

Appendix 1 – Endoscope generations; the majority of colonoscopies were performed with Olympus colonoscopes.

- First generation: Olympus CF140 and 145 and Pentax EC-3830, -3870, and -3885
- Second generation: Olympus CF165 and 170, Fujinon EC250 and 530, and Pentax EC-380
- Third generation: Olympus CF180, Fujinon EC-590, and Pentax EC-3890
- Fourth generation: Olympus CF185 and 190

Appendix 2 – Univariate models to estimate odds ratios (OR) with 95% confidence intervals (CI) for painful (moderate or severe pain) colonoscopy.

Factor	OR (95%CI) (derivative dataset)	
	Pain during colonoscopy	Pain after colonoscopy
	N=15,085	N=15,085
Sedation (vs. no sedation)		
Benzodiazepine-opioid sedation	0.86 (0.50-1.46)	0.91 (0.63-1.31)
Propofol sedation	0.06 (0.02-0.18)	0.46 (0.35-0.60)
Age (patient)	1.02 (1.00-1.04)	1.00 (0.98-1.02)
Male sex (vs. female sex, patient)	0.52 (0.45-0.61)	0.81 (0.75-0.87)
Adequate bowel preparation (vs. inadequate bowel preparation) *	0.80 (0.66-0.95)	0.84 (0.72-0.97)
Previous abdominal surgery (vs. no previous abdominal surgery)	1.04 (0.82-1.32)	0.97 (0.86-1.09)
Previous colonoscopy (vs. no previous colonoscopy)	1.15 (1.01-1.31)	1.26 (1.14-1.40)
BMI (vs. <25)		
≥25 and <30	0.71 (0.64-0.78)	0.88 (0.80-0.96)
≥30	0.62 (0.55-0.70)	0.84 (0.76-0.92)
CIR (vs. <95%)		
≥95%	0.73 (0.58-0.92)	0.67 (0.53-0.85)
No of previous colonoscopies (vs. <100, endoscopist) †		
≥100 and <500	0.75 (0.59-0.96)	0.91 (0.71-1.17)
≥500 and <1000	0.55 (0.40-0.75)	0.72 (0.53-1.00)
≥1000	0.66 (0.44-0.99)	0.77 (0.50-1.19)
Endoscopist's specialty (vs. gastroenterology)		
Surgery	1.13 (0.82-1.59)	1.03 (0.77-1.40)
Board certified	1.14 (0.73-1.78)	1.04 (0.70-1.53)
Endoscope generation (vs. 1st) §		
2nd	0.93 (0.61-1.41)	0.89 (0.64-1.24)

3rd	0.82 (0.46-1.47)	0.80 (0.52-1.21)
4th	0.51 (0.24-1.10)	0.56 (0.34-0.92)
ADR	1.10 (0.73-1.64)	0.93 (0.72-1.19)
Male sex (vs. female sex, endoscopist)	0.72 (0.55-0.92)	0.78 (0.66-0.93)
Age (vs. <40, endoscopist)		
40-49	0.88 (0.63-1.23)	0.97 (0.69-1.36)
50-65	0.77 (0.49-1.22)	0.87 (0.56-1.36)

\*According to BBPS: adequate preparation defined as BBPS of  $\geq 6$ , with  $\geq 2$  points per segment.

†We created subcategories for number of previous colonoscopies because the relationship was not linear.

‡We collapsed categories to the <100 category due to the low number of observations.

§See Appendix 1.

Each factor has a reference value (Statistical Analysis in Methods) except age, which is a continuous variable.

Appendix 3 – Distribution of pain levels depending on sedation modality (see Methods).

	No pain	Little pain	Moderate pain	Severe pain	Total
Pain during colonoscopy*					
No sedation	5,601 (38.85%)	5,576 (38.68%)	2,166 (15.02%)	993 (6.89%)	14,416
Unassisted sedation	2,482 (48.94%)	1,581 (31.18%)	602 (11.88%)	369 (7.28%)	5,071
Assisted sedation	3033 (93.67%)	125 (3.86%)	38 (1.17%)	15 (0.46%)	3,238
Pain after colonoscopy†					
No sedation	6,866 (47.63%)	5,441 (37.74%)	1,486 (10.31%)	561 (3.89%)	14,416
Unassisted sedation	2,651 (52.28%)	1,712 (33.76%)	483 (9.52%)	201 (3.96%)	5,071
Assisted sedation	2,197 (67.85%)	782 (24.15%)	166 (5.13%)	78 (2.41%)	3,238

\*Total of 144 responses to this question were invalid (0.63%).

†Total of 101 responses to this question were invalid (0.44%).

Values represent number of colonoscopies under a given sedation modality, where given pain level was reported by patients.

Appendix 4 – Six separate multivariate regression models to estimate odds ratios (OR) with 95% confidence intervals (CI) for pain (moderate or severe) during and after colonoscopy under no sedation, benzodiazepine-opioid sedation and propofol sedation.

Factor	Models					
	No sedation		benzodiazepine-opioid sedation		Propofol sedation	
	Pain during	Pain after	Pain during	Pain after	Pain during	Pain after
	OR (95%CI)		OR (95%CI)		OR (95%CI)	
Age (patient, continuous)	1.02 (1.00–1.04)					
Male sex (patient, vs female)	0.40 (0.36–0.44)	0.62 (0.55–0.69)	0.45 (0.37–0.55)	0.72 (0.59–0.89)		1.39 (0.96–2.02)
BMI ≥25 and <30 (vs BMI <25)	0.77 (0.68–0.86)		0.86 (0.69–1.06)			
BMI ≥30 (vs BMI <25)	0.65 (0.57–0.75)		0.64 (0.50–0.82)			
Adequate bowel preparation (vs inadequate)	0.75 (0.65–0.87)	0.85 (0.71–1.01)	0.58 (0.44–0.76)	0.61 (0.45–0.83)		
Previous abdominal surgery (vs none)	1.16 (1.05–1.45)				2.12 (0.92–4.90)	
Previous colonoscopy (vs none)	1.26 (1.09–1.45)	1.21 (1.03–1.43)	1.31 (1.04–1.64)	1.30 (1.00–1.68)		1.56 (1.01–2.28)

CIR ≥95% (endoscopist, vs <95%)	0.74 (0.64–0.85)	1.00 (1.00–1.00)		0.99 (0.99–1.00)		
Screening colonoscopy case volume in the previous 3 years (vs <100)*						
≥100 and <500	0.71 (0.58–0.86)			1.28 (0.79–2.08)	†	
≥500 and <1000	0.70 (0.58–0.85)			1.39 (0.84–2.32)	†	
≥1000	0.96 (0.79–1.18)			0.60 (0.28–1.29)	0.5 (0.16–0.80)	
Endoscopist specialty (vs gastroenterology)						
Surgery			1.13 (0.93–1.38)	1.27 (1.01–1.60)	9.86 (4.70–20.66)	
Other			2.44 (1.66–3.59)	1.82 (1.00–3.32)	1.15 (0.24–5.39)	
Endoscope generation‡ (vs first generation)						
Second generation	0.95 (0.80–1.14)	0.87 (0.71–1.06)	0.61 (0.46–0.81)	0.78 (0.56–1.07)	0.49 (0.20–1.20)	
Third generation	1.03 (0.86–1.24)	0.82 (0.67–1.01)	0.55 (0.40–0.75)	0.47 (0.32–0.69)	0.19 (0.07–0.53)	
Fourth generation	0.69 (0.55–0.86)	0.63 (0.49–0.81)	0.22 (0.16–0.32)	0.53 (0.35–0.79)	0.18 (0.04–0.85)	

$p$ value for Hosmer–Lemeshow test for derivation dataset	0.512	0.702	0.401	0.658	0.159	0.245
$p$ value for Hosmer–Lemeshow test for validation dataset	0.515	0.424	0.504	0.727	0.301	0.365

\*We created subcategories for number of previous colonoscopies because the relationship was not linear.

†We collapsed categories to the <100 category due to the low number of observations.

‡See Appendix 1.

Models were built on derivation datasets. Each factor has a reference value (see Statistical Analysis in Methods) except for age, which is a continuous variable. ORs are reported only for variables found significant in stepwise selection with 0.1 level of significance. Empty fields represent variables not included in particular model.

Appendix 5 – Baseline characteristics of patients by sedation modality with regard to variables included in analysis.

Variable	No sedation N (%)	Unassisted sedation N (%)	Assisted sedation N (%)	P value
Age of patient in years, mean (standard deviation)	59.8 (2.7)	60.0 (2.7)	60.0 (2.7)	0.008
Sex of patient, N (%)				<0.001
Female	6,188 (42.9)	2,942 (58.0)	2,574 (79.5)	
Male	8,228 (57.1)	2,129 (42.0)	664 (20.5)	
Bowel preparation, N (%)*				<0.001
Not adequate	1,744 (12.1)	463 (9.1)	364 (11.2)	
Adequate	12,672 (87.9)	4,608 (90.9)	2,874 (88.8)	
Previous abdominal surgery, N (%)				<0.001
No	9,214 (63.9)	2,707 (53.4)	927 (28.6)	
Yes	5,202 (36.1)	2,364 (46.6)	2,311 (71.4)	
Previous colonoscopy, N (%)				<0.001
No	12,534 (86.9)	4,228 (83.4)	2,631 (81.3)	
Yes	1,882 (13.1)	843 (16.6)	607 (18.7)	
BMI, N (%)				<0.001
<25	3,418 (23.7)	1,292 (25.5)	908 (28.0)	
≥25 and <30	6,604 (45.8)	2,316 (45.7)	1,423 (44.0)	
≥30	4,394 (30.5)	1,463 (28.9)	907 (28.0)	
CIR (endoscopist), N (%)				<0.001
<95%	2,205 (15.3)	402 (7.9)	258 (8.0)	
≥95%	12,211 (84.7)	4,669 (92.1)	2,980 (92.0)	
Screening colonoscopy case volume in the last 3 years, N (%)				<0.001

<100	1,130 (7.8)	371 (7.3)	62 (1.9)	
≥100 and <500	4,773 (33.1)	2,509 (49.5)	683 (21.1)	
≥500 and <1000	4,704 (32.6)	1,845 (36.4)	1,107 (34.2)	
≥1000	3,809 (26.4)	346 (6.8)	1,386 (42.8)	
Endoscopist specialty, N (%)				<0.001
Gastroenterology	9,162 (63.6)	2,644 (52.1)	2,407 (74.3)	
Surgery	3,392 (23.5)	2,233 (44.0)	465 (14.4)	
Board certified	1,862 (12.9)	194 (3.8)	366 (11.3)	
Endoscope generation, N (%)*				<0.001
First	1,308 (9.1)	437 (8.6)	392 (12.1)	
Second	6,047 (42.0)	2,324 (45.8)	1,143 (35.3)	
Third	5,213 (36.2)	1,121 (22.1)	1,313 (40.6)	
Fourth	1,848 (12.8)	1,189 (23.4)	390 (12.0)	

\*According to BBPS: adequate preparation defined as BBPS of ≥6, with ≥2 points per segment.

†See Appendix 1.

Values represent number of colonoscopies under a given sedation modality where given variable was present. Percentages may not total to 100 because of rounding.