This approach was also consistent with that reported in previously published work in this area.[6]

Because the presence of providers alone does not ensure access, outflow was used as a proxy for access to local obstetric services. However, to confirm that the outflow stratification of communities correlated with local availability of obstetric providers, a telephone survey of hospital administrators, directors of nursing, or obstetric nurse managers was conducted. The response rate was 100%. Information was obtained on the number of physicians providing routine delivery services in each of the hospitals during each study year. The mean number of physician obstetric providers (per 100 births) for each outflow group was calculated over the 3-year study.

Outcome Measures

The major outcomes evaluated in this study were non-normal neonate (defined as neonatal DRG code 390, 389, 388, 387, or 386), neonatal length of stay, and newborn hospital charges. Newborn length of stay greater than 5 days was chosen as an indicator of significant adverse outcome because such a stay was unlikely to include well or mildly sick babies whose hospital stays were incidental to maternal events such as protracted labor and/or delivery by cesarean section. Infants who died were excluded from this analysis.

Newborn hospital charges exceeding $1000, $1500, and $3000, corresponding respectively to the 90th, 95th, and 97.5 percentiles of charges in the infant population, were evaluated dichotomously. The use of cutoffs in the ninth decile of overall charges established high threshold measures of adverse outcome, ensuring that the mildly sick infants and infants with relatively long stays incidental to long maternal stays were not included in a group of infants with severe conditions. Evaluating the frequency of high charges dichotomously as opposed to continuously (using mean or median charges) had

two advantages. First, it helped ensure that our comparison of outcomes across categories of access was focused on the infants at greatest risk. Second, it helped minimize the effects of both minor differences in average daily charges and of a few infants with extraordinarily high charges on the overall comparison.

Statistical Analysis

Descriptive data are reported by community outflow group. In the first phase of the analysis, differences in demography and rates of adverse neonatal outcome across high- and low-outflow groups were assessed bivariately using chi-squared and *t* tests. Prenatal care adequacy was assessed using the Kotelchuck index.[7] The DRG codes assigned to infants with high charges and longer lengths of stay were also compared bivariately to understand some of the observed differences in outcomes. In the second phase, the independent effect of residence in a high- vs low-outflow community was assessed in a series of logistic regression analyses in which high hospital charges, prolonged length of stay, and DRG codes indicating a non-normal newborn were used as dependent variables. Control variables included delivery by cesarean section, White race, maternal age greater than 35, maternal age less than 18, two parity variables (nulliparous and parity greater than four), and gestational age less than 37 weeks. Hispanic, African-American, and Native American ethnicity as well as maternal smoking were also tested during the analysis, but these had little effect on the results and were not included in the final regressions. When preliminary results suggested a synergistic association between certain poor outcomes and both high outflow and insurance status, the regression analysis was stratified by insurance status and separate analyses were performed on the privately insured and Medicaid populations. Self-pay patients were excluded from all analyses because self-pay status is not independent of outcome. In other words, self-pay patients will often qualify for coverage only when an expensive adverse outcome occurs. Additionally, infants who were coded DRG 385 (infant died or transferred) were excluded from the analysis since infants who are transferred or die may have short lengths of stay and the charges may not reflect the significance of their condition.

TABLE 2—Characteristics of Rural Mothers by Obstetric-Patient Outflow Group and Insurance Status, Rural Washington State, 1987 to 1989

	Mothers in Low-Outflow Areas (n = 14 715)	Mothers in High-Outflow Areas (n = 3377)	Significance
Non-Hispanic White, %	85.3	81.6	<.01
Insured	90.5	88.5	<.01
Medicaid	76.1	71.1	<.01
Aged <18 y, %	4.3	4.1	.75
Insured	1.7	1.8	.85
Medicaid	8.5	7.8	.39
Aged >35 y, %	5.4	4.7	.13
Insured	6.9	5.9	.10
Medicaid	2.7	2.8	.93
Nulliparous, %	39.4	34.0	<.01
Insured	38.6	33.9	<.01
Medicaid	40.8	34.0	<.01
More than 4 previous births, %	3.6	5.6	<.01
Insured	2.7	4.1	<.01
Medicaid	5.2	8.0	<.01
Delivered by cesarean section, %	21.2	20.2	.21
Insured	21.8	20.0	.07
Medicaid	20.1	20.5	.78
Married, %	76.2	74.1	.01
Insured	93.1	91.2	<.01
Medicaid	48.0	47.5	.76
Received inadequate prenatal care, %	15.0	17.0	<.01
Insured	7.1	9.0	<.01
Medicaid	28.0	29.4	.34
Covered by Medicaid, %	37.5	39.4	.04

Results

Community Characteristics

During the 3-year study period, residents of the 43 rural hospital primary service areas experienced just over 30 000 births, representing approximately 13% of all births in Washington State. The data file described above linking birth certificates to hospital discharge abstracts included 29 809 births. When the 43 rural communities were stratified into groups by outflow for obstetric care, 16 fell into the high-outflow group and 15 fell into the low-outflow category. Excluding the residents of the 12 medium-outflow communities from the study left a total of 31 communities, whose residents experienced 19 984 births during the study period.

The catchment areas of the 43 rural hospitals and the locations of Level III referral centers are shown in Figure 1. Fourteen of the 16 (87%) high-outflow communities are located east of the mountains, whereas 11 of the 15 (73%) low-outflow communities are located in this region west of the Cascades. The majority of both high- and low-outflow communities are quite isolated and at significant distances from the nearest communities providing obstetric services.

As shown in Table 1, the two groups of communities differed widely in terms of both the number of births to residents and the medical resources available locally. High-outflow communities had 1.1 obstetric providers per 100 births compared with 2.8 providers in low-outflow communities. Of the 16 high-outflow communities, 8 had no obstetric providers for at least 1 year of the 3-year period, 2 had no local obstetric providers for 2 years of the study period, and 5 had no obstetric providers during the entire 3-year period. All 15 low-outflow communities, on the other hand, had local services available throughout the study period.

The risk statuses of the women giving birth in the two groups of commu-

TABLE 3—Birth Outcomes and Resource Use among Rural Residents, by Obstetric-Patient Outflow Group and Insurance Status, Rural Washington State, 1987 to 1989

	Mothers in Low-Outflow Areas (n = 14 715)	Mothers in High-Outflow Areas (n = 3377)	Significance
Neonatal deaths per 1000 births, no.	4.35	4.16	.98
Insured	4.37	1.95	.17
Medicaid	4.35	7.51	.21
Very low birthweight outcomes (<1500 g), %	0.7	0.7	.95
Insured	0.6	0.5	.91
Medicaid	0.7	0.9	.61
Low-birthweight outcomes (<2500 g), %	4.9	4.3	.12
Insured	4.1	3.7	.38
Medicaid	6.2	5.4	.30
Gestational age <37 weeks, %	8.8	8.0	.04
Insured	7.4	7.0	.60
Medicaid	11.3	9.6	.08
Gestational age >41 weeks, %	12.6	13.1	.41
Insured	11.1	10.8	.74
Medicaid	15.2	15.9	.57
Mean gestational age, weeks	39.3	39.4	.83
Insured	39.4	39.4	.93
Medicaid	39.3	39.4	.15
Mean length of stay, days	2.3	2.4	.18
Insured	2.3	2.6	.01
Medicaid	2.3	2.4	.17
Baby length of stay >5 days, %	2.9	4.1	<.01
Insured	2.7	4.6	<.01
Medicaid	3.4	4.1	.26
Mean infant charges	$817	$1 041	.02
Insured	$780	$1 086	.01
Medicaid	$924	$1 133	.33
Median infant charges	$386	$ 433	<.01
Insured	$416	$ 481	<.01
Medicaid	$363	$ 393	.01
Baby charges >$1000, %	9.3	13.2	<.01
Insured	9.4	14.9	<.01
Medicaid	10.1	12.4	<.01
Baby charges >$1500, %	4.8	7.2	<.01
Insured	4.5	8.1	<.01
Medicaid	5.6	6.9	.06
Baby charges >$3000, %	2.3	3.7	<.01
Insured	2.2	4.0	<.01
Medicaid	2.7	3.9	.02

nities are compared in Table 2. Proportionately fewer women from high-outflow communities were White, married, and nulliparous compared with women from low-outflow communities, while proportionately more of them were Medicaid insured, had had more than four previous births, and had received inadequate prenatal care as measured by the Kotelchuck index (although the difference in the rate of inadequate care is only 2%). These patterns remained in most categories even after stratifying for insurance status. Medicaid patients were more like to receive inadequate prenatal care overall, but the difference between high- and low-outflow residents in this regard was not significant.

Neonatal Outcomes

Infants born to women from communities with the poorest local access to care did not experience a greater risk of neonatal death, low birthweight, or prematurity. Residents of high-outflow areas did, however, use more neonatal resources, as measured by newborn lengths of stay and hospital charges (Table 3). Length of stay remained significantly different only for insured patients, whereas the differences in charges held up for both groups in all categories but mean charges.

Diagnoses for Newborns with High Charges and Prolonged Lengths of Stay

Neonates with high charges and lengths of stay greater than 5 days were analyzed by individual DRGs. Fewer than 1% of normal newborns (DRG 391) had charges exceeding $3000 or lengths of stay exceeding 5 days. The percentages did not differ for high- vs low-outflow residents. Approximately 70% of extremely premature neonates (DRG 386) had long lengths of stay or high charges, but the percentages again did not differ for high- vs low-outflow residents. However, premature infants with major complications (DRG 387) were significantly more likely to have charges greater than $3000 (71.4% vs 50.5%, $P < .01$) if their mothers resided in high- vs low-outflow communities. As expected, analysis of prolonged length of stay followed the same pattern (76.8% vs 54.9%, $P < .01$). Similar results were found in term infants with major complications (DRG 389) for charges greater than $1500 and $3000 and for lengths of stay greater than 5 days. All these differences were statistically significant (37.8% vs 21.3%, 19.5% vs 8.7%, 17.1% vs 11.2%, respectively; $P < .01$).

Further stratification of the data by insurance type was difficult because of small numbers; however, the trends indicated that differences between high- and low-outflow community residents were greater for insured than for Medicaid patients. In addition, an evaluation restricted to babies with a length of stay greater than 5 days or with hospital charges of more than $3000 showed that babies from high-outflow communities were nearly twice as likely as those from low-outflow communities to be delivered at a gestational age of 41 weeks or more (18.6% vs 9.7%, $P < .001$). Analysis of the ICD-9 diagnosis codes assigned to neonates with high charges and/or long lengths of stay did not reveal any other significant or suggestive differences associated with residence in high- vs low-outflow communities. This included no differences found in rates of congenital anomalies. The most common diagnosis for infants with long lengths of stay was neonatal jaundice. However, the frequency of this diagnosis as well as the

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* (1.17, 1.44)	1.22* (1.05, 1.40)	2.34* (1.89, 2.92)	1.28 (.96, 1.69)	2.28* (1.68, 3.11)	1.57** (1.07, 2.32)	2.01* (1.52, 2.67)	1.15 (.80, 1.66)
Control variables								
White	.91	1.09	.97	.86	1.21	1.07	.73	1.15
Age >35 y	1.18	1.25	1.29	.85	1.12	.70	1.56**	.74
Age <18 y	1.10	.88	.89	.67	.37	.59	1.19	.69
Nulliparous	1.28*	1.24*	1.44*	1.62*	1.23	1.61*	1.73*	1.45**
Parity >4	.82	1.24	.76	1.85*	.44	1.72	.51	1.51
Cesarean section	1.78*	1.95*	2.45*	2.80*	2.06*	1.96*	2.57*	3.02*
Married	1.01	1.07	.74	1.10	.79	1.25	.71	.97
Inadequate care	.99	.86**	.95	.71	1.24	.74	.65	.83
Gestational age >41 weeks	.82	.85	1.05	.88	.97	.67	1.01	.61
Gestational age <37 weeks	. . .	. . .	10.74*	7.18*	18.21*	11.17*	14.01*	9.82*
Overall χ^2 (significance)	125.07*	181.34*	546.77*	310.22*	410.68*	222.04*	471.37*	275.78*
Constant	−1.41	−1.60	−3.83	−3.74	−4.99	−4.88	−4.26	−4.52
Mean of dependent variable	.229	.219	.043	.050	.021	.024	.026	.031
Number of cases	10 669	6540	10 669	6540	10 669	6540	10 669	6539

*Significant at .01.
**Significant at .05.

length of stay it entailed did not differ for neonates from high- vs low-outflow communities.

Regression Analysis

The logistic regression analysis was performed to determine whether differences in outcomes between residents of low- vs high-outflow communities held up after controlling for parity, race, maternal age, and gestational age. Cesarean section and adequacy of prenatal care were entered last into the regression analyses and did not affect the significance or magnitude of the odds ratio for residence in a high-outflow community. Results of the regression analyses are presented in Table 4.

The first regression analysis assessed the association between having a neonate coded as "non-normal" (DRGs 386 through 390) and high-outflow residence. High-outflow community residents, both privately insured and Medicaid, were shown to have a significantly greater risk of having a non-normal neonate. The analysis of resource use shows that births to women from high-outflow communities are at greater risk of incurring hospital charges greater than $3000. However, only privately insured births are associated with charges greater than $1500. This is also the case for neonatal lengths of stay beyond 5 days.

Because resource usage is so strongly associated with prematurity, a regression analysis was also performed to determine whether residents of high-outflow communities are more likely to experience prematurity after controlling for other factors. Results of that analysis (not tabulated) show that outflow status is not associated with prematurity.

Discussion

The results of this study indicate that women with poor local access to obstetric services are less likely to bear a normal neonate, at least as indicated by DRG codes. Moreover, births to privately insured women are more likely to result in neonates with high charges and prolonged lengths of stay. This raises the fundamental question of whether these findings represent increased pathology resulting from delays in access to appropriate levels of care or a systematic bias in treatment and the discharge threshold for patients who have to seek care outside their own service area.

There are several plausible mechanisms through which the lack of local access to care would adversely affect birth outcomes. Local providers of obstetric services in rural areas serve as the entry point to the regionalized system of perinatal care. Without such a portal, patients with complications may experience delays in access to the neonatal intensive care services that have been shown to improve outcomes for high-risk infants.[8] It is also possible that travel for obstetric services may constitute a risk beyond the effects of delays caused by having to travel. Such a risk may occur through increased stress—physical and psychological—which may interfere with the normal birth process. Poor local access to providers may also affect the adequacy of some aspects of care in the prenatal period. Although compliance with prenatal protocols cannot be measured with these kinds of data, it is notable that nearly one fifth of the high-outflow community neonates with high charges or prolonged lengths of stay were postdates compared with half as many neonates from low-outflow communities. This may be explained by a lack of ready access to antenatal testing leading to delays in the diagnosis of placental

dysfunction and thus to adverse outcomes and increased resource usage.

If the above explanations are correct, why would differences in resource usage be mainly seen only in the insured population? It is known that during the study period, Medicaid patients had difficulty accessing care even in rural Washington communities with adequate numbers of providers.[9] This is also consistent with the prenatal care data presented in Table 2. It is further possible that because poverty is a marker for other physiological and sociodemographic characteristics associated with poor obstetric outcomes, the lack of local obstetric providers is a relatively less important risk factor for Medicaid patients than it is among the privately insured.

However, given this pattern of results, nonpathologic explanations must also be considered. It is possible that increased charges and lengths of stay seen among patients from high-outflow communities result not from increased pathology, but rather from differences in intensity and length of treatment for patients with poor local access to health care services who were discharged to distant communities. Physicians caring for these patients who identify minor problems with neonates may have concerns about returning these neonates to communities without adequate local outpatient follow-up. Less restrictive private insurance may give greater latitude in these decisions, which explains the differences observed across insurance type. Even if this is the case and the biologic outcomes are not different, the differences in charges and lengths of stay are real and have obvious financial implications for health care costs. However, this phenomenon may be eliminated by the utilization management strategies that characterize managed care insurance programs.

Another possibility is that the distant facilities used by high-outflow patients have systematically higher charges than those facilities used by low-outflow patients. However, the charge thresholds used in the analysis far exceed the differences that might be created by interfacility variation in standard charges. Only the hospital charges for the birth stay at the hospital in which the birth occurred have been taken into account in this analysis. Other costs, such as charges for prenatal care, physician charges for delivery and newborn care, or travel costs and the associated inconveniences, are not included.

It may also be suggested that outflow is a poor proxy for access to obstetric care. This is because patients needing higher-level services are referred out of rural communities so that communities with more high-risk women would automatically have higher outflow. However, the frequency of adverse outcomes is quite small compared with the magnitude of outflow differences between high- and low-outflow communities. More than 86% of patients in high-outflow communities delivered outside of their service areas (22% in tertiary care hospitals), whereas fewer than 17% of patients from low-outflow communities did so (Table 1). Nonetheless, it is possible that there were significant biologic risk differences between the populations of the outflow groups that we were unable to detect with our methodology.

The observed differences in lengths of stay and charges were not the result of poor care in the high-outflow communities. It must be borne in mind that fewer than 15% of deliveries of neonates from high-outflow communities occurred in the local hospitals. The mean lengths of stay and hospital charges from these few local births were less than those among low-outflow cases. This confirms that the increased use of resources was the result of births to women who traveled for delivery, because of either referral, choice, or inability to obtain local services.

In a changing health care system that ultimately must address both improved access and decreased costs, it is important to define the scope of services necessary at a local level to optimize outcomes in a cost-efficient manner. Previous work has documented the importance and cost-effectiveness of access to prenatal care, particularly for low-income women.[10,11] Our study suggests that local obstetric and neonatal services provide an efficient portal to a regionalized system of care for rural women and their babies. Further studies are needed to confirm this work and more clearly define the elements of perinatal services necessary to optimize birth outcomes in the rural United States. □

Acknowledgments

This work was supported by a grant to the WAMI Rural Health Research Center of the University of Washington's School of Medicine from the Federal Office of Rural Health Policy, Health Resources and Services Administration, Public Health Service. Dr Nesbitt also gratefully acknowledges the support of the Robert Wood Johnson Foundation.

We also wish to thank David Feit for his cartographic work.

References

1. Institute of Medicine. *The Effect of Medical Professional Liability on the Delivery of Obstetrical Care.* Washington, DC: National Academy Press; 1989.
2. Schmittling G. *Facts about Family Practice, 1993.* Kansas City, Mo: American Academy of Family Physicians; 1993.
3. Schmittling G, Tsao C. Obstetric privileges for family physicians: a national study. *J Fam Pract.* 1989;29:179–184.
4. Schmittling G. *Facts about Family Practice, 1990.* Kansas City, Mo: American Academy of Family Physicians; 1990.
5. *Health Care in Rural America.* Washington, DC: US Congress, Office of Technology Assessment; September 1990. OTA-H-434.
6. Nesbitt TS, Connell FA, Hart LG, et al. Access to obstetric care in rural areas: effect on birth outcomes. *Am J Public Health.* 1990;80:814–818.
7. Kotelchuck M. An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed adequacy of Prenatal Care Utilization Index. *Am J Public Health.* 1994;84:1414–1420.
8. Paneth N. The role of neonatal intensive care in lowering infant mortality. In: Kotch JB, Blakely CH, Brown SS, Wong FY, eds. *A Pound of Prevention: The Case for Universal Maternity Care in the U.S.* Washington, DC: American Public Health Association; 1992:49–63.
9. Rosenblatt RA, Whelan A, Hart LG. Obstetric practice patterns in Washington State after tort reform: has the access problem been solved? *Obstet Gynecol.* 1990;76:1105–1110.
10. Gortmaker SL. The effects of prenatal care upon the health of the newborn. *Am J Public Health.* 1979;69:653–657.
11. Moore TR, Origel W, Key TC, et al. The perinatal and economic impact of prenatal care in a low-socioeconomic population. *Am J Obstet Gynecol.* 1986;154:29–33.