Potentially Inappropriate Screening Colonoscopy in Medicare Patients

Variation by Physician and Geographic Region

Kristin M. Sheffield, PhD; Yimei Han, MS; Yong-Fang Kuo, PhD; Taylor S. Riall, MD, PhD; James S. Goodwin, MD

Importance: Inappropriate use of colonoscopy involves unnecessary risk for older patients and consumes resources that could be used more effectively.

Objectives: To determine the frequency of potentially inappropriate colonoscopy in Medicare beneficiaries in Texas and to examine variation among physicians and across geographic regions.

Design, Setting, and Participants: This retrospective cohort study used 100% Medicare claims data for Texas and a 5% sample from the United States from 2000 through 2009. We identified Medicare beneficiaries aged 70 years or older who underwent a colonoscopy from October 1, 2008, through September 30, 2009.

Main Outcome Measures: Colonoscopies were classified as screening in the absence of a diagnosis suggesting an indication for the procedure. Screening colonoscopy was considered potentially inappropriate on the basis of patient age or occurrence too soon after colonoscopy with negative findings. The percentage of patients undergoing potentially inappropriate screening colonoscopy was estimated for each colonoscopist and hospital service area.

Results: A large percentage of colonoscopies performed in older adults were potentially inappropriate: 23.4% for the overall Texas cohort and 9.9%, 38.8%, and 24.9%, respectively, in patients aged 70 to 75, 76 to 85, or 86 years or older. There was considerable variation across the 797 colonoscopists in the percentages of colonoscopies performed that were potentially inappropriate. In a multilevel model including patient sex, race or ethnicity, number of comorbid conditions, educational level, and urban or rural residence, 73 colonoscopists had percentages significantly above the mean (23.9%), ranging from 28.7% to 45.5%, and 119 had percentages significantly below the mean (23.9%), ranging from 6.7% to 18.6%. The colonoscopists with percentages significantly above the mean were more likely to be surgeons, graduates of US medical schools, medical school graduates before 1990, and higher-volume colonoscopists than those with percentages significantly below the mean. Colonoscopist rankings were fairly stable over time (2006-2007 vs 2008-2009). There was also geographic variation across Texas and the United States, with percentages ranging from 13.3% to 34.9% in Texas and from 19.5% to 30.5% across the United States.

Conclusions and Relevance: Many colonoscopies performed in older adults may be inappropriate. The likelihood of undergoing potentially inappropriate colonoscopy depends in part on where patients live and what physician they see.

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Colonoscopy has become the dominant modality for colorectal cancer screening.1 Underuse of colonoscopy screening has been well documented,1,5 but there is also growing evidence of overuse.4,7 It has been found that 23.5% of Medicare patients who had negative findings at screening colonoscopy underwent another screening examination less than 7 years later.7 Colonoscopy repeated within 10 years after negative screening results represents overuse based on current guidelines.8,9 Screening colonoscopy performed in the oldest age groups may also represent overuse according to guidelines from the US Preventive Services Task Force (USPSTF) and the American College of Physicians.8,9

See also pages 526 and 551

Complications from colonoscopy are increased in older populations (aged 75 years or older).10 Moreover, competing causes of mortality with advancing age (ie, causes of...
death other than colorectal cancer) shift the balance between life-years gained and colonoscopy risks.\textsuperscript{11,12} Colonoscopy screening capacity is limited,\textsuperscript{13,14} and the overuse of screening colonoscopy drains resources that could otherwise be used for the unscreened at-risk population.\textsuperscript{15} The decision to undergo colonoscopy screening is ultimately up to the patient. However, physicians and health care systems may exert considerable influence on patients’ decisions and adherence to screening recommendations.\textsuperscript{1,16-18} Physician preferences and practice setting may influence colorectal screening rates.\textsuperscript{19,20} State-level variation has been reported in the use of colorectal cancer screening procedures, suggesting the presence of local practice patterns.\textsuperscript{21}

The purpose of this study was to determine the frequency of potentially inappropriate screening colonoscopy in Medicare beneficiaries. We selected beneficiaries who underwent colonoscopy in 2008-2009 and classified the procedure as screening or diagnostic. Screening colonoscopy was considered inappropriate on the basis of patient age or occurrence too soon after a previous colonoscopy with negative findings. The use of 100% Texas Medicare data allowed us to examine variation among physicians and across geographic regions.

## METHODS

### DATA

The primary data source for this study was the 100% Medicare claims and enrollment files for Texas (2000-2009). The Denominator File contained patients’ demographic and enrollment characteristics. The outpatient standard analytic files and the carrier files were used to identify outpatient facility services and physician services. Inpatient hospital claims data were identified in the Medicare Provider Analysis and Review File. We built a crosswalk between National Provider Identifier (2008-2009) and the unique provider identification number (2006-2007) on Medicare claims and linked to the American Medical Association physician file to obtain physician data. Medicare claims were linked to 2000 US Census data by zip code of the patients’ residences to obtain zip code-level aggregate information on educational levels of area residents.

We also used claims and enrollment data from a 5% random national sample of Medicare beneficiaries to examine geographic variation across the United States. Cohort selection criteria and variable definitions were identical to those for Texas data.

### COHORT

We identified Medicare beneficiaries aged 70 years or older who underwent complete colonoscopy between October 1, 2008, and September 30, 2009 (n=119477). We limited the index procedures to those performed in patients aged 70 years or older to allow for at least 5 years of Medicare claims data to identify prior colonoscopies. Colonoscopies were identified by the following Current Procedural Terminology (CPT), Healthcare Common Procedure Coding System (HCPCS), and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes: CPT 44388-89, 44392-94, 45378, 45380, 45382-85; HCPCS G0105, G0121; and ICD-9-CM 45.23, 45.25, 45.27, 45.41-43, 48.36. Colonoscopies with CPT modifier codes of 52 or 53 were considered incomplete and were excluded.

We excluded beneficiaries who had not been continuously enrolled in Medicare parts A and B or who had been enrolled in a health maintenance organization in the previous 7 years (n=21976). We excluded beneficiaries with a history of colon cancer, inflammatory bowel disease, or colon resection in the 7 years before the colonoscopy (n=65535). We also excluded colonoscopies performed during an inpatient hospital admission or the same day as an emergency department visit (n=9410). Finally, we restricted the cohort to Texas residents who underwent colonoscopy performed by a Texas physician, yielding a final sample of 74681 beneficiaries. We constructed a second cohort of beneficiaries who underwent colonoscopy between October 1, 2006, and September 30, 2007, to examine the stability over time in estimates of physician-level performance. That cohort was constructed exactly like the 2008-2009 cohort and included 73922 beneficiaries.

### VARIABLES

#### Inappropriate Colonoscopy

We classified the 2008-2009 colonoscopy as inappropriate if it was (1) an early repeated colonoscopy without clear indication in a patient aged 70 to 75 years or (2) contrary to USPSTF age-based screening recommendations. The USPSTF recommends against routine screening in patients aged 76 to 85 years and against any screening in those older than 85 years.\textsuperscript{8} In the USPSTF suggestions for practice, physicians are counseled to provide screening to patients aged 76 to 85 years only if other considerations support providing the service in an individual patient, and they are counseled to discourage screening in patients older than 85 years.\textsuperscript{8}

The identification of screening colonoscopy is complicated by the fact that few colonoscopies are submitted with the screening code.\textsuperscript{7,22} It is estimated that approximately two-thirds of colonoscopies are performed for colorectal cancer screening purposes;\textsuperscript{22} however, only 14.6% of all Medicare-claim colonoscopies in 2007-2008 included a screening code on the Medicare claim. Consistent with prior research,\textsuperscript{7} we examined the diagnoses on the colonoscopy claim and on inpatient and outpatient claims in the 3 months before the procedure to determine whether the colonoscopy was performed without a clear indication other than screening. We reasoned that a diagnostic colonoscopy would produce relevant diagnoses on the colonoscopy claim or on claims in the 3 months before the procedure. Patients who did not have any indications for diagnostic colonoscopy were considered to have undergone screening colonoscopy.

The following were considered indications for diagnostic colonoscopy: (1) a claim for a barium enema or abdominal computed tomographic study in the 3 months before colonoscopy or (2) a diagnosis on both the colonoscopy claim and any inpatient or outpatient claim in the prior 3 months for anemia, gastrointestinal bleeding, constipation, diarrhea, abdominal pain, ischemic bowel disease, irritable bowel syndrome, change in bowel habits, hemorrhoid, weight loss, or other conditions wherein colonoscopy might plausibly be indicated (see the Appendix for full list, http://www.jamainternalmed.com).\textsuperscript{7}

Colonoscopies that did not meet these criteria for a diagnostic procedure were considered screening colonoscopies and labeled as “potentially inappropriate” if performed in patients aged 76 years or older. We modified criterion 2 of the algorithm just described to require a diagnosis consistent with an indication for colonoscopy on either the colonoscopy claim or any claim in the prior 3 months. Colonoscopies that did not meet these modified criteria for a diagnostic procedure were labeled as “probably inappropriate” screening colonoscopies if performed in patients aged 76 years or older.
To define early repeated colonoscopy in patients aged 70 to 75 years, we examined Medicare claims data from January 1, 2001, through September 30, 2008, to identify previous procedures. If beneficiaries had undergone more than 1 previous colonoscopy, we selected the latest procedure. Beneficiaries who had undergone colonoscopy with negative results and had no indications for colonoscopy in 2008-2009 were classified as having undergone early repeated colonoscopy. These colonoscopies were labeled potentially or probably inappropriate based on the described algorithms. Early repeated colonoscopies in patients with a family history of colorectal cancer (ICD-9-CM diagnosis, code V16.0) were classified as appropriate.

Colonoscopist

We linked patients to the performing physician by using the National Provider Identifier on the colonoscopy claim. Medicare Centers for Medicare & Medicaid Services provider specialty codes were used to categorize physician specialty as gastroenterology, generalist, surgery, or other.

For each physician, we calculated the volume of colonoscopies performed in Medicare enrollees from October 1, 2008, through September 30, 2009. Physician volume was stratified into quartiles: (1) less than 65, (2) 65 to 115, (3) 116 to 175, and (4) more than 175 colonoscopies.

Patient Characteristics

Patient demographic data obtained from the Denominator File included age, sex, and race. A Charlson comorbidity score was estimated using inpatient and outpatient claims files from the year before the 2008-2009 colonoscopy. The percentage of residents in the patient's zip code with less than 12 years of education was used as a surrogate for patient education. Area of residence was classified as metropolitan, nonmetropolitan, or rural. The place of service was classified as a hospital-based facility, office, or ambulatory surgical center.

Geographic Area

Hospital service areas (HSAs), described in The Dartmouth Atlas of Health Care 1998, were used to assess geographic variation across 208 areas in Texas. Hospital referral regions (HRRs) were used to assess geographic variation across 306 regions in the United States.

STATISTICAL ANALYSIS

Descriptive statistics were used to describe the percentage of colonoscopies performed in Medicare patients in 2008-2009 that were potentially or probably inappropriate, stratified by patient and provider characteristics. Two-level hierarchical general linear models (HGLMs), adjusted for patient and colonoscopist characteristics and clustering of patients by colonoscopist, were used to identify independent predictors of potentially inappropriate colonoscopy.

Two-level HGLMs provided estimates for each colonoscopist of the percentage of colonoscopies performed that were potentially inappropriate, after adjustment for patient sex, race or ethnicity, number of comorbid conditions, educational level, urban or rural residence, and place of service. The percentage of Medicare beneficiaries in whom colonoscopy was potentially inappropriate was estimated for each HSA in Texas, using an unconditional 2-level HGLM with HSA as a random effect, and for each HRR in the United States, using an unconditional 2-level HGLM with HRR as a random effect.

RESULTS

Figure 1 is a US map presenting the percentages of potentially inappropriate colonoscopies in a 5% sample of Medicare recipients aged 70 years or older (n=56 566) by HRR. The overall percentage for the United States was
23.5%, varying from 19.5% to 30.5% by HRR. **Figure 2** shows similar variations across HSAs in Texas. The overall percentage for Texas was 23.4%, varying from 13.3% to 34.9% by HSA. An analysis using the algorithm for probably inappropriate colonoscopy produced similar results for both maps (not shown).

We next examined the role of the colonoscopist in inappropriate colonoscopy. We restricted our analyses to 100% Medicare data for Texas because 100% data enables substantial numbers of colonoscopies for each physician and stable estimates.

The cohort included 74,681 Medicare beneficiaries aged 70 years or older who underwent colonoscopy in Texas in 2008-2009. **Table 1** presents the percentages of colonoscopies that were potentially or probably inappropriate, stratified by patient and colonoscopist characteristics. Overall, 23.4% of colonoscopies were potentially inappropriate and 18.9% were probably inappropriate. Approximately 10% of colonoscopies performed in patients aged 70 to 75 years were potentially inappropriate, which for this age group indicates an early repeated colonoscopy. Notably, about 39% of colonoscopies performed in patients aged 76 to 85 years and 25% performed in those aged 86 years or older were potentially inappropriate. This means that of the 1,042,790 Medicare beneficiaries in Texas, approximately 0.9%, 2.7%, and 0.6% of those aged 70 to 75, 76 to 85, or 86 years or older, respectively, underwent potentially inappropriate colonoscopy in 2008-2009.

In the multivariate model in **Table 2**, female sex, black race, more comorbid conditions, higher educational levels, and residence in a nonmetropolitan or rural area were
associated with lower odds of potentially inappropriate colonoscopy. Patients who underwent colonoscopy in an ambulatory surgical center or office setting had higher odds of potentially inappropriate colonoscopy, as did those whose colonoscopy was performed by higher-volume colonoscopists, generalists or surgeons, or US-trained physicians. A multivariate model using potentially inappropriate colonoscopy as the outcome produced substantively equivalent results (not shown).

Figure 3 presents a cumulative ranking of Texas colonoscopists by percentage of colonoscopies that were potentially inappropriate, generated from a multilevel model adjusting for patient characteristics. The intraclass correlation coefficient (ICC) for this model was 6.0%, indicating that 6.0% of the variance in whether a colonoscopy was potentially inappropriate was explained by the physician. Seventy-three colonoscopists had percentages significantly above the mean (23.9%), ranging from 28.7% to 45.5%, and 119 colonoscopists had percentages significantly below the mean (23.9%), ranging from 6.7% to 18.6%. The high- and low-percentage colonoscopists differed, with the high-percentage group including more surgeons, more US medical school graduates, and fewer recent graduates (Table 3).
of colonoscopies performed per year was significantly higher among physicians with a high percentage of inappropriate colonoscopies (175.5 vs 99.2; *P* < .001). A model using probably inappropriate colonoscopy as the outcome produced an ICC of 7.6%. In addition, the results for Figure 3 and Table 3 were very similar to those previously reported for potentially inappropriate colonoscopy.

We also examined the stability over time of colonoscopist rankings for percentage of potentially inappropriate colonoscopies performed. We identified 687 physicians who performed colonoscopies in 2 time periods: October 1, 2008, through September 3, 2009, and October 1, 2006, through September 30, 2007. We then ranked them by the percentages of potentially inappropriate colonoscopies performed in each period. The rankings were fairly stable over time (Spearman *ρ* = 0.69; *P* < .001). For example, of the 174 colonoscopists in the highest quartile for percentage of inappropriate colonoscopies in 2006-2007, 89.1% of them were in the highest (63.2%) or second-highest (25.9%) quartiles in 2008-2009. Similarly, of the 169 colonoscopists in the lowest quartile in 2006-2007, 85.2% were in the lowest (58.6%) or next lowest (26.6%) quartile in 2008-2009. Similar results were observed when using probably inappropriate colonoscopy as the outcome.

Overall, 23.4% of colonoscopies performed in Medicare beneficiaries aged 70 years or older in 2008-2009 in Texas and across the United States were potentially inappropriate according to age-based screening recommendations or results of previous screening. We observed geographic and physician-level variation in percentages of potentially inappropriate colonoscopies. For some physicians, more than 30% of the colonoscopies they performed in Medicare patients in 2008-2009 were potentially inappropriate. Physician rankings were relatively stable over time. Approximately 6.0% of the variation in our outcome was attributable to the physician. Previous studies examining the role of the provider in explaining variations in practice behavior have generally reported comparable ICCs.26-29

Throughout this report we have used the terms potentially inappropriate and probably inappropriate colonoscopy. It is impossible using claims data to determine whether any given colonoscopy procedure in a specific patient was appropriate or inappropriate. What claims data can provide is an analysis of patterns, of how the percentage of potentially inappropriate colonoscopies varies by physician and geographic region. We made the assumption that colonoscopies performed without clear diagnostic indication were performed for screening purposes rather than to evaluate symptoms. We reasoned that diagnostic colonoscopy would produce relevant diagnoses on the colonoscopy claim and in the 3 months before the procedure. An alternative approach would be to identify patients with a charge for screening colonoscopy as opposed to diagnostic colonoscopy. However, only 14.6% of all Medicare-claim colonoscopies in 2007-

### Table 2. Multilevel Multivariate Logistic Regression Analyses of Patient and Provider Characteristics Associated With Potentially Inappropriate Colonoscopy in 2008-2009 Texas Medicare Claims

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Female</td>
<td>0.95 (0.82-1.10)</td>
</tr>
<tr>
<td>Race or ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Black</td>
<td>0.99 (0.89-1.11)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.93 (0.84-1.04)</td>
</tr>
<tr>
<td>Other</td>
<td>1.00 (0.89-1.12)</td>
</tr>
<tr>
<td><strong>Comorbid conditions, No.</strong></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>1</td>
<td>0.99 (0.89-1.11)</td>
</tr>
<tr>
<td>2</td>
<td>0.99 (0.89-1.11)</td>
</tr>
<tr>
<td>3 or more</td>
<td>0.98 (0.89-1.08)</td>
</tr>
<tr>
<td><strong>Residents in the patient’s zip code</strong></td>
<td></td>
</tr>
<tr>
<td>with &gt;12 y of education, %</td>
<td></td>
</tr>
<tr>
<td>&lt;9</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>9-18</td>
<td>0.95 (0.80-1.12)</td>
</tr>
<tr>
<td>18-26</td>
<td>0.91 (0.76-1.09)</td>
</tr>
<tr>
<td>≥26</td>
<td>0.87 (0.72-1.05)</td>
</tr>
<tr>
<td><strong>Place of service</strong></td>
<td></td>
</tr>
<tr>
<td>Hospital-based facility</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Ambulatory surgical center</td>
<td>1.22 (1.15-1.29)</td>
</tr>
<tr>
<td>Office</td>
<td>1.52 (1.42-1.64)</td>
</tr>
<tr>
<td><strong>Colonoscopists by volume of colonoscopies</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;65</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>65-115</td>
<td>1.23 (1.17-1.30)</td>
</tr>
<tr>
<td>116-175</td>
<td>1.35 (1.22-1.49)</td>
</tr>
<tr>
<td>&gt;175</td>
<td>1.63 (1.45-1.82)</td>
</tr>
<tr>
<td><strong>Colonoscopists by specialty</strong></td>
<td></td>
</tr>
<tr>
<td>Gastroenterologist</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Generalist</td>
<td>1.27 (1.10-1.47)</td>
</tr>
<tr>
<td>Surgeon</td>
<td>1.27 (1.15-1.39)</td>
</tr>
<tr>
<td>Other</td>
<td>0.92 (0.59-1.43)</td>
</tr>
<tr>
<td><strong>Colonoscopists by county of training</strong></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Outside United States</td>
<td>0.78 (0.72-0.84)</td>
</tr>
</tbody>
</table>

*Data were analyzed for 65,553 claims. “Potentially inappropriate” was defined as explained in Table 1. An analysis using the algorithm for “probably inappropriate” colonoscopy produced similar results.*

*For each physician, volume was calculated as the total number of colonoscopies performed in Medicare enrollees in 2008-2009; analyses were restricted to providers who had performed ≥20 colonoscopies during this period.*

2008 included a screening code on the claim, even though it is estimated that nearly two-thirds of colonoscopies are performed for screening purposes.22

The USPSTF colorectal cancer screening guidelines specify age limits for routine screening, limits based on a targeted systematic evidence review26 and decision-analytic modeling analysis11 showing that screening in patients older than 75 years produced a gain in life-years that was small compared with the risks of screening. The American College of Physicians also recently issued a guidance statement recommending that clinicians...
The American College of Gastroenterology, American Cancer Society, US Multi-Society Task Force on Colorectal Cancer, and American College of Radiology do not address age limits for screening.  

Surgeons were overrepresented in the group of physicians with significantly higher percentages of potentially inappropriate colonoscopies. It is possible that some colonoscopies performed by surgeons were surveillance colonoscopies in colon cancer survivors misclassified as

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**Table 3. Characteristics of Texas Colonoscopists With High or Low Percentages of Potentially Inappropriate Colonoscopies**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Physicians With Low Percentage of Inappropriate Colonoscopies</th>
<th>Physicians With High Percentage of Inappropriate Colonoscopies</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>94 (87.8)</td>
<td>69 (97.2)</td>
<td>.03</td>
</tr>
<tr>
<td>Female</td>
<td>13 (12.2)</td>
<td>2 (2.8)</td>
<td></td>
</tr>
<tr>
<td>Type of specialist, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastroenterologist</td>
<td>95 (89.6)</td>
<td>55 (77.5)</td>
<td>.04</td>
</tr>
<tr>
<td>Surgeon</td>
<td>9 (8.5)</td>
<td>15 (21.1)</td>
<td></td>
</tr>
<tr>
<td>Generalist</td>
<td>2 (1.9)</td>
<td>1 (1.4)</td>
<td></td>
</tr>
<tr>
<td>Year of medical school graduation, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before 1980</td>
<td>15 (14.3)</td>
<td>23 (32.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>1980-1989</td>
<td>16 (15.2)</td>
<td>25 (35.7)</td>
<td></td>
</tr>
<tr>
<td>1990-1999</td>
<td>43 (41.0)</td>
<td>22 (31.4)</td>
<td></td>
</tr>
<tr>
<td>2000 or later</td>
<td>31 (29.5)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Location of medical school, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>57 (53.3)</td>
<td>66 (93.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Outside United States</td>
<td>50 (46.7)</td>
<td>5 (7.0)</td>
<td></td>
</tr>
<tr>
<td>Volume of colonoscopies, mean (SD)</td>
<td>99.2 (59.1)</td>
<td>175.5 (81.1)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

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*Of physicians performing colonoscopy, 73 had percentages of potentially inappropriate colonoscopies significantly above the mean and 119 had percentages significantly below the mean. Physician information was available from the American Medical Association file for 107 physicians in the low-percentage and 71 in the high-percentage group, but in the low group, 1 physician was missing specialty information and 2 were missing year of graduation. In the high group, 1 physician was missing year of graduation. “Potentially inappropriate” was defined as explained in Table 1. Analyses were restricted to physicians who performed 20 or more colonoscopies in the 2008-2009 study period.
inappropriate screening colonoscopies. However, our re-
view period was too short to search for prior diagnoses or procedures indicative of colon cancer was 5 to 7 years in all cases. Colonoscopy accounts for 25% of clinical time and total charges in the practices of colorectal surgeons,31 and it is estimated that surgeons perform one-third of screening colonoscopies in the United States.14

Physician recommendation is a key factor affecting pa-
tient adherence to screening guidelines.1,18,32-34 Colonos-
copists often recommend screening colonoscopy and polyp surveillance at shorter intervals than stipulated in national guidelines.15,35-37 Legitimate clinical considerations and patient or referring physician request may prompt colonoscopists to perform colonoscopy at shorter than standard intervals. The evidence supporting a 10-
year interval is substantial but indirect.38 There is evidence that the progression of neoplasia to colorectal cancer may occur more quickly in older patients.39 Other reasons for potentially inappropriate colonoscopy screening may include poor communication between colonos-
copists and primary care physicians,17 disagreement with recommended guidelines, ignorance about the findings of prior endoscopy, and financial incentives. Finally, misperceptions regarding cancer screening by patients and physicians may lead to inappropriate use of colonos-
copy.40,41

Considerable geographic variation in rates of colo-
noscopy and flexible sigmoidoscopy has also been re-
ported at the state level in the United States52 and in Canada.62 Local physician practice patterns or supply may contribute to geographic variation in screening rates.2,3 Regional variations in Medicare spending and medical practice have been well documented in the United States, and evidence suggests that variations are due to the quantity of medical services rather than differences in population health or socioeconomic status.43

The cohort of physicians in this study was limited to
Texas. We needed 100% Medicare data to assess vari-
ation among physicians, and we cannot obtain such data for the entire country. Texas is a state with recognized geographic variation in health care costs and outliers in utilization patterns46; therefore, results may not be gen-
eralizable to other states or the nation as a whole. How-
ever, we also found geographic variation throughout the country when we examined 5% national Medicare data (Figure 1).

Using administrative data, we were unable to deter-
mine the appropriateness of screening for any individual patient. This limitation is most relevant to patients aged 76 to 85 years, in whom other considerations may have supported providing the service, for example, a patient at higher risk because of prior adenomas. Patient prefer-
ence also may influence the use of screening colonos-
copy in this age group. We limited the cohort to patients aged 70 years or older to allow for at least 5 years of prior Medicare claims data. We were unable to obtain records of any colonoscopies performed before Medicare eligi-

bles in the United States. Finally, misperceptions regarding cancer screening by patients and physicians may lead to inappropriate use of colonoscopy.40,41

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Author Contributions: Dr Sheffield had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Sheffield, Riall, and Goodwin. Acquisition of data: Han and Goodwin. Analysis and interpretation of data: Sheffield, Han, Kuo, Riall, and Goodwin. Drafting of the manuscript: Sheffield, Han, Riall, and Goodwin. Critical revision of the manuscript for important intellectual content: Sheffield, Han, Kuo, Riall, and Goodwin. Statistical analysis: Sheffield, Han, and Kuo. Study supervision: Riall and Goodwin.

Conflict of Interest Disclosures: None reported.

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