Anesthesia Staffing And Anesthetic Complications During Cesarean Delivery: A Retrospective Analysis

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Abstract

Background: Hospitals may staff their obstetrical departments with either Certified Registered Nurse Anesthetists (CRNAs) or anesthesiologists or some combination of the two in order to provide anesthesia services.

Objective: To compare frequency of anesthetic complications and deaths in hospital obstetric departments with only CRNAs vs. departments with only anesthesiologists.

Data Sources: Washington State Hospital Discharge data (CHARS) were obtained from 1993 through 2004 for all cesarean sections in Washington hospitals (68 hospitals) in that period. These data were combined with a survey of types of hospital obstetrical anesthesia staffing for each year.

Study Design: The study was designed as a non-experimental retrospective analysis of hospital discharge abstracts covering the period 1993-2004 and a survey of hospital staffing configurations for anesthesia services. The dependent variable was cases with anesthetic complications. Independent variables were hospitals' obstetrical anesthesia staffing patterns, as well as an array of additional variables to control for variability of risk.

Data Extraction Methods: Secondary analysis of public use data sets, combined with additional data from a survey of Washington hospitals regarding obstetrical anesthesia staffing configurations. Response rate for Washington hospitals was 100%.

Principal Findings: Risk-adjusted results showed no difference in death rates or rates of anesthetic complications between the two staffing types examined: CRNA-only vs. anesthesiologist-only.

Conclusions: Because differences in hospitals' obstetric anesthetic staffing configurations do not appear to impact risks of death and complications, hospitals may safely examine other variables such as provider availability and costs in determining obstetrical anesthesia staffing models.

Key Words

Obstetrical anesthesia

Anesthesia/*economics/mortality/standards

Comparative Study

Cost Effectiveness

Data Collection

Humans

Insurance, Health, Reimbursement/economics

Models, Economic

Certified Registered Nurse Anesthetists/*economics

Physicians/*economics

Treatment Outcome

Introduction

This study examines the relationship between anesthetic staffing patterns in hospital obstetric departments and the incidence of deaths and anesthetic complications. Hospitals throughout the United States make choices regarding configuration of obstetrical anesthesia staffing, depending on variations in state law and regulations.

Generally, hospitals can choose from four types of staffing models: (1) Certified Registered Nurse Anesthetists (CRNAs) working alone; (2) anesthesiologists working alone; (3) CRNAs and anesthesiologists working collaboratively under the medical direction of anesthesiologists; and (4) a combination of CRNAs and anesthesiologists working independently within the hospital. Hospitals make this choice primarily based on costs and provider availability, rather than on patient outcomes data, due to lack of related patient outcomes studies (Bell *et al.*, 2000; Dunbar *et al.*, 1998).

This study contributes to the literature by focusing on a younger, healthier population, i.e., females receiving obstetrical anesthesia services. Currently, most outcomes studies in anesthesia have focused mainly on elderly Medicare populations. The majority of these studies have found no difference between the impact of anesthesia providers on patient outcomes (Bechtoldt, 1981; Beecher & Todd, 1954; Forrest, 1980; Pine *et al.*, 2003; Smith *et al.*, 2004). However, one recent study found a significant increase in death rates and failure-to-rescue

rates for patients whose anesthesia care was not medically directed by anesthesiologists (Silber *et al.*, 2000).

This study also extends the literature on the relationship between hospital staffing variations and patient outcomes. Recent studies of patient outcomes are increasingly focusing on the impact of hospital staffing patterns rather than provider characteristics. For example, Needleman and Person examine the impact of nurse staffing ratios on patient outcomes (Needleman *et al.*, 2002; Person *et al.*, 2004). They found that higher ratios of registered nurses (vs. LPNs and nurse aides) were associated with better patient outcomes. Our study examines the relationship between hospitals' obstetric anesthetic staffing and the incidence of deaths and anesthetic complications.

Specifically, this study examines women undergoing cesarean deliveries in the state of Washington between 1993 and 2004, across 42 hospitals (a total of 134,806 deliveries). Incidence rates of anesthetic complications were identified through five ICD-9-CM codes for complications during the administration of anesthesia during labor and delivery. In addition, 15 ICD-9-CM codes designated by the Agency for Health Research and Quality (AHRQ) were used to identify safety problems in the administration of anesthesia (see Table 1 for these codes).

Regarding identification of hospital staffing types, the relationships and responsibilities of anesthesiologists and CRNAs in the collaborative and combined types described above are intricate and hard to reliably identify. As a result, this study includes hospitals with CRNA-only and anesthesiologist-only

staffing, and excludes all other hospitals. We hypothesized that there would be no difference in deaths and complication rates associated with these two types of obstetrical anesthesia staffing.

The potential significance of this study is profound due to the tremendous difference in resources allocated to the training of anesthesiologists vs. CRNAs, and the substantial difference in the average incomes of these two groups. If the lower-cost CRNA input is associated with outcomes that are not significantly different from those of anesthesiologists, hospitals will have the opportunity to consider reducing staffing costs for these services, with no diminution in quality. Hospitals that currently utilize a CRNA-only staffing model will be encouraged to continue. As of 2005, average annual income for anesthesiologists was $379,000 - $657,000 vs. $140,000 - $160,000 for CRNAs (Medical Group Management Association, 2006; Rivera, 2006).

Methods

Patient Data

All cesarean delivery patients identified in the Comprehensive Abstract and Reporting System (CHARS) database of hospital admissions for Washington State were analyzed for the ten-year period 1993-2004. The study involved 134,806 patients — 33,236 patients cared for at hospitals whose obstetrical anesthesia was staffed by CRNAs-only, and 101,570 cared for at hospitals staffed by anesthesiologists-only. Patients were identified as having undergone cesarean delivery if they had any one of the ICD-9-CM procedure codes for

cesarean delivery (74.00 to 74.99) in any one of the 6 procedure fields of the CHARS dataset.

Hospital Data

Hospital data for bed size and location (rural or urban) were obtained from the Washington State Dept. of Health. Hospital data related to staffing and teaching status were obtained through a simple survey of the 72 hospitals in Washington that provide obstetrical anesthesia services on a routine basis.

The hospital staffing survey was initially conducted in 1999 including retrospective descriptions to 1993 and then updated in 2002 and 2004. In each case, the survey was completed by obtaining information from anesthesia practitioners or the Medical Staff secretaries/officers at the hospital. Due to the relatively small number of hospitals and repeated contact and close follow-up, responses were obtained for all hospitals for each of the studied years 1993-2004.

The survey identified the type of obstetrical anesthesia staffing and the main operating room staffing for each hospital for each year of the study. Hospitals were asked if they changed their obstetrical anesthesia staffing during the year. If so, they were put into the category that represented the majority of the year. In addition, hospitals were categorized relative to staffing configuration based on a hospital's indication that 90% of cases were undertaken under a particular staffing pattern.

Three anesthesiologist-only hospitals and one CRNA-only hospital were identified as teaching institutions that had obstetrical anesthesia training

programs. Nine percent of cesarean deliveries at CRNA-only hospitals were at a teaching institution (i.e. with a CRNA residency program) vs. four percent of those at anesthesiologist-only hospitals (with an anesthesiologist residency program).

Dependent Variable: Anesthetic Complications

Patients were identified as having had an anesthetic complication based on ICD-9-CM codes in their CHARS records. The dependent variable was coded as complication=1, no complication=0. Table 1 lists ICD-9-CM codes that identify complications in the administration of anesthetic or other sedation in labor and delivery, as well as codes identified by the AHRQ anesthesia patient safety indicator. In addition to anesthetic complications, death rates and other obstetrical complications (co-morbidities) were measured (see Table 2). Death was identified via CHARS discharge status.

Independent Variables

Independent variables consisted of three categories: hospital characteristics, patient demographic characteristics, and patient comorbidities (see Table 2). Hospital characteristics were *geographic location* (urban, rural), *size* (number of beds), *teaching status* (teaching, nonteaching); and obstetrical anesthesia staffing (CRNA-only vs. anesthesiologists-only). Patient demographic characteristics included age, primary payer (Medicaid, other), type of admission (emergent, urgent, elective), source of admission (physician referral, clinic

referral, HMO referral, emergency room, or hospital transfer), and patient discharge status (death=1, other=0). Patient co-morbidities were identified from ICD-9-CM codes using Panchal's modification of the Charlson Comorbidity Index to reflect the obstetric population (Charlson *et al.*, 1987; Panchal *et al.*, 2000).

Model Development and Validation

Hierarchical modeling was used to test individual and community effects on the dependent variable (Bryk & Raudenbush, 1992). This approach was chosen because individual observations were nested within hospital level variables. The statistical analysis was done using SUDAAN Proc Multilog developed for use with categorical dependent variables. This procedure estimates parameters using generalized estimating equations, and employs a robust variance estimation method for describing the dependence of responses within clusters (Shah *et al.*, 1997). During intermediate model fitting we eliminated one predictor variable, maternal pulmonary embolism, from further consideration due to an F value less than 1, as this resulted in unstable model estimates. Model fit was estimated by a Wald chi-square statistic with a Satterwaite correction for numerator degrees of freedom (Shah et al., 1997). The chi-square tests the null hypothesis that all parameters are equal to zero. The model adjusted for patient characteristics, patient severity, hospital obstetrical anesthesia staffing characteristics, and other hospital characteristics, to predict obstetrical anesthetic complications (see Table 4).

Results

Obstetrical Anesthesia Staffing

In 2004, of the 94 hospitals in Washington, 68 hospitals provided obstetrical anesthesia services, including 44 urban hospitals and 24 rural hospitals. Twenty-eight hospitals (41%) used anesthesiologist-only staffing, and 27 (40%) used CRNA-only staffing. Anesthesiologist-only staffing represented 59% of urban hospitals; CRNA-only staffing represented 79% of rural hospitals.

Anesthetic Complications by Staffing Type

Table 3 shows the incidence of anesthetic complications by type of OB anesthesia staffing. CRNA-only staffed hospitals had an unadjusted complication rate of 0.58%, while anesthesiologist-only staffed hospitals had a rate of 0.76%. The results are significantly different, $p<0.0006$.

The majority of the obstetrical anesthesia complications (ICD-9-CM 668.00 through 668.90) were of the "other" category (668.8). Pulmonary (668.0), cardiac (668.1), and central nervous system (668.2) complication codes represent the most serious complications. Similarly, the majority of the AHRQ-identified complications were also of the least serious type, i.e., drugs causing adverse effects in therapeutic use (E930 – E949), vs. misadventure (E876) or poisoning (E855, 968.0 – 968.7).

Risk-Adjusted Rates of Anesthetic Complications

Table 4 shows the odds ratio for the CRNA-only vs. anesthesiologist-only staffing variable. As shown, the risk-adjusted odds ratio of a patient at a CRNA-only staffed hospital having an obstetrical anesthetic complication as compared to an anesthesiologist-only staffed hospital was not significantly different (p = 0.85)

Table 4 also shows the odds ratio for the three variables found to have a significant effect on the incidence of anesthetic complications: *emergency admissions*, *post-partum hemorrhag*e, and *other complications of labor and delivery*. Emergency patients had an odds ratio of 1.588 of having an anesthetic complication when compared to Elective or Urgent patients (p=0.03). The clinical comorbidities significantly associated with anesthetic complications were *postpartum hemorrhage* (666.0 – 666.3), with an odds ratio of 1.804 (p=0.002); and *other complications of labor and delivery* (669.00 to 669.94), with an odds ratio of 1.736 (p= 0.002). *Other Complications of Labor and Delivery* identifies an assortment of serious maternal complications, such as maternal distress, shock, hypotension, and cardiac arrest.

Death and Cesarean Delivery Rate

Table 3 shows the distribution of patients between the two staffing types for all deliveries and for the 134,806 Cesarean deliveries analyzed. Death rates were extremely low, and there was no significant difference in death rates by type of anesthesia staffing in either case.

Differences in cesarean delivery rates were significant (Chi-Square 360.0, p>0.0001), highest among the anesthesiologist-staffed hospitals (22.5%), and lowest in the CRNA hospitals (20.3%). However, at 21.2% overall, the rate of cesarean delivery was lower than the national rate reported by the CDC (24%, (Centers for Disease Control, 1998).

Variation in Demographics of the Cesarean Delivery Population

Hospitals staffed with only CRNAs treated the greatest percentage of Rural, Medicaid, Teaching, Urgent admission, and very young (under 17 years old) patients. Hospitals with anesthesiologist staffing had the greatest percentage of emergency admissions, older mothers (age >35) and the greatest percentage of patients in the midsize (100-200 beds) hospitals.

CRNA-only hospitals tended to be either smaller (<100 beds) or large tertiary-care size hospitals (>200 beds). Anesthesiologist-only hospitals tended to predominate among the midsize community hospitals (100-200 beds). CRNA-only hospitals tended to treat more Medicaid patients (43% vs. 30% for anesthesiologist-only).

Transfers of sicker patients to a hospital might affect the number of anesthetic complications. CRNA-only hospitals had a significantly greater number of patients transferred from other hospitals. However, hospital transfer was not found to be a significant risk factor for anesthetic complications in regression analysis.

Incidence of Comorbidities Among Types of OB Anesthesia Staffing

Individual comorbidities varied significantly between the two types of staffing, however there seemed to be no pattern overall- CRNA-only staffing had higher percentages for 6 comorbidities, anesthesiologist-only for 8, and there was no difference for 4.

Discussion

After adjustments for comorbidities, hospital size, teaching status, patient transfers and other potentially confounding variables, we found no difference in anesthetic complication rates in hospitals whose obstetrical anesthesia departments were staffed solely by CRNAs as opposed to hospitals staffed solely by anesthesiologists. We also found no difference in mortality rates.

Safety and Quality of Anesthesia Services

Obstetric anesthesia, whether provided by CRNAs or anesthesiologists, is extremely safe, and there is no difference in safety between the two types of staffing. This study supports the conclusion that the decisions about type of anesthesia staffing can reasonably be based on considerations other than safety or quality, such as availability of the type of provider, hospital budgets, or percentage of Medicaid patients cared for at the hospital.

In addition to our findings demonstrating no difference in the incidence of anesthetic complications overall, the incidence of life-threatening complications

was still very small for either type of hospital staffing (less than 1 death per 100,000, 0 incidence of misplaced endotracheal tubes).

In the young, healthy population of women undergoing Cesarean Section, attempts to quantify the safety and quality of anesthesia services through an analysis of death or failure to rescue rates will be unsuccessful due to the extremely small risk of death from direct effects of the anesthesia provider (Cohen *et al.*, 1988). However, this study was able to identify other more specific indicators of anesthetic quality. The ICD-9-CM codes we used to identify anesthetic complications during labor and delivery identify the outcome of interest specifically, rather than indirectly as do death rates. Also, the higher incidence of these codes allow for greater power in the analysis of relative risk. This study found 965 of these types of complications in the study population, as opposed to 17 deaths. Additional support for the validity of this measure is found –the incidence of complications is consistent with that published in a study of anesthetic quality at a hospital in Washington. Posner and Freund (Posner & Freund, 1999) found the incidence of patient injury at their institution for all types of surgical procedures to vary between 0.38% to 1.34%, an incidence consistent with the 0.58% to 0.76% complication rate found in this population. However, it is important to point out that currently no studies have been performed to identify the validity or specificity of these codes.

In addition to the codes specific to anesthetic complications of labor and delivery, this study also used the codes utilized by the AHRQ's Patient Safety Indicator program to identify Anesthesia PSIs. Of interest is the fact that of the 76

Anesthesia PSIs found for the 12-year period, 74 were identified by the least serious E-code, for “Adverse Drug Effect”. Also of interest is the fact that there was only a small overlap - only 20 of the PSIs were also coded using the “complications of anesthesia during labor and delivery” diagnosis codes.

These findings demonstrate support for the safety and quality of care provided by CRNAs working without anesthesiologist involvement. Hospitals whose obstetrical anesthesia was provided by CRNAs working without anesthesiologist direction experienced no difference in anesthetic complications, even after adjusting for case severity and patient demographics. For both types of hospitals, the rate of complications was low and well within the range found at a major teaching institution in Washington for all types of anesthetics (Posner & Freund, 1999).

Limitations

This study has many limitations that should be considered in the analysis and application of results. Our attempts to compensate for these limitations, such as increasing the size of the population, performing regression analysis, and repeating surveys may not have been successful.

First of all, this study relies on administrative data that may not provide an accurate reflection of complications as compared to actual chart review (Iezzoni, 1997; Iezzoni *et al.*, 1994). There may be errors in reporting the complications due to errors or omissions on the part of the coding staff (Hsia *et al.*, 1988). However, we have no reason to suspect that coding for anesthetic complications was systematically different between CRNA-only and anesthesiologist-only

hospitals. In a study involving 205,000 records, Dubois (Dubois *et al.*, 1987) found no difference between hospitals for the small rate of such errors. Additional support for the use of administrative data is that, despite these concerns, the AHRQ has made a decision to use this same type of data in quality analysis through such programs as the Patient Safety Indicators and Inpatient Quality Indicators.

Secondly, the study examines hospital staffing patterns – a hospital-level discriminator, and thus does not give individual provider-level discrimination. It is important to consider the milieu that may exist in the various types of hospitals. Since the records we analyze (the CHARS dataset) do not specifically identify the anesthesia provider, it is impossible to prove that either a CRNA or an anesthesiologist performed the anesthetic. We can only infer the presence of one or the other based on the general staffing pattern in place at the time. That is why it is important that this study not be seen as simply a contrast of the skills or education of the two types of provider — there may be reasons inherent in the hospital staffing pattern other than type of anesthesia provider that affects the incidence of anesthetic complications. For example, CRNA-only hospitals, particularly the large metropolitan medical centers, often pay CRNAs on an hourly basis, while anesthesiologists are rarely paid in this manner- they usually receive fee-for-service reimbursement. Thus the economic incentive for the anesthesiologist might be to end involvement in the case more quickly so as to move on to the next case, while the CRNA gets paid the same and may thus

spend more time with the patient. For this reason, future studies might focus more closely on the type of reimbursement as a predictor of quality.

The third limitation, which is related to the second, is that this study relies greatly upon a survey of hospital staffing patterns conducted by the authors that determined whether the hospitals were CRNA-only or anesthesiologist-only. The accuracy of this hospital survey data regarding type of staffing could be challenged as limited by the degree of record keeping or the extent to which survey respondents had to rely on memory of staffing patterns for the 12-year period. We believe that several factors mitigate this concern. First of all, the survey was extremely simple and involved only one question: What type of staffing the hospital utilized for each year. The initial survey was done in 1999, and then repeated every two years after that, so that a memory of at most 5 years was necessary for the years 1993-1998, with direct evidence available for subsequent years. Also, where possible, supporting evidence was obtained by other providers who worked at the same facility. We found that, due to the broad nature of our characterizations, the CRNA-only and the anesthesiologist-only practices were the most reliable to confirm (as opposed to the Collaborative or Combined), leading to our decision to choose only these types of hospitals for our study. There is precedent in the literature to support this method of characterizing hospitals: such characterizations were used, although even more broadly, in Forrest's (Forrest, 1980) prospective study of anesthetic complications in several California hospitals.

Fourth, the results are unique to a set of hospitals in Washington State and to a set of patients - those undergoing Cesarean delivery - and thus may not be generalizable to other populations. In their study of anesthesia quality, Pine, et al., (Pine et al., 2003) found large variability by state in the percentage of patients cared for by the various staffing patterns, and this may reflect underlying differences in statute and practice patterns that would affect these results. While the pattern of rural hospitals employing CRNAs holds throughout the United States, in the Midwest the collaborative model predominates while on both the West and East coast, anesthesiologist-only hospitals are the most common. This may reflect the underlying economic realities, with anesthesiologists preferring to practice in these areas due to remunerative or lifestyle concerns (Orkin, 1996).

Fifth, there may be unmeasured provider or hospital-level variables (in addition to those cited in the second limitation above) that account for the differences in these complication rates. Further studies should attempt to identify these other variables, such as overall experience of providers, workload of providers, and presence of any other factors that might adversely impact the delivery of obstetrical anesthesia care.

Conclusions

Analysis of the incidence of anesthetic complications in 134,806 Cesarean sections over twelve years suggests that hospitals which utilize CRNAs to provide their obstetrical anesthesia have no difference in rate of death or obstetrical anesthesia complications from those which use anesthesiologists or physician anesthetists.

Further studies are needed to validate these observations. Such studies might:

Validate the coding of anesthetic complications

Identify any practice differences between CRNA-only hospitals and anesthesiologist-only hospitals that might account for these findings

Quantify the extent to which anesthetic complications in labor and delivery are indicative of the quality of anesthetic care.

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Tables

Table 1. ICD-9-CM codes utilized to identify complications

ICD-9-CM Category and description
668 Complications of the administration of anesthetic or other sedation in labor and delivery
Includes: complications arising from the administration of a general or local anesthetic, analgesic, or other sedation in labor and delivery
Excludes: reaction to spinal or lumbar puncture (349.0), spinal headache (349.0)
668.0 Pulmonary Complications
[0-4] Inhalation [aspiration] of stomach contents or secretions, Mendelson's syndrome, pressure collapse of lung
668.1 Cardiac complications
Cardiac arrest or failure following anesthesia or other sedation in labor and delivery
668.2 Central nervous system complications
[0-4] Cerebral anoxia following anesthesia or other sedation in labor and delivery
668.8 Other complications of anesthesia or other sedation in labor and delivery
668.9 Unspecified complications of anesthesia and other sedation

E876 Other and Unspecified misadventures during medical care

E876.3 Other And Unspecified Misadventures During Medical Care, Endotracheal Tube Wrongly Placed During Anesthetic Procedure

E855 Accidental Poisoning by other drugs acting on central and autonomic nervous system

E855.1 Other Nervous System Depressants

E930-E949 Drugs … Causing Adverse Effects in Therapeutic Use

E938.1 Halothane

E938.2 Other Gaseous Anesthetics

E938.3 Intravenous Anesthetics

E938.4 Other And Unspecified General Anesthetics

E938.5 Surface And Infiltration Anesthetics

E938.6 Peripheral Nerve And Plexus Blocking Anesthetics

E938.7 Spinal Anesthetics

E938.9 Other And Unspecified Local Anesthetics

968 Poisoning By Other Central Nervous System Depressants And Anesthetics

968.1 Halothane

968.2 Other Gaseous Anesthetics

968.3 Intraveneous Anesthetics

968.4 Other And Unspecified General Anesthetics

968.7 Spinal Anesthetics

Table 2. Variables Considered in Risk Adjustment

Hospital Characteristics
Geographic Location
Rural
Urban
Hospital Size
Less than 100 beds
100 – 200 beds
greater than 200 beds
Teaching Status
Teaching
Non-teaching
Obstetrical Anesthesia staffing
Anesthesiologist
CRNA
Patient Characteristics
Age
Less than 17 yo
17 to 34 yo
Greater than 34 yo
Primary Payer
Medicaid
Other

Type of admission

Emergent

Urgent

Elective

Source of admission

Physician Referral

Clinic referral

HMO referral

Emergency room

Transfer from Hospital

Other

Patient Status

Death

Other

Comorbidities

ICD-9-CM Diagnosis Codes	Description
668.00 to 668.94	Anesthetic Complication
641.00 to 641.94	Placental Abruption and/or previa
666.00 to 666.34	Postpartum hemorrhage
646.10 to 646.14	Maternal Obesity
648.00 to 648.04	Maternal Diabetes
642.00 to 642.44	Maternal Hypertension

642.50 to 642.94	Maternal Eclampsia
656.00 to 656.93	Fetal Problems Affecting the Mother
659.30 to 659.33	Generalized Infection during labor
659.40 to 659.63	Maternal Multiparity
659.70 to 659.73	Fetal Heart Abnormality
665.00 to 665.11	Uterine Rupture
673.00 to 673.84	Maternal Embolism
660.00 to 660.93	Obstructed Labor
662.00 to 662.33	Prolonged Labor
663.00 to 663.93	Umbilical Cord Complications
669.00 to 669.94	Other Complications of L&D
V23.7	Insufficient Prenatal Care

Table 3. Analysis of Sample

Type of OB Anesthesia Staffing	CRNA-only	Anesthes-iologist-only	Total	*p*
All deliveries	163,717	471,761	635,478	
Number of Cesarean deliveries	33,236	101,570	134,806	
% Cesarean deliveries	20.3	21.5	21.2	<0.0001
All Obstetrical Procedures				
Number of Deaths	9	26	35	
Deaths/100,000 Procedures	5.50	5.51	5.51	0.9948
Cesarean Deliveries Only				
Number of Deaths	4	13	17	
Deaths/100,000 Procedures	12.04	12.80	12.61	0.9143
Anesthetic Complications	192	773	965	
% Complications	0.58%	0.76%	0.72%	0.0006

Source: CHARS dataset, 1993-2004

Table 4. Risk-adjusted Rates of Anesthetic Complications

	Odds Ratio Estimates of Anesthetic Complication			
Variable	**Point Estimate**	**95% Conf. Limits**		***p***
CRNA vs Anesthesiologist Staffing	1.046	0.649	1.685	0.85
Admission Type				
Emergency vs Elective or Urgent	1.588	1.035	2.437	0.03
Postpartum Hemorrhage	1.804	1.229	2.649	0.002
Other Complications of L&D	1.736	1.239	2.432	0.002

Source: CHARS dataset, 1993-2004.