Data Sources for Measuring Colorectal Endoscopy Use Among Medicare Enrollees

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Abstract

Background: **Estimates of colorectal cancer test use vary widely by data source. Medicare claims offer one source for monitoring test use, but their utility has not been validated. We compared ascertainment of sigmoidoscopy and colonoscopy between three data sources: self reports, Medicare claims, and medical records.**

Materials and Methods: **The study population included Medicare enrollees residing in North Carolina (n = 561) who had participated in a telephone survey on colorectal cancer tests. Medicare claims were obtained for the 5 years preceding the survey (January 1, 1998 to December 31, 2002). Information about sigmoidoscopy and colonoscopy procedures conducted in physician offices were abstracted from medical records. Sensitivity, specificity, positive predictive value, negative predictive value, agreement, and κ statistics were calculated using the medical record as the gold standard. Agreement on specific procedure type and purpose was also assessed.**

Results: **Agreement between claim and medical record regarding whether an endoscopic procedure had been done was high (over 90%). Agreement between self report and medical record and between self report and claim was good (79% and 74%, respectively). All three data sources adequately distinguished the type of procedure done. None of the data sources showed reliable levels of agreement regarding procedure purpose (screening or diagnostic).**

Conclusion: **Medicare claims can provide accurate information on whether a patient has undergone colorectal endoscopy and may be more complete than physician medical records. Medicare claims cannot be used to distinguish screening from diagnostic tests. Recognizing this limitation, researchers who use Medicare claims to assess rates of colorectal testing should include both screening and diagnostic endoscopy procedures in their analyses.** (Cancer Epidemiol Biomarkers Prev 2007;16(10):2118–27)

Background

Colorectal cancer is a leading cause of cancer hospitalization in the Medicare population, creating a substantial burden on the Medicare program (1). Effective screening modalities that may lead to prevention of colorectal cancer through excision of adenomas exist (2, 3). Since 1998, Medicare has covered colorectal cancer screening as a benefit for enrollees 50 years and older. Yet, studies show that colorectal cancer screening rates in the United States, including among Medicare beneficiaries, are low. However, exactly how low depends on the data source used to measure them (4-8).

Accurate measurement of colorectal cancer screening would enhance the ability of health professionals, policy makers, and researchers to monitor adherence with guidelines and better target and evaluate intervention efforts. There is a lack of agreement as to the ideal data source for assessing colorectal cancer screening. On the one hand, there is evidence that rates based on self-reported sigmoidoscopy (9-11) and colonoscopy (9) overestimate screening use relative to medical records. Other studies, however, have shown self reports to produce accurate recall of sigmoidoscopy (12, 13) and colonoscopy test use (12). Similarly, although medical records are considered by many to provide the ''gold standard'' for measuring care, procedures may be missing from the medical record if they were conducted outside of the ordering physician's office (9), were misfiled, or were poorly documented (14). Administrative claims data may overestimate or underestimate test use, depending on whether diagnostic or screening tests are included and how a screening test is defined (15). Although prior studies have reported colorectal cancer test rates from Medicare claims (16-18), the use of claims to measure colorectal cancer screening is challenging (15) and their accuracy as a data source for measuring colorectal cancer test use in the Medicare population has not been documented. One recent study found high

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concordance between administrative data and medical records for colonoscopy, but Medicare claims were not assessed (14). Moreover, previous studies have found Medicare claims to underestimate mammography tests (19, 20).

Additional challenges in measuring colorectal cancer screening are presented by the variety of tests available, each with different recommended intervals for repeating the test. In a given population, it is impossible to determine whether people have been screened according to guidelines if there is confusion about whether a person had a sigmoidoscopy, which should be repeated every 5 years, or a colonoscopy, which should be repeated every 10 years. Similarly, if there is confusion about whether a test was conducted for diagnostic or screening purposes, measurement of the effectiveness of policy changes or interventions to increase screening will be less than precise.

In this study, we compare the use of colorectal endoscopy (i.e., sigmoidoscopy and colonoscopy) ascertained by three data sources: self reports, Medicare claims, and medical records. Although we were interested in the ability of each data source to precisely capture the occurrence of a procedure, the primary aim of this study was to assess the validity of Medicare claims for measuring colorectal endoscopy use. In addition, we examine the ability of these data sources to accurately distinguish the type (i.e., sigmoidoscopy versus colonoscopy) and purpose (i.e., screening versus diagnostic) of the procedure done.

Materials and Methods

This study uses data collected by The Carolinas Center for Medical Excellence, the Quality Improvement Organization for Medicare in North and South Carolina. The study was conducted under the statutory authority (42 CFR part 480) of the Medicare Health Care Quality Improvement Program and used accepted procedures for the confidential treatment of personal health information (21). In 2000, The Carolinas Center for Medical Excellence was funded by the Centers for Medicare and Medicaid Services to develop and evaluate interventions designed to increase colorectal cancer test use among Medicare enrollees. The National Cancer Institute provided additional funding to support evaluation of the interventions. Telephone surveys were conducted in 2001 and 2002 with samples of Medicare enrollees in North and South Carolina as part of the evaluation. A summary of the interventions and findings, as well as both survey instruments, can be found at The Carolinas Center for Medical Excellence site.[7]

Population. The eligible population for the validation study were the North Carolina respondents to the 2002 survey. The group included African American and White Fee for Service Medicare enrollees between 50 and 80 years who resided in any of 10 urban counties in North Carolina. Figure 1 summarizes the steps used to create the study sample. Survey respondents (n = 1001) had been randomly selected from two subgroups: individuals who had received selected mailings encouraging them to be tested for colorectal cancer and individuals who were not sent these mailings. We limited inclusion in the validation study to survey respondents without prior colorectal cancer who were between 55 and 80 years at the time of the survey. This step ensured eligibility for colorectal cancer screening during a 5-year look-back period. To facilitate inclusion of information from medical records, eligible participants were also restricted to those for whom a treating physician could be identified, either from Medicare claims or the survey (n = 877).

For the 877 eligible persons, their Medicare claims for colorectal cancer tests and self-reported test use were examined to determine ''presumptive'' testing status. Respondents were ''presumed'' tested if they had a claim for a sigmoidoscopy or colonoscopy or a self report of either test within the previous 2 years. We stratified our study group on presumptive test status in an attempt to increase the likelihood of obtaining medical records with testing information. We used a 2-year window for the stratification in recognition of the potential for recall bias on the part of survey respondents. The potential study population included 574 Medicare enrollees with evidence of prior testing and 303 enrollees without recent testing. To achieve a desired final sample size of 500 enrollees with prior tests and 100 without, we selected 100% of respondents presumed tested and a sample of respondents (n = 120) without evidence of a test. Medical records were accessed and abstracted for 88% of the sample (n = 609). Reasons why records were not abstracted included physician retirement or death, absence of the patient's record in the office, and physician refusal. Study participants were required to have continuous enrollment in Medicare parts A and B and no health maintenance organization enrollment from entry into Medicare until death or the end of the study window, defined as January 1, 1998 to December 31, 2002, yielding a final study group of 561 Medicare enrollees.

Data Sources. We assessed three data sources: self report from the telephone survey, Medicare data, and medical records. A brief description of each follows.

Telephone Survey. The telephone survey included questions on Medicare beneficiaries' health status, access to care, history of selected health conditions, colorectal cancer risk factors, awareness and knowledge of colorectal cancer test procedures, and colorectal cancer test use. The survey used recommended descriptions of endoscopy procedures and questions about procedure use (22). Survey participants were read the following text:

''Two tests for early signs of colon cancer involve a tube with a light on it that the doctor inserts into the rectum. For a sigmoidoscopy, only part of the colon is checked and the patient is fully awake. Sigmoidoscopy is usually performed in a doctor's office. For a colonoscopy, the entire colon is checked. The colonoscopy is sometimes done in a hospital, the patient gets medication to make them sleepy and someone must drive them home after the test.''

After the description, respondents were asked, for each procedure type, if they had heard of the procedure, had ever had the procedure, and, if so, when their most recent procedure was conducted. They were asked to identify the purpose of the procedure (as part of a check up or because of a problem), as well as the name and

[7] http://www.thecarolinascenter.org/mrnc_web/data/crcproject.aspx

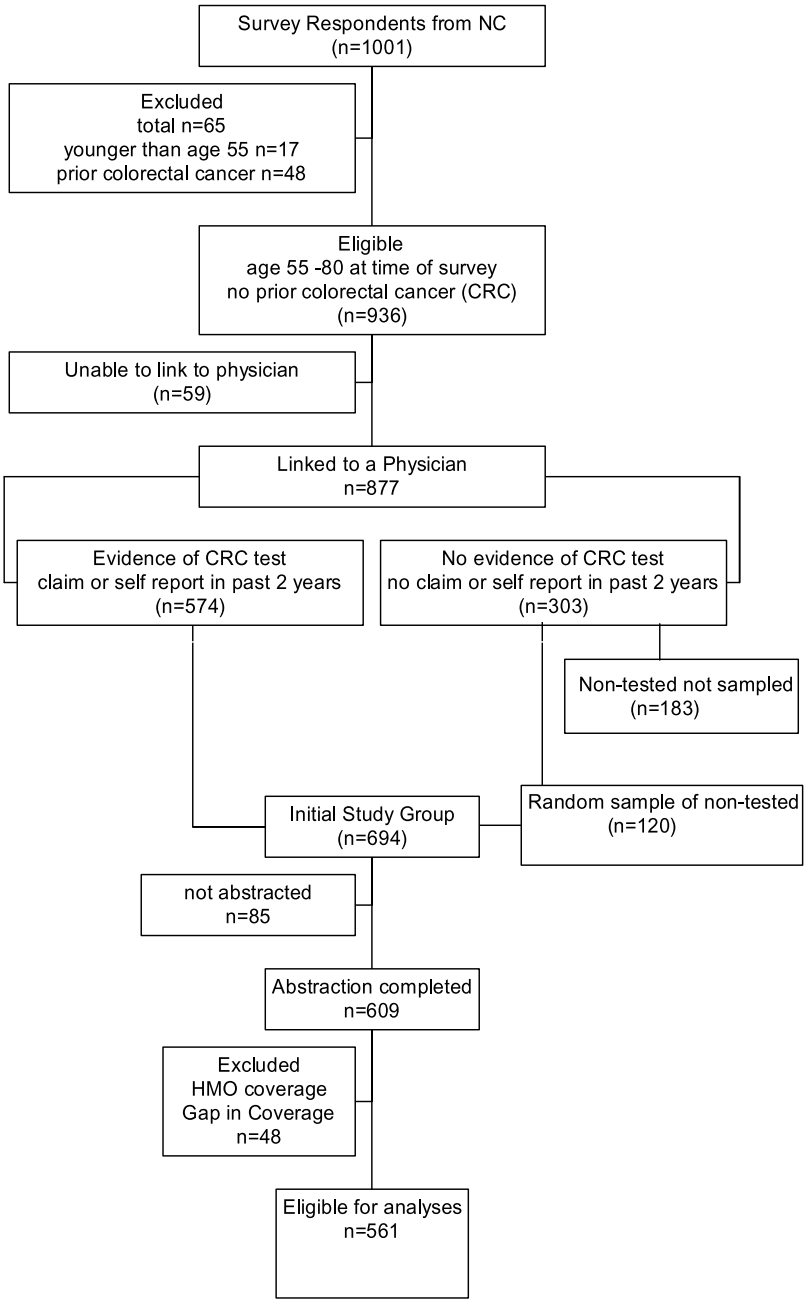

Figure 1. Selection of study population for validation study of colorectal cancer endoscopy in the Medicare population.

address of their primary care provider and the name and address of the physician who conducted their most recent sigmoidoscopy or colonoscopy.

Medicare Data. For survey respondents, Medicare inpatient, physician and hospital out-patient, claims were obtained for a 5-year period, January 1, 1998 to December 31, 2002. These claims were reviewed to identify any bills for sigmoidoscopy or colonoscopy, as well as the unique physician identifier number for the referring and performing physicians associated with these procedures.

We also used Medicare claims to identify a primary care provider for study participants who did not report this information on the survey. We reviewed Medicare claims from all settings for a 2-year period (2001 to 2002) and applied an algorithm developed by the Medicare Health Quality Improvement Program that examines physician specialty and number of visits in a 2-year period to identify a primary care physician (23). We used Medicare enrollment data to identify each beneficiary's demographic characteristics (age, race, sex), dates of Medicare enrollment, type of coverage (part A or part B), and managed care enrollment. Coverage and managed care participation were available on a month-by-month basis to allow determination of precise coverage windows. In addition, we collected information on each beneficiary's eligibility for assistance with Medicare premiums and copayments, the state buy-in program for low-income individuals.

Medical Record. Between June 2004 and May 2005, we abstracted data on sigmoidoscopy and colonoscopy procedures conducted between January 1, 1998 to December 31, 2002 from the medical record maintained at the physician's office. A comprehensive medical record abstraction tool was developed to capture endoscopy use. The tool was modeled after one previously used by one of the authors (S.T.H.; ref. 24). Medical record abstractors, all of whom were nurses, were trained on the electronic abstraction tool and data dictionary using test records. The abstraction tool was then pretested using respondents identified for study inclusion (n = 40). The abstraction tool and data dictionary were modified after the pretest to clarify items found difficult to abstract. Records included in the pretest were reabstracted for inclusion in the study. Once abstractors were in the field, repeat abstraction of medical records by a second abstractor was done on 10% of the medical records throughout the study to assess reliability and monitor data quality. Interrater reliability of 90% and above was achieved throughout the abstraction.

We used a hierarchical approach to identify the appropriate physician office for abstraction. The medical record from the primary care provider was the first record of choice. If the primary care provider identified from the survey could be located, that record was accessed. If the response to the survey question was missing or unusable, or the enrollee-identified primary care provider could not be located, the medical record from the physician identified by the claims algorithm was accessed. Medicare enrollees may undergo endoscopy without referral from a primary care provider. Thus, if the abstracted record from the primary care provider did not include information about endoscopy, we used Medicare claims to determine whether an endoscopy had been done and identify the physician who had done the procedure. For these patients (n = 68), the medical record from the performing physician recorded on the most recent colorectal endoscopic procedure claim was also abstracted.

Before visiting a physician's office, a letter describing the study and The Carolinas Center for Medical Excellence authority to access medical records was mailed to physicians. Follow-up telephone calls to physician offices requested permission to visit the office and abstract medical record information directly into a laptop computer. We obtained detailed information on up to two sigmoidoscopy and two colonoscopy procedures. Additional information abstracted from the medical record included practice-based information (type of practice, number of physicians in the practice, whether the practice used electronic medical records), patient visit information (date of last visit and last well check-up), and patient medical conditions (colorectal cancer risk factors and related conditions). A copy of the abstraction tool is available from the corresponding author (A.P.S.).

Definitions of Endoscopy. Survey respondents were classified as having a procedure during the study window if they reported a sigmoidoscopy within the past 4 years or a colonoscopy within the past 5 years. The look-back period for sigmoidoscopy is shorter than the study period because the telephone survey was designed to capture Medicare colorectal cancer screening coverage intervals for average risk enrollees, defined as every 4 years for sigmoidoscopy. Respondents who reported either a sigmoidoscopy or colonoscopy within the study window were classified as having had an endoscopy procedure. Procedures conducted ''as part of a routine exam or check up'' were classified as screening; those conducted ''because of a health problem'' were classified as diagnostic.

From Medicare claims, diagnostic and screening endoscopy procedures were identified using International Classification of Diseases (9th edition) and Healthcare Common Procedure Coding System codes (see Appendix for the codes used). Enrollees with claims for procedures done between January 1, 1998 and December 31, 2002 were classified as having been tested with the type of endoscopy represented on the claim. Persons were classified as undergoing a screening endoscopy if the claim included a Healthcare Common Procedure Coding System code for a procedure designated as screening.

Endoscopy procedures were identified in the medical record from procedure reports, office visit or progress notes, consultations, flow sheets, and letters. In the event that the patient had undergone more than one procedure, the total number of endoscopy procedures done between January 1, 1998 and December 31, 2002 was abstracted. Details collected for the two most recent procedures of each type included date, performing provider name, reason the procedure was done, and procedure results. Enrollees were classified as having had a sigmoidoscopy or colonoscopy if either procedure was documented in the medical record as having occurred on a date within the study window. Procedures were classified as screening if the medical record indicated the test was conducted for screening or as part of a well-adult physical. Procedures conducted for any other reason were classified as diagnostic.

A number of colorectal endoscopy procedures identified in the medical record had no date for the procedures recorded (n = 138, 32% of all procedures identified). However, following the data abstraction instructions and using other evidence in the medical record, our abstractors determined that the procedure occurred during the study window (January 1, 1998 to December 31, 2002). Procedures without exact dates were included in analyses only if the patient was enrolled during the entire study window to assure that Medicare coverage was in place at the time of the procedure.

Analyses. An analytic dataset was created to combine medical record data with Medicare data and survey responses. Information was linked across sources at the person level. We used descriptive statistics to assess participant and office characteristics and the prevalence of colorectal endoscopy by each data source. χ^2 tests were used to assess differences in demographic characteristics of the study group compared with those eligible but not included in the study and to compare differences of endoscopy use rates by demographic characteristic within each data source, with $P < 0.05$ as evidence of statistical significance.

For the comparisons involving self report (survey to medical record and survey to claim), we calculated the

report-to-records ratio as a measure of net bias in the self report (25, 26). This follows a recommendation from Vernon and colleagues (27) that encourages the quantification of bias in the use of self-reported cancer screening behaviors. The report-to-records ratio was calculated by dividing the number of persons who reported they had the test on the survey by the number of person who actually received the test according to the ''gold'' standard source (either the medical record or the claim; ref. 27).

We measured concordance among data sources by assessing the sensitivity, specificity, positive predictive value and negative predictive value of endoscopy status from self report and claims data when compared with the medical record (28). We calculated agreement, κ statistics, and 95% confidence intervals using standard methods (29). Whereas the medical record is commonly considered the gold standard for information about medical testing, we considered that, for a procedure, such as endoscopy, there might be cases wherein beneficiaries underwent procedures not reported to the primary care provider and the Medicare claim may be considered definitive. Therefore, we also compared concordance of the medical record and self report to the Medicare claims. We used the κ statistic and the benchmarks suggested by Landis and Koch (30) to assess the strength of agreement. These analyses were conducted at the person level for sigmoidoscopy, colonoscopy, and endoscopy (either sigmoidoscopy or colonoscopy). Our assessment of concordance among data sources examined whether the procedure occurred during the study window.

To assess agreement regarding the type and purpose of the procedure, we used data for participants who had a single type of procedure in the ''gold'' source that ''matched'' in one or more of the other data sources. Procedures were considered to ''match'' if they were conducted within $\pm$30 days of each other. Procedures occurring outside this window were excluded (8% of procedures).

All reported analysis results were unweighted. However, we constructed sample weights to reflect the overall study population (n = 1001) and sampling shown in Fig. 1. We compared weighted and unweighted results to judge the robustness of the primary conclusions. Weighted and unweighted measures of agreement between the data sources differed by <3% in all cases. We report unweighted results for two reasons. First, the overall population was itself a sample and not necessarily representative of the North Carolina Medicare population. Second, for some comparisons, the number of subjects with tests was small so that the use of the statistical weights increased the variance of the estimate substantially.

We considered the possibility for the need to adjust for clustering by physician offices. We present results without adjustment for clustering because, although the variance and hence the length of confidence intervals for estimates of concordance would increase with adjustment for clustering, the effect on these results would be minimal due to the large number of physician offices where medical records were abstracted and the limited number of offices with multiple records per office.

Results

Study Participants and their Physicians. Of the 561 participants in the study, 89% were 65 years or older, and 61% were females (Table 1). Almost half of the group, 47%, had more than high school education. Eligible participants included in the study were less likely to be African American and more likely to have higher educational attainment. Abstractions were conducted at 269 physician offices (Table 2). The physicians included

Table 1. Characteristics of Medicare enrollees included in validation study, 2002

		Included in study		Not included in study	
		n	Percentage	*n*	Percentage
	All study participants	561	100	375	100
Age	50-64	59	10.5	50	13.3
	65-74	351	62.7	226	60.3
	75-80	150	26.8	99	26.4
Race*	African American	132	23.5	136	36.3
	White	429	76.5	239	63.7
Sex	Female	342	61.0	235	62.7
	Male	219	39.0	140	37.3
Education*	Less than high school	94	16.8	110	30.0
	High school	196	34.9	131	35.7
	Post–high school	264	47.1	126	34.3
Marital status	Married	358	63.8	214	57.1
	Divorced/separated/single	55	9.8	34	9.1
	Widowed	144	25.7	120	32.0
Low income	No state ''buy in''	525	93.6	344	91.7
	State ''buy in''	36	6.4	31	8.3
Enrollee region of residence	Eastern North Carolina	83	14.8	47	12.5
	Central North Carolina	328	58.5	236	62.9
	Western North Carolina	150	26.7	92	24.6

NOTE: Percentages may not add to 100% due to missing data.
*χ^2 test significant at $P < 0.05$ for difference between those included and not included in study.

Table 2. Characteristics of physician offices included in the medical record abstraction for validation study

		n	Percentage
	All physician offices	269	100
Practice type	Primary care	184	68.4
	Gastroenterologist	28	10.4
	Multispecialty	38	14.1
	Others	18	6.7
Practice size	Solo	54	20.1
	2-5 physicians	112	41.6
	6-10 physicians	56	20.8
	11-20 physicians	17	6.3
	21 physicians and over	30	11.2
Type of records	Paper	237	88.1
	Electronic	31	11.5
Practice location	Eastern North Carolina	49	18.2
	Central North Carolina	160	59.5
	Western North Carolina	60	22.3

in the medical record abstraction were identified primarily from the information provided in the survey, although in 35% of the cases, the medical record abstracted was from a physician not identified by the participant (data not shown). The majority of offices visited for record abstraction were primary care practices. Most practices were small, with 62% either solo or comprising two to five physicians. The majority of medical records accessed were paper-based, with only 11% of records accessed in electronic format. In the medical record abstraction, data were obtained on 429 procedures, likely an underestimate of total endoscopy utilization during the study window because detailed data were only collected for the two most recent procedures of each type. Based on the record abstraction, 20% of participants had more than one endoscopy procedure during the 5-year study period.

Prevalence of Endoscopy Use by Data Source. The colorectal cancer test use rates observed among study participants were low in all three data sources (Table 3). The rates obtained from self report and Medicare claims were comparable for sigmoidoscopy (23% versus 22%), colonoscopy (38% versus 35%), and endoscopy (50% versus 45%), although the rates from self report were somewhat higher in each case. For colonoscopy, use rates from medical records were comparable with those obtained by claims and survey. In contrast, sigmoidoscopy rates were substantially lower in medical records than in claims or self report. Looking across all data sources, the percentages of the sample with evidence of sigmoidoscopy or colonoscopy in any source were 36% and 50%, respectively (data not shown).

Significant variation in sigmoidoscopy test use was seen across regions of the state in all data sources (Table 3). Self-reported colonoscopy rates varied significantly by race, education level, and Medicaid eligibility status. Claim-based and medical record–based rates of colonoscopy use were not significantly associated with participant characteristics.

Bias observed in the self-reported data, as measured by the report-to-records ratio, was higher for comparisons of the survey and medical record than for the survey to claims and higher for sigmoidoscopy than colonoscopy. The report-to-records ratio for sigmiodoscopy was 1.9 for the survey to medical record comparisons and 1.2 for the survey to claims comparisons. The report-to-records ratio for colonoscopy was 1.1 in both survey to medical records and survey to claims comparisons.

Concordance between Data Sources. Concordance between the data sources as to whether the study participant had a colorectal endoscopic procedure was better for Medicare claims to the medical record than either the survey to the medical record or the survey to

Table 3. Prevalence of colorectal endoscopy use by study participants (*n* = 561) by data source

		Sigmoidoscopy			Colonoscopy			Endoscopy		
		Self report	Claim	Medical record	Self report	Claim	Medical record	Self report	Claim	Medical record
		n = 128	*n* = 121	*n* = 85	*n* = 216	*n* = 197	*n* = 191	*n* = 281	*n* = 252	*n* = 237
	All study participants	22.8	21.6	15.2	38.5	35.1	34.1	50.1	44.9	42.3
Age	50-64 y	25.4	13.6	8.5	39.0	33.9	30.5	50.8	35.6	32.2
	65-74 y	23.9	22.2	15.4	40.2	33.6	33.0	52.4	43.9	40.7
	75-80 y	19.3	23.3	17.3	34.0	38.7	38.0	44.0	50.7	50.0*
Race	African American	28.8	18.2	13.6	28.0	34.1	33.3	40.9	41.7	42.4
	White	21.0	22.6	15.6	41.7*	35.4	34.3	52.9*	45.9	42.2
Sex	Female	23.7	19.6	16.7	35.7	32.5	33.0	46.8	43.6	42.7
	Male	21.5	24.7	12.8	42.9	39.3	35.6	55.3	47.0	41.6
Education	Less than high school	20.2	13.8	9.6	22.3	35.1	33.0	28.7	39.4	38.3
	High school	24.0	22.4	14.8	34.7	34.7	34.2	46.9	45.9	41.8
	High school plus	23.5	24.2	17.4	46.6*	34.8	33.7	59.8*	45.8	43.6
Marital status	Married	24.9	22.1	15.4	41.9	37.7	34.6	55.0	46.4	42.7
	Divorced, separated, single	14.5	21.8	14.5	34.5	32.7	32.7	40.0	43.6	40.0
	Widowed	20.8	20.1	14.6	31.9	29.9	33.3	42.4*	41.7	41.7
Low income	No State ''buy in''	23.0	21.7	15.0	39.4	35.6	34.3	51.1	45.4	42.6
	State ''buy in''	19.0	19.0	19.0	14.3*	23.8	28.6	23.8*	33.3	33.3
Region	Eastern North Carolina	19.3	27.7	13.3	45.8	34.9	34.9	50.6	44.6	44.6
	Central North Carolina	18.9	17.1	10.7	35.4	34.1	31.7	46.0	41.8	37.2
	Western North Carolina	33.3*	28.0*	26.0*	41.3	37.3	38.7	58.7*	52.0	52.0*

NOTE: Colorectal endoscopy includes sigmoidoscopy and colonoscopy procedures.
*χ^2 test significant at $P < 0.05$ for difference in test use rates by demographic characteristic within the data source.

claims (Table 4). Sensitivity and specificity of Medicare claims for measuring sigmoidoscopy and colonoscopy exceeded 90%. Negative predictive value and agreement for sigmoidoscopy and colonoscopy measured by claims also exceeded 90%. The positive predictive value of claims to capture sigmoidoscopy was lower (65%), indicating there were more claims for sigmoidoscopy tests than were found in the medical record. κ statistics for sigmoidoscopy represent ''substantial agreement'' (0.72) and for colonoscopy are considered ''almost perfect agreement'' (0.89). Agreement between the claim and medical record was not improved by combining both procedures into a single category of endoscopy, although the positive predictive value was higher than that seen for sigmoidoscopy, likely due to the fact that many of the study participants with a claim for sigmoidoscopy, but no evidence of the test in the medical record, had both a claim and medical record documentation for a colonoscopy procedure.

Comparisons of medical record and claim when the claim was designated as the ''gold standard'' showed similar results for colonoscopy and endoscopy. However, the sensitivity statistic for sigmoidoscopy was substantially lower (65%), again reflecting the fact that this study population had more claims for sigmoidoscopy than were found in the medical records.

Concordance between self report and medical record for sigmoidoscopy, colonoscopy, and endoscopy was lower than for the claim to medical record comparison. Sensitivity ranged from 56% to 74% and agreement from 69% to 79%. κ statistics for these comparisons represent ''fair agreement.'' Comparison of self report to claim also revealed lower agreement than the claim to medical record comparisons. Sensitivity was 43% for sigmoidoscopy, 69% for colonoscopy, and 73% for endoscopy. Again, the κ statistics for these comparisons indicated agreement in the ''fair'' (for sigmoidoscopy and endoscopy) to ''moderate'' (for colonoscopy) range. Agreement between data sources as to the type of endoscopic procedure conducted (i.e., sigmoidoscopy or colonoscopy) was good (Table 5). Claim and medical record agreed 93% of the time, self report and medical record agreed 82% of the time, and claim and self report agreed 77% of the time. In contrast, agreement between data sources as to the purpose of the test (i.e., screening versus diagnostic) was poor in all comparisons: 52% for claim to medical records, 65% for self report to medical record, and 29% for claim to self report.

Discussion

This report is the first study to compare Medicare claims, medical records, and self report as data sources for measuring colorectal endoscopy use in the Medicare population. We undertook this study primarily to answer the question of whether Medicare claims can be used to measure colorectal cancer test use. Our findings support the validity of Medicare claims as a data source for measuring colorectal endoscopy. There was substantial agreement between claims and medical records in ascertaining colorectal endoscopy use, with agreement better for colonoscopy than sigmoidoscopy. The fact that the concordance for colonoscopy is greater than for sigmoidoscopy may be due to factors related to the study protocol rather than to higher accuracy of data for colonoscopy *per se*. For this study, if we had a claim for a test but no evidence of it in the medical record, we accessed procedure reports from the performing physician for the most recent procedure. Since few enrollees will have a sigmoidoscopy after a colonoscopy, this meant our second data collection generally occurred in

Table 4. Measures of concordance for colorectal endoscopy use by Medicare claims, medical records, and self report

Data sources compared*	Type of test	Test use by source						Measures of concordance			
		Both sources (*A*)	Non–gold only (*B*)	Gold only (*C*)	Neither source (*D*)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Agreement (95% CI)	$\kappa^{\dagger}$ (95% CI)
Claim to medical record	Sigmoidoscopy	79	42	6	434	93 (87-98)	91 (89-94)	65 (57-74)	99 (98-100)	91 (89-94)	0.72 (0.64-0.80)[B]
	Colonoscopy	180	17	11	353	94 (91-98)	95 (93-98)	91 (87-95)	97 (95-99)	95 (93-97)	0.89 (0.81-0.97)[A]
	Endoscopy	230	22	7	302	97 (95-99)	93 (90-96)	91 (88-95)	98 (96-99)	95 (93-97)	0.89 (0.81-0.98)[A]
Medical record to claim	Sigmoidoscopy	79	6	42	434	65 (57-74)	99 (98-100)	93 (87-98)	91 (89-94)	91 (89-94)	0.72 (0.64-0.80)[B]
	Colonoscopy	180	11	17	353	91 (87-95)	97 (95-99)	94 (91-98)	95 (93-98)	95 (93-97)	0.89 (0.81-0.97)[A]
	Endoscopy	230	7	22	302	91 (88-95)	98 (96-99)	97 (95-99)	93 (90-96)	95 (93-97)	0.89 (0.81-0.98)[A]
Self report to medical record	Sigmoidoscopy	38	90	30	403	56 (44-68)	82 (78-85)	30 (22-38)	93 (91-95)	79 (75-82)	0.27 (0.20-0.35)[D]
	Colonoscopy	132	84	59	286	69 (63-76)	77 (73-82)	61 (55-68)	83 (79-87)	75 (71-78)	0.45 (0.37-0.53)[C]
	Endoscopy	170	111	60	220	74 (68-80)	67 (61-72)	61 (55-66)	79 (74-83)	70 (66-73)	0.39 (0.31-0.47)[D]
Self-report to claim	Sigmoidoscopy	47	81	63	370	43 (33-52)	82 (78-86)	37 (28-45)	85 (82-89)	74 (71-78)	0.23 (0.15-0.32)[D]
	Colonoscopy	136	80	61	284	69 (62-75)	78 (74-82)	63 (57-69)	82 (78-86)	75 (71-78)	0.46 (0.38-0.54)[C]
	Endoscopy	183	98	69	211	73 (67-78)	68 (63-73)	65 (60-71)	75 (70-80)	70 (66-74)	0.40 (0.32-0.49)[D]

NOTE: Concordance measures were assessed using the following formulas: Sensitivity = $[A / (A + C)] \times 100$; Specificity = $[D / (B + D)] \times 100$; PPV = $[A / (A + B)] \times 100$; NPV = $[D / (C + D)] \times 100$; Agreement = $[(A + D) / (A + B + C + D)] \times 100$; κ = (percentage of agreement − percentage of expected agreement) / 1 − percentage of expected agreement, where expected agreement = $\{[(A + B) / (A + B + C + D)] \times [(A + C) / (A + B + C + D)]\} + [(C + D) / (A + B + C + D)] \times [(B + D) / (A + B + C + D)] \times 100$.

Abbreviations: 95% CI, 95% confidence interval; PPV, positive predictive value; NPV, negative predictive value.

*Comparisons are made using the second source listed as the ''gold standard.''

† Strength of agreement based on κ: A = 0.81-1.00 *Almost Perfect*. B = 0.61-0.80 *Substantial*. C = 0.41-0.60 *Moderate*. D = 0.21-0.40 *Fair*.

Table 5. Agreement regarding type and purpose of colorectal endoscopy for Medicare claims, medical records, and self report

	Test type by source					Test purpose by source				
Data sources compared*	SIG in both sources	SIG in source 1 COL in source 2	COL in source 1 SIG in source 2	COL in both sources	Agreement on type of test (95% CI)	Screening in both sources	Screening in source 1 nonscreening in source 2	Nonscreening in source 1 screening in source 2	Nonscreening in both sources	Agreement on purpose of test (95% CI)
Claim to medical record (n =137) †	42 31%	9 6%	1 1%	84 62%	93% (88-97%)	17 14%	0 0%	60 48%	48 38%	52% (43-61%)
Self report to medical record (n =107) †	19 18%	7 7%	12 11%	68 64%	82% (75-89%)	55 57%	24 25%	10 11%	7 7%	65% (55-74%)
Self report to claim (n =124) †	21 17%	13 11%	15 12%	75 60%	77% (70%-85%)	18 15%	86 70%	2 1%	17 14%	29% (20-36%)

NOTE: Limited to study participants with a single test in the ''gold'' source and evidence of a test in the second source.
Abbreviations: SIG, sigmoidoscopy; COL, colonoscopy.
*Source 1 refers to the first source listed, and source 2 refers to the second source listed in each comparison. The second source is considered the ''gold.''
† n's do not sum to total because of missing information as to type or purpose of test in medical record or survey.

gastroentrologists offices, where colonoscopies were done. However, because other researchers have reported better agreement for colonoscopy than sigmoidoscopy in comparisons of self report and medical record, the precise reason for the better concordance is not known (31).

Our data showed more procedure use in Medicare claims than in medical records, for both sigmoidoscopy and colonoscopy. We believe this is due to the fact that Medicare is the primary payer for most enrollees, yet most enrollees have more than one physician. The medical record has been defined by others as the ''gold standard'' for information about colorectal endoscopy use (10, 12). However, to be a gold standard, the medical record should contain comprehensive information about all services. We found many instances in which primary care provider records contained information indicating that a colorectal endoscopy procedure had been done, but no supporting documentation, such as a procedure report, making it difficult to identify precisely when a procedure had been done. In this study, we found that of the 252 of beneficiaries who had an endoscopy recorded in Medicare claims, 19% had no evidence of the procedure in the primary care provider's record, and additional work was needed to locate the doctor who did the procedure and abstract the correct medical record. Whereas it is possible that the procedures reported on Medicare claims were never done, we think it is more likely that the information on the primary care providers records are incomplete. An earlier study that compared eye procedures identified from Medicare claims with the medical records of ophthalmologists found that 99% of the procedures reported on the claims were validated on the medical record (32). Based on our results, we believe that Medicare claims provide a more complete picture of colorectal endoscopy use than can be found in any single or even multiple physician office records, suggesting that claims may actually be the preferred data source for measuring colorectal endoscopy use in the fee-for-service Medicare population.

Despite the utility of the Medicare data to measure colorectal endoscopy use, our results suggest that claims cannot be used to distinguish screening from diagnostic procedures. The inability of Medicare claims to distinguish screening procedures likely reflects policies regarding coding and reimbursement. Medicare's coverage policy states that if, during the course of a screening colonoscopy, a lesion or growth that results in a biopsy or removal of the growth is detected, the procedure should be coded as diagnostic rather than screening. Thus, procedures conducted for the purpose of screening may be reported by the patient or recorded in the medical record as screening, but coded in the claims as diagnostic. The inability to accurately distinguish diagnostic and screening procedures in the Medicare claims has significance for researchers who use these data to measure screening rates. Studies that limit the claims to only those with a screening code will miss close to half of all procedures reported as screening in the medical record. Studies that include both diagnostic and screening codes on claims to assess screening will overestimate true screening rates. However, inclusion of all endoscopies can provide a benchmark of the number of Medicare beneficiaries who have ever had an endoscopy. In studies that include all endoscopies, the term ''testing'' in lieu of screening may more accurately reflect what is being reported.

Whereas the primary focus of our analysis was the ability of Medicare claims to measure colorectal endoscopy, our study provides insight into the utility of other sources of information about endoscopy use. We found that test use rates based on enrollee survey responses were higher than those based on medical record or claims data. We also observed differentially higher rates of self-reported colonoscopy by race, which has been found by Fiscella and colleagues (33). Whether the higher use rates obtained through survey represent an overestimate, as suggested by others (9-11), or accurately reflect test use perhaps from times not covered by the claim or medical record is unknown. We also showed that all three data sources (self report, claims, and medical records) accurately distinguish the type of procedure done (sigmoidoscopy versus colonoscopy).

A few methodologic considerations of our study should be recognized. First, the process we used to

identify the appropriate medical records for our study group may have resulted in some errors of assignment. Whereas it would not have been possible to abstract a chart for a patient if he/she had never seen a selected physician; it would have been possible to abstract a chart from the wrong physician because patients may have more than one physician who serve as the primary care provider, especially over a 5-year period. However, we attempted to correct such mismatches by abstracting a second record from the performing physician if no evidence of an endoscopic procedure was found when it was expected based on self report or claims. Agreement between data sources may have been higher had this study been conducted in an integrated health care system wherein communication between physicians performing procedures and those providing primary care are enhanced by shared medical records or electronic data systems. A second limitation of this study is that the data come from a single state. Test use and communication patterns of physicians may be different in other parts of the country. Finally, these analyses were restricted to fee-for-service Medicare enrollees. The extent to which the results might be generalized to other states may depend on the state proportion of Medicare enrollees covered under managed care plans. At the time of this study, North Carolina had a small percentage of the Medicare population enrolled in managed care plans (5%). However, nationally, the percentage of the Medicare population covered under such plans was about 13% and varied from state to state (34).

This study provides an important contribution to the literature on validation of data sources for colorectal cancer tests. Unlike most validation studies that are conducted in managed care or a single provider setting, our study was conducted in a nonintegrated system, thereby providing insights into the type of concordance that exists in community settings, wherein the majority of Medicare enrollees receive care (34).

The community-based approach to this study also allows the results to be used to inform cancer screening and early detection practice. The fact that information about endoscopy procedures done by another provider is not always found in the primary care physician's medical records is problematic. How can primary care physicians know when to recommend a colorectal cancer test if procedure reports are not sent to them and the date of the last procedure is not recorded in the medical record? The burden falls on the patient to accurately recall when the last test was completed, which is especially concerning given the 5-year to 10-year intervals recommended for routine screening with endoscopy. Unlike other preventives services, such as mammography or flu shots, that can be ''associated'' with a yearly event like a birthday, remembering due dates for colorectal endoscopy can be complicated. And, for Medicare reimbursement, the interval between tests must be exact (for average risk enrollees, at least 47 months following the month of the last covered screening sigmoidoscopy and 119 months following the month of the last covered screening colonoscopy). An earlier study found that patient reports of invasive procedures had high agreement with the medical record, with some telescoping of the time of the procedure (35).

There is considerable interest in the use of electronic health records along with optimism that information technology will enhance preventive care. However, emphasis must be placed not only on promoting the use of electronic health records but also on assuring portability of electronic health information and interoperability across electronic health record systems so that information about preventive services, such as colorectal cancer screening conducted by one physician will be accessible to other physicians in different offices, caring for the same patient. Furthermore, since the proportion of offices using electronic records was quite small, at least at the time of our study in North Carolina, approaches to communicating screening information across practices that are not dependent on electronic health records are also needed. A policy requiring physicians who perform an endoscopy procedure to report the results of the procedure to the patient's primary care provider would enhance the ability of primary care providers to appropriately counsel their patients on the need for colorectal cancer tests. The Mammography Quality Standards Act provides a model for such an approach (36).

Finally, colorectal cancer care is very costly to Medicare (over $3.5 billion dollars in 1996; ref. 37). Prevention of colorectal cancer through regular endoscopy could reduce the cost to Medicare of colorectal cancer treatment. To ensure that patients receive appropriate screening, the Centers for Medicare and Medicaid Services could consider using claims to help physicians identify persons who need colorectal cancer screening.

Appendix. Identification of colorectal endoscopy procedures in Medicare claims

Procedure	Codes to identify diagnostic procedures	Codes to identify screening procedures
Sigmoidoscopy	45330 (CPT) 45331 (CPT) 45333 (CPT) 45334 (CPT) 45337-45339 (CPT) 45.24 (ICD-9-CM) 45.42 (ICD-9-CM) 48.21-48.25 (ICD-9 CM)	G0104 (HCPCS)
Colonoscopy	45378 (CPT) 45380 (CPT) 45382-45385 (CPT) 45.21-45.23, 45.25 (ICD-9 CM)	G0105 (HCPCS) G0121 (HCPCS)
Endoscopy	Any of the above	Any of the above

Abbreviations: ICD, International Classification of Diseases (9th edition); HCPCS, Healthcare Common Procedure Coding System.

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