

# The Evaluation of Surgical Stapling in Robotic Thoracic Procedures – Clinical Outcomes and Resources Utilization

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## INTRODUCTION

Few case studies have shown the favorite results of hybrid/bedside staplers used in robotic procedures.<sup>1,2</sup>

## OBJECTIVE

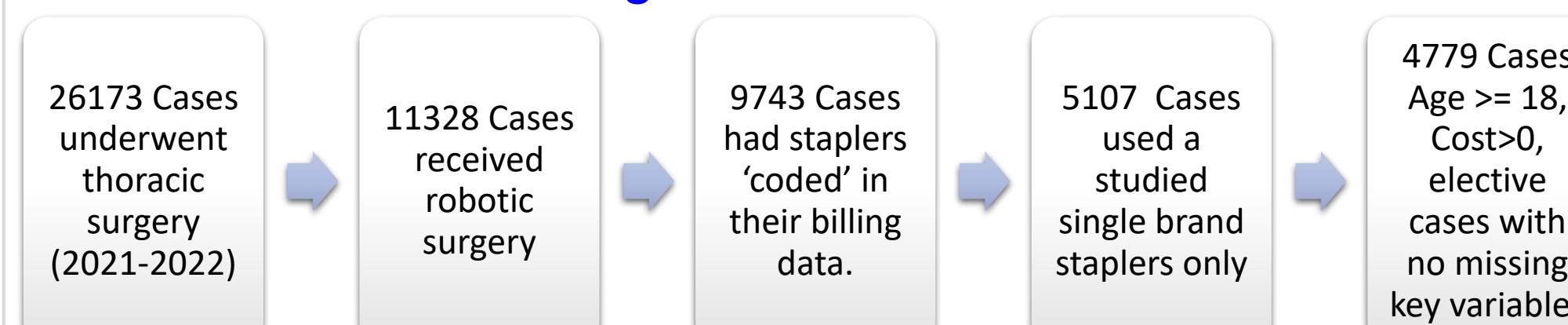
This study aims to evaluate the effectiveness of bedside staplers compared with robotic staplers on thoracic robotic surgical procedure.

## METHOD

### Data Sources:

PINC AI™ Healthcare Data, 2021-2022

### Cohort Selection: Figure 1



### Definition of staplers

- Bedside stapler (BS): Medtronic staplers (Signia™, Tri-stapler™, and other Medtronic staplers)
- Robotic stapler (RS): Intuitive SUREFORM™ staplers.

### Baseline variables

Include both patient and hospital characteristics.

### Outcomes variables

**Clinical outcomes:** used ICD 10 diagnosis and procedure codes, CPT codes to identify blood transfusion, bleeding, air leak, pneumothorax, bronchopleural fistula according to existing literature<sup>3-5</sup>

**Healthcare resources utilization:** operating room (OR) time in minutes, total inpatient costs in 2022 US dollars, and lengths of stay (LOS)

### Statistical analysis

**Baseline variable balance between two groups** was evaluated by Chi-square or Fisher exact test, and t-test or ANOVA.

**Multivariable general linear mixed models (GLMMs) with respective gamma or binomial distribution and log-link function** were used to obtain adjusted outcomes variations between BS and RS.

**Sensitivity analysis:** was done by propensity scores matching methods<sup>6</sup> to test the robustness of results obtained from GLMMs.

## RESULTS

- Majority of robotic lobectomy used RS (84.2%). (Table1)
- Patients who use RS are likely to increase the risk of bleeding by 2.5% compared to BS. Also, BS has equivalent clinical outcomes compared with RS in blood transfusion, air leak, and pneumothorax (Table 2 & 3)
- BS users were likely to save \$4,331 USD per thoracic inpatient procedure, compared to RS (p<0.001) (Table 4)
- BS users were likely to save 19 minutes per thoracic procedure compared to RS (p<0.001) (Table 4)
- No significant difference in length of stay between BS and RS. (Table 4)
- Sensitivity analysis showed similar results compared BS to RS. Table 3 & 4)

Table 1: Baseline characteristics in two groups

Covariates	BS (%)	RS (%)	P-value
Total (N= 4779)	15.53	84.17	
Age >=65	68.33	66.11	0.240
Male	45.15	41.05	0.037
Non-Hispanic			
White	63.61	70.75	<0.001
Medicare	65.63	65.32	0.374
Lung cancer	77.36	80.43	0.055
Lobectomy	55.93	61.28	0.006
CCI >= 3	67.12	63.34	0.049
Moderate/Major /Extreme APR severity	59.43	53.60	0.003
South Region	71.02	41.14	<0.001
Hospital in Urban	95.69	94.05	0.078
Bedside >=500	69.54	59.03	<0.001
Teaching hospitals	70.35	66.63	0.047
High volume hospitals	60.78	64.70	0.041
High volume surgeons	66.58	73.30	<0.001
Thoracic surgeons	40.57	57.74	<0.001
Discharge year 2022	51.48	52.54	0.596

Table 2: Unadjusted outcomes by type of staplers

Clinical outcomes		RS (N=4037) N(%)	BS (N=742) N(%)	P-value
Blood transfusion		1.7%	2.3%	0.27
Bleeding		5.4%	4.0%	0.14
Air leak		16.5%	16.7%	0.84
Pneumothorax		12.8%	11.3%	0.27
Bronchopleural fistula		0.12%	0.27%	0.34
Resources utilization		Mean(STD)	Mean(STD)	P-value
Inpatient cost (2022 USD)		\$28,020 (\$22,655)	\$24,083 (\$13,620)	<0.001
OR time (minutes)		230 (97)	216 (84)	<0.001
Length of Stay (Days)		4 (4.1)	4 (3.2)	0.15

Table 3: Summary of GLMMs – Adjusted clinical outcomes and sensitivity analysis

Adjusted Rates (%) Reference: BS	Main Model – GLMMs <sup>1</sup>			Sensitivity analysis - PSM				
	RS (%)	BS (%)	Odds ratio (95% CI)	P-value	RS (%)	BS (%)	Odds Ratio (95% CI)	P-value
Blood Transfusion	1.8	2.0	0.87(0.49, 1.54)	0.64	3.1	2.3	1.36(0.72, 2.58)	0.336
Bleeding	5.6	3.1	1.93(1.24, 3.00)	0.003 <sup>2</sup>	9.6	4.0	2.51(1.62, 3.90)	<0.001 <sup>2</sup>
Air leak	16.9	14.7	1.22(0.95, 1.56)	0.112	20.1	16.7	1.25(0.96, 1.63)	0.094
Pneumothorax	13.0	10.5	1.29(0.99, 1.67)	0.059	13.9	11.3	1.28(0.93, 1.72)	0.137

<sup>1</sup>Bronchopleural fistula did not include the multivariable GLMMs due to no or rare incidence in some subgroups; <sup>2</sup>p-value < 0.05 showed statistical significance.

Table 4: Summary of GLMMs – Adjusted resources utilization and sensitivity analyses

Adjusted Resources Utilization	Main Model: GLMMs			Sensitivity analysis: PSM				
	RS (MEAN)	BS (MEAN)	Mean Differences (95% CI)	P-value	RS (MEAN)	BS (MEAN)	Mean Differences (95% CI)	P-value
Inpatient cost (2022 USD)	\$28,085	\$23,753	\$4,331 (\$3,362, \$5,301)	<0.001 <sup>1</sup>	\$29,547	\$24,083	\$5,464 (\$3,885, \$7,043)	<0.001 <sup>1</sup>
OR time (minutes)	231	212	19.1(12.3, 25.7)	<0.001 <sup>1</sup>	237.4	215.7	21.6(11.7, 31.6)	<0.001 <sup>1</sup>
LOS (days)	3.7	3.7	-0.01(-0.23, 0.21)	0.932	3.9	3.9	0.07(-0.3, 0.4)	0.705

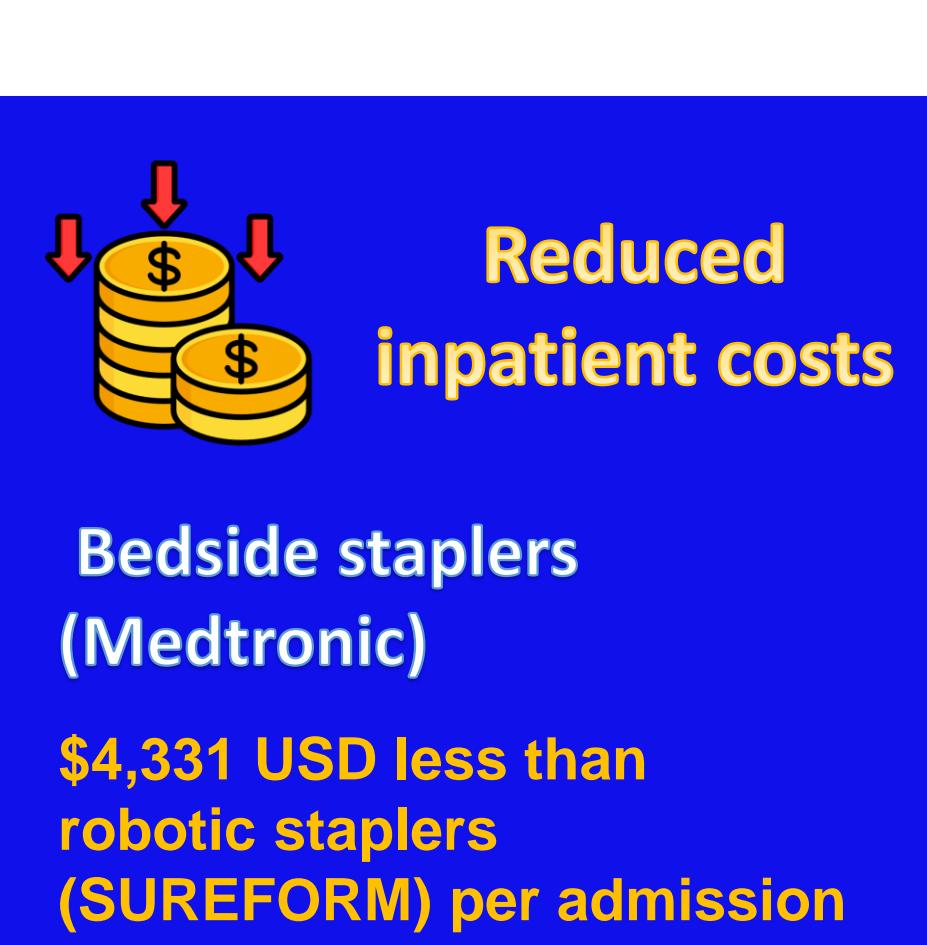
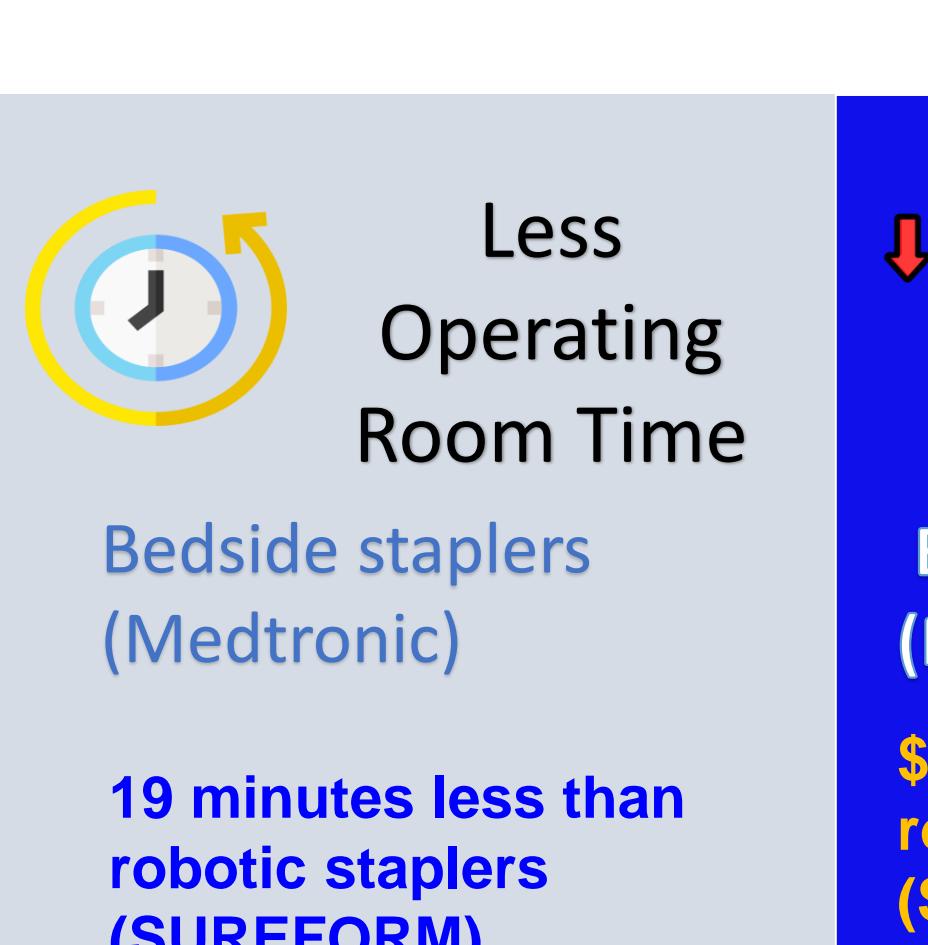
<sup>1</sup>p-value<0.05 showed statistical significance.

Abbreviation in all tables: RS: robotic staplers; BS: bedside staplers; OR: operating room; STD: standard deviation; GLMMs: general linear multivariate models; CI: confidence interval; PSM: propensity score matching;

3. Prior study included manual/powered staplers but did not provide details about the staplers, brand, or products. It may include products from JNJ, Medtronic, and/or other brands. This study included Medtronic staplers only in BS group.
4. The current study did not include conversion rate as an outcome because two studies (Servais et al., 2022 & Herrera et al., 2022)<sup>8-9</sup> suggested that the conversion rate may not indicate worse outcomes.

## CONCLUSIONS

Bedside Stapler is more effective and cost-saving than robotic staplers in thoracic robotic procedures



## REFERENCES

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## CONTACT INFORMATION

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