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## Accuracy of Medicare claims for identifying findings and procedures performed during colonoscopy

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### Abstract

**Background**—Administrative claims data are frequently used for quality measurement.

**Objective**—To examine the accuracy of administrative claims for potential colonoscopy quality measures, including findings (polyp or tumor detection), procedures (biopsy or polypectomy), and incomplete colonoscopy.

**Design**—Cross-sectional study.

**Patients**—Patients age 65 and older undergoing colonoscopy in the Clinical Outcomes Research Initiative National Endoscopic Database in 2006. We linked colonoscopy records for these patients to Medicare colonoscopy claims by using patient age, sex, date of procedure, and performing provider's Unique Physician Identification Number.

**Main Outcome Measurements**—Sensitivity, specificity, positive and negative predictive values of the Medicare claims for potential quality measures, including colonoscopy findings and procedures.

**Results**—We linked Medicare colonoscopy claims to 15,168 of the 30,011 Clinical Outcomes Research Initiative colonoscopy records. Sensitivity of the claims for colon polyps was 93.4%, with a specificity of 97.8%. Sensitivity of claims for other diagnoses, including colorectal tumors was suboptimal, although specificity was high. In contrast, sensitivity of claims for procedures—biopsy (with or without cautery) or polypectomy—was high (87.2%–97.6%), with specificity >97%. Claims had poor sensitivity for identification of incomplete colonoscopy.

**Limitations**—Potential for inaccurate matching of colonoscopy records and Medicare claims.

**Conclusions**—Medicare claims have high sensitivity and specificity for polyp detection, biopsy, and polypectomy at colonoscopy, but sensitivity is low for other diagnoses such as tumor detection and for incomplete colonoscopy. Caution is needed when using Medicare claims data for certain important quality measures, in particular tumor detection and incomplete colonoscopy.

Examination of quality of care for routine clinical problems and procedures is becoming increasingly important. As a high-volume and high-cost procedure, colonoscopy is attracting attention for quality measurement.<sup>1</sup> Previous studies, often based on case series or retrospective chart review, have shown significant variation between providers in important

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colonoscopy quality measures, such as incomplete colonoscopy, polyp detection, and polypectomy rates.<sup>2-15</sup> On a systems level, administrative claims data are an attractive data source for quality measurement, but the accuracy of such data for important colonoscopy quality measures is unknown. Studies of Medicare claims data have shown that coding for procedures is generally quite accurate.<sup>16-19</sup> However, coding for diagnoses is often suboptimal.<sup>17,20-22</sup> The aim of this study was to examine the accuracy of Medicare administrative claims for important colonoscopy quality measures, including findings such as polyp or tumor detection and procedures such as biopsy and polypectomy, and incomplete colonoscopy.

## METHODS

This study was approved by the Institutional Review Board of the University of Washington. We obtained a waiver of consent for Health Insurance Portability and Accountability Act. authorization.

### Data sources

We obtained records for patients age 65 and older who underwent colonoscopy by physicians participating in the Clinical Outcomes Research Initiative (CORI) National Endoscopic Database in 2006.<sup>23-25</sup> The CORI data warehouse contains data derived from the medical records of GI endoscopy procedures. Practice sites participating in CORI use specialized software to generate all procedure reports. Data including procedure indications, findings, and performance of biopsy or polypectomy are entered into the software to generate the medical record report. Data are also entered regarding patient demographics, comorbidity using the American Society of Anesthesiologists classification, procedure completeness, medications used, and immediate complications. Efforts are made by CORI to include broad representation of current endoscopic practice, with sites chosen for participation according to size, location, and type (academic vs Veterans Affairs vs community based). Patient demographic data available in the CORI endoscopy reports include age, sex, and race/ethnicity. Because personal health information is removed from the CORI data to comply with Health Insurance Portability and Accountability Act regulations, the exact date of birth is not available, but age is available to 1/100th year. All reports contain standard data elements about the colonoscopy, including the indications for the endoscopic procedure, findings and diagnoses, extent of colonoscopy (eg, colonoscopy to cecum), and additional procedures performed, such as biopsy and polypectomy. Most data are entered in a check-box format or from pull-down lists; options for entering data in free text format are also available. Before a procedure report can be completed, endoscopists must enter patient demographic information, at least 1 colonoscopy indication, the extent of the examination, quality of the bowel preparation, abnormal findings or alternatively that the examination was normal, and the occurrence of unplanned events or interventions.

We excluded endoscopists whose practices were no longer active CORI participants in 2009 and endoscopists from Veterans Affairs or military sites, because these facilities generally do not submit claims to Medicare. The 270 eligible endoscopists were mailed informational materials about the study and given the opportunity to opt out of participating. A total of 190 endoscopists from 55 practice sites gave consent to use their data for this study. Our analysis was limited to procedures documented in CORI that were performed on patients covered by Medicare. CORI endoscopists were matched to their Unique Physician Identification Numbers (UPINs) to facilitate identification of corresponding colonoscopy claims from the Medicare databases. This list of participating physicians' UPINs was submitted to the Centers for Medicare and Medicaid Services (CMS). By using the relevant Current Procedural Terminology (CPT) and Healthcare Common Procedures Coding System (HCPCS) (Table 1), claims for colonoscopy procedures performed by these physicians in

2006 were extracted from the Medicare Carrier and Out-patient files through the Chronic Conditions Warehouse (CCW).<sup>26</sup> The Carrier File contains claims for inpatient and outpatient physician services, whereas the Outpatient File contains claims from institutional providers, such as hospital outpatient departments and ambulatory surgery centers. Each claim includes important items such as the date of service, performing provider UPIN, procedures performed, and associated diagnoses. Procedures are coded by using the CPT or HCPCS codes, whereas diagnoses are coded by using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnostic codes. Beneficiaries are identified on the claims by using a unique health care identification number. We used the Beneficiary Summary File from the CCW to obtain relevant patient demographic information, such as age and sex.

### Linkage of data sources

We used 4 matching criteria to link the CORI procedure reports to the corresponding Medicare claims: performing provider UPIN, patient age (to 1/100 year), patient sex, and date of service. We required exact matching for performing provider UPIN and patient sex. To define the colonoscopy claim date of service, we used the variables `expnsdt1` and `expnsdt2` in the CCW file, which identify the first and last dates of service for the line item in the claim. If the first and last dates of service were not the same, the date of service in the CORI record could match to any date within the range of service dates  $\pm 1$  day. Patient age in the Medicare files was calculated from the date of service and beneficiary birth date. We matched patient age to 1/100th of a year and date of service  $\pm 1$  day. We did not link to any direct identifiers in the CMS claims.

Some CORI records matched to more than 1 claim in the Carrier or Outpatient CCW File. In these instances, we used CPT/HCPCS and ICD-9-CM codes from all available claims in the Carrier and Outpatient Files in our analysis. Conversely, in some instances ( $n = 8$ ), 1 Medicare colonoscopy claim appeared to match to more than 1 CORI colonoscopy record. For example, there may have been more than 1 patient with the same age who underwent colonoscopy by the same physician within the range for date of service range that was required for matching. In cases in which we could not be certain which procedure was a true match to the colonoscopy claim, we excluded the claim from analysis. After applying these matching criteria and exclusions, we had 15,168 matched claims for analysis.

### Definition of findings and additional procedures performed in CORI records

We used the CORI check-box data and searched free text fields to identify the findings and procedures performed at colonoscopy. The additional procedures of interest included biopsy with or without electrocautery, snare polypectomy, and ablation. Findings of interest included colon or rectal polyps, colon or rectal tumors, angiodysplasia, diverticulosis, and internal or external hemorrhoids. We used the CORI variable for extent of examination to identify incomplete colonoscopy. We created 2 different definitions of incomplete colonoscopy. Consistent with guidance from CMS about coding for incomplete colonoscopies, the first definition identified complete colonoscopy as an examination that reached proximal to the splenic flexure.<sup>27</sup> In accordance with common clinical practice, the second definition identified complete colonoscopy as an examination that reached the cecum, terminal ileum, or surgical anastomosis.

### Definitions of findings and additional procedures performed in claims data

We used the CPT/HCPCS codes to identify additional procedures and ICD-9-CM codes to identify diagnoses associated with the colonoscopy (Table 1). Incomplete colonoscopy was identified by use of the HCPCS modifier 53 (ie, “discontinued procedure”) on the colonoscopy claim.<sup>27</sup>

## Data analysis

By using the CORI colonoscopy record as the criterion standard, we examined the sensitivity, specificity, and positive and negative predictive values of the Medicare claims for diagnoses and additional procedures documented in CORI.

## RESULTS

We matched 15,168 CORI colonoscopy reports to the Medicare claims, with 14,928 unique patients. Characteristics of the patients and providers are shown in Table 2. Participating endoscopists had a mean of 82.4 colonoscopies (standard deviation 85.9) included in this study. Sensitivity and specificity of the claims codes for colonoscopy findings varied considerably (Table 3). Sensitivity and specificity were quite high for colorectal polyps, at 93.4% and 97.8%, respectively. However, sensitivity of Medicare claims for colon or rectal tumors was only 56.9%, with a specificity of 97.8%. Because of the low overall prevalence of colon or rectal tumors, the positive predictive value of a claims code for colon or rectal tumors was low, at 26.1%. Similarly, sensitivity of claims for other diagnoses, including diverticulosis, angiodysplasia, colitis, and internal or external hemorrhoids was relatively low, although in all cases the specificity of the codes was >90%.

In contrast, the sensitivity and specificity of the claims for biopsy or polypectomy were quite high (Table 3). Coding for ablation procedures was less accurate, with sensitivity of 46% and specificity of 99%. Finally, the claims coding for incomplete colonoscopy was suboptimal. When incomplete colonoscopy was defined as a colonoscopy that did not reach proximal to the splenic flexure, consistent with CMS coding guidelines,<sup>27</sup> sensitivity of the claims was 65.5%, with a specificity of 99.7%. If we defined incomplete colonoscopy as one that did not reach the cecum, terminal ileum, or surgical anastomosis to be more consistent with clinical practice, the sensitivity of the claims was 30.6%, with a specificity of 99.9%.

Because identification of malignant colorectal tumors is an important goal of colonoscopy, this may be used as a quality measure. To further explore why accuracy of claims coding for colorectal tumors is low, we examined procedures in which there was a discrepancy between CORI and the Medicare claims in the presence of a malignant colon or rectal tumor. An ICD-9 code for colon, rectal, or anal polyp was found on the Medicare claims in 65 of the 88 procedures (73.9%) in which a colorectal tumor was documented in CORI but not in the claims. Conversely, a colorectal polyp was identified in 241 of 329 CORI records (73.2%) when a malignant colorectal tumor was documented in the Medicare claims, but not in CORI. If polyps and tumors are combined in the analysis, the sensitivity of Medicare claims for colorectal polyps or tumors is 97.1%, with a specificity of 97.3% (Table 3).

In secondary analyses, we found substantial variation between practices in sensitivity and specificity of the Medicare claims for colonoscopy with biopsy, snare polypectomy, and polyp or tumor detection. Because of small numbers of incomplete colonoscopies, we did not look at variation in accuracy for this measure. When examining 44 sites with at least 50 procedures included in our database, we found that sensitivity of the Medicare claims for colonoscopy with biopsy varied between 28.6% and 100% (Supplemental Table, available online at [www.giejournal.org](http://www.giejournal.org)). Sensitivity was 50% at 6 sites, between 50% and 80% at 8 sites, and >80% at 30 sites. Specificity for colonoscopy with biopsy varied between 63% and 100%, but was <80% at only 4 sites. Sensitivity for snare polypectomy varied between 81.8% and 100%, with 3 sites having sensitivity <90%. The range for specificity for snare polypectomy was 35% to 100%, but only 2 sites had specificity <90%. There was also substantial variation in sensitivity for polyp detection. At 1 site, sensitivity was only 1.5%, but sensitivity was >90% at 38 of the 44 sites. When we looked at sensitivity for polyps and tumors combined, sensitivity ranged from 70.7% to 100%, and specificity from 72.4% to

100%. Because of the small numbers of colorectal tumors in this data set, we did not examine variability in sensitivity and specificity of the claims for tumors alone. We also examined variation in accuracy by practice type (academic vs community) and found similar sensitivity and specificity for polyps, polyps and tumors combined, biopsy, and snare polypectomy (data not shown).

## DISCUSSION

We found high sensitivity and specificity of Medicare claims for procedures performed, but accuracy of claims for identification of incomplete colonoscopy was suboptimal. Furthermore, the claims coding had high sensitivity and specificity for identification of colorectal polyps found during colonoscopy, but lacked sensitivity for other important diagnoses, including colorectal tumors. These findings are similar to those of other studies examining coding for other procedures and diagnoses,<sup>16-22</sup> which have generally found that coding for procedures is more accurate than for diagnoses. However, to our knowledge, this is the first study to examine coding accuracy specifically for colonoscopy procedures and diagnoses.

The higher accuracy of claims coding for procedures performed is not surprising because the codes submitted for procedures will directly influence payment received. Therefore, providers have a strong incentive to accurately code procedures to maximize reimbursement. For example, if more than 1 method of treatment is applied to a given polyp, providers may choose to submit a code for the procedure with higher reimbursement. This may result in providers submitting codes for snare polypectomy or ablation over biopsy, potentially explaining the lower sensitivity of the Medicare claims for biopsy as documented in the CORI records. Conversely, diagnosis coding does not directly affect reimbursement. Providers are required to document only 1 diagnosis on submitted claims and may choose not to submit ICD-9-CM diagnosis codes for conditions other than the primary diagnosis. For example, if both polyps and hemorrhoids are found at colonoscopy, the endoscopist may choose to submit an ICD-9-CM diagnosis code for polyps because hemorrhoids may be the less clinically important diagnosis. This may explain the high sensitivity of claims coding for colorectal polyps compared with other diagnoses, such as diverticulosis and hemorrhoids. It should also be noted that CMS claims allow for submission of only 4 ICD-9-CM diagnosis codes, which may explain the lower sensitivity of the claims for certain diagnoses that may be less clinically important. Last, endoscopists may delay submitting claims for colonoscopy until biopsy results are available. This may lead to choice of more accurate ICD-9-CM diagnosis codes, but should not affect coding for procedures performed. The CORI software also offers the option for endoscopists to update the colonoscopy report with pathology results. We do not know whether endoscopists in this study delayed claims submissions while awaiting biopsy results.

The low sensitivity of the claims for malignant colorectal tumors is particularly concerning. We examined claims for colonoscopies in which a tumor was documented in the CORI record, but not in the claims. In >70% of these claims, there was an ICD-9-CM code submitted for a colorectal or anal polyp. When a malignant colorectal tumor was found in the colonoscopy claims, but not in the CORI record, a colorectal polyp was found in >70% of the CORI records. This suggests that endoscopists may often code colorectal polyps as tumors when submitting colonoscopy claims or vice versa. For example, at the one site with extremely low sensitivity for polyps (1.5%), sensitivity increased to 99.9% when looking at polyps and tumors combined. The CORI software has check-box data entry points for colon tumors, but endoscopists may use this field when a malignant tumor is suspected but not established. Endoscopists may also use this field for benign colon tumors such as lipomas. This may cause some of the misclassification of tumors and polyps that we found. In



addition, documentation of pathology results in CORI is frequently incomplete, so the diagnosis of colon and rectal tumors cannot be confirmed from the CORI data. If the claims codes are determined at the time of the procedure, endoscopists may choose to code masses as polyps because the diagnosis of malignancy has not been confirmed. Based on these findings, investigators may need to use codes for polyps and tumors in combination when using CMS administrative data in future studies.

We also found suboptimal sensitivity of the claims for incomplete colonoscopy. Medicare guidelines define an incomplete colonoscopy as one that does not reach proximal to the splenic flexure,<sup>27</sup> whereas most gastroenterologists consider a complete colonoscopy as one that reaches the cecum, terminal ileum, or surgical anastomosis. Although higher when the Medicare definition of incomplete colonoscopy was used, the sensitivity of the claims was low for either of these definitions. This has clear implications for using claims data to study incomplete colonoscopy as a quality measure. For example, recent Canadian studies found decreased effectiveness of colonoscopy in detecting right-sided colorectal tumors.<sup>28,29</sup> Concerns have been raised about these data because of the potential for imprecise coding of complete colonoscopy. Although administrative data are coded differently in Canada, it is possible that colonoscopies were coded as complete when in fact they did not reach the cecum, making detection of proximal polyps and cancers less likely.

We also found substantial variability at different practice sites in the sensitivity and specificity of Medicare claims for polyp or tumor detection, colonoscopy with biopsy, and snare polypectomy. We chose to examine variability by practice site because many practices have coders who handle much of the claims submission. In addition, examining by a provider would be difficult given the low frequency of some of our measures, such as incomplete colonoscopy or tumor detection, in this data set. These results indicate that there are differences in coding choices and patterns by practice site, which may influence reimbursement for services provided.

The strengths of this study are its inclusion of a large number of colonoscopies from diverse practice sites around the country. We were able to link colonoscopy claims directly to the colonoscopy report and to use the actual colonoscopy report as the criterion standard for findings and additional procedures, such as biopsy and polypectomy performed. Our study has some limitations. The first is in the methods that we used to link the CORI records to the Medicare claims. If our matching criteria did not find “true” linkages, our results may be inaccurate. Because we wanted to use records with a high likelihood of matching to maximize the accuracy of our results, we used strict criteria for linkage based on 4 matching variables. Because of these strict criteria, we believe that we have a highly accurate match, but cannot test or verify the accuracy. However, other studies using similar methods to link patient data with administrative records have found high degrees of accuracy (>95%), even without the use of direct patient identifiers.<sup>30</sup>

We used the CORI data repository as our criterion standard because it contains data derived from the medical records reports of endoscopic procedures. Additional strengths of CORI are its inclusion of procedures from diverse practice types and geographic regions. Although data in CORI are derived from medical records, it is possible that they do not accurately represent all the aspects of the colonoscopy that we examined. For example, physicians may not report findings that are potentially of little clinical significance, such as small hemorrhoids. In addition, physicians who participate in CORI are most commonly fellowship-trained gastroenterologists. Physicians who participate in CORI may have greater interest or expertise in endoscopy, and the coding patterns of these physicians may differ from those of endoscopists who do not participate in CORI or from those of physicians of other specialties. In addition, some CORI endoscopists opted out of participation in this

study. The coding patterns of endoscopists who opted out may also differ from those who agreed to participate.

In summary, we found high sensitivity and specificity of Medicare claims data for procedures performed during colonoscopy, such as biopsy and snare polypectomy. Sensitivity was high for a diagnosis of colorectal polyps, but suboptimal for other diagnoses, including colorectal malignancies. With increasing emphasis on measurement of quality for medical procedures including colonoscopy, there is interest in using claims data as a data source. Our results suggest caution is warranted in using claims data for some potential quality measures, including tumor detection and incomplete colonoscopy.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Abbreviations

<b>CCW</b>	Chronic Conditions Warehouse
<b>CMS</b>	Centers for Medicare and Medicaid Services
<b>CORI</b>	Clinical Outcomes Research Initiative
<b>CPT</b>	Current Procedural Terminology
<b>HCPCS</b>	Healthcare Common Procedures Coding System
<b>ICD-9-CM</b>	International Classification of Diseases, 9th Revision
<b>UPIN</b>	Unique Physician Identification Number

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**Take-home Message**

- Administrative claims data are increasingly used for quality assessment. Because claims data may not be accurate for all quality measures, caution is needed when using claims data for certain measures, such as tumor detection and incomplete colonoscopy.

**TABLE 1**

CPT and ICD-9-CM codes to identify procedures and findings in Medicare claims

<b>Finding</b>	<b>ICD-9-CM codes</b>
Diverticulosis	562, 562.1, 562.10, 562.11, 562.12, 562.13
Colon or rectal polyp	211.3, 211.4, 569.0
Colon or rectal tumor	153.x, 154.x, 239.0, 235.2, 230.3
Angiodysplasia	569.84, 569.85
Internal or external hemorrhoids	455.x
Colitis	555.x, 556.x, 009.0, 008.45, 558.x
Colonic ulcer	569.41, 569.82
<b>Additional procedures</b>	<b>CPTcode</b>
Colonoscopy with biopsy, single or multiple (colonoscopy with biopsy)	44389, 45380
Colonoscopy with removal of tumor(s), polyp(s), or other lesion(s) by hot biopsy forceps or bipolar cautery (colonoscopy with hot biopsy)	44392, 45384
Colonoscopy with removal of tumor(s), polyp(s), or other lesion(s) by snare technique (colonoscopy with snare polypectomy)	44394, 45385
Colonoscopy with ablation of tumor(s), polyp(s), or other lesion(s) not amenable to removal by hot biopsy forceps, bipolar cautery, or snare technique (ablation) (colonoscopy with ablation)	44393, 45383

*CPT*, Current Procedural Terminology; *ICD-9-CM*, International Classification of Diseases, 9th Revision, Clinical Modification.

TABLE 2

## Characteristics of patients and endoscopists

Patient characteristics *	No. (%) <sup>†</sup>
Age, y, mean ± standard deviation	74.5 ± 5.8
Sex	
Female	8203 (54.9)
Male	6735 (45.1)
Race	
White	14,292 (96.0)
African American	429 (2.9)
Asian/Pacific Islander	60 (0.4)
American Indian	77 (0.5)
Mixed	25 (0.2)
Unknown	55 (0.4)
Hispanic ethnicity	679 (4.6)
Primary indication for colonoscopy	
Average risk screening	3694 (24.3)
Surveillance of colorectal polyps or cancer	4525 (29.8)
Family history of colorectal polyps or cancer	893 (5.9)
Positive fecal occult blood test	471(3.1)
GI bleeding	1503 (9.9)
Anemia	921 (6.1)
Inflammatory bowel disease	177 (1.2)
Evaluation of other symptoms	2023 (13.3)
Evaluation of other abnormal study	186 (1.2)
Other miscellaneous	490 (3.2)
<b>Provider characteristics (n = 190) *</b>	<b>No. (%)</b>
Practice type	
Academic	28 (14.7)
Community	162 (85.3)
Geographic region	
Northeast	54 (28.4)
North Central	24 (12.6)
Northwest	19 (10.0)
Southeast	31(16.3)
South Central	23 (12.1)
Southwest	39 (20.5)

\* We obtained patient demographic information, primary indication from colonoscopy, practice type, and geographic region from the Clinical Outcomes Research Initiative colonoscopy report.

<sup>†</sup> Demographic characteristics are shown for the 14,938 unique patients. Primary indications are shown for the 15,168 unique colonoscopies.

**TABLE 3**

Performance characteristics of Medicare claims for potential quality measures

Findings	Frequency in CORI records (%)	Frequency in CMS claims (%)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Colorectal polyp	44.6	42.9	93.4	97.8	97.1	94.9
Colorectal tumor	1.3	2.9	56.9	97.8	26.1	99.4
Colorectal polyp or tumor	45.2	45.4	97.1	97.3	96.8	97.6
Diverticulosis	65.9	39.2	57.8	96.7	97.1	54.2
Angiodysplasia	1.6	0.9	47.8	99.9	92.2	99.1
Internal or external hemorrhoids	47.8	14.6	29.6	99.2	97.3	60.6
Colitis	4.2	3.5	53.6	98.6	63.4	98.0
Colonic ulcer	0.9	0.3	26.5	99.9	66.0	99.4
Additional procedures						
Biopsy	23.1	22.9	87.2	96.4	87.9	96.1
Hot biopsy	9.8	9.8	92.8	99.2	92.9	99.2
Snare polypectomy	24.8	26.0	97.6	97.7	93.3	99.2
Ablation	0.1	0.6	46.2	99.4	6.6	100.0
Incomplete colonoscopy*						
Colonoscopy did not reach proximal to splenic flexure	1.6	1.4	65.5	99.7	75.0	99.5
Colonoscopy did not reach cecum, terminal ileum, or surgical anastomosis	4.1	1.4	30.6	99.9	91.3	97.1

\* Centers for Medicare and Medicaid Services (CMS) guidance defines incomplete colonoscopy as not reaching proximal to the splenic flexure. Incomplete colonoscopy was defined by inclusion of modifier-53 on the colonoscopy claim.