Case mix and charges for inpatient and outpatient chemotherapy

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Case mix and charges for chemotherapy treatment were examined by an analysis of the inpatient discharges for DRG 410 (chemotherapy) from eight teaching hospitals and of outpatient visits from two teaching hospitals. Discharges for ovarian cancer were the most common and the least expensive, costing $1,600 or half as much as the most costly, less common conditions (leukemia and testicle cancer). Diagnosis explained 13 percent of the inpatient charge variation; metastasis explained less than 1 percent. Outpatient chemotherapy overlapped with inpatient among only 3 of the 10 most common diagnoses. The implication is that the two settings are complementary with regard to chemotherapy administration.

Introduction

Chemotherapy for patients with cancer utilizes a wide variety of settings and a wide variety of techniques, ranging from simple injections given in a private physician's office to continuous infusions in an inpatient facility. This article has two major goals. The first is to determine what the diagnostic case mix of chemotherapy inpatients can contribute to refining diagnosis-related groups (DRG's) for inpatient chemotherapy. The second is to examine the diagnostic evidence for similarities among types of cancer treated in inpatient and outpatient settings.

The administration of chemotherapy is in many ways prototypical of other issues in medical care technology, because care has increasingly shifted from an inpatient to an outpatient setting. Other comparable examples of this shift are parenteral nutrition, respirator-assisted ventilation, and lens procedures (Young, 1983; Ginsburg and Carter, 1986).

A peculiarity of reimbursement for chemotherapy is that when it is the primary reason for inpatient admission, chemotherapy falls into a single DRG (410) instead of being classified as a procedure in a DRG determined by the patient's diagnosis. Although prospective payment using DRG's was first widely applied in the Medicare program, other third-party payers are showing substantial interest in the system. Medicaid, for example, reimburses by DRG in eight States, with another four planned for implementation in the near future (Hellinger, 1986). Rather than being limited to patients 65 years of age or over, this article covers the entire spectrum of patients (18 years of age or over) receiving chemotherapy.

The chemotherapy DRG is the least expensive of all the oncology DRG's. This is reflected in its relatively low Medicare reimbursement weight (0.428 for 1987) (Prospective Payment Assessment Commission, 1986). The weight of the chemotherapy DRG increased 23 percent from .349 in 1984 to its present weight, indicating increased complexity in the cases being treated on an inpatient basis. Admission for chemotherapy is also one of the most rapidly growing DRG's in number of discharges, both before and after the prospective payment system was implemented (Ginsburg and Carter, 1986).

This latter finding runs counter to the belief that chemotherapy is increasingly being administered on an outpatient basis. There is certainly, however, another explanation for the growth of DRG 410. Admissions that fall into other, more heavily weighted, medical DRG's such as DRG 82 (lung cancer) and that involve chemotherapy as a procedure are increasingly being viewed as admissions for chemotherapy and are being assigned to DRG 410.

Despite the relatively low payment rate for DRG 410, hospitals may still have a considerable financial incentive to treat a given patient on an inpatient basis. One of these incentives is of course that the same treatment is reimbursed at a much higher rate for inpatients. Another incentive is that if certain high-cost cases are "losers," relative to the overall reimbursement for DRG 410, these losers can be diluted by less expensive borderline cases that might otherwise be seen in the outpatient department.

Understanding the case mix of chemotherapy patients is also crucial for other reasons that go beyond narrow reimbursement issues. The cost of clinical trials has never been reimbursed directly by Medicare but under the previous payment system was in practice passed along in the overall cost-accounting system (Wagner and Power, 1986). Most of these clinical trials involve chemotherapy either as the primary treatment or as an ancillary treatment. The increasing scrutiny of the costs of these clinical trials under the prospective payment system may greatly reduce the incentives for oncology medical research (Yarbro and Mortenson, 1985; Davis, 1985; Katterhagen and Mortenson, 1984).

Finally, case-mix issues for cancer patients receiving chemotherapy have not been addressed, although systems for adjusting payments according to case mix or severity are either in place or being strongly proposed (Hilsenbeck, 1984; Lion and Malbon, 1986;

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Mortenson and Winn, 1984; Mortenson and Yarbro, 1985; Young, 1984). New work at Johns Hopkins University examines various measures of severity to explain more variance in the oncology DRG's, with mixed results (Horn and Sharkey, 1986).

There are about 2 million discharges from short-term, general hospitals each year of patients with a principal diagnosis of cancer, or about 5 percent of the 39 million total discharges from all such hospitals (National Center for Health Statistics, 1984). In fiscal year 1983 in Massachusetts, about 15 percent of all cancer-related discharges, or about 300,000 discharges, appeared to be primarily for admissions for chemotherapy. In both State and national samples, the chemotherapy DRG has the largest number of discharges of any oncology DRG for teaching hospitals. Even in community hospitals, it is the second leading cancer DRG, exceeded in number of discharges only by other medical treatments of lung cancer, DRG 82 (Lion and Malbon, 1986; Mortenson and Yarbro, 1985).

No comparable data are available for chemotherapy administered on an ambulatory basis. One analysis of chemotherapy administered in physicians' offices is available, but this provides no case-mix data for comparison with hospital outpatient departments (Prager, 1984). Most knowledgeable experts agree, however, that in recent years complex chemotherapy is being performed more and more frequently on an outpatient basis. In fact, some hospitals are beginning to split chemotherapy regimens among inpatient, outpatient, and home settings (Hetzel, Kaufman, and Zimbler, 1982; Rutherford, 1980).

This article presents data that describe the case mix within DRG 410, admission for chemotherapy. Charges within the DRG are analyzed by primary cancer diagnosis. The relationship between one measure of patient severity (the presence of metastases) and charges is then examined on a diagnosis-specific basis. Implications are drawn from these findings for the refinement of DRG 410. In addition, the diagnostic mix of outpatient chemotherapy visits is examined to determine how case mix varies between inpatient and outpatient settings. If the diagnostic patterns are similar, the implication is that outpatient treatment may be substituted for inpatient: Conversely, dissimilar patterns imply that treatment across the sites is complementary and that fears of substitution in order to obtain greater reimbursement are largely unfounded.

Methods

Sample and data sources

The inpatient data used in this analysis come from the Massachusetts Rate Setting Commission and cover discharges during fiscal year 1983 for eight major teaching hospitals in the Boston metropolitan area. The Massachusetts Rate Setting Commission data are in the public domain and all discharges from all short-term general hospitals are available for 1983. Diagnostic data appear to be unusually accurate in this data set. For example, less than 2 percent of the discharges in DRG 410 lacked a diagnosis of cancer in the Rate Setting Commission data set, compared with about 4 percent on the 1984 MEDPAR file.

There were 1,776 discharges in DRG 410 in the 8 hospitals. Children under age 18 in these hospitals were excluded, bringing the total down to 1,660. (The children's hospital in the area was excluded in its entirety.) An additional 46 discharges were excluded because the charges were 2 standard deviations above the mean or, in 1 case, because charge data were missing. The remaining 1,614 cases had a mean length of stay of 2.8 days for an admission for chemotherapy, with a range of 1 to 17 days. The mean charge was $2,173, with a range of $286 to $8,478. The coefficient of variation for the entire chemotherapy DRG was .67.

Data on hospital-based outpatient case mix for chemotherapy are not widely available; few secondary data bases contain this information and those that do either lack information on procedures performed and charges or have an insufficient volume of oncology clinic visits for this analysis. The outpatient chemotherapy data used here come from data collected for a 1-month period in 1984 in two of the major teaching hospitals in Boston. The data collection yielded 474 usable visits for intravenous chemotherapy for this 1-month period. This figure represents more than 90 percent of all chemotherapy visits for that month in both hospitals. Children under 18 were excluded from this data set as well.

Coding from the *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* for principal and secondary diagnoses is used to measure case mix in both sets of data. Billed charges were obtained for all cases, both inpatient and outpatient. For the outpatient chemotherapy visits, all charges for procedures ordered at the time of visit were included, even if the procedures were done on a different day.

Finally, it is important to keep in mind that both the inpatient and outpatient data for chemotherapy used in this study are from major teaching hospitals in an urban area. Patterns of use of chemotherapy may differ from those of community hospitals.

Diagnostic classification of inpatient discharges

By definition, the principal diagnosis in the oncology DRG is V58.1, admission for chemotherapy. The primary site of cancer was therefore determined by the secondary diagnoses. Six percent of the cases had more than one primary site of cancer indicated. If the discharge had more than one primary site, a hierarchical selection was made with the more common site being selected first, as determined by the 94 percent of cases with only one primary site. Using this technique, each discharge is counted only once in the case-mix analysis. Cancers in remission receiving

Table 1

Number of discharges in chemotherapy diagnosis-related group (DRG), by primary site of cancer

ICD-9-CM code[2,3]	Diagnosis	Number of discharges[1]			Percent of total discharges
		Metastases not mentioned	With metastases mentioned[4]	Total discharges	
Total		898	716	1,614	100.0
183 (V10.43)	Cancer of ovary	311	124	435	27.0
162 (V10.11)	Lung cancer	75	156	231	14.3
174 (V10.3)	Cancer of breast	15	95	110	6.8
180 (V10.41)	Cancer of cervix	57	31	88	5.5
191 (V10.85)	Brain cancer	66	2	68	4.2
182 (V10.42)	Cancer of uterus	34	33	67	4.2
201 (V10.72)	Hodgkin's disease	54	6	60	3.7
205 (V10.62)	Myeloid leukemia[5]	57	(4)	57	3.5
186 (V10.47)	Cancer of testicle	8	44	52	3.2
172 (V10.82)	Malignant melanoma	8	34	42	2.6
All other		213	191	404	25.0

[1]Based on data trimmed 2 standard deviations above the mean for total charges.
[2]*International Classification of Diseases, 9th Revision, Clinical Modification.*
[3]Based on either a code of active cancer or a code of history of cancer. The history of cancer code is shown in parentheses.
[4]These discharges have at least one metastasis (ICD-9-CM codes 196-199) as a secondary diagnosis, as well as having a diagnosis of cancer or history of cancer at a primary site. For example, admission for chemotherapy for lung metastases (197.0) with a history of breast cancer (V10.3) is shown in this table as breast cancer, not lung cancer.
[5]Nine cases of myeloid leukemia, including all of the myeloid leukemia shown as disseminated, fell more than 2 standard deviations above the mean for charges and were trimmed prior to this analysis.

adjuvant chemotherapy were coded as "history of cancer" in this data set. These are analyzed for the primary site indicated by the history code.

Results

Inpatient case mix

The leading diagnoses for the discharges in this analysis are shown in Table 1. Cancer of the ovary and fallopian tubes is the major primary cancer treated in the chemotherapy DRG, accounting for 27 percent of the cases. This is a relatively uncommon malignancy but chemotherapy involves the administration of platinum, which is still usually an inpatient procedure. Cancer of the ovary is followed by primary cancers of the lung, breast, cervix, brain, and uterus, in that order. About 40 percent of the cancers receiving inpatient chemotherapy were shown as having metastasized. This should be considered a minimum estimate, as metastases are not necessarily coded.

Inpatient charges

The mean hospital charges within the chemotherapy DRG are displayed in Table 2. The mean total charge was $2,173. Examining charge differences by diagnosis alone, the highest-cost primary cancers (testicle, $3,245, and myeloid leukemia, $3,361)[1] are approximately twice as expensive as the lowest (ovary, $1,600). The less common cancers are significantly more expensive as a group for a chemotherapy admission than are the leading 10 diagnoses. This is indicated in Table 2 by a mean charge for cancers other than the 10 most common of $2,635, compared with a mean charge of $2,173 for all cancers having chemotherapy. Although separating the chemotherapy DRG into subgroups based on primary site of the cancer produces large differences in total charges, that charge variation is not necessarily more tightly clustered in the diagnosis groups than in the chemotherapy DRG taken as a whole. In fact, the coefficient of variation increases for 3 of the 10 primary diagnoses examined.

Overall, a primary cancer with metastases appears to be only slightly more expensive for the administration of chemotherapy than one in which no metastases are specified ($2,326 compared with $2,052, or 13 percent more [$p < .001$]). One reason the charges are so similar may be that adjuvant and palliative chemotherapy for a given type of cancer frequently require the same drugs, administration procedures, and lengths of stay. A more compelling reason, however, is that any data of this sort almost certainly understate the proportion of patients with metastases, because these are the patients most apt to receive chemotherapy. Probably the vast majority of the patients shown in this data set have metastatic disease. This is particularly likely for the patients with Hodgkin's disease and with cancer of the ovary.

Differences in total charges were compared for each of the diagnoses through a one-way analysis of variance and the Scheffe multiple range test. The results of the multiple comparisons are shown in Table 3. Total charges for cancer of the ovary are significantly different ($p < .05$) than charges for cancer of the lung, brain, and testicle and myeloid leukemia. Charges for myeloid leukemia and testicle

[1]The cost for myeloid leukemia would have been even higher, but all of the discharges for disseminated myeloid leukemia fell more than 2 standard deviations above the mean and were trimmed. Five of these trimmed discharges involved expenses of more than $50,000 and appeared to have been miscoded into the chemotherapy DRG, because they apparently involved bone marrow transplants.

Table 2

Mean charges[1] in chemotherapy diagnosis-related group (DRG), by primary site of cancer

Diagnosis	Metastases not mentioned	With metastases mentioned[2]	All discharges	Coefficient of variation
Cancer of ovary	$1,508	$1,831	1,600	.63
Lung cancer	1,913	2,357	2,213	.59
Cancer of breast	1,293	1,832	1,759	.79
Cancer of cervix	2,137	([3])	2,058	.83
Brain cancer	2,406	2,656	2,414	.54
Cancer of uterus	1,945	2,111	2,027	.55
Hodgkin's disease	1,940	1,633	1,909	.76
Myeloid leukemia[4]	3,361	([3])	3,361	.50
Cancer of testicle	3,249	3,244	3,245	.36
Malignant melanoma	1,859	2,111	2,063	.42
All other	2,472	2,816	2,635	.63
Mean charge for all cancers with a primary diagnosis designated	2,052	2,326	2,173	.67

[1]Based on data trimmed 2 standard deviations above the mean for total charges.

[2]These discharges have at least one metastasis (from the *International Classification of Diseases, 9th Revision, Clinical Modification*, codes 196-199) as a secondary diagnosis as well as having a diagnosis of cancer or history of cancer at a primary site. For example, admission for chemotherapy for lung metastases (197.0) with a history of breast cancer (V10.3) is shown in this table as breast cancer, not lung cancer.

[3]Fewer than five cases.

[4]Nine cases of myeloid leukemia, including all of the myeloid leukemia shown as disseminated, fell more than 2 standard deviations above the mean for charges and were trimmed prior to this analysis.

Table 3

Statistically significant charge differentials in chemotherapy diagnosis-related group, by primary site of cancer

Mean charges in dollars		Ovary	Lung	Breast	Cervix	Brain	Uterus	Hodgkin's	Myeloid leukemia	Testicle	Melanoma
$1,600	Ovary										
2,213	Lung	*									
1,759	Breast										
2,058	Cervix										
2,414	Brain	*									
2,027	Uterus										
1,909	Hodgkin's										
3,361	Myeloid leukemia	*	*	*	*		*	*			
3,245	Testicle	*	*	*	*	*	*	*			
2,063	Melanoma								*	*	

*Denotes pairs of groups significantly different at the .05 level as determined by the Scheffe multiple range test.

cancer are also significantly different from charges for most cancers.

The explanatory power of primary diagnosis and presence of metastases for variation in total charges within the chemotherapy DRG was tested using multiple regression analysis. Only discharges that were classified into 1 of the 10 most common diagnostic categories were included in the equation, with cancer of the ovary used as the base case. The regression was first performed using only the primary diagnoses as independent variables and explained 13.1 percent of the variation in total charges. The regression results presented in Table 4 included presence of metastases as a variable and explained 13.8 percent of the variance. Cancer of the lung, brain, and testicle and myeloid leukemia were the most significant diagnoses in this analysis. Other regressions were also performed to test the interaction between diagnosis and presence of metastases, but none of the interactions was found to be significant.

The finding of a relatively small difference for all types of cancer combined may indicate that severity by itself, at least as measured by presence of metastases, does not explain the majority of cost variation in other oncology DRG's. As previously seen, diagnosis alone accounts for significant differences within the chemotherapy DRG. This is, of course, less likely in other oncology DRG's, which tend to be limited to a few cancer diagnoses, rather than encompassing a range of conditions.

Inpatient and outpatient chemotherapy compared

The leading cancer diagnoses for chemotherapy administered on an inpatient or outpatient basis are compared in Table 5. Inspection of this table indicates that there are differences in the leading chemotherapy diagnoses based on site of care. The leading outpatient department diagnosis, with over one-third

Table 4

Regression of total charges on selected primary cancer sites within the chemotherapy diagnosis-related group

Diagnosis or presence of metastases	*b*	Standard error	*t* statistic
Lung cancer	507.21	107.28	***4.73
Breast cancer	1.80	142.56	0.01
Cancer of cervix	439.20	146.34	**3.00
Brain cancer	882.61	164.62	***6.36
Cancer of uterus	370.34	165.16	*2.24
Hodgkin's disease	359.41	173.03	*2.08
Myeloid leukemia	1,837.71	177.93	***10.33
Cancer of testicle	1,492.58	189.86	***7.86
Melanoma	320.50	207.16	1.55
Presence of metastases	270.83	86.40	**3.14
R^2 = 0.1379			
F value = 19.1745			
N = 1,210			

*$p < .05$.
**$p < .01$.
***$p < .001$.

NOTES: R^2 is the percent of variance explained. *F* is the ratio of explained to unexplained variance. *N* is the number of cases.

Table 5

Comparison of leading diagnoses for the administration of chemotherapy, inpatient compared with outpatient

	Inpatient		Outpatient	
Diagnosis	Percent of total cases	Rank	Percent of total cases	Rank
Cancer of ovary	27.1	1	—	—
Lung cancer	14.5	2	6.5	5
Breast cancer	6.8	3	34.6	1
Cancer of the cervix	5.5	4	—	—
Brain cancer	4.3	5	—	—
Cancer of the uterus	4.2	6	—	—
Hodgkin's disease	3.6	7	—	—
Myeloid leukemia	3.1	8	—	—
Cancer of the testicle	3.0	9	2.1	9
Malignant melanoma	2.6	10	—	—
Colon cancer	—	—	11.6	2
Non-Hodgkin's lymphoma, not further specified	—	—	8.6	3
Stomach cancer	—	—	7.4	4
Kidney and urinary tract cancer	—	—	6.3	6
Cancer, site unspecified	—	—	4.2	7
Lymphosarcoma and reticulosarcoma	—	—	2.3	8
Head and neck cancer, not further specified	—	—	2.3	8
All other	25.3	—	13.9	—

NOTE: The total number of discharges or visits was 1,614 for inpatients and 474 for outpatients.

of the cases, is chemotherapy for cancer of the breast. This compares with only 7 percent of the inpatient chemotherapy case load. Lung cancer accounts for 15 percent of the inpatient chemotherapy case load, compared with only 7 percent of the outpatient. Cancer of the testicle accounts for similar small percentages in both inpatient and outpatient settings. There is virtually no overlap in the other seven leading diagnoses; that is, cancer of the ovary, cervix, and brain appear to receive chemotherapy almost entirely on an inpatient basis; colon cancer, non-Hodgkin's lymphoma, and stomach cancer appear to receive chemotherapy almost entirely on an outpatient basis. These results suggest that inpatient and outpatient chemotherapy administration do not appear to be easily interchangeable, at least at this point in time.

Even for those three cancers that appear to be seen fairly routinely for chemotherapy administration on both an inpatient and outpatient basis, the heterogeneity of a given disease in different patients and in the same patient over time makes comparison difficult. For example, a given patient on a single chemotherapy program may well receive some components of that program in the hospital and others as an outpatient. A patient with testicular cancer may receive velban and platinum during a 5-day hospitalization and then come to the outpatient department for weekly injections of bleomycin. Thus, if outpatient and inpatient charges for this patient were examined, the comparison would be between a complex in-hospital treatment and a single outpatient visit in which a relatively easily administered, different drug is given.

When both the primary diagnosis and the drug administered are the same, site of care may still differ because of the dosage level or schedule of administration. For example, some patients with breast cancer receive outpatient adriamycin chemotherapy, consisting of a single intravenous injection once a week at a low and less toxic dose. Other patients with the same disease receive high doses of adriamycin by continuous intravenous infusion, requiring 4 days in the hospital.

It should come as no surprise, then, that the charges incurred as an inpatient for chemotherapy administration are substantially higher than those for the same diagnosis when the chemotherapy is done on an outpatient basis. A comparison of these charges is shown in Table 6 for breast cancer, lung cancer, and cancer of the testicle, which are the three cancers that overlap between inpatient and outpatient settings. For all three primary sites of cancer, the inpatient cost is four to five times higher than outpatient cost.

Table 6

Total charges associated with the administration of chemotherapy

Diagnosis	Inpatient admission	Hospital outpatient visit	Inpatient to outpatient ratio
Breast cancer	$1,759	$372	4.7
Lung cancer	2,213	558	4.0
Cancer of the testicle	3,245	739	4.4

Discussion

Analysis of the diagnostic content of DRG 410, admission for chemotherapy, has provided some basic descriptive data not previously available. The analysis also produced a number of findings with policy implications. Cancer of the ovary was the most common inpatient chemotherapy diagnosis, accounting for 27 percent of total discharges. Cancer of the lung, breast, and cervix followed next, with each of the remaining conditions accounting for less than 5 percent of total discharges. A minimum of 40 percent of the discharges from the chemotherapy DRG were for metastatic disease, as indicated by ICD-9-CM coding.

When charges were examined, the least expensive diagnoses (cancer of the ovary and breast) were also two of the three conditions with the largest number of discharges. The most expensive diagnoses, myeloid leukemia and testicular cancer, were less common in the hierarchy of common cancers. These cancers were significantly more expensive to treat than nearly all of the other primary cancers.

Regression analysis showed that all individual diagnoses except for breast cancer and melanoma were significant predictors of total charges for chemotherapy discharges. The presence of metastases, independent of diagnosis, explained only a small amount of charge variation. Because of the size of the sample, however, this was statistically significant. When diagnosis and presence of metastases were considered in combination, there was little improvement in explained variance.

The presence of metastases may not be a viable severity measure for explaining charge variation for admissions for chemotherapy. First, the extent of metastatic cancer indicated in this data set is a bare minimum from a medical perspective. Second, presence of metastatic disease is not used in any of the severity measures currently being considered by researchers addressing the oncology DRG's. While it is intuitively appealing to consider use of this variable as a severity measure, this analysis does not indicate its value, at least for chemotherapy admissions.

Examination of the most common visits made for intravenous chemotherapy on an outpatient basis showed that there is little overlap between the outpatient and inpatient diagnoses. Cancer of the breast accounted for more than one-third of the outpatient cases, compared with less than 7 percent of the inpatient cases. Outpatient visits for lung cancer, however, were only one-half as frequent as inpatient encounters. These findings imply that there is little substitution between inpatient and outpatient chemotherapy treatments for common cancers.

Although these data cannot be used as evidence of a trend, informed medical opinion indicates that more cancer is being treated on an outpatient basis than in the past. Currently, for breast cancer, there is a wide variety of chemotherapy regimens that can be administered on an outpatient basis. Clinicians are now observing an increase in ovarian cancer treatments available for outpatients. This is the primary cancer that now shows the lowest inpatient charge and is probably the easiest to shift to the outpatient department in terms of technology.

A trend toward increased outpatient chemotherapy has a serious impact on cancer cases that still require inpatient treatment. As more cancer patients can be treated on an outpatient basis, the severity of illness of patients remaining in DRG 410 will undoubtedly continue to increase. The reimbursement weight for DRG 410 has been recalibrated to reflect what is already a 23 percent increase between 1984 and 1987. If outpatient treatment is determined to be medically appropriate, it has a number of advantages over inpatient treatment. Provided that length of stay does not fall for those patients being treated in an inpatient setting, the next recalibration of DRG 410 should show an even higher weight as ovarian cancer moves to the outpatient side and cancers in other medical DRG's are classified in the chemotherapy DRG.

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