Does Reimbursement Influence Chemotherapy Treatment for Cancer Patients?

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ABSTRACT

Prior to the Medicare Prescription Drug, Improvement and Modernization Act of 2003 (MMA), Medicare reimbursed physicians for chemotherapy drugs at rates that substantially exceeded the costs the physicians paid for those drugs. We examined the effect of physician reimbursement on chemotherapy treatment of Medicare beneficiaries over age 65 with metastatic lung, breast, colorectal, or other gastrointenstinal cancers between 1995 and 1998 (9357 patients). A physician's decision to administer chemotherapy to metastatic cancer patients was not measurably affected by higher reimbursement. Providers who were more generously reimbursed , however, prescribed more expensive chemotherapy regimens to metastatic breast ($P<0.038$), colorectal ($P<0.079$) and lung ($P<0.039$) cancer patients.

In the late 1990s, investigations by the Department of Health and Human Services, the Department of Justice, and the House Committee on Energy and Commerce revealed that Medicare payments for Part B covered drugs, of which chemotherapy agents represent the vast majority, were substantially higher than physicians' costs of acquiring these drugs.[1] Prior to 2004, Medicare reimbursed for chemotherapy drugs at the lesser of the billed charge or 95 percent of the Average Wholesale Price (AWP) (100 percent prior to 1998).[2] But oncologists and institutions purchased these drugs at prices well below the AWP. For example, in 1999, the average widely available discount to physicians was 12 to 30 percent of AWP and reached as high as 86 percent.[3]

Although the MMA altered the structure of chemotherapy reimbursements, so that physicians are now paid based on manufacturers' average sales price (ASP) plus six percent and an administrative fee, data exploring the relationship between different reimbursement incentives and practice patterns are still important. First, they provide clues for how the MMA might change chemotherapy treatment for Medicare beneficiaries. Second, since there is considerable variation in reimbursement rates for chemotherapy within the private market, with many insurance

companies basing their rates on AWP, this research may uncover treatment distortions that persist in the private market. More generally, this work should help us understand the extent to which financial incentives, in this case unintentional ones, can affect the clinical decisions of individual physicians.

We have analyzed the relationship between physician prescribing decisions and Medicare reimbursement. An alternative analysis would have been to analyze the spread between Medicare reimbursement and the prices at which the oncologist purchased the drugs, but we could not observe purchase prices. Nonetheless, because chemotherapy drugs can be bought directly from manufacturers or through national group purchasing organizations, similar types of clinics or physicians in terms of bargaining power and volume of business should have been able to purchase drugs at similar prices.[4] Thus, variation in reimbursement, the variable we analyze, should track closely with variation in the physician's profit from dispensing drugs.

Specifically, we asked two questions. Were physicians who were more highly reimbursed or who experienced greater increases in their reimbursement more likely to prescribe chemotherapy? And conditional on prescribing chemotherapy, were such physicians more likely to employ expensive drugs?

Methods

To assess how reimbursement affected treatment, we exploited differences in Medicare reimbursement rates across physicians at a point in time and for the same physician over time.

Variation in Medicare reimbursement rates at a point in time stemmed from the discretion local carriers had prior to October 2002 to determine the composition of Heath Care Common Procedure Codes (HCPCs), the basis for Medicare reimbursement. In particular, individual carriers processing Part B claims chose the specific National Drug Code (NDC) (corresponding to a unique chemical entity, form, strength, package size, manufacturer, and AWP) that determined the reimbursement rate for all NDCs in the HCPC. Because their choices varied, the reimbursement for a HCPC covering a multi-source drug, or a single source drug available in different forms or package sizes, varied across carriers.[5] Although such variation was typically on the order of 10 percent or less, it was much larger for some commonly prescribed chemotherapy drugs.[6] For example, in 1999 the spread between the highest and lowest reimbursement for 10mg Doxorubicin was about 27 percent ($52.44 versus $38.03). Moreover, these reimbursements

changed differentially over time based on revisions to the AWP for specific NDCs.

Data Sources

Cohort Development

To study chemotherapy treatment, we analyzed the Surveillance, Epidemiology, and End Results (SEER) cancer registries and linked Medicare claims.[7] Our sample consisted of all Medicare-eligible patients over age 65 with lung, breast, colorectal, or other gastrointenstinal (pancreatic, esophageal, liver, and stomach) (GI) cancers who had metastatic cancer between 1995 and 1998 and had Medicare claims filed during this period.[8]

We chose these cancers because they account for over 60 percent of cancer deaths in North America[9] and, when metastatic, chemotherapy is a primary component of their treatment. We did not use data from before 1995 because of changes in recommended treatment.

We defined metastasis as presentation with Stage IV disease, as documented by SEER abstractors within four months of diagnosis, or documentation of two or more Medicare claims separated by 30 days for a secondary cancer site.[10]

We studied only patients with metastatic disease because these patients have a relatively short expected survival, regardless of treatment. In other words, we expected little effect on outcomes from any variation in treatment. Moreover, treatment options are less standardized than in early stages where cure is the goal. Thus, observed treatment differences across metastatic patients, in contrast to those at earlier stages of the disease, are more likely to result from physician decisions and patient preferences rather than unobservable differences in health. And since patient preferences are unlikely to vary systematically with financial incentives, any relationship between treatment and reimbursement is most likely attributable to physician response.

Outcome Ascertainment

Receipt of Chemotherapy

We analyzed whether the patient received chemotherapy treatment in the three month period after a metastatic cancer diagnosis, conditional on the patient's surviving at least 28 days, not having been in chemotherapy treatment three months prior to this diagnosis, and not entering hospice. We defined patients as receiving any chemotherapy

if they had a single claim for a chemotherapy-related code.[11]

Specific agents (J9s) were identified from outpatient settings (Physician/Supplier (NCH) or Outpatient (OUTPT) files); drugs administered to inpatients are not recorded on the claim because they are bundled with the DRG payment. We included anti-emetics that could be administered intravenously, and were thus reimbursed by Medicare, as well as calcium leucovorin, which is given intravenously in combination with chemotherapy agents such as fluorouracil.[12]

Costliness of Agents Used

In addition to analyzing whether reimbursement affected the likelihood of chemotherapy, we also analyzed the costliness of the agents used when chemotherapy was prescribed. Reimbursement amounts were garnered from the NCH files only, because drug payments cannot be identified in institutional claims. We excluded the roughly 15 percent of reimbursements for (J9) chemotherapy claims with unidentified agents (J9999) because we could not determine the drugs used nor the standard dosages for these treatments.

To remove variability in spending caused by patient-specific dosing, which is affected by height, weight, and

organ function, and the number of doses a patient received, which is affected by therapy tolerance and response, we defined the initial treatment regimen as the combination of chemotherapeutic agents, anti-emetics, and leucovorin administered to the patient within the first 28 days after a metastatic diagnosis. Each regimen was treated as if a standard quantity was administered by assuming: 1) each drug was given according to the most common dose and schedule recommended in the Dana-Farber Cancer Institute's Oncology Protocol System; and 2) each patient had a body surface area of 1.7 m^2. Anti-emetics were dosed in combination with the highest frequency dosed chemotherapy agent a patient received.

Each standardized dose was then priced using the average "national" (across all SEER regions) reimbursement for that agent within a tumor site and year and summed for all drugs a patient received. By using national average prices to determine expenditure, any variation across patients is attributable to the drugs prescribed rather than the prices paid to physicians. Furthermore, by standardizing dosages, this measure captures a physician's initial regimen choice, rather than any adjustments dictated by a patient's tolerance of and response to treatment.

Definition of Explanatory Variables

To measure how generously each physician was reimbursed, we defined a summary measure or index for the set of regimens prescribed by a provider for a given tumor site in a given year. The index was the sum of the weighted average difference between the physician's and the national mean reimbursement for each agent the physician prescribed, where the weights were the ratio of national spending on a regimen to total spending on all chemotherapy regimens (see appendix). In some analyses we deflated the index by Medicare's 1997 Geographic Practice Cost Index (GPCI) for the relevant region in order to account for variation across regions in the cost of administration.

In summary, this index captured how generously an individual physician was reimbursed relative to the national average for the set of agents that physician prescribed.

Statistical Analyses

To model the impact of reimbursement generosity on a patient's likelihood of chemotherapy treatment we used probit regressions with provider-specific random effects.

Our models include year indicator variables to control for national trends in treatment patterns.

We also controlled for a patient's age and age squared, year of metastatic cancer diagnosis, gender, race (White, Black, Asian, Hispanic, or other), marital status (single, married, separated/divorced, or widowed), tumor grade (well, moderately, or poorly differentiated, undifferentiated, or unknown), census tract per capita income or the state average if missing, and a dummy variable for whether the state average income was used. Comorbidities were identified from diagnostic billing codes for various conditions in both inpatient and outpatient claims, assigned scores based on severity, and then summed to form an index, the Deyo-Charlson score.[13] When we estimated results across all tumor sites, we also included indicator variables for tumor site.

To estimate the impact of the provider's reimbursement generosity on the expensiveness of chemotherapeutic agents prescribed, we used linear regressions with provider-specific random effects. We conducted our analysis pooling across tumor sites as well as separately by site, since the types and costs of regimens varied markedly by cancer site. We included year indicator variables in all models and controlled for the same set of patient characteristics as

in the probability of chemotherapy models.

Results

Chemotherapy Utilization

Exhibit 1 presents summary statistics for metastatic cancer patients overall and by cancer site. Almost half of the sample presented with Stage IV disease at diagnosis (SEER stage distant), although this proportion varied considerably across tumor sites. About 40 percent of the sample was treated with chemotherapy (third row). Breast cancer patients were much less likely to receive chemotherapy, possibly because of the hormone therapy option, which we cannot observe in Medicare claims. Lung cancer patients also had relatively low chemotherapy rates, likely because chemotherapy was just gaining acceptance for this group during the study period.[14]

Overall and within tumor sites, we did not find measurable effects of variation in reimbursement on the likelihood of treatment (Exhibit 2). In fact, only in the case of breast cancer did the estimated effect of reimbursement generosity on the likelihood of chemotherapy treatment go in the expected positive direction, with a one-standard deviation increase in the excess reimbursement index increasing the probability of chemotherapy treatment

by an insignificant 0.011, or 1.1 percentage points off a base chemotherapy treatment rate of 25 percent. Based on the upper limit of a 95 percent confidence interval for the breast cancer effect, it is unlikely that the true effect exceeds 3.1 percentage points (0.031=0.011+1.96(0.011/1.06)). For colorectal, GI, and lung cancer, the upper limits of the 95 percent confidence interval imply effects no larger than 1.2, 1.3, and 1.9 percentage points respectively.

Results were qualitatively similar when we deflated the reimbursement index by Medicare's GPCI. In all cases, we could rule out large effects of reimbursement on chemotherapy treatment, with the upper limits of the 95 percent confidence intervals indicating effects no larger than 3.1 percentage points for breast cancer and less than 2 percentage points for the other cancer sites. Results were also similar when we restricted the sample to those who initially presented with Stage IV disease or considered the probability of chemotherapy treatment within 28 days rather than three months of a metastatic cancer diagnosis (results not shown).

Costliness of Agents Used

Monthly chemotherapy spending varied markedly across

tumor sites (Exhibit 1, row 2). Metastatic breast and colorectal cancer patients on average received regimens that cost less than $1,000 per month, whereas the regimens prescribed to other GI cancer patients cost on average $1,400 per month and to lung cancer patients over $3,600 per month.

The reimbursement index had a significant effect on the costliness of chemotherapeutic agents prescribed (Exhibit 3). More generously reimbursed providers prescribed more expensive regimens to breast ($P<0.038$), colorectal ($P<0.079$) and lung ($P<0.039$) cancer patients. In contrast, more generously reimbursed providers prescribed less expensive regimens to metastatic GI cancer patients ($P<0.038$). For breast cancer patients, a $1 increase in a physician's reimbursement resulted in the use of agents that were $23 more expensive. Another way to interpret the values in the table is to estimate the effect of a one standard deviation increase in the index. Among breast cancer patients receiving chemotherapy, a one standard deviation increase in the reimbursement index (2.89, not shown in exhibits) was associated with a $67 increase in spending on chemotherapeutic agents (evaluated by multiplying 2.89 by the regression coefficient of 23.1). For colon and lung cancer patients, a one standard

deviation increase in physicians' reimbursement index (1.14 and 33.9) raised spending by $40 and $150, respectively. With average chemotherapy spending of $858, $705, and $3,772 for breast, colon, and lung cancer patients, such increases would raise spending 4 to 8 percent.

These results were even stronger and more precisely estimated when we used Medicare's GPCI to deflate the reimbursement index and projected chemotherapy spending (Exhibit 4). We could not know the administrative costs of each physician, but since any practice cost deflator should apply only to administrative costs and not the cost of the drug itself, the results with and without the practice cost deflator should bound the true effect of variation in reimbursement.

Discussion

We found no evidence that reimbursement incentives affected oncologists' decisions to administer chemotherapy to metastatic cancer patients. Once a decision to give chemotherapy was taken, however, physicians receiving more generous Medicare reimbursements used more expensive treatment regimens. Except for the non-colorectal gastrointestinal cancer site, which was so heterogeneous

that such patients may not have been well characterized in our data, these results were similar whether aggregated or stratified by tumor site.

Our study has some limitations. To ascertain chemotherapy we relied on claims data, which are not created for research and may be less accurate than desired. Claims-based comorbidity measurement is not the same as performance status on which clinicians make treatment decisions.

The use of Medicare data limited us to elderly patients, and practice patterns and incentives may differ for younger patients with commercial insurance. Nonetheless, many commercial insurance companies also base reimbursement rates on AWP. A survey of 32 health plans found that many reimbursed for chemotherapy drugs at 95 percent of AWP, but others reimbursed at rates as low as 75 percent and still others at rates as high as 125 percent of AWP.[15] If our results generalize to the commercially insured, they suggest that chemotherapy administration to such patients should be little affected by such variation, but the mix of agents may well respond.

As noted in the introduction, Medicare no longer uses AWP as a basis for reimbursement. Our results suggest that rates of chemotherapy administration will not change much

provided oncologists continue to accept Medicare patients. On the other hand, since physicians will no longer differentially profit from using particular agents, this new reimbursement method may modify the mix of chemotherapy drugs used.

Oncologists are loath to acknowledge that financial motives can affect treatment decisions. Although reimbursement seems to have little effect on the primary decision to administer palliative chemotherapy to patients with advanced solid tumors, it appears to affect the choice of drugs used in those undergoing treatment.

Oncologists have maintained that the markup on the drugs compensated for Medicare's prior failure to reimburse for the cost of administering the drug. In response, Medicare now pays a fee for administration, but, as noted above, reimburses the drug at a 6 percent markup over what the physician paid. These changes should make choice of agents based more on clinical considerations and patient preferences and less on reimbursement decisions.

Exhibit 1. Characteristics of End-stage Cancer Patients by Site

	Overall	Breast	Colo-rectal	Other GI	Lung
Index of Physician Reimbursement	.697 (15.4)[a]	.014 (1.76)	.103 (.113)	3.43 (46.4)	.919 (11.5)
28 Day Spending on Chemotherapy ($)	2103 (2215)	848 (767)	733 (661)	1443 (1423)	3675 (2421)
Chemo w/in 3 months (%)	41	25	53	50	42
Age (years)	74 (5.73)	74 (5.99)	75 (6.00)	74 (5.50)	74 (5.39)
Male (%)	39	0	46	56	54
SEER Stage [b]					
Local (%)	20	46	15	14	10
Regional (%)	34	40	48	28	24
Distant (%)	46	14	37	59	66
Charlson Score	.292 (.623)	.188 (.515)	.239 (.555)	.355 (.739)	.363 (.671)
Observations	9357	2246	2173	544	4014

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

[a] Standard deviations in parentheses.

[b] SEER stage of tumor is given at first diagnosis.

Exhibit 2. Effect of a One Standard Deviation Increase in the Mean Reimbursement Index [a] on the Probability of Chemotherapy Treatment

	Overall	Breast	Colo-rectal	Other GI	Lung
Excess Reimburse-ment Index	-.008 [-.0013][b] (1.35)[c]	.011 [.020] (1.06)	-.015 [-.032] (1.08)	-.025 [-.0016] (1.30)	-.0008 [-.0002] (0.08)
Treatment Rate	.411	.253	.525	.496	.418
Sample Size	9357	2246	1822	984	4014

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

[a] The percent increase in price associated with a one standard deviation increase in the reimbursement index is 0.114, 0.008, 0.866, and 0.223 for breast, colorectal, GI, and lung cancer patients respectively.

[b] Probit coefficients for the estimated effect of a variable are given in brackets.

[c] z-statistics from Probit coefficients in parentheses.

Exhibit 3: Effect of Excess Reimbursement on Spending by Site

	Overall	Breast	Colo-rectal	Other GI	Lung
Excess Reimbursement Index	2.82 (1.16)[a]	23.1 (2.08)	35.5 (1.76)	-6.33 (2.08)	13.0 (2.06)
Sample Size	3170	492	919	375	1384

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

[a] t-statistics in parentheses.

Exhibit 4: Effect of Excess Reimbursement on Spending by Site, Using Medicare's 1997 Practice Expense GPCI

	Overall	Breast	Colo-rectal	Other GI	Lung
Excess Reimbursement Index	2.90 (1.20)[a]	29.9 (3.19)	44.1 (2.62)	-7.35 (2.58)	15.4 (2.40)
Sample Size	3170	492	919	375	1384

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

[a] t-statistics in parentheses.

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Data and Methods Technical Appendix

The goal of this study was to estimate the impact of Medicare reimbursement on chemotherapy treatment. Because the study relied on retrospective claims data, great care had to be taken to account for potential unobservable characteristics of patients, clearly identify treatment, and quantify reimbursement and spending. The more technical aspects of these efforts are detailed here.

A. Additional Methodological Details

Cohort Development

To minimize differences in treatment due to unobserved patient health, we limited our sample to patients with metastatic disease. As mentioned in the text, we defined metastatsis as presentation with Stage IV disease, as documented by SEER abstractors within four months of diagnosis, or documentation of two or more Medicare claims separated by 30 days for a secondary cancer site.[i] Secondary cancer site claims were drawn from the Physician/Supplier (NCH), Outpatient (OUTPT), Home Health Agency (HHA) or Medicare Provider Analysis and Review (MEDPAR) files.

To further increase homogeneity, we excluded patients who had more than one primary cancer. Males were excluded from the breast cancer sample. We also excluded the less

than one percent of patients whose dates of diagnosis or death differed by more than two months in the SEER and Medicare claims databases, or whose cancer was first identified at the time of death or autopsy.

We eliminated the 16 percent of patients who were enrolled in a health maintenance organization (HMO) at some point during the study period because we lacked complete treatment and billing information for them.

Outcome Ascertainment

Receipt of Chemotherapy

The specific codes used to identify chemotherapy receipt from claims include: the International Classification of Diseases, Ninth Revision, Clinical Modifications (ICD-9-CM) procedure codes of 9925 or V codes of V58.1, V66.2 or V67.2, diagnosis-related groups code 410, or HCPCs of 96400 through 96549, J9000 through J9999 or Q0083 through Q0085 and revenue center codes 0331, 0332 and 0335.[ii,iii,iv,v,vi]

Costliness of Agents Used

For our analysis of chemotherapy spending, we defined

standardized doses of the agents administered to each patient within the first 28 days after a metastatic diagnosis. Each standardized dose was priced using the average "national" or SEER unit reimbursement for that agent within a tumor site and year and summed for each patient. For example, if chemotherapy regimen *c* was the combination of drugs with J-codes 1, 5, and 14, the price of regimen *c* in year *t* and tumor site *s* was given by $P_{tsc} = J_{ts1} + J_{ts5} + J_{ts14}$, where J_{tsn} is the standardized monthly cost of J-code *n* in year *t* and tumor site *s*.

Definition of Explanatory Variables

We calculated the relative generosity of reimbursement to a provider using a weighted average difference of a provider's reimbursement for each prescribed regimen relative to the average for that regimen nationally for a given tumor site and year. We used this weighting scheme to standardize across providers for the mix of drugs used and thereby ensure that the index captured reimbursement rather than practice pattern differences.

Specifically, an oncologist's reimbursement level R_{its} was computed using the set of regimens $c(i,t,s)$ prescribed by provider *i* in year *t* for tumor site *s*. The index of

reimbursement generosity was:

$$R_{its} = \frac{\sum_{c \in c(i,t,s)} (P_{itsc} - P_{tsc}) W_{tsc}}{\sum_{c \in c(i,t,s)} W_{tsc}}$$, where P_{itsc} is the average reimbursement for patients receiving chemotherapy regimen *c* prescribed by provider *i* in year *t* and site *s*, and P_{tsc} is the national average reimbursement of regimen *c* in year *t* and tumor site *s*. W_{tsc}, the weight for regimen *c*, is the ratio of national spending on that regimen to total spending on all chemotherapy regimens for a given site.

Statistical Methods

In all models, we included provider random effects because of the grouped-error nature of the data; many patients are treated by the same physician and thus their treatment decisions will be affected by the same physician-specific practice patterns. Because we incorporate physician-specific random effects and year indicator variables that control for common time trends, the effects we estimate are identified off of changes in reimbursement and treatment within physicians relative to the nation over our sample period, as well as some element of between-physician variation.

Use of Reimbursement as the Principal Explanatory Variable

As pointed out in the text, reimbursement is the policy relevant variable, and we believe that it is highly correlated with profit. Nonetheless, our estimated response to reimbursement could differ from the response to profit for two reasons. First, there is undoubtedly some variation across physicians in purchase prices. If we were trying to measure the response to profit and used reimbursement as a measure of profit, any random variation in purchase price would be random measurement error and would bias down our estimate of the response to profit. Although we cannot know the magnitude of any such bias, we believe a generous assumption is that the magnitude of any variation in purchase price would equal the variation in reimbursement. If so, our estimates as a measure of response to profit should be doubled, but we would still conclude that profit potential had little effect on the probability of chemotherapy. On the other hand, our conclusion that profit potential altered the mix of agents used would be even stronger.

Second, manufacturers may have taken account of the Medicare variation in their pricing by charging more in more generously reimbursed regions. We are skeptical that any such behavior was quantitatively important, partly because of the existence of national purchasing groups and

partly because oncologists purchased drugs for their entire practice, not just the Medicare portion. But to the degree any such pricing response existed, our estimates as a measure of the response to profit would also be too small.

B. Additional Details from the Exhibits

Appendix Exhibit 1. Characteristics of End-stage Cancer Patients by Site

	Overall	Breast	Colo-rectal	Other GI	Lung
SEER Grade [a]					
Well-Differentiated (%)	5.2	7.7	6.7	5.6	2.9
Moderately Differentiated (%)(%)	28.5	29.4	60.7	24.6	11.5
Poorly Differentiated (%)	30.4	33.8	23.5	37.0	30.8
Undifferentiated (%)	8.9	1.9	1.2	3.6	18.2
Unknown (%)	27.0	27.2	7.9	29.2	36.7
Marital Status					
Single (%)	6.40	7.5	6.2	6.4	6.0

Married (%)	58.7	47.8	58.2	63.2	5.9
Separated or Divorced (%)	5.70	5.1	4.7	5.1	6.7
Widowed (%)	31.2	39.5	30.9	25.3	28.0
Race					
White (%)	.87.6	89.7	88.4	80.5	87.6
Black (%)	6.5	7.0	5.8	8.4	6.3
Other (%)	2.3	1.4	2.3	4.0	2.3
Asian (%)	2.5	1.3	2.3	4.8	2.7
Hispanic (%)	1.1	0.6	1.2	2.3	1.1
Registries[b]					
SF, San Jose, LA (%)	26.3	20.1	25.9	34.5	28.2
Connecticut (%)	15.6	13.3	14.8	16.8	17.0
Michigan (%)	27.3	37.9	25.1	23.1	23.4
Hawaii, Iowa, Seattle (%)	22.2	19.0	24.7	18.8	23.5
New Mexico (%)	2.0	2.2	1.7	2.2	2.0
Utah (%)	2.5	3.5	3.7	1.6	1.4
Georgia (%)	4.2	4.0	4.1	3.0	4.5
Per Capita Income[c] ($)	17536 (5818)[d]	17275 (5793)	17302 (5699)	18101 (5667)	17678 (5918)
Observations	9357	2246	2173	544	4014

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

[a] Grade of tumor at first diagnosis.

[b] Registries are listed separately if they have a distinct Part-B carrier.

[c] Per capita income in a patient’s census tract in 1990.

[d] Standard deviations in parentheses.

Appendix Exhibit 2. Average Number of Patients Per Physician in Models of the Effect of the Mean Reimbursement Index on the Probability of Chemotherapy Treatment

	Overall	Breast	Colo-rectal	Other GI	Lung
Patients Per Physician	13.4	5.2	4.0	3.2	7.9

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

Appendix Exhibit 3. Additional Statistics from Models of the Effect of Excess Reimbursement on Spending by Site

	Overall	Breast	Colo-rectal	Other GI	Lung
Patients Per Physician	5.4	1.8	2.6	1.7	3.4
R-squared Within	0.3898	0.0229	0.0570	0.0349	0.0386
R-squared Between	0.4746	0.1013	0.0663	0.0837	0.0159
R-squared Overall	0.4198	0.0578	0.0711	0.0483	0.0036

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

Appendix Exhibit 4. Additional Statistics from Models of the Effect of Excess Reimbursement on Spending by Site, Using Medicare's 1997 Practice Expense GPCI

	Overall	Breast	Colo-rectal	Other GI	Lung
Patients Per Physician	5.4	1.8	2.6	1.7	3.4
R-squared Within	0.3740	0.0167	0.0747	0.0383	0.0352
R-squared Between	0.4614	0.1256	0.0491	0.0956	0.1052
R-squared Overall	0.4015	0.0663	0.0642	0.0518	0.0682

SOURCES: Surveillance, Epidemiology, and End Results (SEER) program. Co-existing illness and treatment came both from SEER and Medicare-linked claims, 1995-1998.

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