Table 1: Studies on interval cancers (including post colonoscopy colorectal cancers) (CRC = colorectal cancer)

Author	Study type	n	Results/Factors influencing results
Baxter[324]	Data base analysis Case control study	10292 CRC cases 51460 controls	7% of cases and 9.8% of controls had undergone colonoscopy (83% complete) OR for complete colonoscopy: 0.99 for right-sided, 0.33 for left sided CRC, independent of age and sex
Brenner [326 371]	Data base analysis Case control study	1688 CRC cases 1932 controls	41.1% of cases and 13.6% of controls had undergone colonoscopy OR for colonoscopy 0.44 for right-sided and 0.16 for left sided CRC, adjusted for age and sex
Brenner[28]	Case control study	78 interval cancers 433 CRC	Female sex (OR 2.28) and right-sided localisation (OR 1.98) as risk factors, more frequent in incomplete colonsocopies (26% vs 12.9%)
Brenner[325]	Case control study	3148 CRC cases 3274 controls	155 cases and 260 controls had colonoscopic polyps detected before. Significant factors were incomplete removal (OR 3.73), no surveillance after polypectomy (OR 2.96) and 3 or more polyps initially (OR 2.21)
Bressler[327]	Data base analysis	4920 CRC cases vs. surgical patient group	4% miss rate right sided CRC (interval between colonoscopy and CRC > 6 months) 2654 with colonoscopy within 3 years
Bressler[29]	Data base analysis surgical patient group (n=710), recto-	31074 CRC cases 12487 with colonoscopy within 3 years	miss rates CRC (interval between colonoscopy and CRC > 6 months): right colon 5.9% (n=3288 CRC total case no.), transverse colon: 5.5% (n=777), splenic flexure/descending colon. 2.1% sigmoid: 2.3% (n=7712). Risk factors: age (OR 1.05), diverticular disease (OR 6.88), polyp removal (OR 0.66), prox. CRC location (OR 2.52)
Corley[17]	Database analysis	314872 Colonoscopies	772 interval cancers (0.25%; interval between colonoscopy and CRC > 6 months), 12% screening colonoscopies. Interval CRC depends on ADR of colonsocopists (see 3.5, ADR), 60% proximal location
Farrar[328]	Local cancer registry	83 CRC	5.4% interval CRC (occurrence within 5 years), controls: sporadic CRC. 27% develop in prior polypectomy sites. Interval CRC predominantly right-sided, no other factors

Imperiale[329]	Colonoscopy database	1256 colonoscopies	5 years after negative colonoscopy (=51%/2436 of neg. colonoscopies with f-up), no CRC 16% adenomas, 1.3% advanced adenomas,
Kaminski[16]	Screening database	45026 colonoscopies	42 interval CRC (0.01%), defined as CRC within 5 years after colonoscopy. Interval CRC depends on ADR of colonoscopists (see 3.5, ADR). Other factors: only age, not sex/family history
Leaper[330]	Local database	5055 colonoscopies	17 interval CRC (5.9%), 9/17 incomplete colonoscopy, other reasons misinterpretation etc.
Pabby[331]	Post hoc analysis Polyp Prevention Trial	2079 Patients	13 interval CRC, 4 incomplete polypectomy, 4 de novo carcinomas, 3 missed, 3 false negative Bx
Pohl[332]	Model calculation	Literature analysis	miss rate per colonoscopy: 0.07% missed cancers, 0.11% cancers from missed adenomas. Fast growing de novo carcinomas are mentioned, but not analysed
Robertson[333]	Post hoc analysis 8 studies with f-up Kolo	9167 patients	F-up 47 months, interval CRC 0.6% (n=54), 52% missed CRC , 19% incomplete polypectomies, 24% de novo carcinomas, 5% false negative biopsy
Samadder[334]	Regional insurance data, cancer registry	126851 colonoscopies	159 interval CRC 6-60 months after colonoscopy (0.12%), proximal locatrion (OR 2.24) and pos. family history (OR 2.27), earler stage and lower mortality than cancers found during screening
Singh[336]	Regional insurance data	35975 colonoscopies	181 interval CRC 6-60 months after negative colonoscopy (0.5%), proximal location more frequent (47% vs 28%)
Singh[335]	Regional insurance data	45985 patients	300 interval CRC 6-36 months after negative colonoscopy (0.65%), age (OR 0.4 60-69 y, 0.10 50-59 y vs. ≥70 a) und colonoscopy by a non-gastroenterologist (OR 1.78-3.38) as risk factors. Higher rate of proximal interval CRC
Singh[337]	Meta analysis 12 studies	7912 interval CRC	more frequent in the proximal colon (OR 2.4), in older patients (OR 1.15 > 65 y), diverticular disease (OR 4.25), lower stage(OR 0.79), no mortality advantage

OR odds ratio

Table 2: Studies on caecal intubation rates and influencing factors (OR=Odds Ratio), some studies analyse vice versa the risk factors for an incomplete colonoscopy.

			Caecal intubation rate		Influencing factors
Author		n	unadjusted	adjusted	multivariate(OR)
Aslina[30]	retrospective	5477	83.4%	88.0-89.2%*	*complete* colonoscopy + time course((1.09), Screening (1.65) - bowel prep (0.17), in-patient (0.46), path. imaging (0.53), female (0.67)
Bhangu[39]	retrospective	10026	-	90.2%	*complete* colonoscopy + male (1.17), indication (variable), > 100 colonoscopies p.a. (1.62) - age (0.81/0.44), surgeon (0.71)
Dafnis[40]	retrospective	5145	-	81%	*complete* colonoscopy + male (1.68), age (younger up to 1.87) - diverticulosis (0.79), complexity (low 2.8)
Gupta[41]	retrospective	129549	-	95.3%	*partial* colonoscopy + age (up to 1.88), clinical picture (1.4-1.9), indication (variable, e.g. screening 0.69), Poor bowel prep (up to 9.9), female (0.62)
Harris [42]	prospective	6004	89%	-	*complete* colonoscopy + good bowel prep (3.7-4.4), private practice (3.2), - female (0.74), indication (variable), in-patient (0.54) decrease in saturation (0.42), ratio of experienced colonoscopists (up to 0.42, inverse), case number (> 1500: 0.54, inverse)
Kolber[43]	prospective	577	-	96.5%	*partial* colonoscopy + poor bowel prep (4.5), age > 65 (2.9)

Nagrath[44]	retrospective	1056	88.5%	93.5%	*partial* colonoscopy + female (1.95), diagnostic or symptomatic vs. screening (1.78), poor bowel prep (2.0), carcinoma (4.4)
Radaelli[45]	prospective	12835	80.7%	-	*complete* colonoscopy + younger age (up to 1.4), indication (variable) (Screening 1.2), sedation (1.5-2.4) - centre case number < 1000 (0.87), endoscopist case number (0.67 < 300, 0.82 < 500), female (0.72), poor bowel prep (0.6-0.01)
Shah[31]	prospective	331608	86.9%	-	*partial* colonoscopy + age (1.2), female (1.35), history of abdominal surgery (1.07), ambulatory (3.6) not influenced by case number

+/- = factor influences rate positively/negatively (either increases caecal intubation rate or rate of incomplete colonoscopies)
* task force adjusted (1st line), individual decision (second line)

Table 3: Studies on factors influencing adenoma detection rates from (screening) colonoscopies

Author	Study type	n	Indication	Results (significant factors)
Adler[61]	prospective	12134	Screening	patient related factors: gender, age, bowel prep Examiner related factors: qualification, endoscope generation
Barret[62]	prospective	3266/1200529*	49.6% Screening/ 38.9% abdo symptoms	ADR total 17.7%, incidence of CRC 2.9%. Factors associated with high ADR: male gender, >50 years., family history, +ve FOBT
Bhangu[39]	prospective	10026	9% Screening	ADR markedly dependent on case number p.a.
Bretagne[63]	retrospective	3462	Screening	ADR for: 1 adenoma 25.4% to 46.8%; 2 adenomas 5.1% to 21.7%; 3 adenomas 2.7% to 12.4%; 1 adenoma ≥ 10mm 14.2% to 28.0%; carcinoma 6.3% to 16.4%.
Harris[42]	prospective	6004	10.2% Screening	endoscopist experience correlates with caecal intubation rate & ADR; WT correlates with ADR
Imperiale[64]	retrospective	2664	Screening	ADR 7% to 44%; markedly influenced by examination time
Jover[65]	prospective	4539	Screening	ADR correlates with WT (≥8 min) and bowel prep quality
Lee[66]	retrospective	31088	+ve FOBT	ADR correlates with caecal intubation rate, WT, bowel prep quality, bowel relaxation, endoscopist experience, time of day
Regula[67]	retrospective	50148	Screening	advanced adenoma (≥10mm, HGIN, tubulovillous) significantly more frequent in males

WT=withdrawal time . * n=3266 absolute number in a week, n=1200529 data extrapolated to a year

Table 4: Adenoma detection rates from comparative studies on colonoscopies with different indications

Author	study type	n colonoscopies	Results
Adler[68]	prospective	1397	carcinoma/polyps: screening 16.0%, bleeding 22.1%, symptoms* 7.7%
Anderson[69]	retrospective	9100	significantly higher ADR in screening-colonoscopy (37%) vs. surveillance-colonoscopies (25%)
Chey[70]	prospective	917	IBS vs. healthy controls: histologically significanlty lower adenoma rate in IBS group
De Bosset[71]	prospective	509	polyp/neoplasia ≥ 1 cm, screening 28.5%, symptomatic 15.4%, FOBT pos. 27.5%, haematochezia 28.8%
Gupta[72]	retrospective	41775	risk for obstipation only indication lower for relevant findings than obstipation with screening or s screening only
Kueh[73]	retrospective	2633	significantly less risk for neoplasia for abdominal pain indication compared to iron deficiency anaemia and rectal bleeding
Lasson[74]	prospective	767	indication PR bleed (n=405): carcinoma 13.3% (n=54), adenoma >1cm 20.5 % (n=83)
Lieberman[75]	retrospective	6669	polyp/neoplasia ≥ 1 cm: screening 6.5%, non specific symptoms 7.3%, FOBT+ 17.0%
Minoli[76]	prospective	1123	carcinoma: screening 8%, symptoms 6.2%, haematochezia 11.9%
Neugut[77]	retrospective	1172	adenoma >1cm or carcinoma depending on indication: PR bleed 14.5%, abdominal pain 7.1%, Change in bowel habits 7.1%,
Obusez[78]	retrospective	786	constipation only indication: adenoma 2.4% (n=19), ADR for patients < 40 years 2.9%, <50 years 1.7%

Patel[79]	prospective	559	prevalence of IBS in 559 patients with Rome III criteria only 15.4% (n=21) with additional red flag criteria ** 27.7% (n=117)
Pepin[80]	retrospective	563	constipation as only indication: carcinoma 1.7%, adenoma 19.6%, advanced adenoma 5.9%

* symptoms =iron deficiency anaemia, diarrhoea, constipation, pain; ** weight loss, faecal blood, anaemia

Table 5: Studies on bowel preparation/cleanliness and colonoscopy quality – ADR, and completeness

ADR outcome

Author		n	Score	Result
Harewood[156]	retrospective	93004	2 tier (adequate/non adequate)	correlation with polyps up to 9 mm OR 1.23 No correlation with polyps greater than 10 mm
Froehlich[149]	prospective	5382	5 tier, non validated Evaluation with 3 tier score	completeness 71% vs. 90% vs 90% polyp rate 24% vs 33% vs 29% (OR 1.7/1.4) polyps > 1 cm 4.3% vs. 67.& vs 6.4% (OR 1.8/1.7)
Adler[61]	prospective	12134	5 tier, non validated	ADR multivariate depending on poor preparation sign. From score 4 (OR 0.67) / 5 (OR 0.22)
Jover[65]	RCT (Secondary analysis)	4539	5 tier, non validated	ADR multivariate not depending on bowel prep
Lai[146]	prospective	3 Videos	Boston Bowel Prep Scale	cut-off of 5 shows ADR-diferrence of 40% vs 24%
Kim[152]	prospective	482	Boston Bowel Prep Scale	cut-off of 8 shows ADR- diferrence of 45% vs 33%

Completeness outcome

Author		n	Score	Result
Aslinia[30]	retrospective	5477	5 tier, non validated	preparation multivariate (OR 0.17), 30.5% of Incomplete colonoscopies
Bowles[10]	prospective	9223	no score	19.6% insufficient preparation reason for caecal non-intubation
Bernstein [140]	prospective	587	5 tier, non defined/validated	sign. stage 3-5 vs. stage 1-2

Kim[152]	prospective	909	3 tier, non validated	96% complete colonoscopy, 1./% incomplete due to poor prep, increased introduction time with poor prep (OR2.8)
Nelson[150]	prospective	3196	3 tier, non validated	fewer complete colonoscopies with poor prep (19.3 % vs 2.8% vs 2.2%)
Gupta[41]	prospective	129549	4 tier, non validated	multivariate poor prep OR 9.9

OR=Odds Ratio

Table 6: Studies on colonoscopy withdrawal times and adenoma detection rates (ADR)

Author	study type	n colonoscopy/endoscopist	WT	Result
Adler[61]	prospective	12134/21	without Px (78.3%)	no influence of WT multivariate with median/mean WT 6-11 min
Barclay[176]	prospective	2053/12	without Px (76.5%)	WT >6 min vs. <6 min: ADR 28.3% vs. 11.8%
Barclay[170]	retrospective/prospective	2053 vs.2253 / 12	without Px	in comparison to above study prospective introduction of WT ≥ 8 min ADR 24.2% vs. 35.4%
Butterly[177]	prospective	7996/42	without Px (52.5%)	Influence of WT ≥9min on ADR + detection of SSA
Gellad[178]	prospective	(initial 3121 vs 1441 Follow up 304/13 centres)	without Px (46.2%)	no correlation of WT and NPL-rate
Gromski[179]	prospective	1210/4	WT= WT total -Px (100%)	1st year fellows, WT <10 min: ADR 9,5%; >10 min ADR 32,3%
Lee[175]	retrospective / prospective	752 and 220/11	WT= WT total -Px(100%)	ADR-groups (retrospective) no difference in WT
Lee[172]	prospective data/ retrospective analysis	31088/147	without Px (53,7%)	WT <7min vs. >11min ADR 42,5% vs 47,1%
Lin[180]	retro/ prospective	850 and 541/10	without Px (%?)	Monitoring: WT 6,57 min vs. 8,07 min; PDR 33.1% and 38.1%
Moritz[173]	prospective	4429/67	without Px (56%)	WT < 6min or >6 min: PDR 18.2% vs. 20.8%
Overholt[169]	prospective	15955/315	incl. Px* (100%)	WT < 6min and > 6min: significant increase in ADR and PDR
Sawhney[174]	prospective	23910/42	without Px (%?)	WT <7min and >7min: no influence on PDR
Simmons[171]	retrospective	10955/43	without Px (%?)	Influence of WT on PDR (multivariate) if WT ≥7min
Taber[181]	retrospective	A1405; B1387	B without Px (%?)	no increase of PDR if WT >10 min in comparision to <10 min

abreviations: WT= withdrawal time (% examinations without polyps, which was base of ADR-calculation), Px=polypectomy, SSA sessile serrated adenomas. * WT including time for polypectomy and biopsy

Table 7: Complication rates of (screening) colonoscopy

Author	n colonoscopies	indications	study period	study type	results
Adler[345]	12134	screening	2006 - 2008	prospective	Documentation of complications insufficient, d documented complications 0.15%, 0.46 when audited (0.33 without patient feedback)
Bokemeyer[346]	269144	screening	2003 - 2006	prospective	cardiopulmonary 0.10%. Bleeding (post polypectomy) 0.8%, surgery 0.03%. perforations 0.02% of colonoscopies and 0.09% of polypectomies
Bowles[10]	9223	61.2% diagnostic	4 months	prospective	perforation in 0.13%; bleeding (referral to hospital) in 0.06%
Crispin[47]	236087	Screening/ Non-Screening	2006	prospective	complication total. 0.32%; cardiopulmonary 0.06%, bleeding 0.2%, perforation 0.03%
Kang[347]	17102	n.a.	2000 to 2007	retrospective	perforations: diagnostic intervention 0.07%, therapeutic intervention 0.4%
Ko[348]	21375	Screening	n.a.	prospective	30-day complication rate 0.2%, bleeding 0.16%, perforations 0.02%
Nelson[150]	3196	Screening	1994 to 1997	prospective	complications 0.3%; severe complications 0.1%
Niv[372]	252064***	n.a.	2000 to 2006	retrospective	known complications in 0.04%, of which 86.3% perforations, 8.8% bleeding und 4.9% cardiopulmonary
Pox[349]	2821392	Screening	2003 to 2008	prospective	complication rate total. 0.28%, Severe complication rate 0.058%
Rabeneck[15]	97091	n.a.	2002 to 2003	retrospective	bleeding 0.16%, perforations 0.085%, Colonoscopy total death rate 0.0074%
Sieg[350]	82416	n.a.	1998 to 1999	prospective	complication rate total. 0.02% (+ polypectomy 0.36%),

Singh[226]	24509****	n.a.	2004 to 2006	retrospective	perforations 0.005% (+polypectomy 0.06%), bleeding 0.001% % (+polypectomy 0.26%) complication rate total. 0.29%; bleeding (post polypectomy) 0.64%, perforations (post polypectomy) 0.18%
Warren[351]	53220	26% Screening/ 53.3% Polypectomy	2001 to 2005	retrospective	bleeding 0.16%, perforations 0.64% Severe complication rate (Screening-colonoscopy) 0.28
Zubarik[352]	1196	n.a.	1997 to 1998	prospective	1.7% complications resulting in reattendance

* 2257 Patients with total of 3976 loop resections
** 17102 colonoscopies; 20660 Sigmoidoscopies; 6772 therapeutic interventions; total 53 perforations
*** 252064 documented colonoscopies /102 known colonoscopy -associated adverse events
**** lower gastrointestinal tract endoscopies (incl. Sigmoidoscopy, +/- Polypectomy, APC, Dilatation)
*****466 Interventions (either colonoscopy with sedation or flexible sigmoidoscopy without sedation