Published in final edited form as:

Clin Gastroenterol Hepatol. 2008 May ; 6(5): 515–520. doi:10.1016/j.cgh.2008.01.007.

Complications of Pediatric Colonoscopy: A Five-Year Multicenter Experience

KALPESH THAKKAR^{*}, HASHEM B. EL-SERAG[‡], NORA MATTEK[§], and MARK GILGER^{*}

^{*}Section of Pediatric Gastroenterology, Hepatology and Nutrition, Texas Children's Hospital and Baylor College of Medicine, Houston, Texas

[‡]Sections of Gastroenterology and Health Services Research, Houston Veterans Affairs Medical Center and the Department of Medicine at Baylor College of Medicine, Houston, Texas

[§]Department of Medical Informatics and Clinical Epidemiology, Oregon Health & Science University, Portland, Oregon

Colonoscopy has become a routine modality for the evaluation and treatment of colonic disorders in children. Although generally considered a safe procedure, colonoscopy has the potential for complications. Most informed consent forms describe adverse effects of sedative medicines, perforation, infection, and bleeding as possible risks of colonoscopy. However, the frequency of these complications remains unclear. There are limited pediatric data showing complication rates, and most prior studies involved small numbers of procedures. Furthermore, there might be additional complications that need to be added to consent protocols, because most current complication data are extrapolated from the much larger experience in adult populations.

A review of pediatric literature demonstrated a wide array of potential complications and no large multicenter studies during the past 25 years. The largest study was conducted in 1978–1979 and included a survey of 1400 proctosigmoidoscopies performed during an 18-month period at 25 medical centers in the U.S.¹ This study was only published in abstract form and reported complications in 0.2% of all colonoscopy procedures. These complications included one hemorrhage requiring transfusion and one perforation. In the second largest study, Stringer et al² prospectively described a series of 250 flexible colonoscopies done in the United Kingdom during a 3.5-year period with no adverse events. Several other studies reported complications (Table 1) in pediatric colonoscopy, but the majority of these studies examined a small number of procedures.

Determination of potential colonoscopy-related complications and their expected frequency in children can lead to enhanced risk-benefit analysis by physicians and patients and improved informed consent. There is a lack of systematic, multicenter studies in the pediatric population. Therefore, we conducted the current study to examine the frequency, type, and clinical determinants of immediate complications encountered during pediatric

colonoscopies performed in 12 U.S. centers by using Pediatric Endoscopy Database System–Clinical Outcomes Research Initiative (PEDS-CORI) database.

Methods

Clinical Outcomes Research Initiative (CORI)

PEDS-CORI, a pediatric component of Clinical Outcomes Research Initiative (CORI), was created in November 1999. During the study period, there were 12 active PEDS-CORI sites that consistently met quality standards in North America. These centers included 104 pediatric gastroenterologists, representing about 10% of total North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) members. Participating sites in PEDS-CORI agree to use a structured computerized report generator to produce all endoscopic reports and comply with quality control requirements.³

Study Design

This was a cross-sectional retrospective study with colonoscopy information compiled from January 1, 2000, through December 31, 2005, in PEDS-CORI on patients aged 0–18 years. We identified complications recorded shortly after each procedure was finished. PEDS-CORI software gives several options to record specific complications (Table 2) and also allows for reporting of complications not listed through an option labeled “Other.” We categorized the types of complications as cardiopulmonary, gastrointestinal, and all other miscellaneous complications (Table 2).

For each colonoscopy included in the study, we also collected demographic characteristics (sex, age, race/ethnicity), primary indication for the colonoscopy, American Society of Anesthesiologists (ASA) class, presence of a fellow at the procedure, and type of sedation. We excluded incomplete procedures, duplicate procedures, and procedures performed on patients older than 18 years.

All participating PEDS-CORI sites have waiver of consent approval via the institutional review board at each site. The 12 sites were Texas Children’s Hospital (Houston, TX), Children’s Healthcare of Atlanta at Egleston, Doernbecher Children’s Hospital (Portland, OR), Children’s Healthcare of Atlanta (Scottish Rite), Children’s Hospital of Buffalo, Phoenix Children’s Hospital, Children’s Hospital of The King’s Daughters (Norfolk, VA), Maine Medical Center (Portland, ME), Children’s Hospital of Wisconsin (Milwaukee, WI), Scott & White Memorial Hospital (Temple, TX), Children’s Hospital of Columbus, and University of Kentucky Children’s Hospital (Lexington, KY).

Statistical Analysis

Chi-square tests were used to compare the distribution of categorical variables describing patient demographics and procedure details (presence of fellow, type of sedation, polypectomy performed) among procedures with and without any complications reported. Multiple logistic regression analysis was used to investigate demographic (eg, age, sex) and clinical (eg, sedation type, polypectomy) characteristics associated with risk of cardiopulmonary events and gastrointestinal bleeding separately while controlling for

potential confounding variables. For each outcome (cardiopulmonary event or gastrointestinal bleeding), Pearson χ^2 test was used to compare immediate complication rates across levels of categorical variables (eg, sex, sedation type, polypectomy performed). Simple logistic regression was used to estimate the crude risk of cardiopulmonary events and gastrointestinal bleeding for variables that were identified as significantly associated with the outcomes during categorical analysis ($P < .05$). Multiple logistic regression models included all variables determined significant on univariate analysis. In constructing the models, we followed the commonly used heuristic of 10 outcome events for each explanatory variable. The adjusted risks estimate for each independent predictor variable was expressed as odds ratios. All analyses were performed by using SAS software (SAS Institute, Inc, Cary, NC).

Results

During the study period, 8841 colonoscopies were recorded at 12 PEDS-CORI sites, and 1049 (11.9%) were excluded for incomplete procedure notes, duplicate records, or patient age older than 18 years. Thus, a total of 7792 colonoscopy procedures performed on 7007 patients between January 1, 2000 and December 31, 2005 were included in the analysis. The most common primary indications were lower gastrointestinal bleeding (27.1%), abdominal pain/bloating symptoms (20.3%), diarrhea (14.2%), and inflammatory bowel disease (8.5%). The mean age for these patients was 11 years (standard deviation, 4.6). Race was described as white non-Hispanic in 77%, black non-Hispanic in 11%, Hispanic in 8%, and Asian in 2%. Approximately half of the procedures (50.1%) were conducted in female patients. Among the procedures included, 4857 (62%) were performed under general anesthesia, and 2935 (38%) were done under intravenous sedation. Approximately 66% (1948 procedures) with intravenous sedation had documentation of at least one sedation medication, most commonly midazolam (84%), ketamine (57%), meperidine (31%), or fentanyl (31%).

There were 88 procedures (1.1%; 95% confidence interval [CI], 0.9–1.3) in 86 patients with at least 1 complication recorded. Among procedures with complications, 56.8% reported gastrointestinal complications, 35.2% reported cardiopulmonary complications, and 10.2% reported miscellaneous complications including drug reaction or rash. The most common complication was gastrointestinal bleeding (reported among 34, 38.6% of those with a complication) followed by hypoxia (reported among 22, 25% of those with a complication). Only one perforation (0.01%) was recorded. No deaths were recorded. Seven (8%) of all procedures with a complication reported more than 1 complication type. Among 348 polypectomy procedures, complications were reported in 8 cases (2.3%; 95% CI, 0.7–3.9), of which 5 (1.4%) were due to gastrointestinal bleeding.

Patients with and without any complication were compared with regards to demographic and clinical features (Table 3). Overall, patients with complications were younger and were more likely to have procedures performed while under intravenous sedation (Table 3). There were no significant differences in gender distribution, ASA class, or the presence of a fellow at the procedure. Procedures done under other non-general sedation types (intravenous sedation) were associated with significantly higher rates of complications as compared with general anesthesia (1.7% vs 0.8%, $P < .0001$). Hypoxia (19/51) was the most common

reported complication associated with non-general sedation types, whereas bleeding (22/37) was the most common complication in patients undergoing general anesthesia. Among procedures in the intravenous sedation group with medications documented, those done with midazolam and fentanyl had a higher rate of complications (6.2%) than those done with midazolam and meperidine (2.9%) or midazolam and ketamine (1.5%).

Unplanned interventions were reported in 49 (56%) of the procedures with complications reported (Table 4). The most common intervention was administration of oxygen during the procedure (reported among 21.6% of those with an intervention). Cardiopulmonary resuscitation or transfusions were not reported for any patient.

The multivariable logistic regression analysis of potential determinants of complications included separate models for cardiopulmonary and bleeding events, because these outcomes likely have different independent predictors (Tables 5 and 6). Variables that were significant in unadjusted univariate analysis were included in each model. For the cardiopulmonary event model, both gender and sedation type were included; whereas age and polypectomy were evaluated in the bleeding model. In the cardiopulmonary event model, intravenous sedation was independently associated with an 8.5 (95% CI, 3.3–22.1) times higher risk of cardiopulmonary complication as compared with general anesthesia. Female gender was associated with a 3.3 (95% CI, 1.4–7.7) times higher risk of cardiopulmonary complications. Both younger age (younger than 10 years) and polypectomy remained independent risk factors for bleeding complications (Table 6). Specifically, patients of 0–10 years of age had an estimated 3.23 times increased risk for a bleeding complication (95% CI, 1.52–6.83) as compared with those 11–17 years of age, and polypectomy procedures carried a 2.67 (95% CI, 1.01–7.03) times increased risk for bleeding.

Discussion

We found that the immediate complication rate of pediatric colonoscopy is approximately 1.1%. Data from large studies in adults suggest that the overall complication rate is approximately 0.3%. For example, a study by the American Society for Gastrointestinal Endoscopy involving 25,000 diagnostic colonoscopies reported a complication rate of 0.35%.⁴ In another large study, Jentscura et al⁵ reported an overall complication rate of 0.4% in 26,695 prospectively registered colonoscopies. The most common complications in adult patients are hemorrhage, preparation-associated complications, adverse effects of sedative medicines, perforation, and bacteremia.⁶ Death is a rare complication, occurring in approximately 0.0006% of procedures.⁷ Colonoscopy with polypectomy has been reported to have a higher complication rate of up to 3.0%,^{4,8} related to postpolypectomy hemorrhage and perforation.⁶

Gastrointestinal bleeding has also been reported as the most prevalent complication in adult studies.⁷ Adult studies have also reported that older age is a risk factor for gastrointestinal bleeding.^{7,9} In this study, the higher complication rate associated with younger age can be largely accounted for by bleeding complications. Our regression analysis showed that younger age was an independent predictor of bleeding-related complications, and 71% (24/34) of bleeding events in our cohort were reported in children younger than 10 years of

age. Therefore, bleeding events during colonoscopy are likely associated with extremes of age. In addition, we found no association between age and sedation type; thus, sedation type is unlikely to be a confounder for bleeding complications in younger children.

The nature of gastrointestinal bleeding reported in our study requires further investigation. Significant hemorrhage is a rare event in adult studies, with reported rates of less than 0.04%; however, rates of bleeding during polypectomy might range from 0.2%–6.1%.^{4,10–12} Among the 8 complications reported during polypectomy in our patients, 5 were related to gastrointestinal bleeding. In pediatric studies, rates of bleeding-related complications during polypectomy ranged from 0%–5.6%.^{13–16} Juvenile polyps, the most frequent type of polyp identified in children, have peak prevalence in children ages 1–7 years.^{17,18} However, the adjusted analysis showed that polypectomy is an independent predictor of bleeding-related complications.

Cardiopulmonary complications were the second most commonly reported, consistent with existing adult data in which intraprocedural cardiopulmonary complications frequently included hypoxia, hypotension, and arrhythmia.^{19–21} Risk factors for cardiopulmonary complications in adults include intravenous sedation, obesity, advanced age, and chronic lung disease.²² In general, children require more sedation medication than adults; therefore, hypoxic events and adverse effects of sedative medicines might be more likely.^{23,24} In this study, the higher complication rate associated with intravenous sedation can be largely accounted for by hypoxia-related events, and our regression model confirmed the association of cardiopulmonary complications with intravenous sedation. The additional finding of higher risk of cardiopulmonary complications among female patients would require further investigation, because biologic factors would not explain this difference. However, adult studies have suggested that colonoscopy is more difficult in female patients, with lower cecal intubation rates.^{12,25} Residual confounding by factors not accounted for (eg, comorbidities) might also contribute to this finding.

The perforation reported in our cohort occurred during colonoscopy in a patient with severe Crohn's colitis; partial colectomy was subsequently performed. The rate of perforation in adult colonoscopies is also very low, estimated at less than 0.2% (range, 0.03%–0.81%).^{4,8,9,19,26} Overall, adult studies did not demonstrate a clear association between polypectomy and the rate of perforation.⁶ Predisposing factors to perforations included the presence of adhesions, strictures, or severe diverticular disease; these conditions are less common in pediatrics.¹⁰ Perforations encountered in smaller pediatric studies occurred at rates from 0.07% to 6.7%, with the majority associated with polypectomy.^{1,13,15,27,28} Our study suggests that perforation is an extremely rare event, with a rate of approximately 0.01%.

This study was limited by lack of specific details on reported complications such as hypoxia and bleeding. In addition, the CORI software does not have explicit criteria for how the complications are defined. This has been left to the individual practitioner. Our findings reflected only immediate complications; therefore, overall complications (eg, 30-day) were likely to be underestimated. This limitation might particularly affect procedures done under general anesthesia, because many complications associated with general anesthesia in the

pediatric literature would not be included in our database. One prospective pediatric study of 68 outpatient colonoscopies done under general anesthesia suggested a 15% rate of adverse symptoms (eg, sore throat, diarrhea, and excessive gas) after 30-day follow-up.²⁹ Adult studies suggested that colonoscopy has a low incidence (2.2%) of bacteremia.³⁰ However, pediatric studies showed clinically relevant bacteremia is extremely rare after colonoscopy with biopsies in children.^{31–33}

The strengths of our study are the large number of procedures examined and the multicenter structure of the database. In addition, because the data are generally entered immediately after the procedure is complete, the study should be less susceptible to poor documentation because of recall failure. The data obtained from PEDS-CORI also served as the endoscopy report for the patient's medical record, providing an incentive for accuracy and completeness.

Our data suggested that the immediate complication rate of pediatric colonoscopy is higher than the overall complication rate reported in adult literature (0.3%). However, the study designs (eg, retrospective review, survey of colonoscopists, prospective studies) have influence on reported complication rates. Cardiopulmonary complications and gastrointestinal bleeding might have a higher report rate in studies designed to examine immediate complications.⁷ For example, a recent CORI report of cardiopulmonary complications in 174,255 colonoscopy procedures revealed a 1.1% (95% CI, 1.0–1.2) immediate complication rate.²¹ Because our data were generally entered shortly after completion, the reported complication rate might be an underestimate.

In conclusion, complications of colonoscopy in children occur in approximately 1% of procedures. This study suggests that the immediate complication rate of colonoscopy in children is comparable to the adult population.

Acknowledgments

The PEDS-CORI project is supported by TAP and AstraZeneca pharmaceuticals. PEDS-CORI is associated with NASPGHAN and CDHNF. Nora Mattek is a research data analyst for the CORI project.

Abbreviations used in this paper

ASA	American Society of Anesthesiologists
CDHNF	The Children's Digestive Health and Nutrition Foundation
CI	confidence interval
CORI	Clinical Outcomes Research Initiative
NASPGHAN	North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition
PEDS-CORI	Pediatric Endoscopy Database System–Clinical Outcomes Research Initiative

References

1. Ament ME. Prospective study of risks of complication in 6,424 procedures in pediatric gastroenterology (abstract). *Pediatr Res*. 1981; 15:524.
2. Stringer MD, Pinfield A, Revell L. A prospective audit of paediatric colonoscopy under general anaesthesia. *Acta Paediatr*. 1999; 88:199–202. [PubMed: 10102155]
3. Gilger MA, Gold BD. Pediatric endoscopy: new information from the PEDS-CORI project. *Curr Gastroenterol Rep*. 2005; 7:234–239. [PubMed: 15913484]
4. Silvis SE, Nebel O, Rogers G, et al. Endoscopic complications: results of the 1974 American Society for Gastrointestinal Endoscopy Survey. *JAMA*. 1976; 235:928–930. [PubMed: 128642]
5. Jentschura D, Raute M, Winter J, et al. Complications in endoscopy of the lower gastrointestinal tract: therapy and prognosis. *Surg Endosc*. 1994; 8:672–676. [PubMed: 8059305]
6. Dominitz JA, Eisen GM, Baron TH, et al. Complications of colonoscopy. *Gastrointest Endosc*. 2003; 57:441–445. [PubMed: 12665750]
7. Waye JD, Kahn O, Auerbach ME. Complications of colonoscopy and flexible sigmoidoscopy. *Gastrointest Endosc Clin N Am*. 1996; 6:343–377. [PubMed: 8673332]
8. Waye JD, Lewis BS, Yessayan S. Colonoscopy: a prospective report of complications. *J Clin Gastroenterol*. 1992; 15:347–351. [PubMed: 1294644]
9. Levin TR, Zhao W, Conell C, et al. Complications of colonoscopy in an integrated health care delivery system. *Ann Intern Med*. 2006; 145:880–886. [PubMed: 17179057]
10. Macrae FA, Tan KG, Williams CB. Towards safer colonoscopy: a report on the complications of 5000 diagnostic or therapeutic colonoscopies. *Gut*. 1983; 24:371–383. [PubMed: 6341177]
11. Gibbs DH, Opelka FG, Beck DE, et al. Postpolypectomy colonic hemorrhage. *Dis Colon Rectum*. 1996; 39:806–810. [PubMed: 8674375]
12. Bowles CJ, Leicester R, Romaya C, et al. A prospective study of colonoscopy practice in the UK today: are we adequately prepared for national colorectal cancer screening tomorrow? *Gut*. 2004; 53:277–283. [PubMed: 14724164]
13. Jalihal A, Misra SP, Arvind AS, et al. Colonoscopic polypectomy in children. *J Pediatr Surg*. 1992; 27:1220–1222. [PubMed: 1432534]
14. Bartnik W, Butruk E, Ryzko J, et al. Short- and long-term results of colonoscopic polypectomy in children. *Gastrointest Endosc*. 1986; 32:389–392. [PubMed: 3803837]
15. Poddar U, Thapa BR, Vaiphei K, et al. Colonic polyps: experience of 236 Indian children. *Am J Gastroenterol*. 1998; 93:619–622. [PubMed: 9576458]
16. Guitron A, Adalid R, Nares J, et al. Colonic polyps in children: experience with polypectomy. *Rev Gastroenterol Mex*. 1999; 64:19–22. [PubMed: 10532118]
17. Hyer W, Beveridge I, Domizio P, et al. Clinical management and genetics of gastrointestinal polyps in children. *J Pediatr Gastroenterol Nutr*. 2000; 31:469–479. [PubMed: 11144430]
18. Durno CA. Colonic polyps in children and adolescents. *Can J Gastroenterol*. 2007; 21:233–239. [PubMed: 17431512]
19. Wexner SD, Garbus JE, Singh JJ, et al. A prospective analysis of 13,580 colonoscopies: reevaluation of credentialing guidelines. *Surg Endosc*. 2001; 15:251–261. [PubMed: 11344424]
20. Holm C, Christensen M, Schulze S, et al. Effect of oxygen on tachycardia and arterial oxygen saturation during colonoscopy. *Eur J Surg*. 1999; 165:755–758. [PubMed: 10494641]
21. Sharma VK, Nguyen CC, Crowell MD, et al. A national study of cardiopulmonary unplanned events after GI endoscopy. *Gastrointest Endosc*. 2007; 66:27–34. [PubMed: 17591470]
22. Yilmaz M, Aydin A, Karasu Z, et al. Risk factors associated with changes in oxygenation and pulse rate during colonoscopy. *Turk J Gastroenterol*. 2002; 13:203–208. [PubMed: 16378306]
23. Tolia V, Peters JM, Gilger MA. Sedation for pediatric endoscopic procedures. *J Pediatr Gastroenterol Nutr*. 2000; 30:477–485. [PubMed: 10817274]
24. Gilger MA. Conscious sedation for endoscopy in the pediatric patient. *Gastroenterol Nurs*. 1993; 16:75–79. [PubMed: 8218452]
25. Kim WH, Cho YJ, Park JY, et al. Factors affecting insertion time and patient discomfort during colonoscopy. *Gastrointest Endosc*. 2000; 52:600–605. [PubMed: 11060182]

26. Ettersperger L, Zeitoun P, Thieffin G. Colonic perforations complicating colonoscopy: 15 consecutive cases observed over 16 years. *Gastroenterol Clin Biol*. 1995; 19:1018–1022. [PubMed: 8729414]
27. Dillon M, Brown S, Casey W, et al. Colonoscopy under general anesthesia in children. *Pediatrics*. 1998; 102:381–383. [PubMed: 9685442]
28. Liebman WM. Fiberoptic endoscopy of the gastrointestinal tract in infants and children: II—fiberoptic colonoscopy and polypectomy in 15 children. *Am J Gastroenterol*. 1977; 68:452–455. [PubMed: 607794]
29. Steiner SJ, Pfefferkorn MD, Fitzgerald JF. Patient-reported symptoms after pediatric outpatient colonoscopy or flexible sigmoidoscopy under general anesthesia. *J Pediatr Gastroenterol Nutr*. 2006; 43:483–486. [PubMed: 17033523]
30. Botoman VA, Surawicz CM. Bacteremia with gastrointestinal endoscopic procedures. *Gastrointest Endosc*. 1986; 32:342–346. [PubMed: 3533703]
31. el-Baba M, Tolia V, Lin CH, et al. Absence of bacteremia after gastrointestinal procedures in children. *Gastrointest Endosc*. 1996; 44:378–381. [PubMed: 8905353]
32. Byrne WJ, Euler AR, Campbell M, et al. Bacteremia in children following upper gastrointestinal endoscopy or colonoscopy. *J Pediatr Gastroenterol Nutr*. 1982; 1:551–553. [PubMed: 6821116]
33. Snyder J, Bratton B. Antimicrobial prophylaxis for gastrointestinal procedures: current practices in North American academic pediatric programs. *J Pediatr Gastroenterol Nutr*. 2002; 35:564–569. [PubMed: 12394385]

Table 1

Complication Rates of Colonoscopy in Pediatric Literature Arranged by Sample Size in Descending Order

First author, year	Country	Number of procedures	Complication rate (%)	95% CI
Ament, 1979	USA	1400	0.2	0.04–0.63
Stringer, 1999	UK	250	0.4	0.01–2.21
Kawamitsu, 1989	Japan	151	0	0–2.41
Hassall, 1984	USA	139	3.6	1.21–8.37
Dillon, 1998	Ireland	136	2.2	0.56–5.88
Williams, 1982	England	123	0	0–2.4
Sotomayor, 1990	Spain	112	0	0–2.64
Torres, 1989	Venezuela	93	0	0–3.17
Huaroto, 1994	Peru	88	0	0–3.35
Sasaki, 1981	Japan	83	0	0–3.55
Plucnar, 1981	Denmark	76	0	0–3.87
Tam, 1987	China	65	0	0–4.50
Poerregaard, 1998	Denmark	50	0	0–5.82
Bartnik, 1986	Poland	48	0	0–6.05
Liebman, 1977	USA	15	6.7	0.33–28.73

Table 2**PEDS-CORI Software Options to Record Complications**

Cardiopulmonary
Arrhythmia
Chest pain
Hypertension
Hypotension
Hypoxia
Pulmonary edema
Respiratory distress
Tachycardia
Wheezing
Other cardiopulmonary event
Gastrointestinal
Bleeding
Nausea/vomiting
Perforation
Other gastrointestinal event
Other events
Drug reaction
Paradoxical reaction
Rash/hives

Table 3

Comparison of Colonoscopy Procedures With and Without a Complication Reported in Pediatric Patients Undergoing Colonoscopy Between January 1, 2000, and December 31, 2005, in 12 Sites of the PEDS-CORI Registry

Variable	No complication (%)	Any complication (%)	P value
Total	7704	88	
Age group (y)			
0–5	1282 (16.6)	28 (31.8)	<.001
6–10	1830 (23.8)	24 (27.3)	
11–14	2488 (32.3)	19 (21.6)	
15–17	2104 (27.3)	17 (19.3)	
Gender			
Female	3853 (50.0)	52 (59.1)	.09
Male	3851 (50.0)	36 (40.9)	
ASA level			
I	4281 (55.6)	55 (62.5)	.22
II	1996 (25.9)	21 (23.9)	
III	204 (2.7)	2 (2.3)	
IV	17 (0.2)	1 (1.1)	
Unknown	1206 (15.7)	9 (10.2)	
Fellow			
Present	1138 (14.8)	10 (11.4)	.37
Absent	6566 (85.2)	78 (88.6)	
Sedation type			
General anesthesia	4820 (62.6)	37 (42.0)	<.0001
Other sedation	2884 (37.4)	51 (58.0)	
Primary indication			
Abdominal pain/bloating	1570 (20.4)	13 (14.8)	
Surveillance of adenomatous polyp	34 (0.4)	1 (1.1)	
Anemia	102 (1.3)	1 (1.1)	
Change in bowel habits	41 (0.5)	0 (0)	
Surveillance of colorectal cancer	3 (<0.1)	1 (1.1)	
Constipation	97 (1.3)	1 (1.1)	
Surveillance of Crohn's	77 (1.0)	2 (2.3)	
Evaluation of established Crohn's	182 (2.4)	1 (1.1)	
Diarrhea	1100 (14.3)	9 (10.2)	
Family history of colorectal cancer	8 (0.1)	0 (0)	
Family history of polyps	22 (0.3)	0 (0)	
Graft vs host disease	12 (0.2)	1 (1.1)	
Infectious colitis	4 (0.1)	0 (0)	
Lower GI bleed°	2082 (27.0)	31 (35.2)	
Inflammatory bowel disease	654 (8.5)	5 (5.7)	

Variable	No complication (%)	Any complication (%)	P value
Polyp seen on: barium enema	9 (0.1)	0 (0)	
Polyp seen on: colonoscopy	35 (0.5)	0 (0)	
Positive FOBT	25 (0.3)	0 (0)	
Weight loss	270 (3.5)	1 (1.1)	
Surveillance of ulcerative colitis	52 (0.7)	1 (1.1)	
Evaluation of ulcerative colitis	101 (1.3)	2 (2.3)	
Lower GI bleed includes hematochezia and melena			

Abbreviations: FOBT, fecal occult blood test; GI, gastrointestinal.

Table 4

Type and Frequency of Unplanned Interventions Among 88 Pediatric Colonoscopies With Complications Between January 1, 2000, and December 31, 2005, in 12 Sites of the PEDS-CORI Registry

Type of intervention	N	%
Sedation reversed	3	3.4
Oxygen	19	21.6
Hospital admit	6	6.8
Surgery	2	2.3
IV fluids	6	6.8
Procedure stopped	3	3.4
Code 99/CPR	0	0
Other	11	12.5
Transfusion	0	0
Sent to ED	0	0
Cautery	6	6.8

Abbreviations: CPR, cardiopulmonary resuscitation; ED, emergency department.

Table 5

Multiple Logistic Regression Model Characteristics Associated With Cardiopulmonary Complications (n = 31) in Multivariate Analysis Among 7792 Colonoscopy Procedures in Pediatric Patients Between January 1, 2000, and December 31, 2005, in 12 Sites of the PEDS-CORI Registry

Characteristic	Adjusted odds ratio	95% CI
Sedation type		
General anesthesia	1 (reference)	
Other sedation	8.48	3.25–22.11
Gender		
Male	1 (reference)	
Female	3.30	1.42–7.67

Table 6

Multiple Logistic Regression Model Characteristics Associated With Gastrointestinal Bleeding Complications (n = 34) in Multivariate Analysis Among 7792 Colonoscopy Procedures in Pediatric Patients Between January 1, 2000, and December 31, 2005, in 12 Sites of the PEDS-CORI Registry

Characteristic	Adjusted odds ratio	95% CI
Polypectomy		
No	1 (reference)	
Yes	2.67	1.01–7.03
Age category		
11–17 y	1 (reference)	
0–10 y	3.23	1.52–6.83