Do Anesthesia Fellowship-trained Doctors Utilize General Anesthesia More or Less Frequently Than Non-fellowship Trained Doctors?

Yu Cai | Taehoon Ha | Siyang Pei | Xuewei Quan

Study Objectives

Primary
- To identify whether the fellowship-trained anesthesiologists are more or less likely to provide general anesthesia for non-routine c-section as compared to non-fellowship trained anesthesiologists.

Secondary
- To identify confounding factor(s):
  - Patient's Age, Race, BMI
  - Attending anesthesiologists' ID number and years of training since residency

Research Questions

1. Use the Pilot data to determine the needed information for sample size for alpha of 0.05 and power of 80%.

2. Identify whether the fellowship-trained anesthesiologists are more or less likely to provide general anesthesia for non-routine cesarean deliveries comparing to non-fellowship trained anesthesiologists.

3. Whether there is other variable(s) associated with anesthesia type

4. Whether there is a confounder
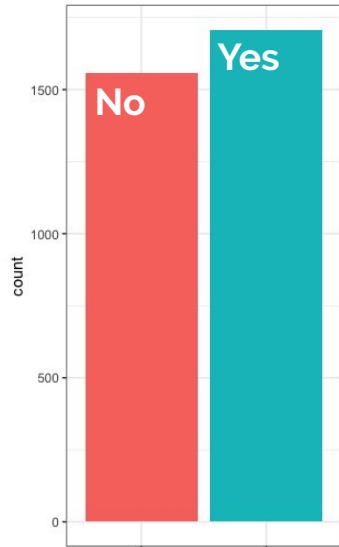
Data Exploration - Continuous Variable
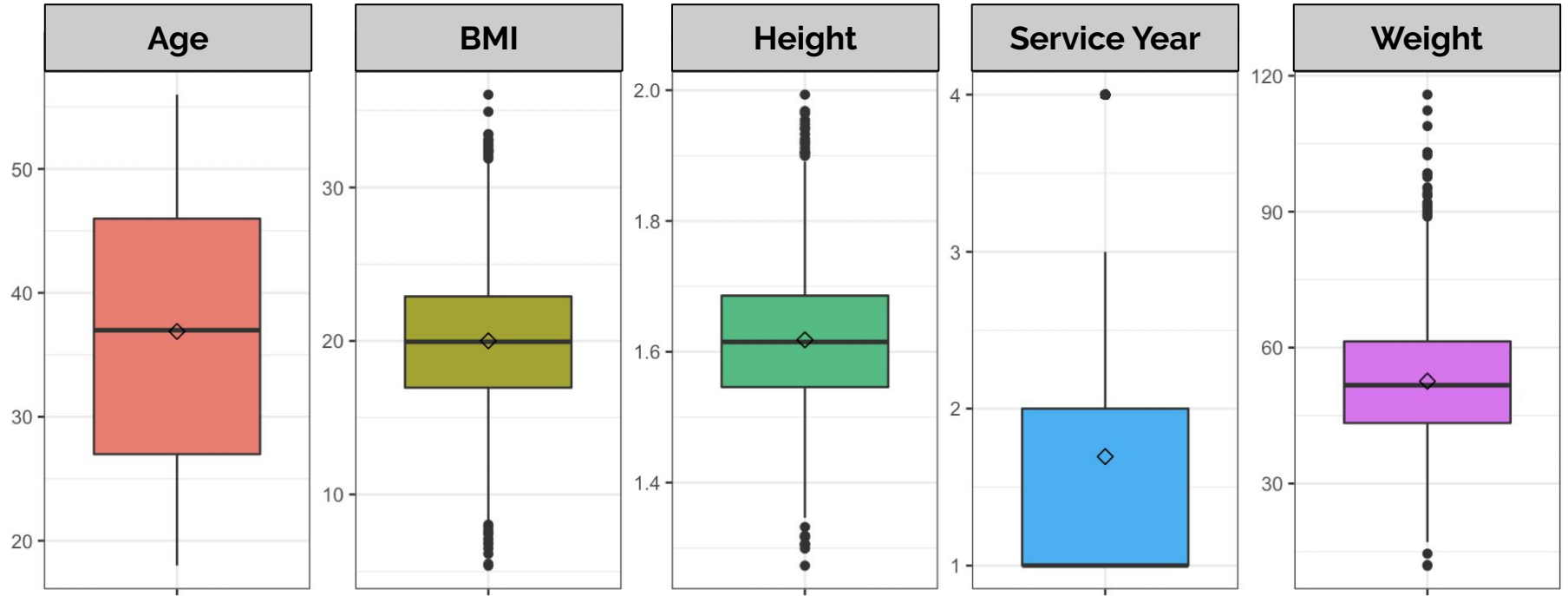
Data Exploration - Continuous Variable by Anesthesia Type
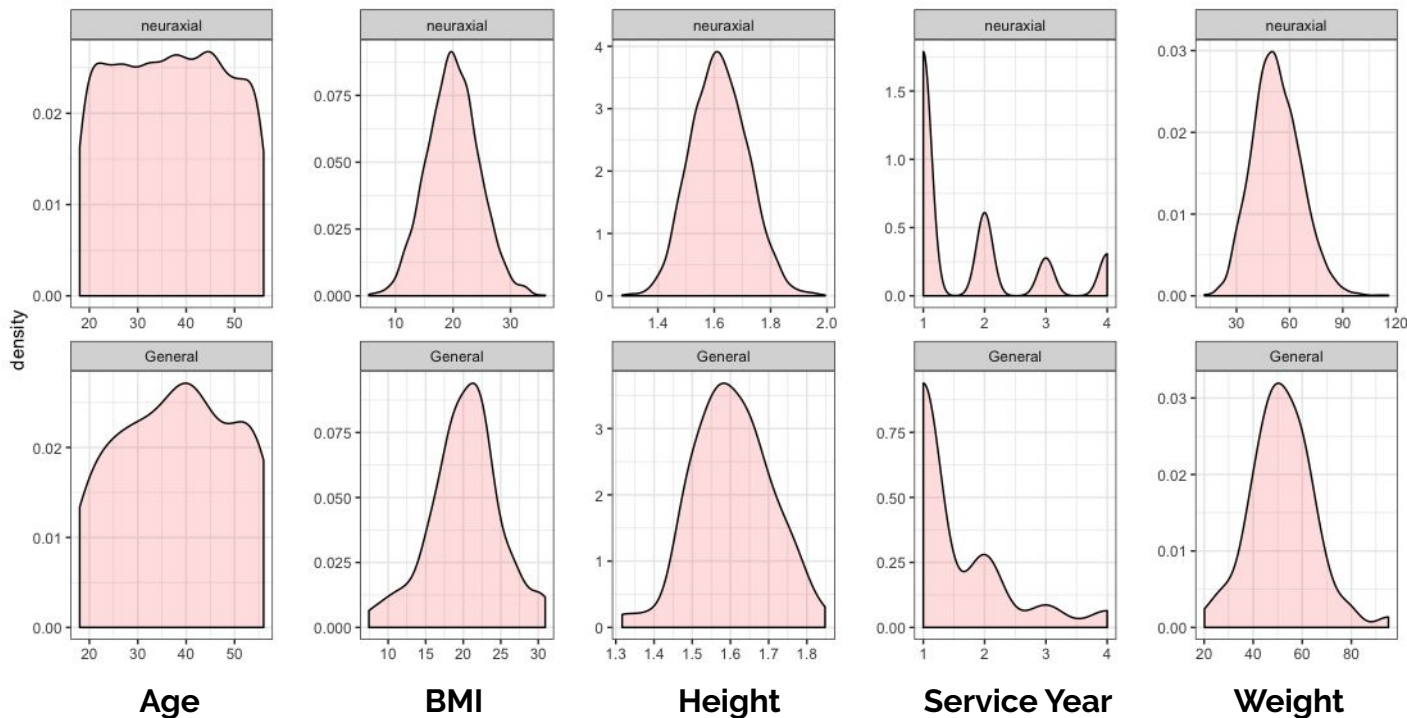
Data Exploration - Categorical Variable
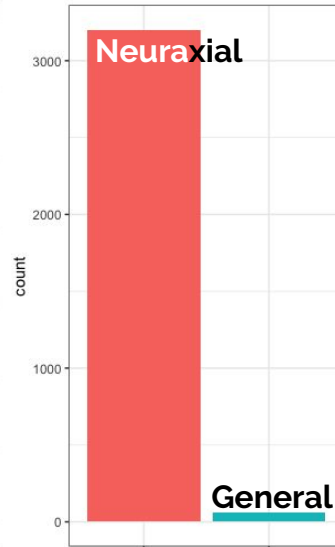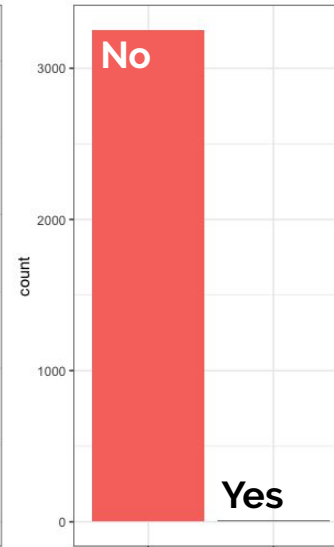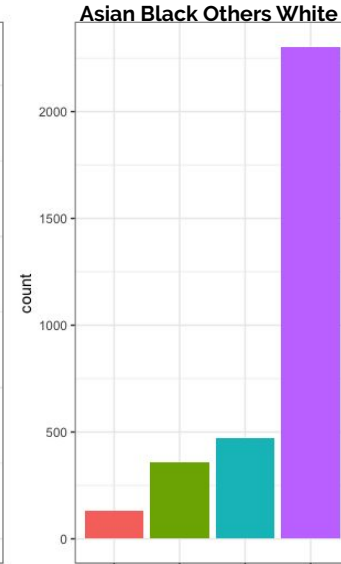
Sample Size Calculation - Methods

Using pilot data to determine sample size

- **Requirement**
  - Power to test the primary objective is 80%
  - Two-sided, 0.05 level of significance
- **R function**
  - '`pwr`' package
  - Effective Size : `ES.h()`

  $$2 * \arcsin\left(\sqrt{p_1}\right) - 2 * \arcsin\left(\sqrt{p_2}\right)$$

  - Sample Size : `pwr.2p.test()`

Sample Size Calculation - Results

1633 patients for each group, 3266 patients in total.

```
pwr.2p.test(h=ES.h(p1 = 4/187, p2 = 2/210),
                power = 0.8, sig.level=0.05, alternative="two.sided")
```

- 1633 patients for each group

- Select first 3266 patients from full data

- Also confirmed our sample size using Fisher's test and simulation
  - No significant difference in power and sample size

Primary Outcome Summary from Pilot Data

	General	Neuraxial
Fellowship Training:		
Yes	4(2.14%)	183(97.86%)
No	2(0.95%)	208(99.05%)

Testing Difference Between Groups - Methods

When comparing groups, the criteria below have been applied in order to choose the appropriate statistical tests.

- **Continuous Variables**
  - Normal Distribution in Both Groups: two-sample t-test
  - Non-normal Distribution in Either One Group: Wilcoxon rank-sum test

- **Categorical Variables**
  - **2x2 Contingency Table**
    i. All Expected Cell Counts >= 5 : Chi-square test
    ii. Any Expected Cell Counts < 5 (Inefficient Count) : Fisher's exact test

  - **RxC Contingency Table**
    i. Less than 20% of Expected Cell Counts < 5 : Chi-square test
    ii. More than 20% of Expected Cell Counts < 5 : Fisher's exact test

Testing Difference Between Groups - Result (by Type of Anesthesia)

Table 1: By Type of Anesthesis (N = 3266)

Anesthesis Type	General, N=64	neuraxial, N=3202	p-value	
Service Year			0.09..	Wilcoxon Rank Sum
Mean +/- SD	1.47 +/- 0.82	1.7 +/- 1.01		
Median (min, max)	1 (1, 4)	1 (1, 4)		
Fellowship Training			0.01...	Chi-Square Test
No	42 (65.62%)	1516 (47.35%)		
Yes	22 (34.38%)	1686 (52.65%)		
Anesthesia Failed			1....	Fisher's Test
No	64 (100%)	3191 (99.66%)		
Yes	0 (0%)	11 (0.34%)		
Patient Race			0.63....	Fisher's Test
Asian	3 (4.69%)	128 (4%)		
Black	8 (12.5%)	351 (10.96%)		
Others	6 (9.38%)	466 (14.55%)		
White	47 (73.44%)	2257 (70.49%)		
Height			0.26.	Two-sample t-test
Mean +/- SD	1.6 +/- 0.1	1.62 +/- 0.1		
Median (min, max)	1.6 (1.32, 1.85)	1.62 (1.27, 1.99)		
Weight			0.74..	Wilcoxon Rank Sum
Mean +/- SD	51.87 +/- 12.96	52.63 +/- 13.58		
Median (min, max)	51.44 (20.15, 95.11)	51.77 (11.92, 115.8)		
BMI			0.57..	Wilcoxon Rank Sum
Mean +/- SD	20.21 +/- 4.73	20 +/- 4.47		
Median (min, max)	20.44 (7.43, 30.92)	19.93 (5.38, 36.03)		
Age			0.37..	Wilcoxon Rank Sum
Mean +/- SD	38.17 +/- 11.88	36.87 +/- 11.28		
Median (min, max)	39 (18, 56)	37 (18, 56)		

> **Only fellowship training status showed the significant difference between general and neuraxial anesthesia.**

- Significant imbalance of sample size between general (n = 64) vs. neuraxial anesthesia (n = 3202)

- Significant difference in fellowship training (Chi-square test, two-sided α = 0.05, p-value = 0.01)

- Zero count of 'Yes' in anesthesia fail in general anesthesia group

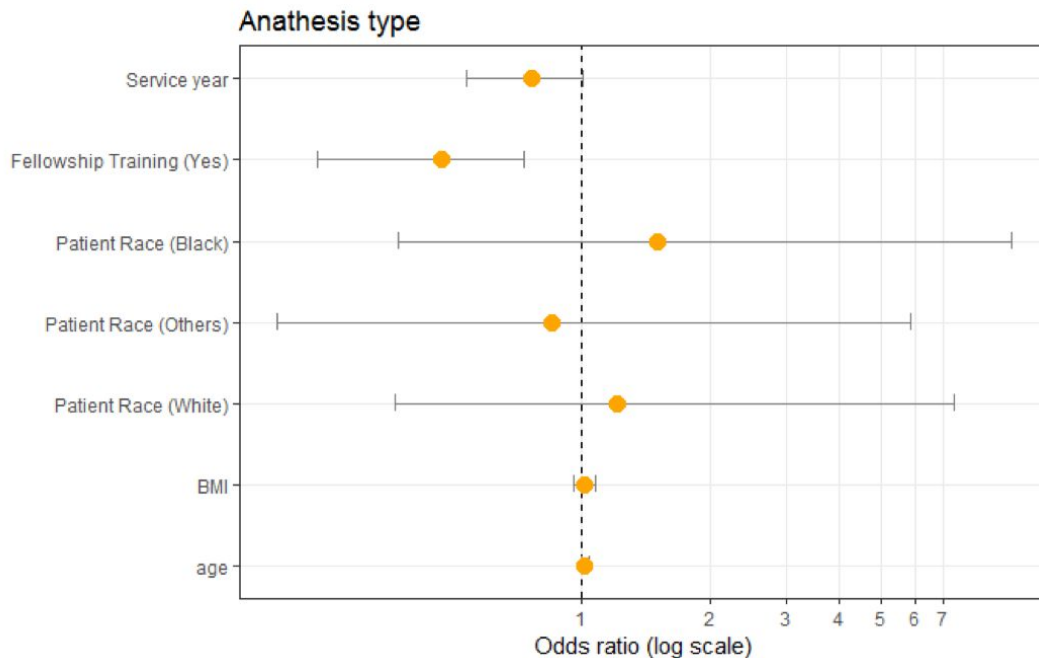# Secondary Variable of Interest - Method

- **Univariate and Multivariate Analysis**
  - Method: Logistic Regression

- **Detecting Confounding Variables**
  - Method: Statistical test and logistic regression between predictors

Secondary Variable of Interest - Result (Univariate Analysis)

According to the univariate analysis, service year and fellowship training are significantly associated with the type of anesthesia.

Univariate Analysis Summary

	OR	P-value
Service Year	0.7621	0.072
Fellowship Training (Yes)	0.471	0.0046
Race (Black)	0.9725	0.9675
Race (Others)	0.5494	0.4016
Race (White)	0.8885	0.8444
BMI	1.0104	0.7138
Age	1.0103	0.363

Anathesis type

Secondary Variable of Interest - Result (Multivariate Analysis)

For multivariate analysis, **service year** and **fellowship training** are also significantly associated with the **type of anesthesia**.

Multivariate Analysis Summary

	OR	P-value
Service Year	0.7768	0.0965
Fellowship Training (Yes)	0.4832	0.0063
Race (Black)	0.9413	0.9298
Race (Others)	0.5373	0.3858
Race (White)	0.8823	0.8358
BMI	1.0097	0.7292
Age	1.0082	0.4651

Anathesis type
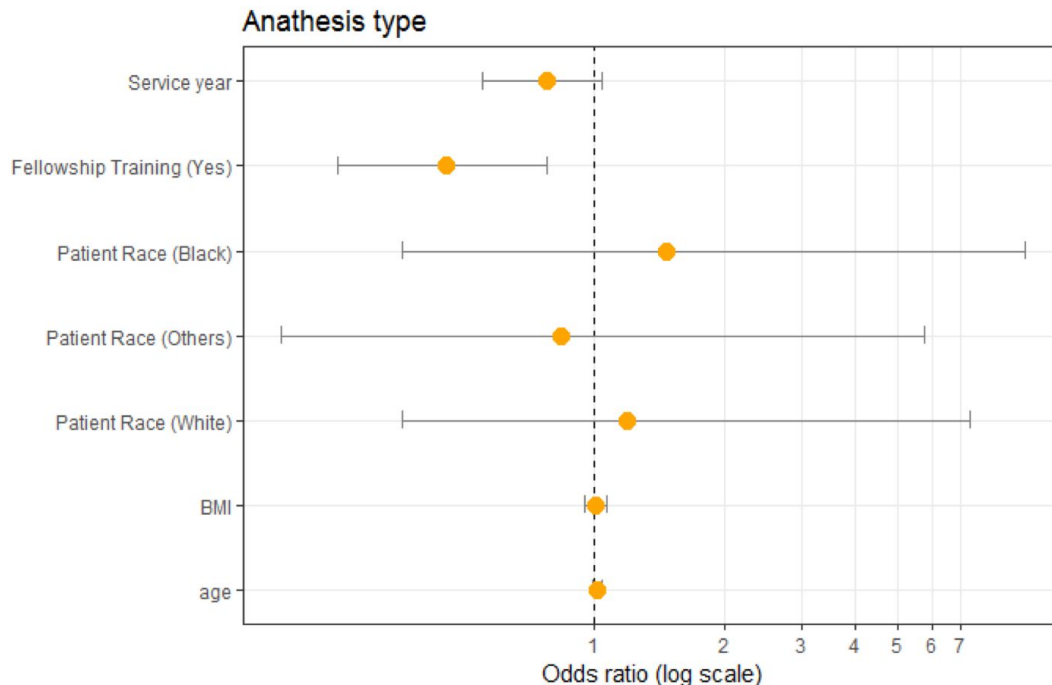
Check confounder(s)

There is an association between service year **and** fellowship training **status.**
The reference group is the fellowship-trained doctors.

Method	p-value
Wilcoxon rank-sum test	0.011

Method	Odds Ratio	p-value
GLM	2.723	0.004
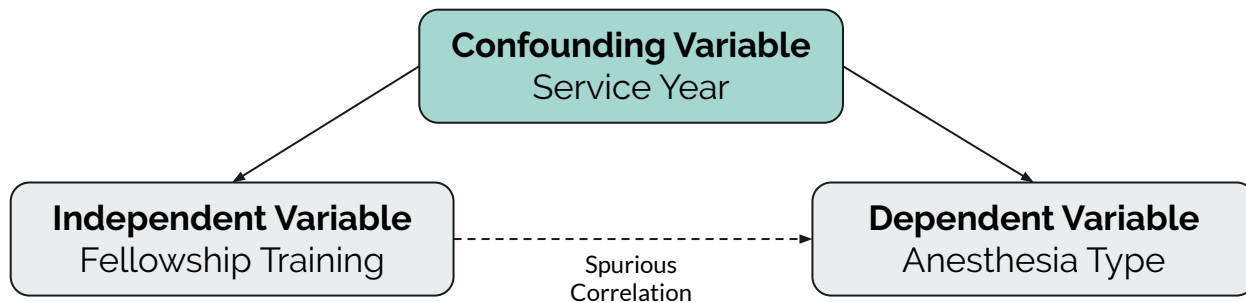
Conclusion

- **Sample size**: 3266 patients are need in total for 80% power at 0.05 of significance level for a two-sided test.

- **Group comparison**: Fellowship training status showed the significant difference between general and neuraxial anesthesia.

- Comparing with non-fellowship training anesthesiologists, the odds of using general anesthesia is 0.471 times lower in attending fellowship training anesthesiologists.

- Service year is a confounder.

Testing Difference Between Groups - Result (by Fellowship Training)

> **Four variables showed the significant difference between the trained and the non-trained.**

- Relatively balanced sample size between fellowship training no (n = 1558) vs. fellowship training yes (n = 1708)

- Significant difference in service year (p = 0.01), type of anesthesia (p = 0.01), anesthesia fail (p = 0.02), and age (p = 0.04) between the trained vs. the non-trained.

- Treated service year as continuous

Table 2: By Fellowship Training (N = 3266)			
Felloship Training	**No, N=1558**	**Yes, N=1708**	**p-value**
Service Year			0.01..
Mean +/- SD	1.47 +/- 0.82	1.7 +/- 1.01	
Median (min, max)	1 (1, 4)	1 (1, 4)	
Type of Anesthesis			0.01...
General	42 (2.7%)	22 (1.29%)	
neuraxial	1516 (97.3%)	1686 (98.71%)	
Anesthesis Failed			0.02...
No	1557 (99.94%)	1698 (99.41%)	
Yes	1 (0.06%)	10 (0.59%)	
Patient Race			0.39...
Asian	55 (3.53%)	76 (4.45%)	
Black	178 (11.42%)	181 (10.6%)	
Others	234 (15.02%)	238 (13.93%)	
White	1091 (70.03%)	1213 (71.02%)	
Height			0.21.
Mean +/- SD	1.62 +/- 0.1	1.62 +/- 0.1	
Median (min, max)	1.62 (1.3, 1.96)	1.62 (1.27, 1.99)	
Weight			0.47..
Mean +/- SD	52.45 +/- 13.73	52.76 +/- 13.41	
Median (min, max)	51.41 (12.01, 102.41)	51.98 (11.92, 115.8)	
BMI			0.93..
Mean +/- SD	20.01 +/- 4.62	20.01 +/- 4.34	
Median (min, max)	19.98 (5.48, 34.92)	19.91 (5.38, 36.03)	
Age			0.04..
Mean +/- SD	37.33 +/- 11.31	36.5 +/- 11.26	
Median (min, max)	37.5 (18, 56)	37 (18, 56)	

- 0.01.. **Wilcoxon Rank Sum**
- 0.01... **Chi-Square Test**
- 0.02... **Chi-Square Test**
- 0.39... **Chi-Square Test**
- 0.21. **Two-sample t-test**
- 0.47.. **Wilcoxon Rank Sum**
- 0.93.. **Wilcoxon Rank Sum**
- 0.04.. **Wilcoxon Rank Sum**

End of Document

Appendix: Selected Data

Continuous Variables:

	N	N.complete	Mean +/- SD	Median.IQR
Doctor ID	3266	3266	4981.84 +/- 2912.61	5009.5 (2418.25,7463.5)
Service Year	3266	3266	1.7 +/- 1	1 (1,2)
Height	3266	3266	1.62 +/- 0.1	1.62 (1.55,1.69)
Weight	3266	3266	52.61 +/- 13.56	51.74 (43.34,61.38)
BMI	3266	3266	20.01 +/- 4.48	19.95 (16.97,22.89)
Age	3266	3266	36.9 +/- 11.29	37 (27,46)

Correlated (Height, Weight)

Correlated (Weight, BMI)

Correlation:
- Anesthesia Technique: Fellowship Trained and Service Year
- Fellowship Trained: Anesthesia Technique, Service Year and Anesthesia Failed

Categorical Variables:

	N=3266	N
Fellowship_Trained:		3266
No	1558 (47.7%)	
Yes	1708 (52.3%)	
Anesthesia_Technique:		3266
neuraxial	3202 (98.0%)	
General	64 (1.96%)	
Anesthesia_Failed:		3266
No	3255 (99.7%)	
Ye	11 (0.34%)	
Race:		3266
Black	359 (11.0%)	
White	2304 (70.5%)	
Others	603 (18.5%)	

Appendix: Full Data

Continuous Variables:

	N	N.complete	Mean +/- SD	Median.IQR
Doctor ID	11000	11000	4988.67 +/- 2895.27	4964 (2470,7495.25)
Service Year	11000	11000	1.7 +/- 1.01	1 (1,2)
Height	11000	11000	1.62 +/- 0.1	1.62 (1.55,1.69)
Weight	11000	11000	52.78 +/- 13.62	52.16 (43.39,61.51)
BMI	11000	11000	20.03 +/- 4.49	20 (17.02,23)
Age	11000	11000	37 +/- 11.3	37 (27,47)

Correlated (Height / Weight)

Correlated (Weight / BMI)

Correlation:
- Anesthesia Technique: Fellowship Trained and Service Year
- Fellowship Trained: Anesthesia Technique, Service Year and Anesthesia Failed

Categorical Variables:

	N=11000	N
Fellowship_Trained:		10902
No	5233 (48.0%)	
Yes	5669 (52.0%)	
Anesthesia_Technique:		10984
General	213 (1.94%)	
neuraxial	10771 (98.1%)	
Anesthesia_Failed:		11000
No	10953 (99.6%)	
Ye	47 (0.43%)	
Race:		10472
Asian	403 (3.85%)	
Black	1171 (11.2%)	
Others	1552 (14.8%)	
White	7346 (70.1%)	