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Abstract

The number of rural hospitals offering labor and delivery services has been declining across the United States for decades. As a part of this trend, labor and delivery services at Cook County North Shore Hospital in Grand Marais, Minnesota were discontinued in July 2015. The closure necessitates that patients now travel to Duluth, 110 miles away, for hospital-based delivery services. Partnership between Duluth's regional campus medical school and this rural community has grown to incorporate researching the effects of this closure on the Cook Country region including the community of Grand Marais. A prior study undertaken evaluated patients' perspectives on this loss of local obstetrical services. The present study's purpose was to characterize the utilization and clinical outcomes of obstetrical care for patients before and after local labor and delivery services were discontinued. Retrospective chart review compared measures before and after delivery services were discontinued locally. Although not statistically significant, patterns since closure include an increased percentage of inductions, home births, and cesarean deliveries for women in Cook County.

Introduction

There has been a significant decline over the past couple of decades in the number of rural communities providing obstetrical services throughout the United States, Canada, and elsewhere.[1–4] According to the United States Census Bureau statistics from 2010, nearly 18 million reproductive-aged women live in rural counties. Up to 40% of counties housing these rural women lack a qualified healthcare provider.[5] It has also become increasingly clear that there is an association between loss of hospital-based obstetrical services and birth outcomes in rural counties.[6–8] One of the limitations discussed in Kozhimannil et al's 2016 national analysis is that county data is the only available unit of analysis, but that counties vary considerably. It was suggested that future work assess the associations between obstetrical service loss and individual outcomes.

Our study focuses on patients seen at the Sawtooth Mountain Clinic (SMC) in Grand Marais, Minnesota. Grand Marais has a population of 1,351 and is the county seat of Cook County. Cook County has a median household income of $51,793, a poverty rate of 10.1%, a population of foreign-born residents of 4.7%, and a percentage of the population over 25 years of age with a bachelor's degree or higher of 39.6%.[9] In addition to patients in Cook County and surrounding areas, SMC also partners with the Grand Portage Band of Lake Superior Chippewa Health Services to provide some services for Band members in Cook County and on the Grand Portage Indian Reservation. Cook County North Shore Hospital (CCNH) in Grand Marais discontinued local obstetrical services in July of 2015. For decades prior to this closure, CCNH did not have epidural or surgical capabilities. Local providers would assess women during prenatal care and determine whether they were low-risk, thus candidates for local delivery. Surgical or higher risk patients were referred to regional providers for collaborative prenatal care between local and regional providers, with deliveries planned for a regional hospital. No regular home birth providers practiced in the area, so these patients did not have care coordinated by SMC providers either prior to or post closure. Since the closure of local obstetrical services, hospital management of labor and delivery now requires travel to a regional hospital in Duluth, Minnesota, 110 miles away. St. Mary's and St. Luke's Hospitals are located within a mile of each other on the same central hillside in Duluth, making the slight difference to each of them from CCNH insignificant. Only emergent deliveries are currently done at CCNH. Grand Marais serves as one of the longitudinal Rural Medical Scholars Program (RMSP) preceptorship sites for medical students from the University of Minnesota Medical School's Duluth campus. Given the campus's mission to improve healthcare outcomes in rural Minnesota and American Indian communities by educating medical students, creating strong regional partnerships, and fostering research, a closer look at the local effects of obstetrical service closure was felt to be relevant not only to the affected community, but to the

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future providers of rural communities elsewhere facing similar issues.

A prior study, which also grew out of the RMSP preceptorship in Grand Marais, looked at patients' perspectives as a result of the loss of local obstetrical care.[10] The present study's purpose is to add to the initial study by characterizing obstetrical care utilization and obstetrical care clinical outcomes for patients before and after local labor and delivery service discontinuation. By taking a unique opportunity to observe these characteristics in one rural community before and after local obstetrical unit closure, we aim to better understand the changes resulting from local closure and whether prior patient concerns voiced are being actualized. This individual community study contributes a better understanding of the effects of local obstetrical care service closure on rural-dwelling parturient women.

Methods

Data Collection

A retrospective chart review was conducted on patients at SMC in Grand Marais, comparing pregnancy and delivery outcomes before and after local delivery service discontinuation. This study included patients who received prenatal care at SMC for singleton pregnancies with deliveries occurring at 24 weeks gestation or longer between January 1, 2013 and May 15, 2017, the maximum possible duration for available chart review time and resources. The time period for deliveries before the discontinuation of obstetrical services is from January 1, 2013 to June 30, 2015 when data collection began (2 years and 6 months duration); while the time period after the discontinuation is from July 1, 2015 - May 15, 2017 (1 year and 10.5 months duration). Data from the charts was entered into a REDCap database by trained study investigators.[11] The study was conducted in compliance with the University of Minnesota's Institutional Review Board requirements for human research protection.

Statistical Methods

Demographics and characteristics of the patients and pregnancies were summarized overall, and before/after discontinuation of local labor and delivery services using descriptive statistics. Delivery patterns and birth outcomes were summarized by year using descriptive statistics (mother's age, gravidity/parity, gestation at delivery, delivery site, type of delivery, inductions, baby sex, baby weight, baby APGAR scores, etc.).

Due to the correlated nature of the data (multiple deliveries per mother), generalized estimating equations (GEE) with a repeated measures statement for mother were used to test for differences in the rates of interest listed above from before to after the discontinuation of services, using an independent working correlation structure. For binary outcomes (i.e. inductions, assisted deliveries, and C-sections), a binary distribution and logit link were used in the GEE, and for continuous outcomes (i.e. gestation, baby weight, and APGAR scores), a normal distribution and identity link were used in the GEE. Results are reported as regression point estimates β and standard errors (SE), as well as odds ratios and 95% confidence intervals (for binary outcomes only). P-values <0.05 were considered statistically significant, and SAS v.9.4 (SAS Institute, Cary, NC) was used for analysis.

Results

Sample

Our sample size for analysis was 160 deliveries at 24 weeks gestation or longer, resulting from singleton pregnancies for 137 women. In addition to data on delivery characteristics, we extracted data on a subset of the babies resulting from these deliveries (n=110). Data was unavailable for babies from the remaining 50 deliveries due to incomplete records from out-of-county providers available in SMC medical records. All 160 deliveries were live births. About half of the deliveries (n=78, 49%) were from before the discontinuation of labor and delivery services, and the other half were from after (n=82, 51%). Most women had only one delivery in the dataset (n=115/137, 84%), while a small number had 2 deliveries (n=21, 15%), and only one had 3 deliveries (1%). A small group of mothers (14%, n=19/137) had at least one delivery in both time periods. There were no statistically significant differences in mother age, mother gravidity, or baby sex between deliveries before and after discontinuation of delivery services in Grand Marais (Table 1). **Outcomes**

As expected, significantly fewer deliveries occurred at CCNH after delivery services were discontinued. Deliveries at St. Mary's Hospital in Duluth became more common, increasing from 33.3% to 51.2%, but there was no statistically significant change in the deliveries at St. Luke's Hospital in Duluth (41% vs. 38%) or deliveries at a hospital other than those listed (1.3% vs. 3.7%). The proportion of home births trended up (1.3% vs. 4.9%), but statistical significance was not achieved. There were no statistically significant changes in the gestational age at delivery, NICU transfers, baby weight, or baby APGAR scores when comparing deliveries before and after the discontinuation of delivery services. Both induction rates and cesarean section rates trended up (23.1% to 29.3% and 25.6% to 28% respectively) after local delivery services were discontinued, however these changes were not statistically significant.

Table 1. Delivery and Baby Characteristics

	Deliveries Before July 1, 2015 (2 years 6 months) *Adjusted Mean ± SE or unadjusted n (%)*	Deliveries on or After July 1, 2015 (1 year 10.5 months) *Adjusted Mean ± SE or unadjusted n (%)*	Regression β ± SE	OR (95% CI)	p-value
Delivery Characteristics (N=160)					
N	78	82			
Mother's Age	29.50 ± 0.51	29.61 ± 0.60	0.11 ± 0.74		0.882
Mother's Gravidity (n=104)	2.49 ± 0.23	2.61 ± 0.24	0.12 ± 0.32		0.709
Gestation at delivery (weeks)	39.39 ± 0.27	39.22 ± 0.16	-0.17 ± 0.28		0.548
Delivery location					
Cook County North Shore Hospital	18 (23.1%)	2 (2.4%)	-2.48 ± 0.73	0.08 (0.02-0.35)	<.001*
St. Mary's Hospital, Duluth[1]	26 (33.3%)	42 (51.2%)	0.74 ± 0.30	2.10 (1.16-3.81)	0.015*
St. Luke's Hospital, Duluth[1]	32 (41.0%)	31 (37.8%)	-0.13 ± 0.32	0.87 (0.47-1.63)	0.671
Home Birth	1 (1.3%)	4 (4.9%)	1.37 ± 1.13	3.95 (0.43-35.97)	0.223
Hospitals not in Duluth or Cook County	1 (1.3%)	3 (3.7%)	1.07 ± 1.16	2.92 (0.30-28.60)	0.356
Induction					
No	60 (76.9%)	58 (70.7%)			
Yes	18 (23.1%)	24 (29.3%)	0.32 ± 0.34	1.38 (0.70-2.70)	0.348
Type of Delivery					
Vaginal	53 (68.0%)	53 (64.6%)	-0.15 ± 0.30	0.86 (0.48-1.55)	0.619
Assisted	5 (6.4%)	6 (7.3%)	0.14 ± 0.62	1.15 (0.34-3.91)	0.820
Cesarean[2]	20 (25.6%)	23 (28.0%)	0.12 ± 0.31	1.13 (0.62-2.07)	0.692
Baby Characteristics (N=110)[3]					
N	47	63			
Baby's sex (n=106)					
Male	26 (57.8%)	32 (52.5%)	-0.22 ± 0.39	0.81 (0.38-1.73)	0.581
Female	19 (42.2%)	29 (47.5%)			
Baby transferred to NICU (n=106)					
No	42 (91.3%)	57 (95.0%)			
Yes	4 (8.7%)	3 (5.0%)	-0.59 ± 0.79	0.55 (0.12-2.58)	0.451
Baby's weight (ounces) (n=99)	125.40 ± 2.29	121.70 ± 2.54	-3.70 ± 3.45		0.284
Baby APGAR score at 1 minute (n=101)	8.00 ± 0.18	8.23 ± 0.19	0.23 ± 0.26		0.379
Baby APGAR score at 5 minutes (n=101)	8.91 ± 0.05	8.82 ± 0.11	-0.08 ± 0.12		0.484

*p<.05, each row is its own regression model, [1]The two hospitals in Duluth are less than a mile apart with St Luke's being closer to Grand Marais. [2]Includes 1 vacuum assisted cesarean, [3]Data from 50 of the 160 deliveries was unavailable due to not having access to records from other institutions which would have reported outcomes.

Discussion

Population-based studies have shown that the need for rural women to travel to access intrapartum maternity services is associated with adverse outcomes for newborns and mothers and increased interventions.[6,12] These findings include increased rates of inductions and unplanned out of hospital deliveries.[1,12–14] This project's aim to characterize utilization and clinical outcomes of obstetrical care for patients in one specific community before and after local labor and delivery service discontinuation shows consistency with what has been documented in these population-based studies. The patterns seen in Grand Marais and Cook County including increasing induction rate, cesarean delivery rate, and percentage of home births may have resulted from loss of local obstetrical services. Given our lack of statistically significant findings, however, larger studies are needed to confirm these trends, but patterns should continue to be monitored. Others have discussed the changing risk and cost to communities and individual parturient patients when local delivery is no longer an option.[1,3,10,15–19] The risks and costs to an individual community such as Grand Marais can thus start to be more easily articulated and calculated if these trends continue. The local change in services produced ripple effects observed at a regional level as birth location shifted to hospitals in Duluth. Interestingly, one Duluth hospital experienced an increase percentage of deliveries while the other experienced a decrease in deliveries to mothers from Cook County. Explanation for this trend is beyond the scope of this study, but likely results from patient preferences, insurance coverage, and/or availability of neonatal services at each. Further evaluation of this trend may be of interest to regional hospitals desiring to attract out-of-region patients.

There are some limitations to keep in mind when interpreting the findings of this study. First, the sample size is small, and the analyses are likely under powered, increasing the risk of Type II error. Continuing to follow trends, and ultimately looking at an expanded time frame before and after the service change would improve sample size. Second, we were not able to extract all the data for the babies, as previously addressed, which may bias the baby-level outcomes. Lastly, these results are from a small rural town in Minnesota and may not be fully generalizable to areas of the country with different demographics or pregnancy characteristics. Additionally, the pregnancies in this sample are mostly low-risk with only a small number of pregnancy complications reported. The discontinuation of delivery services may have a stronger impact on more complicated pregnancies than the deliveries in our sample, but unfortunately, we do not have the sample size to explore this possibility.

Conclusion

After discontinuation of local hospital delivery services in Grand Marais, Minnesota, the proportion of deliveries decreased at Cook County North Shore Hospital and increased in Duluth as expected. Our data do not provide enough evidence to conclude that rural pregnancy outcomes changed after the discontinuation of the local hospital delivery services. Nevertheless, patterns in this dataset are consistent with population-based studies and warrant further investigation: increasing rates of home births, inductions, and caesarian deliveries. With loss of local obstetrical services, each of these variables trended upward. The results of our study can be used to help design larger studies of rural pregnancy outcomes at the individual level in communities with comparable demographic characteristics facing potential changes to local service availability. Comparison could also be made to trends being seen in communities with contrasting demographic profiles. Further refinement of the patterns highlighted in our study could allow rural communities to better understand the local effects of loss of obstetrical services, and the risks and costs associated. This understanding can allow communities to better respond to the specific healthcare needs and concerns of their rural parturient women.

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