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Regional Variation in Anesthesia Assistance during Outpatient Colonoscopy Is Not Associated with Differences in Polyp Detection or Complication Rates

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Abstract

Background & Aims—We investigated the rate and predictors of anesthesia assistance during outpatient colonoscopy, and whether anesthesia assistance is associated with colonoscopy interventions and outcomes.

Methods—We performed a retrospective cohort study using a 20% sample of Medicare administrative claims submitted during the 2003 calendar year. We analyzed data from 328,177 adults, 66 y old or older, over who underwent outpatient colonoscopy examinations.

Results—Overall, 8.7% of outpatient colonoscopies were performed with anesthesia assistance. In multivariate analysis, independent predictors of anesthesia assistance included black race, female sex, and a non-screening indication; anesthesia assistance increased with median income and comorbidities. General and colorectal surgeons, fewer years in their practice, and non-hospital

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Disclosures

The members of the writing committee declare that they have no conflict of interest.

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site of service were also significantly associated with anesthesia assistance. The strongest predictor of anesthesia assistance was the Medicare carrier, with odds ratios ranging from 0.22 (95% confidence interval [CI], 0.12–0.43) for the Arkansas carrier (crude rate 0.9%) to 9.90 (95% CI, 7.92–12.39) for the Empire carrier in New York area (crude rate 35.3%), compared with the Wisconsin carrier (crude rate 4.3%). There was also considerable variation amongst endoscopists; 75% of providers had no colonoscopies with anesthesia assistance recorded in their dataset, whereas 4.5% of providers had anesthesia assistance in at least three-quarters of their examinations. Anesthesia assistance was not associated with the diagnosis of polyps, the performance of biopsy or polypectomy, or complications in multivariate analyses.

Conclusions—There are significant variations among regions and sites of service in anesthesia assistance during outpatient colonoscopies of Medicare beneficiaries. Although this variation has considerable economic implications, it was not associated with measures of patient risk or outcomes, such as polyp detection or procedure-related complications.

Keywords

colorectal cancer screening; cost efficacy; quality; pain

Background

Colonoscopy is one of the most commonly performed ambulatory procedures in the United States, with an estimated 14 million procedures in 2002.¹ Although unsedated colonoscopy has been shown to be well tolerated^{2, 3} most colonoscopies in the United States are performed with moderate sedation.^{4, 5} In fact, the use of sedation has been associated with a higher quality examination, including higher polyp detection and more complete examination of the colon, when compared to unsedated colonoscopy.⁶

In recent years, there have been reports of increasing use of propofol for deep sedation during colonoscopy.^{7, 8} Purported advantages of propofol sedation include a fast onset of action, short duration of action, and amnestic effects. A systematic review for the Cochrane Collaboration concluded that propofol for sedation during colonoscopy resulted in faster recovery and discharge times, and increased patient satisfaction without an increase in side-effects.⁹ However, there was no difference in procedure time, cecal intubation rate or complications. A safety review of 646,000 colonoscopies with endoscopist-administered propofol sedation demonstrated serious complication rates comparable to or lower than those with standard moderate sedation, including benzodiazepines and opioids.¹⁰ Nonetheless, the current FDA-approved product label for propofol states that it should only be administered by individuals trained in the administration of general anesthesia.¹¹ As a result, another provider (i.e. an anesthesiologist or nurse anesthetist) is usually present during the endoscopic procedure if propofol sedation is used.

Although the American Society for Gastrointestinal Endoscopy states that the use of an anesthesiologist's services during routine colonoscopy in average risk patients is not warranted and is cost-prohibitive,^{8, 12} recent studies have demonstrated that this practice is increasingly common.^{13, 14} Current colonoscopy reimbursement already includes a component to cover the work associated with the administration of intravenous sedation, so the inclusion of an anesthesia professional's services leads to additional charges for sedation. Since the national Medicare mean allowable charge for the additional services of an anesthesia professional was \$106 in 2003, this accounted for nearly \$80 million in Medicare charges for anesthesia assistance (AA) associated with colonoscopy in 2003 (more than double that of 2001).¹⁵ Liu et al. estimate that the national expenditures on AA for both upper endoscopy and colonoscopy in 2009 were \$129 million for Medicare beneficiaries and \$945 million for commercially insured patients.¹³ In light of the importance of controlling

healthcare expenditures, utilization of expensive adjunct services is coming under increasing scrutiny. Therefore, the aim of this study was to determine the patient and provider characteristics that are associated with use of AA during outpatient colonoscopy. Our secondary aim was to determine whether use of AA was associated with colonoscopy interventions and outcomes, including whether polyps were diagnosed, polypectomy or biopsy was performed, or complications occurred.

Methods

We conducted a retrospective cohort design study using a 20% nationally representative sample of Medicare administrative claims. We included Medicare beneficiaries age 66 and over who had a colonoscopy claim submitted during calendar year 2003. To identify baseline comorbidity and subsequent complications of colonoscopy, beneficiaries were excluded if they were not eligible for both Medicare Part A and Part B for the entire 12 months before and 12 months after the index colonoscopy, or if they were enrolled in a Medicare HMO any time within the 12 months before and 12 months after the index colonoscopy. For this study, we included data for only the first colonoscopy claim submitted for each patient during 2003. Colonoscopy claims were identified using relevant Healthcare Common Procedure Coding System (HCPCS) and Current Procedural Terminology (CPT) codes from the Carrier and the Outpatient Files, which contain claims for physician services (HCPCS codes G0121, G0105; CPT codes 45378, 44388, 45380, 44389, 45384, 44392, 45385, 44394, 45382, 44391, 45379, 45381, 45383, 45384, 45386, 45387, 44390, 44393, 44397). Diagnoses were ascertained using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9) diagnostic codes associated with the colonoscopy and prior claims.

The provider performing the colonoscopy was identified using the Unique Physician Identification Number (UPIN) on the colonoscopy claim. This UPIN was linked to the American Medical Association's (AMA) Physician MasterFile to identify relevant provider-related variables, including physician age, years in practice, and specialty or subspecialty training.¹⁶ Providers were classified as gastroenterologists, general surgeons, colorectal surgeons, internists, family physicians or other according to the primary or secondary specialty in the AMA MasterFile, as described in our previous work.¹⁷

Using the provider's listed practice ZIP code in the AMA MasterFile, provider practice location was designated as urban, large rural, small rural, or isolated rural according to the Rural Urban Commuting Area (RUCA) classification.¹⁸ RUCAs classify ZIP codes depending on their population size and the strength of their commuting ties to larger cities and towns. As a proxy for each provider's overall annual colonoscopy volume, we used their total number of colonoscopy claims in the 20% Carrier File for 2003. We used the site of service variable on the colonoscopy claim to identify site of service. Because the indications for inpatient colonoscopy are quite different from those for outpatient colonoscopy, we included only exams performed in an outpatient setting (hospital outpatient, ambulatory surgery center, office, or other outpatient).

We linked the index colonoscopy data to the Medicare Denominator File to obtain data about patient demographic characteristics, including patient age, sex, race, and state and ZIP code of residence. Using the ZIP code of residence, we classified patient residence into urban, large rural, small rural, and isolated rural according to RUCAs. From U.S. Census data, we obtained the ZIP-code level median household income as an indicator of patient socioeconomic status.

We used diagnoses from the colonoscopy claims as well as the Carrier and MedPAR claims in the 12 months prior to the colonoscopy to define patient comorbidity. Patient comorbidity was classified using Deyo's modification of the Charlson comorbidity index.¹⁹

Outcome measures

The primary outcome of this study was utilization of AA during colonoscopy as identified by CPT code 00810 on the same day as the colonoscopy. Secondary outcomes included diagnostic biopsy (CPT codes 44389, 44392, 45380 or 45384), polyp detection (ICD-9 code 211.3 and 211.4), colonoscopic polypectomy and colonoscopic complications. We ascertained the performance of polypectomy through either codes for a snare polypectomy (CPT codes 44394 or 45385) or when codes for both a biopsy and an associated ICD-9 diagnosis of a polyp were present. Complications of colonoscopy included gastrointestinal bleeding (ICD-9 codes 578.1, 578.9, 995.89–998.13), perforation (ICD-9 569.83, 998.2), emergent or urgent hospitalization (identified from MedPAR codes) within 30 days of colonoscopy or emergency room visit within 30 days of the colonoscopy, regardless of diagnosis (identified from Medicare Part B files).

Colonoscopy indication

Colonoscopy indication was classified using combinations of CPT/HCPCS codes on the colonoscopy claim, the ICD-9 diagnosis codes from the colonoscopy claim, and claims in the 6 months prior to the index colonoscopy, as previously described.¹⁷ If colonoscopy indication could not be classified, the colonoscopy was excluded from analysis.

Data analysis

Bivariate tests of association between provider or patient characteristics and use of AA were done using Chi-square tests for categorical variables. To account for clustering of outcomes by the individual provider, we developed a generalized estimating equation model with an independent correlation matrix to examine provider variables associated with AA. Provider characteristics of interest included specialty training, annual colonoscopy volume (by quartile), rural versus urban practice location, years in practice and endoscopy site of service. We also adjusted for relevant patient characteristics, including patient age, race, sex, comorbidity, indication for colonoscopy, ZIP-code based median income, rural versus urban residence, as described above, as well as Medicare carrier (i.e. a contractor who determines the reimbursement for individual procedures). For the analysis of secondary outcomes (i.e. association of AA with biopsy, polyp diagnosis, polypectomy and complications), the same generalized estimating equation model was used, adjusting for procedure indication, patient characteristics (age, sex, race, median income (per \$1000) and Charlson comorbidity score) and provider characteristics (specialty, procedure volume, and years in practice). Due to the limited number of perforations, race was classified as white vs. other for the perforation model. The patient's RUCA classification and provider site-of-service was also included for all models with the exception of the perforation model. The performance of polypectomy or biopsy was also included in the models assessing bleeding, perforation, hospitalization and emergency department visits as these interventions have been shown to be associated with complications of colonoscopy.²⁰ Finally, we categorized providers according to the proportion of procedures performed with AA and performed bivariate tests of association with provider RUCA, specialty, endoscopic volume and years in practice. We restricted this final analysis to only those providers with at least 6 colonoscopies in the dataset. Most analyses were performed using SAS version 9.1 (SAS Institute, Cary, North Carolina) with the exception of the multivariate regression model looking at predictors of AA, which was performed using STATA 12.0 (College Station, Texas). The study was approved by the Institutional Review Board of the University of Washington.

Results

We identified 382,426 colonoscopies performed in 2003; 54,249 inpatient exams were excluded, leaving 328,167 patients undergoing outpatient colonoscopy in the analysis. Of the 18,578 unique colonoscopy providers identified, 5668 providers had 5 or fewer colonoscopies in the dataset. These providers, and the associated 14,374 procedures, were excluded from the sub-analysis of the association between provider characteristics and the proportion of procedures performed with AA.

Patient, Provider and Facility Characteristics Associated with Use of Anesthesia Assistance

Overall, 8.7% of outpatient colonoscopies among Medicare beneficiaries were performed with AA. Significant differences were found in the use of AA according to patient demographics, provider characteristics and procedural indication, as shown in Table 1. Given the large sample size, small numerical differences reached high levels of statistical significance. For example, increasing age was associated with slightly increased use of AA from 8.0% in those under 70 to 9.2% in those over 80. Increased patient comorbidity was also associated with increased use of AA, though again there was only a slight increase from 8.2% among those with a comorbidity score of 0 to 10.1% among those with a score greater than 3. Anesthesia assistance was used for 11% of Asians undergoing colonoscopy compared with only 2.7% of American Indians undergoing colonoscopy. Those undergoing colonoscopy for diagnostic indications were more likely to have AA (9.8%) compared to surveillance (6.9%) or screening (4.7%) colonoscopy. Urban patients were more than twice as likely to have colonoscopy with AA as those in rural settings. When considering endoscopist characteristics, specialty training, annual volume, years in practice and site of service were all associated with use of AA. The highest rates of AA were seen with colorectal surgeons (14.8%), with very low (9.2%) or low volume endoscopists (10.5%) and in office-based settings (26.5%). The greatest variation in AA was seen among Medicare carriers, with a range of 0.9% use of AA for patients covered by the Arkansas carrier to 35.3% among patients covered by Empire Medicare Services (Table 1). When looking at individual states, the use of AA ranged from 0.1% in Montana and 0.2% in South Dakota, to 26.0% in Nevada, 27.9% in New York and 48.1% in New Jersey (Figure 1).

We used generalized estimating equations to identify provider characteristics that were independently associated with AA, accounting for clustering of outcomes by provider (Table 2). Significant independent patient predictors of greater use of AA included black race, female gender, non-screening indication, highest quartile of median income and increased comorbidity. Also, general and colorectal surgeons had greater odds of using AA than gastroenterologists. Endoscopists with the greatest number of years in practice were the least likely to use AA, though endoscopic volume was not significantly associated with AA. Compared to hospital outpatient-clinic based colonoscopy, the odds of AA were increased by 81% in ambulatory surgical centers (OR 1.81, 95% confidence interval (CI) 1.60–2.06) and increased 2.7 fold in office settings (OR 2.66, 95% CI 2.14–3.30). Finally, Medicare carrier was strongly associated with AA. When compared to the Wisconsin carrier, the odds of using AA ranged from 0.23 (95% CI 0.12–0.43) for the Arkansas carrier to 9.90 (95% CI 7.92–12.39) for the Empire carrier in the New York area. In *post hoc* analyses, exclusion of those providers who utilize AA for at least 75% of their procedures yielded similar results (data not shown). Likewise, a stratified analysis of low-comorbidity individuals (Charlson score 0, 1, 2 or 3) yielded similar findings to those of the entire cohort (data not shown).

Provider Characteristics Associated with Use of Anesthesia Assistance

Of the 12,910 providers with at least 6 colonoscopies in the dataset, 75% used no AA, and 4.5% used AA in more than three-quarters of their colonoscopies (Table 3). The proportion of procedures performed with AA was associated with endoscopist RUCA, specialty, volume and years in practice. For example, while 5.6% of urban providers employed AA in at least 76% of cases, this was true for 2% or less of rural providers. Also, 67.3% of colorectal surgeons and 72.8% of gastroenterologists had no colonoscopies with AA, while over 80% of general surgeons, internists and family physicians had no colonoscopies with AA.

Association Between Anesthesia Assistance and Colonoscopy Interventions and Outcomes

In the bivariate analysis, there was an association between AA during colonoscopy and the diagnosis of polyps and the performance of diagnostic biopsy and polypectomy (Table 4). However, generalized estimating equations adjusting for measured covariates demonstrated no significant association between AA use and diagnosis of polyps, diagnostic biopsy or polypectomy. There was no association between AA use and colonoscopic complications, including gastrointestinal bleeding, perforation, emergent or urgent hospitalization or emergency room visits within 30 days of colonoscopy either in bivariate analysis or after adjusting for covariates (Table 4).

Discussion

Despite the recommendation from a leading gastroenterology professional society that AA use during colonoscopy is cost-prohibitive in average risk patients,⁸ we found that 8.7% of all outpatient colonoscopies performed in 2003 in Medicare beneficiaries were performed with AA. This includes 8.2% of patients with a comorbidity score of zero and 4.7% of screening colonoscopies. Although clinically important determinants of the need for AA were measured (e.g. age and comorbidity), there was very little variation in AA for these clinical factors relative to variables such as site of service, Medicare carrier and endoscopist specialty. The lowest rates of AA were found in settings where one would expect the highest risk patients (i.e. hospital-based outpatient endoscopy); while the highest rate was seen where predominantly low-risk patients would be expected to undergo colonoscopy (i.e. an office setting).

There are several potential reasons why AA may be utilized during outpatient colonoscopy, particularly in office or ambulatory surgical centers. First, use of AA for deep sedation may lead to improved patient comfort and satisfaction, and it is conceivable that those endoscopists working in non-hospital settings may have less logistical difficulty in getting anesthesia support compared to those working in the hospital setting. While these patient centered outcomes are clearly important, data on improvement in patient satisfaction is conflicting^{21, 22} and justification is needed for the additional costs associated with AA. Moderate sedation administered by the endoscopist is safe and effective, and reimbursement for colonoscopy already includes a component for the work associated with administration of intravenous sedation. A second reason why providers may chose to use AA is that the most commonly used agents for moderate sedation (i.e. opiates and benzodiazepines) are associated with delayed onset of action, difficult titration, lingering effects of sedation and delayed recovery.²³ Use of propofol as an alternative to moderate sedation has been shown to be associated with more rapid onset of action and faster recovery, thereby offering the potential to improve practice efficiency by allowing more procedures to be performed per day.^{21, 23} In addition to improving efficiency, there are financial incentives for endoscopists to employ anesthesia providers since they can generate an additional income stream for their

practice.²⁴ Finally, it is important to note that there are patients for whom AA is clinically indicated, such as those who did not previously tolerate colonoscopy with moderate sedation or individuals at higher risk for sedation related complications. If endoscopists practicing outside of a hospital employ anesthesia providers to be available for these more difficult to sedate or higher-risk individuals, it may be prudent business practice to utilize these providers for more routine cases as well. Overall, 11,516 procedures were performed by those endoscopists who employ AA in over 75% of their colonoscopies in our sample. Thus, 4.5% of the endoscopists account for 40.5% of all colonoscopies performed with AA. Those endoscopists with very high rates of AA overwhelmingly practiced in an urban setting (95%) and were disproportionately represented by gastroenterologists (76%) and colorectal surgeons (10%).

Our findings are robust in that restriction of our analysis to only those individuals undergoing colonoscopy by endoscopists using AA for less than 75% of cases, or to only those individuals with low Charlson comorbidity scores yielded similar results, suggesting that use of AA may often be discretionary. The dramatic regional variation demonstrated in our study also argues against patient preferences or clinical risk as the principal drivers of AA practices. In fact, we found that the highest utilization was seen in New York, New Jersey and Nevada, with the surrounding states having dramatically lower rates of AA (Figure 1). This variation is most likely attributable to variation in reimbursement practices by the different carriers. For example, unlike most other carriers, Empire Medicare Services in New York implemented a policy to allow for payment to anesthesia providers assisting with colonoscopy in 2001.¹⁵ In New York and New Jersey, providers are frequently performing colonoscopy in an office setting where facility and professional fees may be lower than in ambulatory surgical centers or hospital outpatient units. Therefore, even with the additional charge for the anesthesia services, the overall costs to the Medicare system may be lower in the office setting than if the colonoscopy was provided in an ambulatory surgical center or hospital outpatient setting without AA. Other studies have demonstrated considerable regional variation in endoscopist preferences for the use of propofol sedation. In a postal survey of 1353 endoscopists in 2004, propofol was the preferred sedation agent of 25.7% of all endoscopists, with a low of only 6.9% of North-East endoscopists and a high of 42.8% of Mid-Atlantic endoscopists.⁵ Only 7.7% of these respondents administered propofol without the assistance of an anesthesiologist or nurse anesthetist. In a 2003 web-based survey of 724 endoscopists, 22% reported routine use of propofol during colonoscopy.⁴ But there is also variation in the legal and regulatory restrictions on the use of propofol for sedation. The current FDA-approved product label indicates that propofol should only be administered by individuals trained in general anesthesia, and many hospitals restrict its use to anesthesia providers. While nurse-administered propofol sedation (under the supervision of the endoscopist) was previously performed in a limited number of centers, a policy decision by the Centers for Medicare & Medicaid in December of 2009 and updated in January of 2011 essentially limited the use of propofol to anesthesia professionals (i.e. anesthesiologists and nurse anesthetists).²⁴

Other studies have shown increased use of AA over time. One study of outpatient colonoscopies performed in Ontario, Canada between 1993 and 2005 showed an increase in AA from 8.4% in 1993 to 19.1% in 2005.²⁵ Similar to our study, these investigators found that surgeons were more likely to perform colonoscopy with AA. Liu et al., in a study of Medicare and commercially insured patients, reported that the proportion of gastroenterology procedures (both upper endoscopy and colonoscopy) employing AA doubled from approximately 14% in 2003 to more than 30% in 2009.¹³ The majority of these cases occurred in individuals with a predicted American Society of Anesthesiologists (ASA) physical status classification of 1 or 2 (i.e. low-risk) and were deemed to be potentially discretionary. This finding is in line with our results, in which 77% of patients

undergoing colonoscopy with AA had a Charlson comorbidity score of 0 or 1. Liu et al. also demonstrated that the use of AA is increasing more rapidly in commercially insured patients than in Medicare beneficiaries, and that geographic variation in usage persisted or even increased between 2003 and 2009.¹³ This supports the findings of this paper, which are based upon 2003 data. Khiana et al., in sample of Medicare beneficiaries from SEER regions, found that the frequency of AA with outpatient screening colonoscopy increased from 11.0% in 2001 to 23.4% in 2006. In a national survey of 3688 colonoscopies and upper endoscopies covered by a major US health plan, Inadomi et al found that 23.9% of colonoscopies were performed with AA in 2007.⁷ They projected that 53.4% of colonoscopies would use AA by 2015. The underlying explanation for this increase in AA over time is likely multi-factorial, including perceived advantages of propofol compared with moderate sedation and financial incentives for incorporation of AA into endoscopic practice.²⁶ Our finding of an inverse association between years in practice and AA could also be contributing to this increase if it reflects a cohort phenomenon in which younger endoscopists are more comfortable with AA.

Since surgeons may perform other procedures alongside colonoscopy more frequently than other specialties, this could contribute to the higher use of AA seen with surgeon endoscopists. However, this is an unlikely explanation in this study since we only included outpatient colonoscopies, and multiple procedures (e.g. colonoscopy in conjunction with a colorectal surgical procedure) are more likely to occur in the inpatient setting. We speculate that surgeons may be performing these colonoscopies in a setting where anesthesiology professionals are readily available and surgeons are accustomed to employing AA, as was suggested in the study from Ontario.²⁵ Somewhat unexpectedly and in contradistinction to one prior study,¹⁴ we found that AA use was associated with black race. We speculate that this finding may reflect the very high rates of AA use in urban settings where there is more racial diversity (e.g. New York).

The impact of deep sedation upon the quality of the colonoscopy exam is controversial.^{27, 28} While we found that AA was associated with a higher frequency of polyp detection, biopsy and polypectomy in unadjusted analyses, there was no significant association in adjusted analyses. We have previously shown that polyp detection, biopsy and polypectomy are associated with a variety of patient and provider characteristics¹⁷ and many of these characteristics are also associated with AA. Therefore, though it has previously been demonstrated that use of intravenous sedation (either moderate or deep) during colonoscopy is associated with higher odds of complete colonoscopy and polyp detection when compared to unsedated colonoscopy,⁶ convincing evidence of an additional benefit from AA has yet to be demonstrated.

There are some limitations to our study. First, our database represents a 20% sample of Medicare claims from administrative data. Therefore, clinical detail is lacking and there are potential coding inaccuracies. For example, there may be unmeasured patient factors, such as additional comorbidities or prior intolerance to colonoscopy with moderate sedation, that justifiably contribute to the decision to use AA. Although coding for procedures performed is generally accurate,²⁹ providers who do or do not frequently use AA may differ in their coding for diagnoses such as colorectal polyps, which could obscure the effect of AA on colonoscopy outcomes. Also, annual procedure volumes only represent one-fifth of the colonoscopies performed on Medicare beneficiaries and also do not include any other patients (e.g. commercial insurance, uninsured or Medicare HMO), potentially affecting our analyses of colonoscopy volume and AA. Nevertheless, it is unlikely that these clinical and data-related factors could explain the tremendous regional variation in AA use nor explain the site of service variation. In addition, we lack data on polyp histology and cannot determine adenoma detection rates. Finally, our data are from 2003 and may not reflect

current practice or practice in non-Medicare populations. As discussed above, utilization of AA has been increasing since 2003 though the cause of this change is not fully understood¹³. It is unlikely that this increase in utilization has been driven solely by changes in patient risk, but rather by reimbursement considerations for providers or by patient preferences. The continued rise in AA utilization may be increasing the overall costs of colonoscopy, but without substantial benefits to patient safety or outcomes. However, we believe that 2003 is a pivotal time period to explore AA during colonoscopy because few Medicare carriers had explicit policies to cover AA and the American Society for Gastrointestinal Endoscopy had explicitly stated that “the routine assistance of an anesthesiologist for average risk patients undergoing standard upper and lower endoscopic procedures is not warranted and is cost prohibitive.”¹²

Our study has several strengths that merit mention. First, we utilized data from a nationally representative sample of older adults undergoing outpatient colonoscopy in a variety of practice settings. Through the use of claims data, we were able to identify patient level variables that may impact the decision to employ AA, such as age, comorbidity and procedural indication. Second, we were able to assess the association between AA and therapeutic interventions (e.g. polypectomy) and complications of colonoscopy. Finally, our demonstration of only minor variation in AA by age or comorbidity, but significant variation according to Medicare carrier, suggests that decisions about AA are based in large part upon reimbursement practices rather than upon an assessment of patient risk.

In summary, we found significant regional and site of service variation in the use of AA with outpatient colonoscopy among Medicare beneficiaries, even after adjusting for key patient characteristics. This practice has enormous economic implications for society, as the use of an anesthesia provider adds a considerable cost to each procedure and is at variance with recommendations from professional societies. In 2003, charges to Medicare for sedation by anesthesia professionals during colonoscopy were nearly \$80 million.¹⁵ The national Medicare mean allowable charge for code 00810 was \$106 in 2003,¹⁵ though studies from a commercial health plans report that AA added \$358 to the cost of colonoscopy in 2007 and as much as \$509 in 2009.^{7, 13} If the projected growth in use of AA does reach 53% by 2015, the total national expenditure for this service could range from approximately \$800 million to \$3.8 billion annually (assuming 14 million colonoscopies per year), depending upon the level of reimbursement. Therefore, consideration should be given to developing standards to encourage appropriate use of AA with endoscopic procedures. Further studies will be needed to determine the impact of any new standards on patient outcomes.

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Abbreviations

AA	Anesthesia Assistance
HCPCS	Healthcare Common Procedure Coding System
CPT	Current Procedural Terminology

ICD-9	International Classification of Diseases, Ninth Revision, Clinical Modification
UPIN	Unique Physician Identification Number
AMA	American Medical Association
RUCA	Rural Urban Commuting Area

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Figure 1.
Proportion of outpatient colonoscopies with anesthesia assistance among Medicare beneficiaries by state

Table 1

Frequency of Anesthesiology Assistance Stratified by Patient and Provider Characteristics, Site of Service and Medicare Carrier

Characteristic	No Anesthesiology Assistance N (%)	Anesthesiology Assistance N (%)	p-value
Patient Age			<0.0001
66–69	68,973 (92.0)	5957 (8.0)	
70–74	90,821 (91.4)	8521 (8.6)	
75–79	76,365 (91.0)	7534 (9.0)	
80+	63,564 (90.8)	6432 (9.2)	
Patient Race			<0.0001
White	272,002 (91.4)	25,453 (8.6)	
Black	18,388 (90.4)	1962 (9.6)	
Hispanic	3458 (89.5)	404 (10.5)	
Asian	2809 (89.0)	346 (11.0)	
American Indian/Alaska Native	657 (97.3)	18 (2.7)	
Other	2170 (89.9)	243 (10.1)	
Patient Gender			0.19
Male	126,972 (91.4)	11,935 (8.6)	
Female	172,751 (91.3)	16,509 (8.7)	
Indication			<0.0001
Diagnostic	210,642 (90.2)	22,821 (9.8)	
Surveillance	48,650 (93.1)	3616 (6.9)	
Screening	40,431 (95.3)	2007 (4.7)	
Median Income			<0.0001
Lowest quartile	72,605 (93.9)	4734 (6.1)	
Second quartile	80,237 (93.3)	5742 (6.7)	
Third quartile	68,865 (92.6)	5540 (7.4)	
Highest quartile	69,757 (85.6)	11,721 (14.4)	
Comorbidity Score			<0.0001
0	178,616 (91.8)	15,895 (8.2)	
1	60,384 (90.9)	6014 (9.1)	
2	36,243 (90.6)	3770 (9.4)	
3	14,398 (89.8)	1631 (10.2)	
4+	10,082 (89.9)	1134 (10.1)	
Patient RUCA			<0.0001
Isolated rural	3101 (96.3)	117 (3.6)	
Small rural	11,502 (95.0)	609 (5.0)	
Large rural	35,327 (95.5)	1650 (4.5)	
Urban focus	227,870 (90.2)	24,856 (9.8)	

Characteristic	No Anesthesiology Assistance N (%)	Anesthesiology Assistance N (%)	p-value
Endoscopist Specialty			<0.0001
Gastroenterology	218,706 (91.1)	21,333 (8.9)	
General Surgery	38,703 (93.6)	2646 (6.4)	
Colorectal Surgery	16,264 (85.2)	2828 (14.8)	
Internal Medicine	13,990 (93.7)	943 (6.3)	
Family Medicine	7350 (95.4)	352 (4.6)	
Other	4710 (93.2)	342 (6.8)	
Annual Colonoscopy Volume, by Quartile *			<0.0001
33	72,612 (90.8)	7315 (9.2)	
34–55	73,471 (89.5)	8592 (10.5)	
56–82	75,968 (92.6)	6041 (7.4)	
83–367	77,672 (92.3)	6496 (7.7)	
Years in Practice, by Quartile			<0.0001
10	74,727 (91.6)	6818 (8.4)	
10–18	70,674 (90.7)	7236 (9.3)	
18–25	75,566 (90.4)	8026 (9.6)	
>25	67,869 (92.4)	5620 (7.6)	
Site of Service			<0.0001
Ambulatory Surgery Center	78,522 (89.0)	9691 (11.0)	
Hospital Outpatient	208,548 (93.6)	14,339 (6.4)	
Office	12,065 (73.5)	4343 (26.5)	
Other Outpatient	588 (89.2)	65 (10.8)	
Carrier			<0.0001
Administar	14094 (96.7)	480 (3.3)	
Alabama	5955 (98.8)	73 (1.2)	
Arkansas	3890 (99.1)	34 (0.9)	
Cigna	19,644 (96.9)	630 (3.1)	
Empire	19,038 (64.7)	10,376 (35.3)	
First Coast	29,145 (83.4)	5801 (16.6)	
Georgia	8643 (96.4)	322 (3.6)	
Highmark	12,800 (88.1)	1721 (11.9)	
Kansas	3789 (97.9)	81 (2.1)	
Mississippi	3469 (96.9)	110 (3.1)	
Missouri	7086 (97.2)	202 (2.8)	
National Heritage	37,422 (93.7)	2504 (6.3)	
Nebraska	2301 (95.1)	119 (4.9)	
Noridian	29,004 (96.5)	1042 (3.5)	
Oklahoma/N Mexico	6015 (98.4)	99 (1.6)	
Palmetta	23,083 (96.9)	732 (3.1)	

Characteristic	No Anesthesiology Assistance N (%)	Anesthesiology Assistance N (%)	p-value
Pinnacle	4425 (97.8)	100 (2.2)	
Rhode Island	926 (95.4)	45 (4.6)	
Trailblazer	27,126 (93.0)	2048 (7.0)	
Wisconsin MDS	40,013 (95.7)	1788 (4.3)	

Chi-square tests of equal proportion were used to detect significant differences in the frequency of anesthesia assistance.

* Annual colonoscopy volume reflects only the number of outpatient colonoscopies in the 20% sample of Medicare beneficiaries.

Table 2

Generalized Estimating Equation Determination of the Association between Anesthesiology Assistance and Patient and Provider Characteristics

Characteristic	Adjusted Odds Ratio (95% Confidence Interval)
Age	
66–69	1.00
70–74	1.03 (0.99–1.07)
75–79	1.02 (0.98–1.07)
80+	1.04 (0.99–1.09)
Race	
White	1.00
American Indian/Alaska Native	0.64 (0.36–1.14)
Asian	1.32 (0.98–1.78)
Black	1.37 (1.22–1.54)
Hispanic	0.96 (0.79–1.16)
Other	1.16 (0.93–1.46)
Gender	
Male	1.00
Female	1.05 (1.02–1.08)
Indication	
Screening	1.00
Surveillance	1.33 (1.23–1.45)
Diagnostic	1.82 (1.68–1.98)
Median Income	
Lowest quartile	1.00
Second quartile	1.00 (0.92–1.09)
Third quartile	1.04 (0.95–1.15)
Highest quartile	1.52 (1.36–1.70)
Comorbidity Score	
0	1.00
1	1.11 (1.07–1.15)
2	1.08 (1.04–1.13)
3	1.18 (1.11–1.25)
4+	1.21 (1.12–1.31)
Provider RUCA	
Urban focus	1.00
Isolated rural	0.69 (0.34–1.41)
Small rural	1.11 (0.81–1.53)
Large rural	0.79 (0.63–1.00)

Characteristic	Adjusted Odds Ratio (95% Confidence Interval)
Endoscopist Specialty	
Gastroenterology	1.00
General Surgery	1.53 (1.18–1.98)
Colorectal Surgery	1.89 (1.50–2.37)
Internal Medicine	1.02 (0.76–1.38)
Family Medicine	1.23 (0.80–1.88)
Annual Colonoscopy Volume, by Quartile *	
83–367	1.00
56–82	1.01 (0.81–1.24)
34–55	1.18 (0.97–1.44)
33	1.04 (0.84–1.29)
Years in Practice, by Quartile	
10	1.00
10–18	1.01 (0.82–1.25)
18–25	1.02 (0.87–1.19)
>25	0.80 (0.68–0.94)
Site of Service	
Hospital Outpatient	1.00
Ambulatory Surgery Center	1.81 (1.60–2.06)
Office	2.66 (2.14–3.30)
Other Outpatient	1.24 (0.76–2.03)
Medicare Carrier	
Arkansas	0.23 (0.12–0.43)
Alabama	0.29 (0.18–0.46)
Oklahoma/New Mexico	0.42 (0.26–0.68)
Kansas	0.38 (0.17–0.85)
Pinnacle	0.43 (0.22–0.82)
Palmetta	0.73 (0.55–0.97)
Administar	0.75 (0.52–1.09)
Georgia	0.79 (0.54–1.16)
Cigna	0.80 (0.56–1.14)
Noridian	0.83 (0.61–1.14)
Missouri	0.84 (0.57–1.25)
Mississippi	0.90 (0.30–2.67)
Wisconsin MDS	1.00
Rhode Island	1.17 (0.50–2.70)
Nebraska	1.39 (0.73–2.65)
National Heritage	1.55 (1.20–2.01)
Trailblazer	1.72 (1.35–2.20)

Characteristic	Adjusted Odds Ratio (95% Confidence Interval)
Highmark	2.94 (2.31–3.75)
First Coast	4.39 (3.43–5.46)
Empire	9.90 (7.92–12.39)

All variables included in Table 2 are included in the multivariate model.

* Annual colonoscopy volume reflects only the number of outpatient colonoscopies in the 20% sample of Medicare beneficiaries.

Table 3

Frequency of Provider Characteristics According to Provider's Overall Utilization of Anesthesiology Assistance (only those providers with 6 or more procedures in the dataset are included).

Characteristic	Provider's Overall Utilization of Anesthesiology Assistance					p-value
	0% N (%)	1–25% N (%)	26–50% N (%)	51–75% N (%)	76–100% N (%)	
All providers	9683 (75.0)	1658 (12.8)	589 (4.6)	393 (3.0)	587 (4.5)	
Provider RUCA						<0.0001
Isolated rural	160 (89.4)	13 (7.3)	2 (1.1)	3 (1.7)	1 (0.6)	
Small rural	531 (86.3)	43 (7.0)	13 (2.1)	16 (2.6)	12 (2.0)	
Large rural	1217 (82.7)	155 (10.5)	60 (4.1)	23 (1.6)	16 (1.1)	
Urban focus	6997 (72.3)	1340 (13.8)	471 (4.9)	333 (3.4)	543 (5.6)	
Endoscopist Specialty						<0.0001
Gastroenterology	6070 (72.8)	1160 (13.9)	371 (4.6)	287 (3.4)	444 (5.3)	
General Surgery	1963 (80.8)	262 (10.8)	111 (4.6)	44 (1.8)	51 (2.1)	
Colorectal Surgery	530 (67.3)	115 (14.6)	54 (6.9)	31 (3.4)	58 (7.4)	
Internal Medicine	563 (83.2)	63 (9.3)	18 (2.7)	13 (1.9)	20 (3.0)	
Family Medicine	376 (86.6)	26 (6.0)	12 (2.8)	12 (2.8)	8 (1.8)	
Annual Colonoscopy Volume, by Quartile*						<0.0001
33	4405 (77.2)	577 (10.1)	285 (5.0)	180 (3.2)	259 (4.5)	
34–55	2560 (71.9)	511 (14.3)	158 (4.4)	126 (4.5)	208 (5.8)	
56–82	1691 (75.0)	344 (15.3)	89 (4.0)	58 (2.6)	73 (3.2)	
83–367	1027 (74.1)	226 (16.3)	57 (4.1)	29 (2.1)	47 (3.4)	
Years in Practice, by Quartile						0.019
10	2707 (75.4)	455 (12.7)	176 (4.9)	103 (3.9)	150 (4.2)	
10–18	2163 (73.3)	427 (14.5)	122 (4.1)	93 (3.2)	148 (5.0)	
18–25	2225 (74.5)	354 (11.9)	158 (4.3)	100 (3.4)	150 (4.0)	
>25	2162 (76.4)	348 (12.3)	116 (4.1)	81 (2.9)	122 (4.3)	

* Annual colonoscopy volume reflects only the number of outpatient colonoscopies in the 20% sample of Medicare beneficiaries.

Table 4

Bivariate and generalized estimating equation determination of association between anesthesiology assistance (AA) during colonoscopy and colonoscopic findings, interventions and complications

Outcome	AA N (%)	No AA N (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Polyp Diagnosis	11,276 (39.6)	112,276 (37.5)	1.10 (1.07–1.24)	1.04 (0.99–1.09)
Diagnostic Biopsy	8171 (28.7)	80,012 (26.7)	1.10 (1.08, 1.14)	1.03 (0.97–1.10)
Polypectomy	10,608 (37.3)	108,271 (36.1)	1.05 (1.02–1.08)	1.00 (0.95–1.05)
Bleeding	194 (0.7)	2105 (0.7)	0.94 (0.81–1.09)	0.98 (0.84–1.13)
Perforation	38 (0.13)	336 (0.11)	1.13 (0.81–1.59)	1.11 (0.78–1.57)
Emergent/Urgent Hospitalization within 30 Days	895 (3.2)	9583 (3.2)	0.95 (0.90–1.01)	0.98 (0.91–1.06)
Emergency Room Visit within 30 Days	1200 (4.2)	13,078 (4.4)	0.96 (0.91, 1.02)	0.97 (0.91–1.04)

All multivariate models included procedure indication, patient characteristics (age, sex, race, median income (per \$1000) and Charlson comorbidity score) and provider characteristics (specialty, procedure volume, and years in practice). Due to the limited number of perforations, race was classified as white vs. other for the perforation model. The patient's Rural Urban Commuting Area (RUCA) classification and provider site-of-service were also included for all models with the exception of the perforation model. The performance of polypectomy or biopsy was included in the models assessing bleeding, perforation, hospitalization and emergency department visits.