

OBSTETRICS

Hospital delivery volume, severe obstetrical morbidity, and failure to rescue



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BACKGROUND: In the setting of persistently high risk for maternal death and severe obstetric morbidity, little is known about the relationship between hospital delivery volume and maternal outcomes.

OBJECTIVE: The objectives of this analysis were (1) to determine maternal risk for severe morbidity during delivery hospitalizations by hospital delivery volume in the United States and (2) to characterize, by hospital volume, the risk for death in the setting of severe obstetric morbidity, a concept known as failure to rescue.

STUDY DESIGN: This cohort study evaluated 50,433,539 delivery hospitalizations across the United States from 1998–2010. The main outcome measures were (1) *severe morbidity* that was defined as a composite of any 1 of 15 diagnoses that are representative of acute organ injury and critical illness and (2) *failure to rescue* that was defined as death in the setting of severe morbidity.

RESULTS: The prevalence of severe morbidity rose from 471.2–751.5 cases per 100,000 deliveries from 1998–2010, which was an increase of 59.5%. Failure to rescue was highest in 1998 (1.5%), decreased to 0.6% in 2007, and rose to 0.9% in 2010. In models that were adjusted for comorbid risk and hospital factors, both low and high annualized delivery volume were associated with increased risk for failure to rescue and severe morbidity. However, the relative importance of hospital volume for both outcomes compared with other factors was relatively small.

CONCLUSION: Although low- and high-delivery volume are associated with increased risk for both failure to rescue and severe maternal morbidity, other factors, in particular characteristics of individual centers, may be more important in the determination of outcomes.

Key words: failure to rescue, hospital delivery volume, severe obstetrical morbidity

The burdens of maternal death and severe obstetrical morbidity and childbirth in the developed world have been increasing.^{1–3} Dramatic advances in perinatal care over the last 3 decades have not been paralleled by improvements in maternal care. National organizations, including the American Congress of Obstetricians and Gynecologists, American Board of Obstetrics and Gynecology, the Society for Maternal-Fetal Medicine, Amnesty International, and the National Institute of Child Health and Human Development⁴ all recently have issued policy recommendations to increase awareness of the causes of maternal death and to promote improved care of pregnant women.

Referral and/or transfer of complicated patients to centers with expertise, facilities, and staffing to care for mothers at high risk for death have been proposed

as a means of reducing maternal death and severe morbidity.⁴ However, little is known regarding maternal care at low-volume obstetrics centers in the United States; scant data are available on comorbid risk factors, incidence of life-threatening complications, and how often death occurs in the setting of severe morbidity. Outcomes at low-volume hospitals may be critically important, given that, as of 2008, 58% of hospitals that provide obstetrics care performed <1000 deliveries each year, and an additional 21% of hospitals performed 1000–2000 deliveries each year.⁵ In other medical specialties, higher procedural volume has been associated with improved outcomes for high-risk interventions such as lung transplantation⁶ and complex cancer surgery⁷; however, for some lower risk procedures, volume has been associated with lesser⁸ or no benefit.⁹

Given the critical importance of determining the relationship between hospital volume and maternal outcomes, this analysis had 2 main objectives: (1) to determine maternal risk for severe morbidity by hospital delivery volume in the United States and (2) to characterize, by hospital volume, the risk for death in

the setting of severe morbidity, which is a concept that is known as failure rescue.

Methods

Data from the Nationwide Inpatient Sample (NIS) from the Agency for Healthcare Research and Quality were used for this analysis. The NIS is the largest publicly available, all-payer inpatient database in the United States. The NIS dataset contains a random sample of approximately 20% of hospital discharges within the United States, and, through 2011, all hospitalizations for individual centers were included. The sampling frame for the NIS includes nonfederal, general, and specialty-specific hospitals throughout the United States, both academic and community facilities. The NIS included approximately 8 million hospital stays from 45 states in 2010.¹⁰ Because of the deidentified nature of the data set, institutional review board exemption was obtained from Columbia University, New York, NY, to perform this analysis.

We analyzed data from women who were hospitalized for a delivery from 1998–2010. Patients were identified with International Classification of Diseases, Ninth Revision, billing codes V27 and

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TABLE 1
Demographics and hospital characteristics by annualized delivery volume

Volume category	Injuries per 100,000 deliveries							
	50-500		501-1000		1001-2000		>2000	
	n	%	n	%	n	%	n	%
Deliveries, n	3995340	7.9	6678632	13.2	12719964	25.2	27039603	53.6
Age, y								
<20	421012	10.5	604792	9.1	960861	7.6	1699089	6.3
20–24	1349406	33.8	1998147	29.9	3325647	26.1	6129449	22.7
25–29	1136512	28.4	1932605	28.9	3632024	28.6	7550169	27.9
30–34	715802	17.9	1391837	20.8	3015584	23.7	7142120	26.4
≥35	372609	9.3	751250	11.2	1785848	14.0	4518775	16.7
Discharge year								
1998	319923	8.0	542169	8.1	917855	7.2	1670289	6.2
1999	316950	7.9	492742	7.4	1001132	7.9	1777928	6.6
2000	323248	8.1	517540	7.7	985485	7.7	1989851	7.4
2001	294499	7.4	570009	8.5	954945	7.5	1926590	7.1
2002	299284	7.5	527086	7.9	946281	7.4	2139245	7.9
2003	293283	7.3	531976	8.0	919554	7.2	2101735	7.8
2004	300295	7.5	492668	7.4	968214	7.6	2234461	8.3
2005	309023	7.7	503136	7.5	1060452	8.3	2133574	7.9
2006	296637	7.4	515463	7.7	1089574	8.6	2156567	8.0
2007	315523	7.9	503902	7.5	972971	7.6	2530658	9.4
2008	297924	7.5	495864	7.4	1049418	8.3	2188405	8.1
2009	328690	8.2	560429	8.4	937987	7.4	2123926	7.9
2010	300060	7.5	425648	6.4	916097	7.2	2066375	7.6
Household income ZIP code								
Lowest quartile	1035952	25.9	1358262	20.3	2248024	17.7	4785709	17.7
Second quartile	1631562	40.8	2077377	31.1	3216154	25.3	5221307	19.3
Third quartile	910518	22.8	1763445	26.4	3311374	26.0	6683046	24.7
Highest quartile	309366	7.7	1354525	20.3	3632455	28.6	9983036	36.9
Unknown	107942	2.7	125022	1.9	311956	2.5	366504	1.4
Insurance status								
Medicare	27417	0.7	41142	0.6	56650	0.4	118574	0.4
Medicaid	1887247	47.2	2851435	42.7	4896513	38.5	9604893	35.5
Private	1791125	44.8	3354606	50.2	6826356	53.7	15762226	58.3
Self pay	138544	3.5	207729	3.1	493217	3.9	902320	3.3
Other	128984	3.2	208964	3.1	405253	3.2	616780	2.3
Unknown	22023	0.6	14755	0.2	41976	0.3	34808	0.1

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(continued)

650. Use of these codes obtained >95% of delivery hospitalizations.¹¹ For each hospital, we calculated the total number of delivery hospitalizations and divided this

by the number of years in which a hospital had at least 1 delivery. To avoid the inclusion of emergency deliveries that occurred in hospitals that do not

otherwise provide obstetrics services, centers with annualized delivery volume of <50 were excluded; previous analyses that evaluated obstetric volume have used

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