



# Risks Associated With Anesthesia Services During Colonoscopy

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This article has an accompanying continuing medical education activity on page e18. Learning Objective: Upon completion of this test, successful learners will be able to (1) list colonoscopy complications associated with anesthesia instead of IV conscious sedation; (2) describe geographic diversity in use of anesthesia services in performance of colonoscopy; (3) describe polypectomy complications associated with use of anesthesia for colonoscopy.

See editorial on page 801.

**Keywords:** Anesthesia Services; Endoscopy; Propofol; Gastroenterology.

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**BACKGROUND & AIMS:** We aimed to quantify the difference in complications from colonoscopy with vs without anesthesia services. **METHODS:** We conducted a prospective cohort study and analyzed administrative claims data from Truven Health Analytics MarketScan Research Databases from 2008 through 2011. We identified 3,168,228 colonoscopy procedures in men and women, aged 40–64 years old. Colonoscopy complications were measured within 30 days, including colonic (ie, perforation, hemorrhage, abdominal pain), anesthesia-associated (ie, pneumonia, infection, complications secondary to anesthesia), and cardiopulmonary outcomes (ie, hypotension, myocardial infarction, stroke), adjusted for age, sex, polypectomy status, Charlson comorbidity score, region, and calendar year. **RESULTS:** Nationwide, 34.4% of colonoscopies were conducted with anesthesia services. Rates of use varied significantly by region (53% in the Northeast vs 8% in the West;  $P < .0001$ ). Use of anesthesia service was associated with a 13% increase in the risk of any complication within 30 days (95% confidence interval [CI], 1.12–1.14), and was associated specifically with an increased risk of perforation (odds ratio [OR], 1.07; 95% CI, 1.00–1.15), hemorrhage (OR, 1.28; 95% CI, 1.27–1.30), abdominal pain (OR, 1.07; 95% CI, 1.05–1.08), complications secondary to anesthesia (OR, 1.15; 95% CI, 1.05–1.28), and stroke (OR, 1.04; 95% CI, 1.00–1.08). For most outcomes, there were no differences in risk with anesthesia services by polypectomy status. However, the risk of perforation associated with anesthesia services was increased only in patients with a polypectomy (OR, 1.26; 95% CI, 1.09–1.52). In the Northeast, use of anesthesia services was associated with a 12% increase in risk of any complication; among colonoscopies performed in the West, use of anesthesia services was associated with a 60% increase in risk. **CONCLUSIONS:** The overall risk of complications after colonoscopy increases when individuals receive anesthesia services. The widespread adoption of anesthesia services with colonoscopy should be considered within the context of all potential risks.

Colonoscopy is the most common colorectal cancer screening test in the United States among average-risk adults.<sup>1</sup> Nearly all colonoscopies conducted in the United States are performed with medication to reduce discomfort and improve the performance of the test, usually a combination of benzodiazepine and a narcotic (ie, standard sedation) to provide moderate sedation.<sup>2</sup> In the past 10 years, the use of propofol for endoscopy sedation has increased.<sup>3</sup> Propofol is preferred in some settings because sedation occurs rapidly and patients experience a shorter recovery time than standard sedation. The involvement of anesthesia services for colonoscopy sedation, mainly to administer propofol, has increased accordingly, from 11.0% of colonoscopies in 2001 to 23.4% in 2006,<sup>4</sup> with projections of more than 50% in 2015.<sup>5</sup>

Whether the use of propofol is associated with higher rates of short-term complications compared with standard sedation is not well understood. A recent Cochrane review found no evidence of differences in health outcomes after colonoscopy with administration of propofol compared with standard sedation.<sup>6</sup> However, many of the studies included

**Abbreviations used in this paper:** CI, confidence interval; CPT, Current Procedural Terminology; ICD-9-CM, International Classification of Diseases, 9th revision, Clinical Modification; OR, odds ratio; SEER, Surveillance, Epidemiology and End Results.

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in the review had relatively small sample sizes that would not have been able to detect rare outcomes, such as colonic perforation or cardiac outcomes. There are plausible reasons as to why deep sedation with anesthesia during a colonoscopy could increase patients' risks of adverse outcomes, such as aspiration when a sedated patient cannot protect their airway, or perforation when patients are not able to provide feedback to the endoscopist regarding excessive pressure.<sup>7</sup> In studies conducted with claims-based data, the ascertainment of propofol is made by the identification of receipt of anesthesia services with a colonoscopy. In a previous study among Surveillance, Epidemiology, and End Results (SEER) Program–Medicare patients undergoing a colonoscopy from 2000 to 2009, Cooper et al<sup>8</sup> determined that overall complications rates, specifically aspiration pneumonia, were more common among colonoscopies with anesthesia services (0.22%) compared with procedures without anesthesia services (0.16%).

The purpose of our analysis was to compare the risks of colonic, anesthesia-associated, and cardiopulmonary complications between colonoscopies performed with anesthesia services compared with colonoscopies performed without anesthesia services among adults aged 40–64 years.

## Materials and Methods

### Study Design and Population

We conducted an observational cohort study using the Commercial Claims and Encounters Database available from Truven Health Analytics MarketScan Research Databases (Ann Arbor, MI) to identify a cohort of men and women aged 40–64 years who had undergone an outpatient colonoscopy between January 1, 2008, and December 31, 2011. These data included health insurance claims across the continuum of care (eg, inpatient, outpatient, outpatient pharmacy) and insurance enrollment data from employer-based health plans across the United States, which provided coverage for millions of employees, their spouses, and their dependents. This administrative claims database includes a variety of fee-for-service, preferred provider organizations, and capitated health plans. This study was considered exempt from Institutional Review Board review because we accessed de-identified publicly available data in the analysis.

### Colonoscopy Identification

Colonoscopy procedures were identified using Current Procedural Terminology (CPT) codes (45378–45386 and 45391–45392), International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes (45.23 and 48.36), and Healthcare Common Procedure Coding System codes (G0105 and G0121). We restricted the cohort to patients with at least 1 year of health insurance enrollment before the colonoscopy to enable observation of comorbid conditions. We excluded cohort members with prevalent disease conditions that are associated with an increased risk for colorectal cancer, including Crohn's disease (ICD-9-CM code, 555), ulcerative colitis (ICD-9-CM code, 556), or inflammatory bowel disease (ICD-9-CM code, 558.9), and members with a prior diagnosis of colorectal cancer (ICD-9-CM codes, 153–154) within 1 year of the colonoscopy.

When cohort members had more than one colonoscopy during the study period, we selected the first colonoscopy.

### Ascertainment of Anesthesia Use

We assumed that colonoscopy was performed with propofol if anesthesia services were billed in conjunction with a colonoscopy conducted on the same day (CPT code, 00810; or Healthcare Common Procedure Coding System, J3490). We assumed that all other colonoscopies were performed with standard sedation in the absence of a billing code for anesthesia services.<sup>8,9</sup>

### Patient Covariates

Observed patient covariates included sex and age at time of colonoscopy, and comorbidities based on the Charlson comorbidity index.<sup>10</sup> The Charlson comorbidity index was calculated using inpatient diagnoses recorded during the year before the colonoscopy. For each colonoscopy, we determined whether there was polypectomy (yes/no) based on billing codes indicating tissue removal (biopsy: CPT code, 45380; polypectomy: CPT codes, 45383, 45384, and 45385; and ICD-9-CM codes, 45.43 and 48.36). We also used billing codes to ascertain the provider and practice type (gastroenterology vs other). Other provider and practice types included surgeons, ambulatory centers, and physicians not otherwise specified. We also identified the geographic region where the examination was performed based on a 3-digit zip code (ie, Northeast, Southeast, Midwest, Southwest, West, and unknown).

### Outcome Measures

ICD-9-CM codes indicating colonoscopy complications were derived from prior research that collated inpatient and outpatient events associated with verified colonoscopy complications within 30 days after the date of the colonoscopy.<sup>11,12</sup> Our primary outcomes of interest included the following: (1) colonic events: perforation (ICD-9-CM code, 569.83); hemorrhage (ICD-9-CM codes, 578 and 578.1); abdominal pain (ICD-9-CM codes, 789.0–789.09); (2) sedation-associated events: pneumonia (ICD-9-CM codes, 507 and 507.8), infection (ICD-9-CM codes, 780.6, 790.7, 424.9–424.99, and 789.0–789.09), and complications secondary to anesthesia (ICD-9-CM codes, 995.4, 997.1, and 997.3); and (3) cardiopulmonary events: hypotension (ICD-9-CM codes, 458, 458.0, 458.2, 458.8, and 458.9); myocardial infarction (ICD-9-CM codes, 410–410.9); and stroke and other central nervous system events (ICD-9-CM codes, 430, 431, 432, 432.0, 432.1, 432.9, 434.01, 434.9, and 436).

### Statistical Analysis

We describe the characteristics of individuals who received a colonoscopy with and without anesthesia services using means and proportions, as appropriate. We used ArcGIS (Esri, Redlands, CA) to produce US maps indicating the prevalence of use of anesthesia services with a colonoscopy comparing 2008–2009 vs 2010–2011.

In our primary analysis, we used multivariable logistic regression to estimate the association between the use of anesthesia services and any adverse outcome, described earlier, within 30 days of the colonoscopy claim. In addition, we estimated separate multivariable logistic regression models for

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