

Appendix.

Table 1. International Classification of Diseases, 9th Revision (ICD-9), Codes for Comorbidities and Complications

Comorbidities, ICD-9 codes	
Medical risk factors	Other types of hypertension 642.x (and all other 642.x except 642.5,6), eclampsia and severe preeclampsia 642.5,6 Diabetes or abnormal glucose tolerance 648.0,8 Maternal thyroid abnormalities 648.1 Asthma 493.x Herpes 054.x, 647.6 Maternal renal abnormalities 646.2 Maternal liver abnormalities 646.7 Maternal cerebral hemorrhage 431.x-434.x Maternal substance use 648.3 Mental disorder 648.4 Maternal congenital and other heart disease 648.5,6 Maternal soft tissue disorder 654.0,1,4,5,6,7
Pregnancy risk factors	Multiple gestation 651.x Preterm gestation 644.2 Macrosomia 656.6 Antepartum bleeding or placental abruption 641.x.656.0 Congenital fetal CNS anomaly or chromosomal abnormality 655.0,1 Isoimmunization 656.1,2 Uterine scar unrelated to cesarean delivery 654.9 Malpresentation 652.2 (and all other 652.x except 652.1 and 652.5) Intrauterine growth restriction 656.5 Intrauterine fetal demise 656.4 Unengaged fetal head 652.5 Oligohydramnios 657.x Polyhydramnios 658.0 Chorioamnionitis a. 658.4 Other maternal infection 659.2,3 Ruptured membranes greater than 24 hours 658.2 Uterine rupture 665.0,1

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	Maternal hypotension or obstetrical shock 669.1,2 Pulmonary embolism 673.0,1,3,8
Complications, ICD-9 codes	
Vaginal delivery	<u>Hemorrhage:</u> 287.4, 648.22, 649.32, 666.02, 666.04, , 666.10, 666.12, 666.14, 666.20, 666.22, 666.24, 666.32, 667.02, 667.12, 998.11 <u>Laceration:</u> 664.21, 664.31, 664.41, 664.51, 664.61 ,664.81, 664.91, 665.31, 665.41, 674.22 <u>Infection:</u> 646.62, 670.02, 672.02, 996.60, 996.62, 999.3 <u>Thrombotic and other:</u> 512.0, 512.1, 512.8, 518.4, 518.81, 584.5, 584.8, 584.9, 665.51, 669.12, 669.22,669.42, 669.82, , 671.42, 671.52, , 673.12,673.22, 674.32,674.52, 674.92, 785.50, 785.51, 785.59, 996.31, 998.4, 998.7, 999.2, 999.4, 999.5, 999.6, 999.7, 999.8, 999.9
Cesarean delivery	<u>Hemorrhage:</u> 287.4, 648.22, 649.32, 666.02, 666.04, 666.10, 666.12, 666.14, 666.20, 666.22, 666.24, 666.32, 667.02, 667.12, 998.11 <u>Infection:</u> 646.62, 670.02, 672.02, , 674.12, 674.32, 998.59, 999.3 <u>Operative:</u> 669.42, 998.20, 998.4, 999.83 <u>Thrombotic and Other:</u> 512.0, 512.1, 512.8, 518.4, 518.81, 584.5, 584.8, 584.9, 669.12, 669.22, 669.82, 671.42, 671.52, 673.12, 673.22, 674.52, 674.92, 785.50, 785.51, 785.59, 996.31, 996.60, 996.62, 998.60, 998.7, 999.2, 999.4, 999.5, 999.6, 999.7, 999.8, 999.9

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Table 2. Adjusted Rate of Complications by Quartile of Provider Volume

	Quartile 1 (Lowest Volume)	Quartile 2	Quartile 3	Quartile 4 (Highest Volume)	P- value
Complication					
Laceration (4.2%)	5.4%	4.9%	4.5%	4.0%	<0.001
Hemorrhage (5.7%)	7.8%	7.2%	6.2%	5.5%	0.013
Infection (1.3%)	1.9%	1.3%	1.3%	1.2%	0.047
Operative (0.1%)	0.2%	<0.1%	0.1%	<0.1%	0.040
Thrombosis/Other (3.0%)	5.2%	3.5%	3.0%	2.9%	<0.001
Any Complication: risk- adjusted* (12.8%)	17.8%	15.9%	14.0%	12.7%	<0.001
Any Complication: fully- adjusted** (12.8%)	17.7%	16.4%	15.9%	14.2%	<0.001

* Adjusted for medical and pregnancy risk factors (see Appendix Table 2).

** Adjusted for medical and pregnancy risk factors, provider cesarean rate, hospital characteristics (region, rural and urban, profit status, proportion Medicaid, teaching status), and provider volume.

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Table 3. Multivariate Odds of Complications by Provider Volume and Complication Type*

Complication	Provider Volume			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Laceration	1.1 [0.8, 1.4]	1.1 [1.0, 1.2]	1.1 [1.0, 1.2]	Reference
Hemorrhage	1.3 [1.1, 1.5]	1.3 [1.1, 1.4]	1.2 [1.1, 1.3]	Reference
Infection	1.5 [1.1, 2.0]	1.2 [1.1, 1.4]	1.1 [1.0, 1.3]	Reference
Thrombosis/Other	1.6 [1.3, 2.0]	1.1 [0.9, 1.3]	1.1 [0.9, 1.2]	Reference
Operative	1.4 [0.5, 3.9]	0.7 [0.4, 1.2]	0.8 [0.6, 1.1]	Reference

*Adjusted for hospital characteristics (region, rural or urban, profit status, proportion Medicaid, teaching status), maternal risk factors, fetal risk factors, and provider cesarean rate. Odds ratios in bold represent a *P* value less than 0.05.

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Table 4. Complication Rates for High- and Low-Risk Women

Provider Volume	Complication Rate: Bivariate*	Complication Rate: Multivariate**
High-risk women		
Q1 (Lowest volume)	17.2%	19.5%
Q2	15.1%	17.1%
Q3	13.3%	16.3%
Q4 (Highest volume)	12.4%	14.7%
p-value	<0.001	0.036
Low-risk women		
Q1 (Lowest volume)	16.0%	15.3%
Q2	14.4%	14.7%
Q3	12.6%	14.5%
Q4 (Highest volume)	11.3%	12.9%
p-value	0.035	0.047

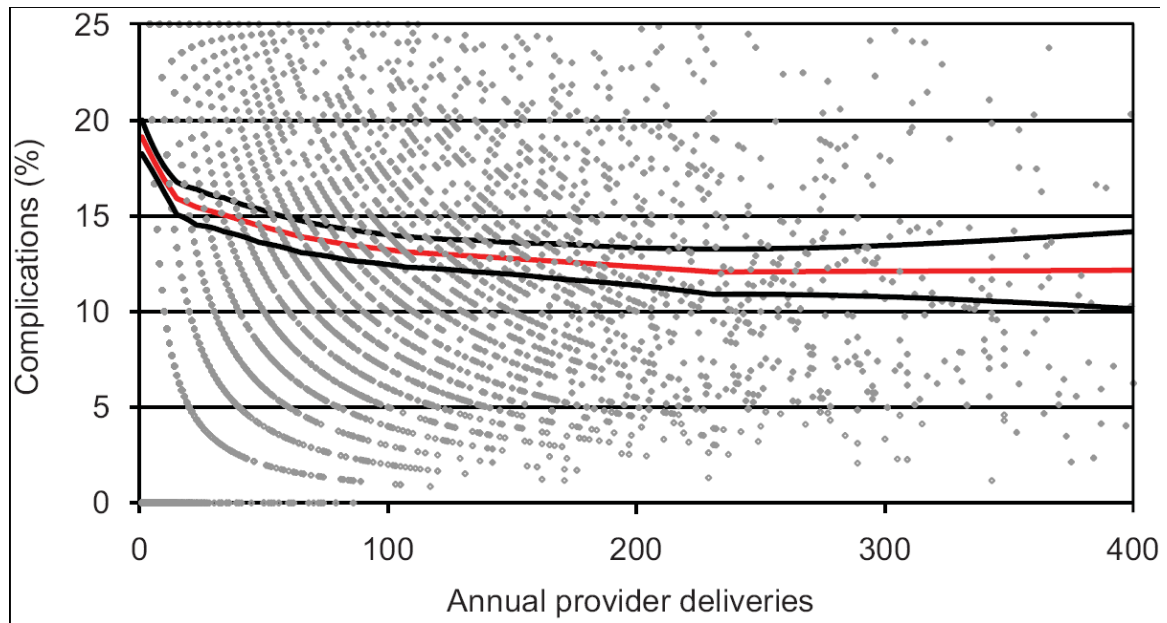
* Adjusted for medical and pregnancy risk factors (see Appendix Table 1)

** Adjusted for medical and pregnancy risk factors, provider cesarean delivery rate, hospital characteristics (region, rural/urban, profit status, proportion Medicaid, teaching status), and hospital volume

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Figure 1. Relationship Between Annual Provider Delivery Volume and Complication Rate



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