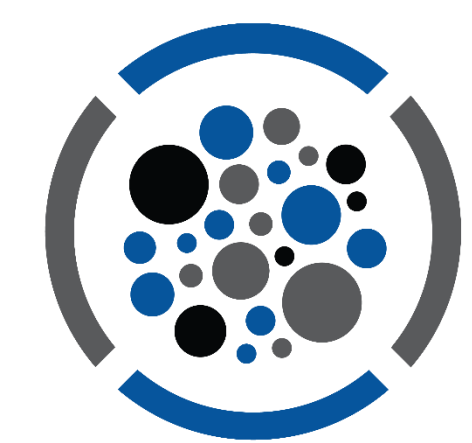


Surgical Site Infections Following Colon Surgery in a Large Network of Community Hospitals

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Abstract

Background: Colon surgeries are commonly performed, and surgical site infections (SSIs) following these procedures are routinely reported to the National Healthcare Safety Network (NHSN). However, the impact of infections present at the time of surgery (PATOS) and emergent surgeries on the epidemiology of colon surgery SSIs has not been well described.

Methods: We retrospectively analyzed prospectively collected data on complex (i.e., deep incisional or organ space) SSIs following colon surgery performed at 34 community hospitals in the southeastern United States from January 2015 to June 2019. We excluded SSIs categorized as PATOS. We then stratified colon surgery SSI rates according to age, sex, body mass index (BMI), operation duration, diabetes diagnosis, American Society of Anesthesiologists (ASA) physical status, wound class, emergent procedure, endoscopic procedure, and hospital colon surgery volume. Finally, we explored effect measure modification of emergent surgery and open surgery on hospital volume using log-binomial modeling and tests of homogeneity.

Results: A total of 722 complex SSIs occurred following 28,642 colon surgeries (prevalence rate [PR], 2.52 per 100 procedures). After PATOS SSIs were excluded, 545 complex SSIs remained (PR 1.90 per 100 procedures). Risk factor analysis revealed that age < 75 years and operation time > 75th percentile (188 minutes) during the 5-year study period significantly increased risk of SSI (Table 1). The most common pathogens that caused SSIs in this study cohort were Escherichia coli, Enterococcus, and Klebsiella (Table 2). 105 (19%) SSIs were culture-negative and 378 (69%) of the SSIs were polymicrobial. We defined hospital volume as high (>500 procedures in the 5-year period) based on the median hospital volume in the dataset. No significant effect measure modification occurred between hospital volume and either laparoscopic surgery or emergent surgery (Table 3).

Conclusion: In our cohort, we found that one-fourth of colon surgery SSIs were categorized as PATOS, which are no longer publicly reported to the Centers for Medicare & Medicaid Services. While most SSI literature describes higher volume hospitals having lower SSI rates, high colon surgery volume was associated with increased SSI rates in our community hospital cohort.

Background

- SSIs following colon surgery are routinely reported to NHSN
- The impact of PATOS and emergent procedures on the epidemiology of SSIs after colon surgery has not been well described.

Methods

- Retrospective analysis of prospectively collected data on complex (deep incisional or organ space) SSIs following colon surgery performed at 34 community hospitals in the Southeastern U.S. from 1/ 2015 to 6/ 2019
- SSIs categorized as PATOS excluded
- Examined effect measure modification of emergent surgery and open surgery on hospital volume using log-binomial modeling and tests of homogeneity

Results

- 722 complex SSIs occurred following 28,642 colon surgeries (prevalence rate [PR], 2.52 per 100 procedures)
- With PATOS SSIs excluded, 545 complex SSIs remained (PR 1.90 per 100 procedures).

Table 1: Characteristics of patients who underwent colon surgery from January 2015 to June 2018 in 34 community hospitals.

Variable	All patients (N=28642)	SSI (N=545)	SSI rate/100 procedures	RR	p value
Age (years, median, Q1-Q3)	63 (52-72)	61 (51-71)			
Age > 75 years (%)	5106 (17.8)	74 (13.5)	1.45	0.72 (0.57-0.92)	0.01
Male	13382 (46.7)	273 (50.1)	2.04	1.14 (0.97-1.35)	0.11
BMI (kg/m ² , median, Q1-Q3)	27.8 (23.8-32.4)	28.3 (24.1-33.0)			
Obesity (BMI > 30, %)	9434 (32.9)	191 (35.1)	2.02	1.10 (0.92-1.31)	0.29
Operation time in min (Q1-Q3)	131 (92-188)	161 (116-222)			
Operation time > 75th percentile = 188 minutes (%)	7102 (24.8)	203 (37.3)	2.86	1.80 (1.52-2.14)	< 0.01
Diabetes (%)	1859 (6.5)	36 (6.6)	1.94	1.25 (0.89-1.75)	0.19
ASA 1-2 (low, %)	9807 (34.2)	177 (32.5)	1.80	0.92 (0.77-1.10)	0.38
ASA 3-5 (high, %)	18835 (65.8)	368 (67.5)	1.95	1.08 (0.91-1.29)	0.38
Wound Class (C, CC, %)	22682 (79.2)	447 (82.0)	1.97	1.20 (0.97-1.49)	
Wound Class (Co, D, %)	5960 (20.8)	98 (18.0)	1.64	0.83 (0.67-1.04)	0.1
Emergency (%)	2810 (9.8)	59 (10.8)	2.10	1.12 (0.85-1.46)	0.42
Endoscopic Procedure (%)	12370 (43.2)	226 (41.5)	1.83	0.93 (0.79-1.10)	0.41
< 500 procedures	3956 (13.8)	73 (13.4)	1.85	0.97 (0.76-1.23)	0.78
> 500 procedures	24686 (86.2)	472 (86.6)	1.91	1.04 (0.81-1.32)	

- Age < 75 years and operation time > 75th percentile (188 minutes) increased risk of SSI
- Most common SSI pathogens were Escherichia coli, Enterococcus, and Klebsiella
- No significant effect measure modification occurred between hospital volume and either laparoscopic surgery or emergent surgery

Table 2: Count and frequency of pathogens that caused complex surgical site infections after colon surgery

Organism	Number of isolates*	% based on 545 SSIs*
Escherichia coli	187	34%
Enterococcus spp	135	25%
No pathogen identified	105	19%
Klebsiella spp	57	10%
Bacteroides spp	47	9%
Candida spp	38	7%
Streptococcus spp	28	5%
Staphylococcus aureus	27	5%
Pseudomonas spp	22	4%
Proteus spp	18	3%
Enterobacter spp	16	3%
Citrobacter spp	16	3%
Clostridium spp	11	2%
Coagulase-negative staphylococci	9	2%
Polymicrobial infection	378	69%

* The sum of the numbers and percentages is more than 545 and 100%, respectively, because polymicrobial infections were counted for multiple pathogens.

Table 3: Colon surgery complex surgical site infection rates, stratified by emergent and, open procedures and surgery volume

Category	Total Surgeries (N)	Complex SSI (N)	SSI Rate/100 procedures	Rate Ratio	95% CI	p value	Test of Homogeneity
High volume laparoscopic (ref)	11119	201	1.81	1			0.41
High volume open	13567	271	2.00	1.11	0.92,1.32	0.28	
Low volume laparoscopic	1251	25	2.00	1.11	0.73,1.67	0.93	
Low volume open	2705	48	1.77	0.98	0.72,1.34	0.91	0.31
High volume elective (ref)	22611	431	1.91	1			
High volume emergent	2075	41	1.98	1.04	0.75,1.42	0.82	
Low Volume elective	3221	55	1.71	0.90	0.68,1.18	0.44	
Low volume emergent	735	18	2.45	1.28	0.81,2.05	0.29	

Conclusions

- 25% of colon surgery SSIs were categorized as PATOS, which are no longer publicly reported to the Centers for Medicare & Medicaid Services
- In contrast to the current literature, we found that high colon surgery volume was associated with increased SSI rates in our community hospital cohort

