BRIEF COMMUNICATIONS

Criterion Validity of Medicare Chemotherapy Claims in Cancer and Leukemia Group B Breast and Lung Cancer Trial Participants

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To determine the accuracy with which Medicare claims data measure chemotherapy use in elderly Medicare beneficiaries with cancer, we performed a criterion validation study. We compared gold-standard clinical trial data for 175 elderly cancer patients treated in two Cancer and Leukemia Group B (CALGB) breast and lung cancer trials (i.e., 45 from trial 9344 and 130 from trial 9730) with contemporaneous ambulatory and in-patient Medicare health insurance claims data from Centers for Medicare and Medicaid Services (CMS). The breast trial participants studied were those elderly enrolled between 1995 and 1997 and treated with doxorubicin and cyclophosphamide or this combination with paclitaxel. The lung trial participants studied were those elderly enrolled between 1998 and 2000 and treated with paclitaxel and carboplatin or paclitaxel alone. Comparing CALGB data with Medicare claims, we found the crude sensitivity for chemotherapy administration was 93% (95% confidence interval [CI] = 88% to 96%). Individual chemotherapy agents had similarly high sensitivities, ranging from 81% (95% CI = 70% to 89%) for carboplatin to 91% (95% CI = 79% to 98%) for cyclophosphamide. Agent-specific specificities were 100%. CMS data reliably captured repeat administration of chemotherapy to within one cycle. Administrative Medicare claims data appear to be a valid source of information for chemotherapy administered to elderly Medicare beneficiaries with cancer. [J Natl Cancer Inst 2005;97:1080–3]

The elderly are numerically underrepresented *(1–3)* and perhaps physiologically misrepresented *(4)* in clinical trials of anticancer therapy. Consequently, the expected benefits and toxicities of chemotherapy in the general population of elderly Americans may not be the same as those in trial participants. Nevertheless, clinicians need information about the expected benefits and toxicities of the chemotherapy in this group of patients. Because Medicare reimburses for intravenous administration of chemotherapy, Medicare claims are a potential source of observational data that could be used to understand the expected benefits and toxicities of chemotherapy. However, before Medicare claims regarding chemotherapy can be used to make robust causal inferences about the use and outcomes of chemotherapy in the elderly, very basic validation studies must first be completed *(5)*. To determine the accuracy with which Medicare claims data capture chemotherapy use in elderly patients, we evaluated the criterion validity of Medicare chemotherapy claims by comparing an external, gold-standard measure of chemotherapy administration, Cancer and Leukemia Group B (CALGB) clinical trial data, with contemporaneous Medicare claims files from the Centers for Medicare and Medicaid Services (CMS).

We formed a retrospective cohort consisting of all patients ages 65 years or older enrolled in one of two CALGB trials: 52 patients from 9344, "Doxorubicin dose escalation, with or without Taxol, as part of the CA adjuvant regimen for node-positive breast cancer" (hereafter, "the CALGB breast cancer protocol") enrolled between 1995 and 1997 *(6)*, and 186 patients from 9730, "Single-agent versus combination chemotherapy in advanced NSCLC (i.e., non–small-cell lung cancer), a CALGB randomized trial of efficacy, quality of life, and cost-effectiveness" (hereafter, "the CALGB lung cancer protocol") enrolled between 1998 and 2000 *(7)*. We carefully linked the cohorts' CALGB clinical trial data (e.g., demographic information, information pertaining to chemotherapy administration) to their CMS Medicare claims files (i.e., denominator, Carrier, OUTPT, and MedPAR files) from the corresponding calendar period to create the CALGB-Medicare data set. We were able to match 228 (96%) of the 238 participants to Medicare files, a rate consistent with that in previous literature *(8)*. Among these 228 eligible patients, 40 were removed from the analytic sample because of enrollment in health maintenance organizations whose claims were not processed through CMS and an additional 13 were removed because of a lack of enrollment in Medicare part B. The final analytic sample contained 175 patients (45 from CALGB 9344 and 130 from CALGB 9730).

Because all members of the analytic sample received chemotherapy, a crude, overall chemotherapy (i.e., non-agent-specific) specificity calculation that used patients as the unit of analysis was not possible. However, both CALGB trials restricted eligibility to patients who had received no prior chemotherapy for their lung or breast cancer and had no history of prior cancer. Therefore, we were able to use time period as the basis for calculating the crude sensitivity and specificity of the claims. We first defined two time periods for each patient, a pretrial time period, when chemotherapy was known not to have been given according to the gold standard, and an intratrial time period, when chemotherapy was known to have been given according to the gold standard. Claims present for care administered during the intratrial period provided information for the

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sensitivity, and claims present for care administered in the pretrial time provided information for the specificity.

A different approach was used to calculate agent-specific test characteristics. Because each patient was treated on only one nonoverlapping CALGB protocol,[1] we estimated the agent-specific sensitivity and specificity with the patient as the unit of analysis by use of claims from the intratrial time period only. We evaluated results according to site of care (i.e., academic tertiary care medical center versus nonacademic tertiary care medical center) to inform generalizability. Finally, for patients on the paclitaxel arm of the CALGB lung cancer trial, we evaluated the accuracy with which Medicare claims files captured repeat administrations (i.e., cycles) of chemotherapy.

CALGB statisticians approved the statistical approaches used in analyzing these data. This study was approved by the University of Chicago and Massachusetts General Hospital institutional review boards and conducted in compliance with their regulations. All analyses were performed using STATA version 8 SE.

Table 1 describes the demographic and disease characteristics of the sample. After examining inpatient and ambulatory Medicare claims files (i.e., Carrier, OUTPT, and MedPAR files) for CALGB treatments rendered during the study period as described by the broad algorithm detailed in Table 2, we found that 163 (93%) of the 175 patients had at least one Medicare claim for chemotherapy during the intratrial period and only 13 (7%) of the 175 patients had any claim for chemotherapy during the pretrial period. The crude sensitivity was thus 93% (95% confidence interval [CI] = 88% to 96%), and the crude specificity was 93% (95% CI = 88% to 96%).

Because this method of chemotherapy ascertainment includes both diagnostic and procedure codes that can refer to provider encounters for chemotherapy, as well as actual infusion of chemotherapy and the chemotherapy agents themselves, we investigated the test characteristics of a more precise ascertainment method, namely, the alphanumeric J9XXX codes for specific intravenous chemotherapy agents in the ambulatory Medicare files (i.e., Carrier and OUTPT files). Although 11 (6%) of the 175 patients appeared to receive at least some of the protocol chemotherapy treatment as inpatients, the sensitivity of the J9XXX codes in the ambulatory files was high at 89% (95% CI = 84% to 93%) and the specificity was high at 100% (i.e., there were no J9XXX codes in the ambulatory files in the pretrial period). That is, this more refined ascertainment algorithm eliminated all false-positive results. In reviewing the code patterns of the broad algorithm's false-positive results, we found that the ICD-9 (International Classification of Disease 9th Revision) diagnostic code V581 (i.e., "encounter or admission for chemotherapy") within ambulatory files accounted for all false-positive results in the remaining 13 patients. Adding the ICD-9 procedure code 99.25 to the J9XXXX algorithm, to identify those patients treated with chemotherapy exclusively as inpatients, and then screening both ambulatory and inpatient Medicare files lead to a further increase in sensitivity to 91% and did not diminish the specificity of 100%. Thus, in combination, the algorithm of procedure codes J9XXX applied to ambulatory files and

Table 1. Demographic and disease characteristics for the analytic sample containing 175 patients*

Variable	Value	No. of patients
Mean age, y (±SD)	71.0 (± 4.5)	175
Sex, proportion		175
Female	0.51	89
Male	0.49	86
Race, proportion		175
White	0.86	150
Black	0.10	18
Hispanic	0.03	6
Asian	0.01	1
Education, proportion		150
<HS	0.26	39
HS graduate	0.36	54
College (at least some)	0.38	57
Marital status, proportion		154
Single (never married)	0.06	9
Married	0.62	95
Divorced	0.11	18
Widowed	0.21	32
Performance status (WHO), proportion		130
0	0.39	51
1	0.49	63
2	0.12	16
CALGB protocol, proportion		175
Lung cancer protocol (trial 9730)	0.74	130
Paclitaxel/carboplatin arm		68
Paclitaxel-only arm		62
Breast cancer protocol (trial 9344)	0.26	45
Doxorubicin/cyclophosphamide arm		17
Doxorubicin/cyclophosphamide /paclitaxel arm		28

*SD = standard deviation; HS = high school; WHO = World Health Organization; CALGB = Cancer and Leukemia Group B.

Table 2. Modified billing code taxonomy indicating chemotherapy administration*

Code type	Value/code no.	Description
ICD-9 diagnosis	V58.1	Encounter or admission for chemotherapy
ICD-9 procedure	99.25	Injection or infusion of cancer chemotherapeutic substance
HCPCS	Q0083-Q0085	Temporary codes
	J9000-J9999	Specific intravenous agent codes
CPT	96408	IV push chemotherapy administration
	96410	IV infusion, up to 1 h
	96412	IV infusion, 1–8 h
	96545	Provision of chemotherapy agent
	96549	Unlisted chemotherapy procedure
Revenue center	0331	Radiology therapeutic-chemotherapy injected
	0332	Radiology therapeutic-chemotherapy oral
	0335	Radiology therapeutic-chemotherapy IV
DRG code	410	Chemotherapy

*ICD-9 = International Classification of Disease 9th Revision; HCPCS = HCFA Common Procedure Coding System; CPT = current procedure terminology; IV = intravenous; DRG = diagnostic-related group.

ICD-9 procedure code 99.25 applied to the inpatient file yielded the highest combined sensitivity and specificity.

To determine agent-specific test characteristics, we investigated whether the following alphanumeric chemotherapy codes were present or absent in the ambulatory Medicare files (i.e., Carrier and OUTPT files) from the intratrial period for each patient: paclitaxel (HCPCS [Health Care Financing Adminstration Common Procedure Coding System] code J9265), carboplatin (HCPCS code J9045), doxorubicin (HCPCS codes J9000, J9001, J9010), and cyclophosphamide (HCPCS codes J9070, J9080, J9090-J9097). The 175 study participants included 11 patients who, according to Medicare files, appeared to have received at least some of their chemotherapy in an inpatient setting, a situation in which individual agents are not discernable. Among the 130 patients treated with paclitaxel according to CALGB, 112 (86%) had at least one J code in their ambulatory Medicare files, indicating the administration of paclitaxel (i.e., sensitivity = 86%, 95% CI = 79% to 92%). Among the 68 patients treated with carboplatin according to CALGB, 55 (81%) had at least one J code in their ambulatory Medicare files, indicating the administration of carboplatin (i.e., sensitivity = 81%, 95% CI = 70% to 98%). Among the 45 patients treated with doxorubicin according to CALGB, 41 (91%) had at least one J code in their ambulatory Medicare files, indicating the administration of doxorubicin (i.e., sensitivity = 91%, 95% CI = 79% to 98%). Among the 45 patients treated with cyclophosphamide according to CALGB, 41 had at least one J code in their ambulatory Medicare files, indicating the administration of cyclophosphamide (i.e., sensitivity = 91%, 95% CI = 79% to 98%). The corresponding specificities for each of these agents were 100%. Of note, these analyses may underestimate sensitivity because 11 (6%) of the 175 patients received at least some of their chemotherapy as inpatients, a situation in which individual agents are not discernable.

To evaluate the dependence of results on the type of treating institution (i.e., tertiary care academic medical centers versus nontertiary care academic medical centers), we replicated the analyses according to whether patients were enrolled in the studies at CALGB main member institutions or at CALGB community affiliates. We found that both crude sensitivity and specificity were nonstatistically significantly higher at community affiliate institutions than at main member institutions (i.e., sensitivity = 97% versus 90%, $P = .07$; specificity = 95% versus 89%, $P = .20$). For individual agents that were identifiable through ambulatory Medicare files with J codes, the results were of a similar magnitude and direction and were not uniformly statistically significant.

In our final analysis, we compared the number of distinct administrations of chemotherapy in the Medicare data with the number of cycles of treatment reported in the paclitaxel-only arm of the CALGB lung cancer cohort of 62 patients. We defined the total number of chemotherapy cycles administered as the sum of the number of temporally distinct occurrences of the paclitaxel code (J9265) in HCPCS fields in the ambulatory files plus inpatient chemotherapy infusion code 99.25 in ICD-9 procedure fields in the inpatient file during the study period. For 89% of lung cancer patients treated on the paclitaxel-only arm, CMS data measured the correct number of cycles of chemotherapy to within one cycle (61.3% patients had the same number of cycles in both data sources, 27.4% had one fewer cycle in CMS data than in CALGB data, 4.8% had two fewer cycles in CMS data than in CALGB data, 4.8% had three fewer cycles in CMS data than in CALGB data, and 1.6% had six fewer cycles in CMS data than in CALGB data).

This criterion validation study of Medicare chemotherapy claims shows that, for elderly Medicare beneficiaries with lung and breast cancer who were treated in one of two randomized, phase III CALGB trials, contemporaneous Medicare claims files reflect the clinical trial therapies with a high degree of drug-specific and overall sensitivity and specificity. We show that determining chemotherapy administration through reliance on only the J9XXX codes, indicating individual drugs administered intravenously, is associated with similarly high sensitivity but with greater specificity in our sample. The values of these test characteristics varied little by drug or by site of care, hinting at a generalizability to other chemotherapy drugs and to nonacademic medical centers. The study also shows that repeated administrations of chemotherapy (i.e., in cycles) are reliably captured to within one cycle for 89% of patients. Broadly, these results support the validity of the growing body of published observational research that uses Medicare chemotherapy claims from within the National Cancer Institute's SEER-Medicare data *(9–20)* to describe chemotherapy use and outcomes among elderly Medicare beneficiaries.

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NOTES

[1]Of note, paclitaxel was included in both the breast and lung cancer trials. However, during the study years, Medicare only reimbursed standard therapies administered clinical trials, not experimental treatments. Given that the paclitaxel was an experimental therapy at the time of the breast cancer trial, Medicare claims would not be expected to capture its use.

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