



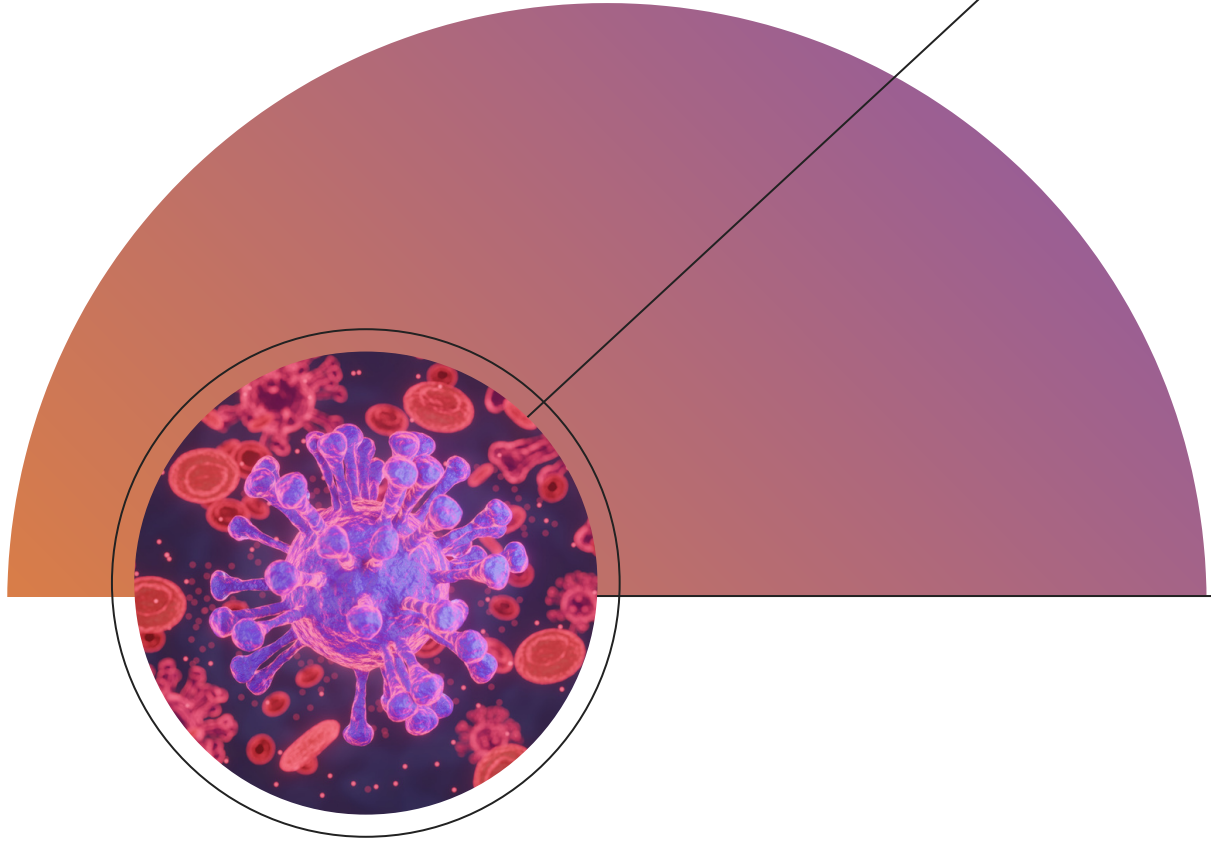
BinDoc Research Note No. 2

Comparing Non- SSI and SSI
Cases after Urgent/Elective Open
Colon Surgeries in Germany 2019-
2021

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Goal



In this research note, we seek to compare descriptively patient characteristics, treatments, and outcomes for patients without a surgical site infection (non-SSI) and with a surgical site infection (SSI), separately for urgent and elective open colon surgeries.

ABSTRACT

In Research Note No. 1, we found for our sample of routine data from Germany in 2019-2021 (BinDoc database) that open colon surgeries have a relatively high SSI-rate (compared to laparoscopic colon surgeries or compared to C-sections), especially when patients enter a clinic urgently, and not electively (SSI-rate of 8.7 vs. 7.1 per 100 patients).

In this research note, we explore descriptively how patients with urgent or elective open colon surgeries, **who did not develop an SSI, differ from patients, who did develop an SSI**, in terms of patient characteristics, treatments and outcomes.

We look at the following characteristics which a patient brings to the hospital upon the first stay, when the colon surgery is performed (see Table 1): age group, gender, adipositas, main diagnosis, and a list of comorbidities captured in the Charlson index (Quan version), as well as some special features like alcohol abuse (ICD-10 F10, K70, G62.1), and pre-operative nutrition status (ICD-10 E12, E43, E44, E45, E46).

We assume that these patient-related factors, especially increasing age and several comorbidities, increase the risk of an SSI. Next, we look at treatment-related influences (during the first stay) - like chemotherapy (OPS 8-54), which presumably increase the risk of an SSI, and at adverse events like blood loss, approximated by blood transfusions (OPS 8-800.c0, 8-800.cx), and anastomotic leakage (ICD K91.83); as well at time to procedure and enterostoma/blind closure. We also consider some clinic-related characteristics like the type of the clinic (public, non-profit, private) and the number of beds. As an extension, we consider the components of the Elixhauser Index to capture comorbidities; we look at more SSI-related treatments like wound toilet, soft tissue coverage, and re-laparotomy (during first stay), and at adverse events like nosocomial urinary tract infection (UTI), pneumonia, and sepsis (30-day timeframe). Finally, we report the patients' dismissal reasons, differentiating between death, regular dismissal, and transferal to another hospital. For all these characteristics, we assume that the differentiation between urgent and elective admission remains crucial, so that we display the above characteristics for urgent/elective cases without an SSI and with an SSI separately.

For urgent open colon surgeries, we find that the percentage of obese patients, of patients with a main diagnosis of ICD-10 K63.1, with comorbidities like congestive heart failure, cerebrovascular disease, chronic pulmonary disease, and hemiplegia, as well as with nutrition problems, coagulopathy and fluid/electrolyte disorders is higher among SSI-patients than among non-SSI patients. The percentage of blood transfusions and anastomotic leakage is likewise significantly higher among SSI patients, and they disproportionately often come from a public clinic.

While these differences say little about causality, they give a first indication of potentially important factors which might increase the risk of an SSI. Concerning the other treatments and adverse events, almost all of them are highly significant. As they are potentially SSI-related and might often follow and not precede an SSI, these latter characteristics, however, might be an indication rather than a predictor of an SSI.

Surprisingly, the death rate is twice as high among non-SSI patients compared to SSI-patients (12.93% vs. 6.41%), a finding that could be explored in more detail.

Interestingly, among elective open colon surgery cases, ICD-10 K63.1 (perforation of intestine), cerebrovascular disease, chronic pulmonary disease, and hemiplegia no longer emerge as significant, but the main diagnoses C18 and D12 (malign and benign neoplasm) do (lowering the risk of an SSI), as well as other comorbidities, especially peripheral vascular disease, diabetes without complications, and metastatic solid tumor, which increase the risk of an SSI.

Other potential influences or indications remain important in elective cases, like blood transfusions, anastomotic leakage, and clinic characteristics, with the proportion of clinics with 600-999 beds being disproportionately high among SSI-cases. For elective cases, most SSI-related treatments and outcomes remain significant (some exceptions), and the mortality rate does not differ between SSI and non-SSI patients (5-6%).

TABLE 1. DIFFERENCES FOR NON-SSI AND SSI CASES OF PATIENTS WITH URGENT/ELECTIVE OPEN COLON SURGERIES

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
age group	15.2 (3.3)	14.9 (3.2)	0.075	15.28 (2.83)	15.04 (2.74)	0.2
female	1687 (51.70%)	160 (51.28%)	0.9	1870 (53.40%)	126 (47.01%)	0.044
adipositas	266 (8.15%)	41 (13.14%)	0.003	334 (9.48%)	48 (17.71%)	<0.001
main diagnosis K57 (diverticular disease of intestine)	701 (21.48%)	73 (23.40%)	0.4	340 (9.65%)	30 (11.07%)	0.5
main diagnosis C18 (malignant neoplasm of colon)	1148 (35.18%)	93 (29.81%)	0.057	1994 (56.57%)	129 (47.60%)	0.004
main diagnosis D12 (benign neoplasm of colon)	32 (0.98%)	2 (0.64%)	0.8	176 (4.99%)	3 (1.11%)	0.004
main diagnosis K63.1 (perforation of intestine, non- traumatic)	137 (4.20%)	24 (7.69%)	0.004	58 (1.65%)	2 (0.74%)	0.4

COMORBIDITIES CHARLSON INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Myocardial infarction (mi)	117 (3.59%)	10 (3.21%)	0.7	102 (2.89%)	11 (4.06%)	0.3
Congestive heart failure (chf)	410 (12.57%)	53 (16.99%)	0.026	261 (7.40%)	41 (15.13%)	<0.001
Peripheral vascular disease (pvd)	284 (8.70%)	36 (11.54%)	0.094	251 (7.12%)	31 (11.44%)	0.009
Cerebrovascular disease (cevd)	115 (3.52%)	22 (7.05%)	0.002	82 (2.33%)	7 (2.58%)	0.8
Dementia	159 (4.87%)	11 (3.53%)	0.3	93 (2.64%)	9 (3.32%)	0.5
Chronic pulmonary disease (cpd)	293 (8.98%)	41 (13.14%)	0.016	304 (8.62%)	31 (11.44%)	0.12
Rheumatic disease (rheumd)	49 (1.50%)	3 (0.96%)	0.6	51 (1.45%)	5 (1.85%)	0.6
Peptic ulcer disease (pud)	55 (1.69%)	3 (0.96%)	0.3	43 (1.22%)	5 (1.85%)	0.4

COMORBIDITIES CHARLSON INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Liver disease, mild (mld)	155 (4.75%)	9 (2.88%)	0.13	141 (4.00%)	17 (6.27%)	0.071
Diabetes w/o chronic compl. (diab)	451 (13.82%)	49 (15.71%)	0.4	599 (16.99%)	59 (21.77%)	0.045
Diabetes w chronic compl. (diabwc)	95 (2.91%)	10 (3.21%)	0.8	92 (2.61%)	3 (1.11%)	0.13
Hemiplegia/paraplegia (hp)	82 (2.51%)	15 (4.81%)	0.017	60 (1.70%)	7 (2.58%)	0.3
Renal disease (rend)	491 (15.05%)	55 (17.63%)	0.2	413 (11.72%)	40 (14.76%)	0.14
Any malignancy (canc)	536 (16.43%)	53 (16.99%)	0.8	701 (19.89%)	58 (21.40%)	0.5
Liver disease, mod/severe (msld)	28 (0.86%)	1 (0.32%)	0.5	12 (0.34%)	2 (0.74%)	0.3
Metastatic solid tumor (metacanc)	651 (19.95%)	63 (20.19%)	>0.9	849 (24.09%)	88 (32.47%)	0.002

COMORBIDITIES CHARLSON INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Aids	2 (0.06%)	1 (0.32%)	0.2	1 (0.03%)	0 (0.00%)	>0.9
Charlson Score	2.34 (2.97)	2.49 (2.94)	0.11	2.42 (3.00)	3.24 (3.16)	<0.001
Alcohol (F10, K70, G62.1)	62 (1.90%)	7 (2.24%)	0.7	32 (0.91%)	6 (2.21%)	0.050
Nutrition (E12, E43 : E46)	207 (6.34%)	33 (10.58%)	0.004	226 (6.41%)	39 (14.39%)	<0.001

IN-STAY TREATMENT OR ADVERSE EVENTS

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Chemotherapy (first stay)	34 (1.04%)	3 (0.96%)	>0.9	51 (1.45%)	7 (2.58%)	0.2
Blood Transfusion 1TE to <6TE	829 (25.41%)	105 (33.65%)	0.002	670 (19.01%)	83 (30.63%)	<0.001
Blood Transfusion >6TE	143 (4.38%)	15 (4.81%)	0.7	71 (2.01%)	12 (4.43%)	0.009
Anastomotic leakage (K91.83)	128 (3.92%)	50 (16.03%)	<0.001	153 (4.34%)	43 (15.87%)	<0.001
Time to Surgery (in hours)	117 (162)	137 (222)	0.4	98 (143)	141 (183)	<0.001
Enterostoma/Blind Closure	784 (24.03%)	103 (33.01%)	<0.001	328 (9.30%)	65 (23.99%)	<0.001

CLINIC CHARACTERISTICS

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Clinic type public	1503 (46.06%)	169 (54.17%)	0.006	1566 (44.43%)	146 (53.87%)	0.003
Clinic type nonprofit	1028 (31.50%)	73 (23.40%)	0.003	1175 (33.33%)	68 (25.09%)	0.005
Clinic type private	732 (22.43%)	70 (22.44%)	>0.9	784 (22.24%)	57 (21.03%)	0.6
<199 beds	266 (8.15%)	25 (8.01%)	>0.9	314 (8.91%)	21 (7.75%)	0.5
200-599 beds	2189 (67.09%)	191 (61.22%)	0.036	2351 (66.70%)	151 (55.72%)	<0.001
600-999 beds	515 (15.78%)	57 (18.27%)	0.3	536 (15.21%)	78 (28.78%)	<0.001
1000+ beds	275 (8.43%)	39 (12.50%)	0.015	303 (8.60%)	20 (7.38%)	0.5

COMORBIDITIES ELIXHAUSER INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Congestive heart failure (chf)	400 (12.26%)	52 (16.67%)	0.025	251 (7.12%)	41 (15.13%)	<0.001
Cardiac Arrhythmias (carit)	720 (22.07%)	88 (28.21%)	0.013	571 (16.20%)	62 (22.88%)	0.004
Valvular Disease (valv)	142 (4.35%)	19 (6.09%)	0.2	137 (3.89%)	15 (5.54%)	0.2
Pulm Circulation Disorders (pcd)	76 (2.33%)	18 (5.77%)	<0.001	66 (1.87%)	10 (3.69%)	0.040
Peripheral Vasc. Disorders (pvd)	284 (8.70%)	36 (11.54%)	0.094	251 (7.12%)	31 (11.44%)	0.009
Hypertension, uncompl (hypunc)	1550 (47.50%)	170 (54.49%)	0.018	1910 (54.18%)	157 (57.93%)	0.2
Hypertension, compl (hypc)	101 (3.10%)	6 (1.92%)	0.2	82 (2.33%)	9 (3.32%)	0.3

COMORBIDITIES ELIXHAUSER INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Paralysis (para)	82 (2.51%)	15 (4.81%)	0.017	60 (1.70%)	7 (2.58%)	0.3
Other Neurological Disorders (ond)	155 (4.75%)	11 (3.53%)	0.3	101 (2.87%)	9 (3.32%)	0.7
Chronic Pulmonary Disease (cpd)	293 (8.98%)	41 (13.14%)	0.016	304 (8.62%)	31 (11.44%)	0.12
Diabetes, uncomplicated (diabunc)	429 (13.15%)	45 (14.42%)	0.5	584 (16.57%)	58 (21.40%)	0.041
Diabetes, complicated (diabc)	117 (3.59%)	14 (4.49%)	0.4	105 (2.98%)	4 (1.48%)	0.2
Hypothyroidism (hypothy)	477 (14.62%)	56 (17.95%)	0.11	506 (14.35%)	52 (19.19%)	0.030
Renal Failure (rf)	491 (15.05%)	55 (17.63%)	0.2	413 (11.72%)	40 (14.76%)	0.14

COMORBIDITIES ELIXHAUSER INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Liver Disease (ld)	194 (5.95%)	10 (3.21%)	0.046	161 (4.57%)	18 (6.64%)	0.12
Peptic Ulcer D, excl bleeding (pud)	11 (0.34%)	2 (0.64%)	0.3	7 (0.20%)	3 (1.11%)	0.030
Aids (aids)	2 (0.06%)	1 (0.32%)	0.2	1 (0.03%)	0 (0.00%)	>0.9
Lymphoma (lymph)	16 (0.49%)	1 (0.32%)	>0.9	20 (0.57%)	3 (1.11%)	0.2
Metastatic Cancer (metacanc)	651 (19.95%)	63 (20.19%)	>0.9	849 (24.09%)	88 (32.47%)	0.002
Solid Tumor wo Metast (solidtum)	517 (15.84%)	52 (16.67%)	0.7	676 (19.18%)	54 (19.93%)	0.8
Rheumatoid arthritis (rheumd)	51 (1.56%)	3 (0.96%)	0.6	62 (1.76%)	6 (2.21%)	0.6

COMORBIDITIES ELIXHAUSER INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Coagulopathy (coag)	438 (13.42%)	61 (19.55%)	0.003	233 (6.61%)	27 (9.96%)	0.035
Obesity (obes)	266 (8.15%)	41 (13.14%)	0.003	334 (9.48%)	48 (17.71%)	<0.001
Weight Loss (wloss)	279 (8.55%)	40 (12.82%)	0.011	309 (8.77%)	49 (18.08%)	<0.001
Fluid&Electrolyte Disorders (fed)	1793 (54.95%)	223 (71.47%)	<0.001	1483 (42.07%)	166 (61.25%)	<0.001
Blood loss anemia (blane)	92 (2.82%)	7 (2.24%)	0.6	58 (1.65%)	6 (2.21%)	0.5
Deficiency Anemia (dane)	189 (5.79%)	23 (7.37%)	0.3	181 (5.13%)	11 (4.06%)	0.4
Alcohol abuse (alcohol)	62 (1.90%)	7 (2.24%)	0.7	32 (0.91%)	6 (2.21%)	0.050

COMORBIDITIES ELIXHAUSER INDEX

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Drug abuse (drug)	18 (0.55%)	3 (0.96%)	0.4	8 (0.23%)	0 (0.00%)	>0.9
Psychoses (psycho)	25 (0.77%)	2 (0.64%)	>0.9	14 (0.40%)	1 (0.37%)	>0.9
Depression (depre)	177 (5.42%)	23 (7.37%)	0.2	155 (4.40%)	15 (5.54%)	0.4
CCIElixScore	12 (14)	14 (14)	0.006	10 (13)	15 (15)	<0.001

OTHER TREATMENTS (SSI-RELATED)

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Catheter (8-831)	1131 (34.66%)	118 (37.82%)	0.3	997 (28.28%)	119 (43.91%)	<0.001
Manip. Urinary Tract (8-132)	26 (0.80%)	8 (2.56%)	0.007	29 (0.82%)	8 (2.95%)	0.004
Respiration Hours none or missing	2417 (74.07%)	235 (75.32%)	0.6	2461 (69.82%)	161 (59.41%)	0.009
Respiration Hours	51 (140)	87 (207)	(0.047)	18 (71)	20 (73)	0.3
Enteral/parenteral nutrition	35 (1.07%)	6 (1.92%)	0.2	57 (1.62%)	27 (9.96%)	<0.001
Lap: Relaparatomie (5- 541.2)	195 (5.98%)	62 (19.87%)	<0.001	241 (6.84%)	56 (20.66%)	<0.001
Colon: Adhesiolysis (5- 469.20)	604 (18.51%)	83 (26.60%)	<0.001	798 (22.64%)	67 (24.72%)	0.4

OTHER TREATMENTS (SSI-RELATED)

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Temp Soft Tissue Coverage (5-916.a)	265 (8.12%)	124 (39.74%)	<0.001	132 (3.74%)	79 (29.15%)	<0.001
Surg. Wound Toilet, Belly (5-896.1b)	70 (2.15%)	68 (21.79%)	<0.001	33 (0.94%)	49 (18.08%)	<0.001
Complex Treatment (8-98f)	773 (23.69%)	115 (36.86%)	<0.001	523 (14.84%)	80 (29.52%)	<0.001
Geriatric Complex (8-550)	96 (2.94%)	17 (5.45%)	0.016	75 (2.13%)	6 (2.21%)	>0.9
LOS ICU	2.4 (4.8)	4.2 (6.4)	<0.001	1.34 (2.89)	2.76 (4.37)	<0.001

FURTHER ADVERSE EVENTS AND OUTCOMES

Parameters	Urgent Non-SSI N=3263	Urgent SSI N=312	p-value	Elective Non-SSI N=3525	Elective SSI N=271	p-value
Ileus	957 (29.33%)	98 (31.41%)	0.4	629 (17.84%)	75 (27.68%)	<0.001
Nosocomial UTI	327 (10.02%)	55 (17.63%)	<0.001	231 (6.55%)	54 (19.93%)	<0.001
Nosocomial Pneumonia	163 (5.00 %)	39 (12.50%)	<0.001	76 (2.16%)	28 (10.33%)	<0.001
Nosocomial Sepsis	252 (7.72%)	51 (16.35%)	<0.001	112 (3.18%)	24 (8.86%)	<0.001
Death	422 (12.93%)	20 (6.41%)	<0.001	178 (5.05%)	16 (5.90%)	0.5
Regular Dismissal	2153 (65.98%)	184 (58.97%)	0.013	2599 (73.73%)	151 (55.72%)	<0.001
Other Hospital	159 (4.87%)	21 (6.73%)	0.2	107 (3.04%)	17 (6.27%)	0.004