

Figure S1. Relative Risk of Selected Adverse Events Stratified by Serum Albumin, Derived from Unadjusted Crude Rates—

Hypoalbuminemia increases unadjusted relative risk of selected adverse events. CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident.

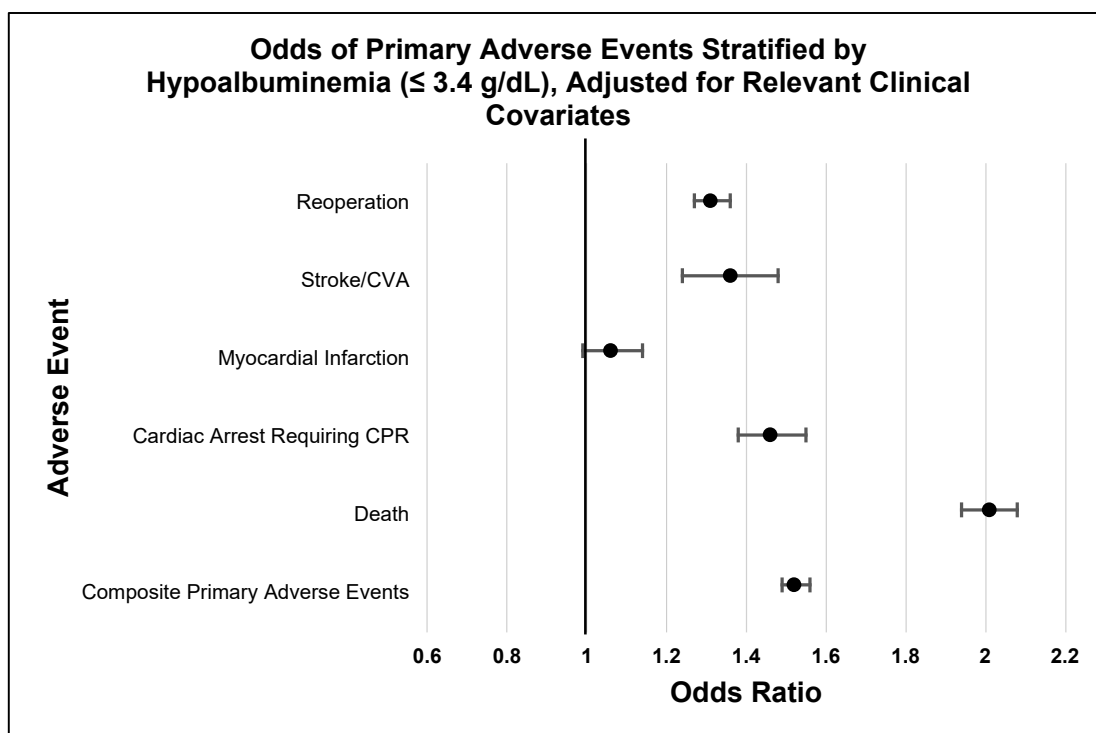
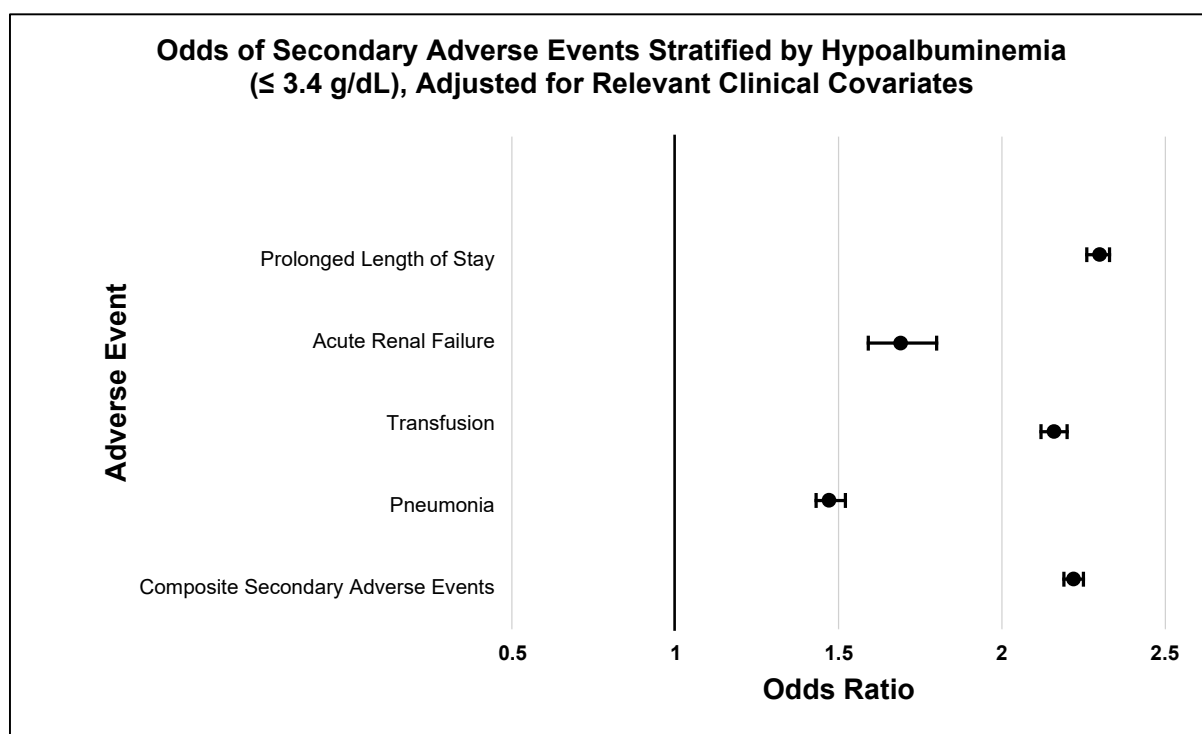


Figure S2. Odds of composite and primary adverse events according to hypoalbuminemia – Hypoalbuminemia increases odds of all primary outcomes except myocardial infarction after multivariate adjustment. The composite odds of primary adverse events are also increased in patients with hypoalbuminemia. CVA – cerebrovascular accident; CPR – cardiopulmonary resuscitation.



*Figure S3. Odds of selected secondary adverse events stratified by serum albumin, adjusted for relevant clinical covariates—
Hypoalbuminemia increases odds of all secondary adverse outcomes after multivariate adjustment. The composite odds of secondary adverse events are also increased in patients with hypoalbuminemia.*

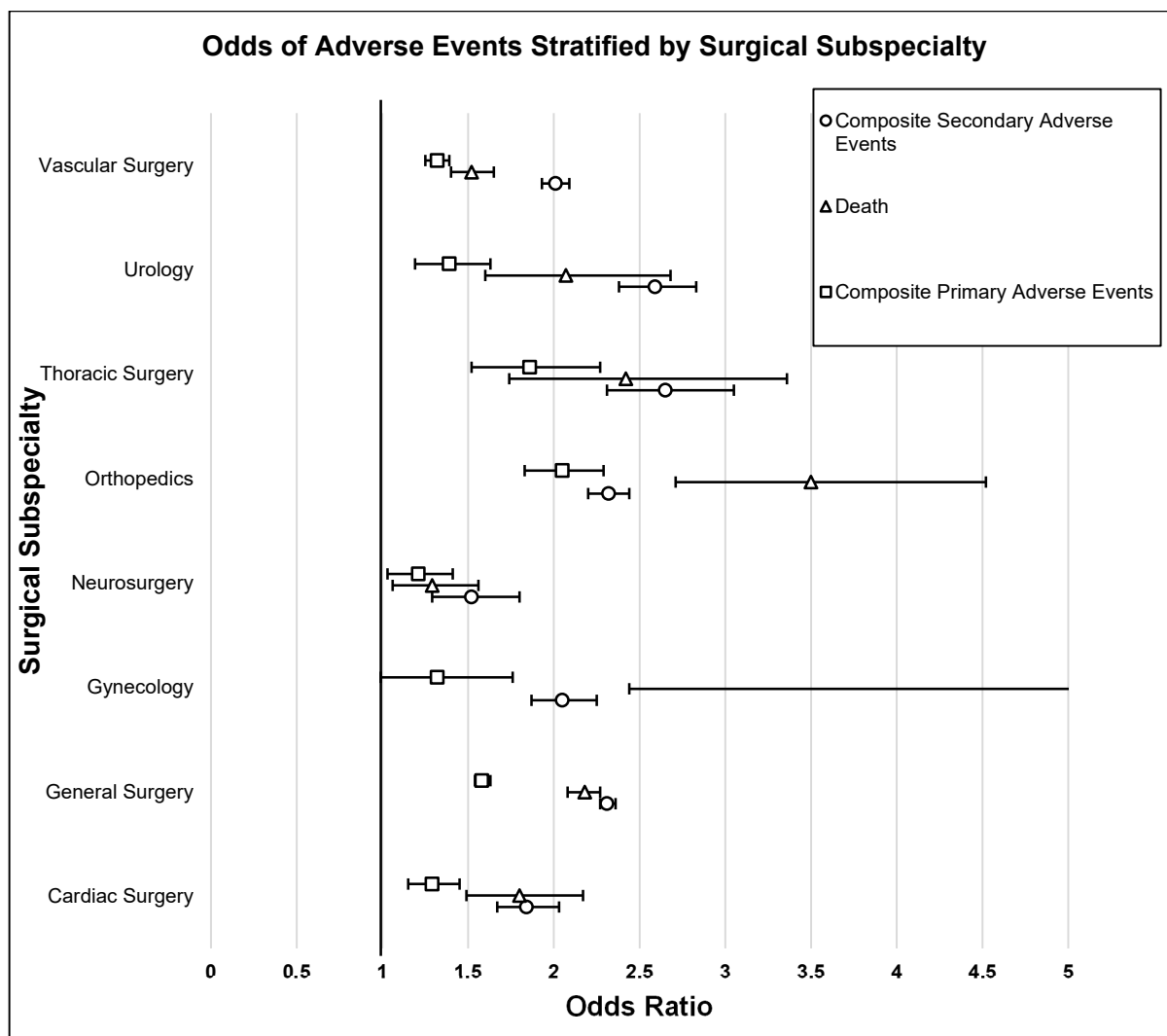


Figure S4. Odds of adverse events in individual specialties, stratified by serum albumin, adjusted for relevant clinical covariates

Hypoalbuminemia increases odds of composite odds of primary and secondary adverse events in the majority of surgical subspecialties.

Table S1. CPT codes used to generate multi-surgical cohort, stratified by surgical specialty

Description	CPT codes
Vascular Surgery	
Open abdominal aortic aneurysm repair	34830, 34831, 34832, 35081, 35082, 35091, 35092, 35102, 35103
Endovascular abdominal aortic aneurysm repair	34701, 34702, 34703, 34704, 34705, 34706
Below knee amputation	27880, 27882, 27881
Above knee amputation	27592, 27590, 27591
Peripheral vascular surgery (Artery and vein bypass procedures: aorto-bifemoral, aorto-femoral, ileo-femoral, femoral-popliteal, femoral-tibial, aorto-femoral-popliteal, femoral-femoral)	35551, 35646, 35647, 35666, 35665, 35540, 35539, 35566, 35565, 35585, 35656, 35556, 35583, 35548, 35661, 35558
General Surgery	
Large bowel/rectal surgery	44150, 44151, 44155, 44156, 44157, 44158, 44211(r), 44212, 44210, 44120, 44204, 44206, 44207, 44208, 44140, 44141, 44143, 44144, 44145, 44146, 45110, 45112, 45119, 45120, 45121, 45395, 45397
Hepatic/Liver resection	47379, 47120(r), 47122, 47125, 47130
Whipple's pancreaticoduodenectomy	48999, 48150, 48152, 48153, 48154
Gastric bypass	43846, 43847, 43644r, 43645(r)
Thoracic Surgery	
Open pneumonectomy or lobectomy	32440, 32442, 32445, 32488, 32482, 32480, 32484, 32486, 32491
VATS lobectomy	32491T, 32663
Urology	
Radical Cystectomy	51570, 51590(r), 51575, 51596(r), 51580, 51570, 51585, 51595
Nephrectomy	50225, 50230, 50220, 50545(r), 50546
Nephroureterectomy	50234(r), 50236(r)
Orthopedic Surgery	
Total hip and knee joint replacement	27130, 27447, 27445
Spinal surgery (Multisegment surgery, cervical arthroplasty/replacement)	22845 22846 22847 22856 22858 22840 22841 22842 22843 22844 63050 63051 22845 22846 22847 22845 22846 22847 22840 22841 22842 22843 22844 22840 22841 22842 22843 22844 22840 22841 22842 22843 22844
Hip fixation	27253, 27254, 27259
Neurosurgery	

Open craniotomy, craniectomy, posterior fossa surgery	61304, 61305, 61522, 61312, 61313, 61314, 61315, 61322, 61323
Cardiac Surgery	
Coronary artery bypass grafting	33510, 33511, 33512, 33514, 33515, 33516, 33517, 33518, 33519, 33520, 33521, 33522, 33523, 33533, 33534, 33535, 33536
Single valve repair or replacement	33602, 33391, 33390, 33600, 33425, 33426, 33427, 33420, 33422, 33470, 33471, 33474, 33468, 33463, 33464, 33430, 33465, 33475, 33405, 33406, 33410
Complex: multiple valve surgeries, aortic procedures, ventricular aneurysmectomy, assist device	33866, 33863, 33413, 33440, 33412, 33411, 33548, 33542, 33975, 33979, 33622
Gynecology	
Hysterectomy	58152, 58541-58544, 58260-58294, 58570, 58571, 58572, 58573, 58550, 58552, 58553, 58554, 58542, 58541, 58543, 58544

Table S2. Optimal serum albumin cutoff (g/dL) to predict 30-day postoperative adverse events, stratified by disseminated cancer status

Outcomes	Disseminated Cancer Absent	Disseminated Cancer Present
<u>Composite Primary Adverse Event</u>	3.5	3.0
Death	3.5	3.1
Cardiac Arrest Requiring CPR	3.5	3.1
Myocardial Infarction	3.9	1.5
Stroke/CVA	3.8	3.2
Reoperation	3.5	3.8

CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident.

Table S3. Subgroup Analysis – Impact of Disseminated Cancer on Crude Rates of Adverse Surgical Outcomes Stratified by Serum Albumin

	N	Serum Albumin >	Serum Albumin ≤	p-value
Death	38,831			
No		36,354 (93.6)	26,958 (97.7)	9,396
Yes		2,477 (6.4)	630 (2.3)	1,847
Cardiac Arrest Requiring	38,831			
No		38,437 (99.0)	27,408 (99.3)	11,029
Yes		394 (1.0)	180 (0.7)	214 (1.9)
Myocardial Infarction	38,831			
No		38,520 (99.2)	27,401 (99.3)	11,119
Yes		311 (0.8)	187 (0.7)	124 (1.1)
Stroke/CVA	38,831			
No		38,654 (99.5)	27,506 (99.7)	11,148
Yes		177 (0.5)	82 (0.3)	95 (0.8)
Reoperation	30,343			
No		28,602 (94.3)	20,785 (95.1)	7,817
Yes		1,741 (5.7)	1,060 (4.9)	681 (8.0)
Composite Primary	38,831			
No		34,503 (88.9)	25,774 (93.4)	8,729
Yes		4,328 (11.1)	1,814 (6.6)	2,514
Superficial Incisional SSI	38,831			
No		36,951 (95.2)	26,392 (95.7)	10,559
Yes		1,880 (4.8)	1,196 (4.3)	684 (6.1)
Deep Incisional SSI	38,831			
No		38,286 (98.6)	27,272 (98.9)	11,014
Yes		545 (1.4)	316 (1.1)	229 (2.0)
Organ/Space SSI	38,831			
No		36,054 (92.8)	25,836 (93.6)	10,218
Yes		2,777 (7.2)	1,752 (6.4)	1,025
Wound Disruption	38,831			
No		38,247 (98.5)	27,265 (98.8)	10,982
Yes		584 (1.5)	323 (1.2)	261 (2.3)
Pneumonia	38,831			
No		37,116 (95.6)	26,753 (97.0)	10,363
Yes		1,715 (4.4)	835 (3.0)	880 (7.8)
Urinary Tract Infection	38,831			
No		37,568 (96.7)	26,802 (97.2)	10,766
Yes		1,263 (3.3)	786 (2.8)	477 (4.2)
Sepsis	38,831			
No		36,201 (93.2)	26,175 (94.9)	10,026
Yes		2,630 (6.8)	1,413 (5.1)	1,217
Septic Shock	38,831			
No		37,056 (95.4)	26,949 (97.7)	10,107
Yes		1,775 (4.6)	639 (2.3)	1,136

Unplanned Intubation	38,831			
No		37,548 (96.7)	26,980 (97.8)	10,568
Yes		1,283 (3.3)	608 (2.2)	675 (6.0)
On Ventilator greater than	38,831			
No		37,079 (95.5)	26,944 (97.7)	10,135
Yes		1,752 (4.5)	644 (2.3)	1,108
Pulmonary Embolism	38,831			
No		38,267 (98.5)	27,263 (98.8)	11,004
Yes		564 (1.5)	325 (1.2)	239 (2.1)
DVT Requiring Therapy	38,831			
No		37,872 (97.5)	27,096 (98.2)	10,776
Yes		959 (2.5)	492 (1.8)	467 (4.2)
Acute Renal Failure	38,831			
No		38,403 (98.9)	27,403 (99.3)	11,000
Yes		428 (1.1)	185 (0.7)	243 (2.2)
Transfusions	38,831			
No		30,631 (78.9)	23,071 (83.6)	7,560
Yes		8,200 (21.1)	4,517 (16.4)	3,683
Unplanned Readmission	30,301			
No		26,272 (86.7)	19,170 (87.9)	7,102
Yes		4,029 (13.3)	2,641 (12.1)	1,388
Prolonged length of stay	38,716			
No		28,738 (74.2)	22,160 (80.5)	6,578
Yes		9,978 (25.8)	5,380 (19.5)	4,598
<u>Composite Secondary</u>	38,831			
<u>Adverse Events</u>				
No		19,028 (49.0)	15,905 (57.7)	3,123
Yes		19,803 (51.0)	11,683 (42.3)	8,120

CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident; SSI – surgical site infection; DVT – deep venous thrombosis.

Table S4. Multivariate Logistic Regression Model. Results presented as odds ratio (95% CI)

Outcomes	OR (95%CI)	p-value
Death	2.01 (1.94 - 2.08)	<.0001
Cardiac Arrest Requiring CPR	1.46 (1.38 - 1.55)	<.0001
Myocardial Infarction	1.06 (1.00 - 1.14)	0.0650
Stroke/CVA	1.36 (1.24 - 1.48)	<.0001
Reoperation	1.31 (1.27 - 1.36)	<.0001
<u>Composite Primary Adverse Events</u>	1.52 (1.49 - 1.56)	<.0001
Superficial Incisional SSI	1.23 (1.19 - 1.27)	<.0001
Deep Incisional SSI	1.52 (1.44 - 1.61)	<.0001
Organ/Space SSI	1.51 (1.47 - 1.56)	<.0001
Wound Disruption	1.56 (1.48 - 1.65)	<.0001
Pneumonia	1.47 (1.43 - 1.52)	<.0001
Urinary Tract Infection	1.33 (1.28 - 1.38)	<.0001
Sepsis	1.60 (1.56 - 1.65)	<.0001
Septic Shock	1.76 (1.70 - 1.82)	<.0001
Unplanned Intubation	1.56 (1.50 - 1.62)	<.0001
On Ventilator greater than 48 Hours	1.67 (1.62 - 1.72)	<.0001
Pulmonary Embolism	1.50 (1.39 - 1.61)	<.0001
DVT Requiring Therapy	1.78 (1.70 - 1.87)	<.0001
Acute Renal Failure	1.69 (1.59 - 1.80)	<.0001
Transfusions	2.16 (2.12 - 2.20)	<.0001
Unplanned Readmission	1.20 (1.17 - 1.23)	<.0001
Prolonged length of stay	2.30 (2.26 - 2.33)	<.0001
<u>Composite Secondary Adverse Events</u>	2.22 (2.19 - 2.25)	<.0001

OR – odds ratio, CI – confidence interval; CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident; SSI – surgical site infection; DVT – deep venous thrombosis.

Table S5. Subgroup Analysis - Impact of Disseminated Cancer in Multivariate Logistic Regression Model

OR (95%CI)	Disseminated Absent	Cancer Disseminated Present
Death	1.88 (1.81 - 1.96)	3.14 (2.82 - 3.50)
Cardiac Arrest Requiring CPR	1.45 (1.36 - 1.54)	1.75 (1.38 - 2.22)
Myocardial Infarction	1.07 (1.00 - 1.14)	1.01 (0.77 - 1.32)
Stroke/CVA	1.33 (1.21 - 1.46)	1.75 (1.24 - 2.46)
Reoperation	1.31 (1.27 - 1.35)	1.35 (1.20 - 1.52)
<u>Composite Primary Adverse Events</u>	1.47 (1.44 - 1.51)	2.03 (1.88 - 2.20)
Superficial Incisional SSI	1.21 (1.17 - 1.25)	1.49 (1.33 - 1.67)
Deep Incisional SSI	1.51 (1.43 - 1.60)	1.62 (1.33 - 1.98)
Organ/Space SSI	1.53 (1.48 - 1.58)	1.40 (1.27 - 1.54)
Wound Disruption	1.56 (1.48 - 1.66)	1.55 (1.27 - 1.88)
Pneumonia	1.47 (1.42 - 1.52)	1.54 (1.37 - 1.73)
Urinary Tract Infection	1.34 (1.28 - 1.39)	1.29 (1.13 - 1.48)
Sepsis	1.60 (1.56 - 1.65)	1.61 (1.46 - 1.77)
Septic Shock	1.76 (1.70 - 1.82)	1.76 (1.55 - 1.98)
Unplanned Intubation	1.55 (1.49 - 1.61)	1.78 (1.56 - 2.04)
On Ventilator greater than 48 Hours	1.66 (1.60 - 1.71)	1.82 (1.61 - 2.06)
Pulmonary Embolism	1.46 (1.36 - 1.58)	1.71 (1.41 - 2.08)
DVT Requiring Therapy	1.76 (1.68 - 1.85)	1.87 (1.61 - 2.18)
Acute Renal Failure	1.68 (1.58 - 1.79)	1.91 (1.51 - 2.41)
Transfusions	2.17 (2.13 - 2.21)	2.08 (1.95 - 2.21)
Unplanned Readmission	1.19 (1.16 - 1.22)	1.32 (1.22 - 1.43)
Prolonged length of stay	2.28 (2.24 - 2.31)	2.56 (2.42 - 2.71)
<u>Composite Secondary Adverse Events</u>	2.19 (2.16 - 2.22)	2.63 (2.48 - 2.78)

OR – odds ratio, CI – confidence interval; CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident; SSI – surgical site infection; DVT – deep venous thrombosis.

Table S6. Spline Analysis

Serum Albumin Concentration Range (g/dL)	0 to 1.4	1.4 to 2.4	2.4 to 3.4	3.4 to 4.4	4.4 to 5.4	5.4 to 6.4	> 6.4
N	2,916	30,526	115,036	525,095	168,077	481	541
Outcomes	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Death	0.62 (0.35 - 1.10)	0.63 (0.58 - 0.69)	0.66 (0.62 - 0.70)	0.45 (0.42 - 0.48)	1.25 (0.90 - 1.72)	2.09 (0.89 - 4.91)	1.17 (0.64 - 2.16)
Cardiac Arrest Requiring CPR	1.42 (0.53 - 3.87)	0.71 (0.61 - 0.83)	0.92 (0.83 - 1.02)	0.55 (0.50 - 0.62)	1.04 (0.66 - 1.66)	0.73 (0.14 - 3.74)	2.28 (1.01 - 5.17)
Myocardial Infarction	1.29 (0.24 - 6.92)	0.91 (0.73 - 1.13)	1.20 (1.07 - 1.35)	0.75 (0.67 - 0.83)	0.71 (0.44 - 1.12)	0.65 (0.07 - 6.10)	1.34 (0.30 - 6.00)
Stroke/CVA	0.41 (0.07 - 2.51)	1.10 (0.83 - 1.46)	0.90 (0.77 - 1.06)	0.67 (0.58 - 0.78)	0.67 (0.35 - 1.30)	3.39 (0.23 - 50.87)	0.02 (0.00 - 1019.19)
Reoperation	0.85 (0.36 - 2.00)	0.98 (0.87 - 1.10)	0.90 (0.85 - 0.95)	0.68 (0.65 - 0.71)	1.11 (0.94 - 1.31)	1.18 (0.60 - 2.33)	1.01 (0.60 - 1.71)
<u>Composite Primary Adverse Events</u>	0.82 (0.50 - 1.35)	0.73 (0.68 - 0.78)	0.77 (0.74 - 0.80)	0.65 (0.62 - 0.67)	1.06 (0.92 - 1.23)	1.29 (0.76 - 2.18)	1.08 (0.73 - 1.61)
Superficial Incisional SSI	0.69 (0.24 - 2.00)	1.38 (1.20 - 1.59)	1.00 (0.94 - 1.06)	0.66 (0.63 - 0.69)	1.37 (1.17 - 1.59)	0.66 (0.31 - 1.40)	1.23 (0.74 - 2.05)
Deep Incisional SSI	1.49 (0.31 - 7.24)	1.20 (0.99 - 1.47)	0.82 (0.74 - 0.90)	0.56 (0.51 - 0.62)	1.37 (0.99 - 1.89)	1.48 (0.49 - 4.47)	1.22 (0.59 - 2.51)
Organ/Space SSI	1.31 (0.60 - 2.87)	0.85 (0.76 - 0.94)	0.71 (0.67 - 0.75)	0.69 (0.65 - 0.72)	1.25 (1.06 - 1.47)	1.03 (0.48 - 2.20)	0.81 (0.40 - 1.64)
Wound Disruption	0.71 (0.21 - 2.38)	0.97 (0.81 - 1.15)	0.85 (0.77 - 0.93)	0.53 (0.48 - 0.58)	0.98 (0.69 - 1.40)	0.13 (0.00 - 29.58)	***
Pneumonia	1.55 (0.80 - 3.03)	0.87 (0.79 - 0.96)	0.79 (0.74 - 0.84)	0.64 (0.61 - 0.68)	1.13 (0.91 - 1.42)	1.27 (0.57 - 2.86)	0.95 (0.49 - 1.85)
Urinary Tract Infection	3.58 (1.21 - 10.60)	0.92 (0.80 - 1.05)	0.79 (0.73 - 0.84)	0.75 (0.71 - 0.80)	1.17 (0.96 - 1.43)	1.45 (0.57 - 3.67)	0.32 (0.08 - 1.30)

Sepsis	1.21 (0.61 - 2.39)	1.15 (1.05 - 1.26)	0.74 (0.70 - 0.78)	0.58 (0.56 - 0.61)	1.21 (1.02 - 1.43)	1.11 (0.58 - 2.14)	1.36 (0.88 - 2.10)
Septic Shock	1.82 (1.01 - 3.28)	0.67 (0.62 - 0.74)	0.71 (0.67 - 0.75)	0.53 (0.49 - 0.56)	1.42 (1.09 - 1.84)	2.65 (1.21 - 5.82)	0.51 (0.21 - 1.24)
Unplanned Intubation	1.43 (0.69 - 2.96)	0.75 (0.67 - 0.83)	0.77 (0.72 - 0.82)	0.59 (0.55 - 0.63)	0.94 (0.71 - 1.24)	1.54 (0.65 - 3.65)	1.52 (0.90 - 2.59)
On Ventilator greater than 48 Hours	0.63 (0.35 - 1.12)	0.72 (0.66 - 0.79)	0.71 (0.67 - 0.75)	0.57 (0.54 - 0.61)	1.36 (1.08 - 1.72)	0.96 (0.40 - 2.27)	0.98 (0.48 - 1.99)
Pulmonary Embolism	2.33 (0.33 - 16.42)	0.76 (0.59 - 0.98)	0.78 (0.69 - 0.89)	0.65 (0.59 - 0.72)	1.08 (0.75 - 1.56)	0.62 (0.11 - 3.64)	1.66 (0.61 - 4.57)
DVT Requiring Therapy	0.99 (0.39 - 2.53)	0.77 (0.67 - 0.89)	0.61 (0.56 - 0.66)	0.62 (0.57 - 0.67)	0.90 (0.68 - 1.21)	1.15 (0.26 - 5.16)	0.44 (0.06 - 3.27)
Acute Renal Failure	0.76 (0.29 - 1.98)	0.83 (0.71 - 0.97)	0.79 (0.72 - 0.87)	0.46 (0.41 - 0.51)	1.66 (1.07 - 2.60)	0.33 (0.03 - 3.37)	1.32 (0.28 - 6.30)
Transfusions	1.43 (0.89 - 2.28)	0.70 (0.65 - 0.74)	0.50 (0.48 - 0.52)	0.53 (0.51 - 0.54)	1.08 (0.97 - 1.20)	1.92 (1.28 - 2.89)	0.81 (0.57 - 1.14)
Unplanned Readmission	0.71 (0.30 - 1.67)	1.16 (1.05 - 1.29)	0.96 (0.91 - 1.00)	0.74 (0.71 - 0.76)	1.10 (0.97 - 1.24)	0.72 (0.41 - 1.24)	1.52 (1.07 - 2.15)
Prolonged length of stay	1.02 (0.65 - 1.58)	0.92 (0.87 - 0.98)	0.43 (0.42 - 0.44)	0.52 (0.51 - 0.53)	1.16 (1.08 - 1.25)	2.64 (1.97 - 3.53)	0.63 (0.48 - 0.81)
<u>Composite Secondary Adverse Events</u>	1.64 (0.93 - 2.89)	0.87 (0.81 - 0.94)	0.43 (0.41 - 0.44)	0.56 (0.55 - 0.57)	1.13 (1.07 - 1.20)	2.10 (1.61 - 2.72)	0.81 (0.66 - 0.99)

***Spline analysis failed as no patients with serum albumin concentration > 6.4 g/dL experienced wound disruption

OR – odds ratio, CI – confidence interval; CPR – cardiopulmonary resuscitation; CVA – cerebrovascular accident; SSI – surgical site infection; DVT – deep venous thrombosis.