

Supplementary Appendix

The following codes were used to identify cancer information in the Danish Cancer Registry:

Colorectal Cancer:

- Colon cancer: ICD-8: 153; ICD-10: C18
- Rectal cancer: ICD-8: 154; ICD-10: C19, C20

Colorectal cancer stage classification:

- Localized:
 - Dukes: A,B
 - TNM*: T1-4,x N0 M0; T1-2 N0 Mx; T1 Nx M0,x
- Regional:
 - Dukes: C
 - TNM*: T1-4,x N1-3 M0
- Metastasized
 - Dukes: D
 - TNM*: T1-4,x N0-3,x M1
- Unknown
 - TNM*: T0,a,is; T2-4,x Nx M0,x; T3-4,x N0 Mx; T1-4,x N1-2 Mx

* Colorectal cancers were classified according to TNM from 2004 on.

The following codes were used to identify conditions in the Danish National Patient Registry:

- *Colorectal surgery (NOMESCO codes):*
 - Open radical resection: JGB00, JGB10, JGB20, JGB30, JGB40, JGB50, JGB60, JGB96, JFB20, JFB30, JFB 33, JFB40, JFB43, JFB46, JFB50, JFB60, JFB63, JFB96, JFH00, JFH10, JFH20, JFH30, JFH33, JFH40, JFH96, JGA00, JGA70
 - Laparoscopic radical resection: JGB01, JGB11, JGB31, JGB97, JFB21, JFB31, JFB34, JFB41, JFB44, JFB47, JFB51, JFB61, JFB64, JFB97, JFH01, JFH11
 - Non-resectional procedures: JGA32-58, JGA73-98, JGW, JFA68, JFA83-84, JFA96-97, JFC, JFF10-13, JFF20-31, JFW

- *Disease included in the adjusted Charlson Comorbidity Index:*
 - Myocardial infarction: ICD-8: 410; ICD-10: I21, I22, I23
 - Congestive heart failure: ICD-8: 427.09, 427.10, 427.11, 427.19, 428.99, 782.49; ICD-10: I50, I11.0, I13.0, I13.2
 - Peripheral vascular disease: ICD-8: 440, 441, 442, 443, 444, 445; ICD-10: I70, I71, I72, I73, I74, I77
 - Cerebrovascular disease: ICD-8: 430-438; ICD-10: I60-I69, G45, G46
 - Dementia: ICD-8: 290.09-290.19, 293.09; ICD-10: F00-F03, F05.1, G30
 - Chronic pulmonary disease: ICD-8: 490-493, 515-518; ICD-10: J40-J47, J60-J67, J68.4, J70.1, J70.3, J84.1, J92.0, J96.1, J98.2, J98.3
 - Connective tissue disease: ICD-8: 712, 716, 734, 446, 135.99; ICD-10: M05, M06, M08, M09, M30, M31, M32, M33, M34, M35, M36, D86
 - Ulcer disease: ICD-8: 530.91, 530.98, 531-534; ICD-10: K22.1, K25-K28

- Mild liver disease: ICD-8: 571, 573.01, 573.04; ICD-10: B18, K70.0-K70.3, K70.9, K71, K73, K74, K76.0
- Uncomplicated type 1 and type 2 diabetes: ICD-8: 249.00, 249.06, 249.07, 249.09, 250.00, 250.06, 250.07, 250.09; ICD-10: E10.0, E10.1, E10.9, E11.0, E11.1, E11.9
- Hemiplegia: ICD-8: 344; ICD-10: G81, G82
- Moderate to severe renal disease: ICD-8: 403, 404, 580-583, 584, 590.09, 593.19, 753.10-753.19, 792; ICD-10: I12, I13, N00-N05, N07, N11, N14, N17-N19, Q61
- Diabetes with end-organ damage: ICD-8: 249.01-249.05, 249.08, 250.01-250.05, 250.08; ICD-10: E10.2-E10.8, E11.2-E11.8
- Any tumor (excluding CRC): ICD-8: 140-194 (excluding 153-154); ICD-10: C00-C75 (excluding C18-C20)
- Leukemia: ICD-8: 204-207; ICD-10: C91-C95
- Lymphoma: ICD-8: 200-203, 275.59; ICD-10: C81-C85, C88, C90, C96
- Moderate to severe liver disease: ICD-8: 070.00, 070.02, 070.04, 070.06, 070.08, 573.00, 456.00-456.09; ICD-10: B15.0, B16.0, B16.2, B19.0, K70.4, K72, K76.6, I85
- Metastatic solid tumor (excluding metastases from CRC): ICD-8: 195-198, 199 (excluding patients with diagnoses 197.59, 197.79); ICD-10: C76-C80 (excluding patients with diagnoses C78.5 and C78.7)
- AIDS: ICD-8: 079.83; ICD-10: B21-B24
- *Non-hepatic alcohol-related disease*: ICD-8: 291-291.9, 303-303.9, 980; ICD-10: F10.2, F10.7, F10.8, I42.6, G62.1, K29.2, G72.1, G31.2, T51, Z72.1

Supplementary Table S1 Percentages of colorectal cancer (CRC) patients with at least one laboratory measurement of any type coded in the laboratory database by year of CRC surgery and county where CRC surgery was performed. A cut-off of 90% was used to identify the study population (years and counties included in the study are indicated in bold)

Year of CRC surgery	Percentage of patients with laboratory measurement			
	Nordjyllands	Ringkjøbing	Viborg	Aarhus
1996	43.5	2.9	6.4	76.2
1997	97.3	8.5	8.3	77.4
1998	100.0	10.5	6.7	80.7
1999	100.0	5.9	10.0	81.8
2000	100.0	10.6	15.2	98.2
2001	100.0	6.9	15.3	100.0
2002	100.0	13.3	14.4	100.0
2003	100.0	19.8	16.5	99.3
2004	99.7	6.5	42.1	99.7
2005	100.0	2.8	93.3	99.7
2006	100.0	94.0	96.1	99.3
2007	99.4	100.0	93.7	99.4
2008	99.7	100.0	96.9	99.4
2009	99.7	100.0	100.0	98.8
2010	100.0	100.0	92.7	100.0
2011	99.7	100.0	97.8	100.0

Supplementary Table S2 Prevalence of individual disease from the Charlson Comorbidity

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	Serum albumin concentration					Missing albumin n = 1,008
	Hypoalbuminemia			Normal albuminemia		
	Severe	Moderate	Mild	Low	High	
	<=25 g/L n = 401	26-30 g/L n = 784	31-35 g/L n = 1,742	36-40 g/L n = 3,065	>40 g/L n = 3,347	
Myocardial infarction	21 (5.2)	50 (6.4)	114 (6.5)	193 (6.3)	190 (5.7)	58 (5.8)
Congestive heart failure	29 (7.2)	46 (5.9)	119 (6.8)	146 (4.8)	110 (3.3)	50 (5.0)
Peripheral vascular disease	18 (4.5)	47 (6.0)	102 (5.9)	154 (5.0)	115 (3.4)	41 (4.1)
Cerebrovascular disease	43 (10.7)	101 (12.9)	195 (11.2)	307 (10.0)	234 (7.0)	79 (1.8)
Dementia	8 (2.0)	10 (1.3)	15 (0.9)	26 (0.9)	12 (0.4)	11 (1.1)
Chronic pulmonary disease	37 (9.2)	110 (14.0)	191 (11.0)	279 (9.1)	224 (6.7)	68 (6.8)
Connective tissue disease	15 (3.7)	21 (2.7)	54 (3.1)	88 (2.9)	92 (2.8)	23 (2.3)
Ulcer disease	37 (9.2)	57 (7.3)	114 (6.5)	199 (6.5)	155 (4.6)	48 (4.8)
Mild liver disease	6 (1.5)	11 (1.4)	16 (0.9)	20 (0.7)	15 (0.5)	10 (1.0)
Diabetes type 1 and 2	31 (7.7)	51 (6.5)	117 (6.7)	209 (6.8)	185 (5.5)	54 (5.4)
Hemiplegia	0	1 (0.1)	3 (0.2)	10 (0.3)	6 (0.2)	1 (0.1)
Moderate to severe renal disease	9 (2.2)	24 (3.1)	40 (2.3)	58 (1.9)	50 (1.5)	14 (1.4)
Diabetes with end-organ damage	15 (3.7)	25 (3.2)	53 (3.0)	83 (2.7)	66 (2.0)	14 (1.4)
Any tumor	42 (10.5)	105 (13.4)	181 (10.4)	286 (9.3)	278 (8.3)	81 (8.0)
Leukemia	1 (0.3)	2 (0.3)	2 (0.1)	9 (0.3)	9 (0.3)	4 (0.4)
Lymphoma	4 (1.0)	4 (0.5)	12 (0.7)	18 (0.6)	21 (0.6)	2 (0.2)
Moderate to severe liver disease	2 (0.5)	2 (0.3)	5 (0.3)	4 (0.1)	5 (0.2)	2 (0.2)
Metastatic solid tumor	17 (4.2)	32 (4.1)	43 (2.5)	55 (1.8)	61 (1.8)	13 (1.3)
AIDS	0	0	1 (0.1)	0	1 (<0.1)	1 (0.1)

in patients undergoing surgery for colorectal cancer in North and Central Denmark, 1997-2012

Supplementary Table S3 Characteristics of patients undergoing surgery for colorectal cancer surgery with and without preoperative serum albumin measurement

	Patients with albumin measurement n = 9,339	Patients without albumin measurement		
		Overall n = 1,008	With other laboratory in the 30 days before surgery n = 490	Without any laboratory test in the 30 days before surgery n = 518
Gender (%):				
- Male	4,928 (52.8%)	514 (51.0%)	242 (49.4%)	272 (52.5%)
- Female	4,411 (47.2%)	494 (49.0%)	248 (50.6%)	246 (47.4%)
Age (%):				
- <60 yr	1,752 (18.8%)	210 (20.8%)	107 (21.8%)	103 (19.9%)
- 60-69 yr	2,556 (27.4%)	237 (23.5%)	123 (25.1%)	114 (22.0%)
- 70-79 yr	3,093 (33.1%)	317 (31.5%)	148 (30.2%)	169 (32.6%)
- >=80 yr	1,938 (20.8%)	244 (24.1%)	112 (22.9%)	132 (25.5%)
Type of admission:				
- Elective	7,260 (77.4%)	534 (53.5%)	307 (62.7%)	227 (43.8%)
- Non-elective	2,069 (22.2%)	465 (46.2%)	178 (36.3%)	287 (55.4%)
- Missing	10 (0.1%)	9 (0.9%)	5 (1.0%)	4 (0.8%)
Cancer site:				
- Colon	5,658 (60.6%)	779 (77.3%)	370 (75.5%)	409 (79.0%)
- Rectum	3,681 (39.4%)	229 (22.%)	120 (24.5%)	109 (21.0%)
Cancer stage:				
- Localized	3,850 (41.2%)	385 (38.2%)	193 (39.4%)	192 (37.1%)
- Regional	2,655 (28.4%)	299 (29.7%)	148 (30.2%)	151 (29.2%)
- Metastasized	1,566 (16.8%)	206 (20.4%)	91 (18.6%)	115 (22.2%)
- Unknown	1,268 (13.6%)	118 (11.7%)	58 (11.8%)	60 (11.6%)
Type of surgery:				
- Open radical resection	7,230 (77.4%)	721 (71.5%)	344 (70.2%)	377 (72.8%)

- Laparoscopic radical resection	888 (9.5%)	121 (12.0%)	76 (15.5%)	45 (8.7%)
- Non-eradictive procedures	1,221 (13.1%)	166 (16.5%)	70 (14.3%)	96 (18.5%)

Comorbidity:

- Low	5,438 (58.2%)	656 (65.1%)	326 (66.5%)	330 (63.7%)
- Moderate	2,881 (30.9%)	268 (26.6%)	125 (25.5%)	143 (27.6%)
- High	1,020 (10.9%)	84 (8.3%)	39 (8.0%)	45 (8.7%)

Alcohol-related disease:

- No	9,164 (98.1%)	988 (98.0%)	484 (98.8%)	504 (97.3%)
- Yes	175 (1.9%)	20 (2.0%)	6 (1.2%)	14 (2.7%)

Marital status:

- Married	5,256 (56.3%)	516 (51.2%)	259 (52.9%)	257 (49.6%)
- Never Married	664 (7.1%)	82 (8.1%)	40 (8.2%)	42 (8.1%)
- Other	3,419 (36.6%)	410 (40.7%)	191 (39.0%)	219 (42.3%)
