Economic Disparities in Treatment Costs among Ambulatory Medicaid Cancer Patients

C. Daniel Mullins, PhD; Stephen E. Snyder, MS; Junling Wang, MS; Jesse L. Cooke, MS; and Claudia Baquet, MD, MPH

Baltimore, Maryland

Background: Cancer is the second leading cause of death in the United States and a major contributor to healthcare expenditure. There are few studies examining disparities in treatment costs. Studies that do exist are dominated by the cost of hospital care.

Methods: Utilizing Maryland Medicaid administrative claims data, a retrospective cohort, design was employed to examine disparities in ambulatory treatment costs of breast, colorectal and prostate cancer treatment by region, race and gender. We report mean and median results by each demographic category and test for the statistical significance of each. Lorenz curves are plotted and Gini coefficients calculated for each type of cancer.

Results: We do not find a consistent trend in ambulatory costs across the three cancers by traditional demographic variables. Lorenz curves indicate highly unequal distributions of costs. Gini coefficients are 0.687 for breast cancer, 0.757 for colorectal cancer and 0.774 for prostate cancer.

Conclusion: Significant variation in nonhospital-based expenditures exists for breast, colorectal and prostate cancers in a population of homogeneous socioeconomic status and uniform insurance entitlement. Observed individual-level disparities are not consistent across cancers by region, race or gender, but the majority of this low-income population receives very little ambulatory care.

Key words: ambulatory ■ cancer ■ disparity ■ economic ■ Medicaid

 From University of Maryland School of Pharmacy (Mullins, Snyder, Wang, Cooke) and University of Maryland School of Medicine (Baquet), Baltimore, MD. Send correspondence and reprint requests for *J Natl Med Assoc.* 2004;96:1565–1574 to: C. Daniel Mullins, University of Maryland School of Pharmacy, Pharmaceutical Health Services Research Department, 515 W. Lombard St., Second Floor, Baltimore MD 21201; phone: (410) 706-0879; fax: (410) 706-5394; e-mail: dmullins@rx.umaryland.edu

INTRODUCTION

Cancer is the second leading cause of death in the United States, and a major contributor to U.S. healthcare expenditures. The NCI periodically estimates the Medicare payments for cancer treatment in the first year after diagnosis. For 1995, those payments totaled $41 billion (1996 dollars).[1] Recently, Brown et al. gave cost estimates for specific cancers[2]; the top five cost estimates were $5.6 billion for breast cancer, $5.5 billion for colorectal cancer, $4.9 billion for lung cancer, $4.6 billion for prostate cancer and $2.6 billion for lymphoma. In addition to these national estimates of total costs, a number of investigations have examined different aspects of per-patient cancer costs. This literature emphasizes the average cost per patient for cancer treatment over some time horizon and sometimes also reports different estimates for various clinical and demographic characteristics.

There are several reasons to be concerned with variability in treatment cost. First, unlike chronic conditions, such as heart disease, we can draw a sharp line between those who do or do not receive treatment for cancer. There are relatively few options in the treatment of cancer, and welfare costs associated with cancer are significant. This, in turn, might lead us to conclude that: 1) in a world with equal access to healthcare, variability in treatment costs should be low, and 2) highly variable treatment costs might point to disparities in effective access to care. Despite the importance of the topic, there have been only a few studies of treatment costs, and these studies primarily sought to document cancer's burden, with some analysis of variation in costs as a secondary element.

Table 1 gives a brief summary of six studies published since 1990 that developed per-patient treatment costs for specific cancers. In the earliest of the studies, Baker et al.[3] estimated medical treatment costs for lung and breast cancers among Medicare patients using a three-phase model—initial therapy, continuing care and terminal care—among Medicare beneficiaries diagnosed with lung or breast cancer. Most subsequent studies have used a

similar conceptual model, though the methods by which the three phases are combined to form an overall cost of treatment have varied, as have the techniques for separating cancer-related costs from all medical costs. Table 2 compares the annualized continuing care phase estimates and overall cost of treatment estimates across the six studies for the three most prevalent cancers in the Maryland Medicaid population. The data provide a baseline for comparison with the results reported in this study.

Although pioneering, Baker's results for breast cancer stand out as being almost double the next highest estimate for both the continuing care phase and the cumulative cost. This may point to problems in using a general index (the MCPI) for a specific disease state, especially when indexing from a distant base year (Baker's cost data begins in 1974), but there also are changes in clinical outcomes and practice patterns over 20 years that make Baker's results difficult to compare with more recently published studies.[3]

The remaining studies which report continuing care costs all use study cost years from the 1990s. They report annualized figures between $3,425 (Warren,[4] breast cancer) and $5,888 (Fireman,[5] prostate cancer). Given the lack of standardization of methods and different disease states, this is not a high level of variability and supports the premise that cancer treatment costs should be fairly consistent across populations.

Taplin et al.[6] conducted their study to evaluate the effect of stage at diagnosis, age and level of comorbidity on the costs of treating colon, prostate and breast cancer in a managed care population. They find that later stage at diagnosis and the presence of comorbid conditions generally increased costs. There was no consistent trend for age.

Legorreta et al.[7] compared the cost of treating breast cancer in 200 female HMO members with newly diagnosed breast cancers in 1989. Their results indicate that costs increased as the stage advanced from 0 to IV. The researchers do not report results by subpopulation.

Data from Kaiser Permanente in Northern California were merged with the SEER registry and used by Fireman, Quesenberry et al. to estimate per patient lifecycle expenditures of the health plan for seven types of cancer using a three-phase model.[5] As in the Taplin paper,[6] they do not report consistent trends with respect to age, but find that earlier stage at diagnosis is less expensive to treat. Reported cost estimates for blacks and whites are not statistically distinct.

Warren et al.[4] presented cost estimates for different phases after breast cancer diagnosis using SEER/Medicare data for 1990–1998. The study's primary objective was to compare average costs of breast conserving surgery with modified radical mastectomy. The pooled five-year treatment costs constructed from the SEER/Medicare data averaged $15,800. Annualized continuing care cancer-related costs for treating black women were $1,046 higher compared to the costs of treating white women. African-American women were also proportionately higher in the initial and terminal phases.

Brown et al.[8] used similar data and methodology to obtain long-term costs of care for patients with colorectal cancer. The average long-term costs were $33,700 for colon cancer and $36,500 for rectal cancer. No cost is reported by race, and reported cost differences across genders were small. The only age related trend was a small decrease in mean costs after age 80. In both the Warren and Brown papers, cancers diagnosed at earlier stages appear less expensive to treat.

There are some general principles that emerge from the review of prior cancer cost studies. Early stage at diagnosis appears to lower treatment costs. Only two studies (Fireman et al., Warren et al.)[4,5] report cost estimates by race. Fireman[5] does not find statistically significant differences, while Warren[4] finds higher payments on behalf of African Americans. The existing literature does not show a clear pattern of cost disparities, but this has not been the primary focus of the studies conducted to date. The current article investigates variation in costs as its principal focus.

Our analysis also differs in its emphasis upon ambulatory costs. Previous research has typically used medical claims data, which are dominated by inpatient costs and usually exclude pharmaceutical costs. Databases, such as the Medicare/SEER Registry, capture most of the costs of care but deemphasize community-based aspects of care. Given a diagnosis of cancer, patients may be able to count upon a referral for acute care. However, community-based care may be more sensitive to such issues as transportation, family support and quality of physician/patient interaction.[9] For this reason, ambulatory care provides a critical setting in which to document the extent of disparities, which might indicate the existence of modifiable barriers to treatment.

METHODS

Data Sources

The study examines ambulatory care costs for patients with breast, colorectal and prostate cancers in the Maryland Medicaid program. The study utilized a retrospective cohort, cross-sectional study design. The data source for this study was Maryland Medicaid administrative claims data, including demographic, eligibility, managed care organization (MCO) enrollment data, pharmacy, medical and

institutional fee-for-service claims data and MCO encounter data over a two-year period (January 1, 1999 to December 31, 2000). In accordance with patient confidentiality concerns, this study was approved by the State of Maryland (Protocol #01–16). It has also been reviewed and deemed to be exempt by the Institutional Review Board of the University of Maryland (exemption no. CDM-040101). No unique individual identifiers were included in the analytical data set, and all results are reported at levels of aggregation that preclude the possibility of identifying specific individuals.

Frequencies and cross-tabulations were computed on all data to validate the completeness and integrity of the data as well as to establish relationships between variables. Algorithms were developed to evaluate claims for adjustment and duplications. Validation of these algorithms was conducted by reviewing raw claims for randomly selected recipients. The resultant data were unique with no duplication.

Population

The Maryland Medicaid population is mostly under age 65, even among cancer patients. There were more females than males in the population. Blacks and whites constituted the majority of the group. In terms of the geographic distribution, about half of the enrollees lived in suburban Maryland; more individuals lived in urban than rural Maryland. More details about the population are reported in another manuscript entitled, "Disparities in Prevalence Rates for Lung, Colorectal, Breast and Prostate Cancers in Medicaid."[10] Maryland Medicaid recipients 18 and older who had a medical or institutional claim with an ICD-9 CM diagnosis code for breast, colorectal or prostate cancers between January 1, 1999 and December 31, 2000 were included in the study cohort (see Figure 1 for ICD-9 CM diagnosis codes used to identify the cancers of interest). A beneficiary was enrolled in the study from the date of the first included claim until one of the study termination criteria were met: 1) patient death or 2) study conclusion on

Table 1. Published Per-Patient Costs of Cancer Treatment 1990–2002

Article	Cancer	Data	Estimation*	Stratification	Control	Notes
Baker 1991	Breast	Medicare	Three phases	Survival time	Random sample Age cell means	Initial phase: three months Cont. phase: 9.25 years Females only
Taplin 1995	Breast Colorectal Prostate	MCO (Group Health)	Three phases	Stage at dx Comorbid level age	Population age Cell means	No overall cost of treatment Phase-specific estimates only
Legoretta 1996	Breast	MCO (US Healthcare)	Fixed Four-year longitudinal	Stage at dx Mammography status	No primary care	N=200 Females only
Fireman 1997	Various (7)	MCO (Kaiser Permanente)	Three phases	Age, race, sex	Population Age-sex cell means	Stratified results only Reported as regression coefficients
Brown 1999	Colorectal	SEER-Medicare	Three phases	Stage at dx	Case-control	
Warren 2002	Breast	SEER Medicare	Three phases	Stage at dx Age, race Treatment*	Case-control	Study of Breast Conserving Surgery vs Modified Radical Mastectomy Females only

* Three phases defined as (1) six-month initial, (2) variable continuing, (3) six-month terminal except as noted

December 31, 2000. However, there was no requirement of continuous eligibility, and patients may qualify for Medicaid intermittently, so the actual period of observation was in some cases less than the potential. In calculating the period of eligibility, recipients were considered continuously eligible for Medicaid if administrative gaps of Medicaid ineligibility were less than 30 days. From these criteria, the actual days of Medicaid enrollment were calculated and costs were annualized based upon average cost per enrolled day multiplied by 365. Inclusion of patients who were not continuously enrolled should not lead to bias in the cost estimate since this study looks at the actual costs incurred by the Maryland Medicaid program.

Data Elements

Data were drawn from the claims records used to pay nonhospital-based expenses for Maryland Medicaid recipients. For every individual with one of the three cancers of interest, demographic and enrollment information was extracted and matched to the medical cost data. From the medical, pharmacy and outpatient institutional data, the claims for each of the three cancers were collected for each recipient. The reimbursed amounts for outpatient chemotherapy, antiemetic, analgesic, hematopoietic and radiation therapy during the study enrollment period were then summed by category. Ideally, we would like to include only the information for cancer-related office visits. However, without the availability of physician specialty, we could not distinguish between cancer- and noncancer-related visits. Thus, data for all physician visits were included. This should not result in bias in research findings, since the objective is to study the actual costs that occurred.

Our data includes pharmacy costs, an item that is not available in most previous studies. From the pre-

Table 2. Per-Patient Costs of Cancer Treatment Published 1990–2002 (1992 $)

	Continuing Care Annualized Treatment Cost	Cumulative Cost (Time Horizons Differ)	Study Cost Year*
		Breast	
Baker 1991	11,432	72,832	1984
Taplin** 1995	4,336 [net 1,084]	NA	1992
Legoretta 1996	NA	35,398	1991
Fireman 1997	4,490	35,282	1992
Warren 2002	3,425	18,835	1998
		Colorectal	
Taplin** 1995	5,272 [net 944]	NA	1992
Fireman 1997	5,837	47,085	1992
Brown 1999	3,673	43,730	1998
		Prostate	
Taplin** 1995	5,516 [net 796]	NA	1992
Fireman 1997	5,888	28,771	1992

* "Study Cost Year" denotes the basis year to which cost estimates were adjusted in each study. Costs are stated in 1992 dollars to minimize the number of years adjustment required to produce comparable cost estimates across all studies; ** Taplin reports only phase specific costs.

scription data, variables were constructed to examine the use and reimbursed amount for oral chemotherapy drugs (e.g., tamoxifen, aromatase inhibitors, capecitabine), antiemetics (e.g., 5-HT_3 antagonists, metoclopramide, prochlorperazine), analgesics (nonsteroidal anti-inflammatory agents, opioid agonists, selective tricyclic antidepressants, gabapentin) and hematopoietic agents (filgrastim, sargramostim, epotin alfa, oprelvakin). This data were also matched to the medical/demographic file.

The resulting analytic file consists of one record per patient with enrollment and termination dates, cause of termination, demographics and summary variables for cost by categories.

Table 3. Annualized Cancer Cost by Demographic Categories for Patients with a Single or Multiple Primary Cancer(s)

Panel A: Cancer Costs across Regions

	Prostate Cancer			Breast Cancer			Colorectal Cancer		
	N	Mean*	Median**	N	Mean*	Median**	N	Mean*	Median**
Rural	174	832.61	138.55	358	998.03	509.47	259	983.91	216.98
Suburban	684	1,448.59	202.56	1315	1,227.48	493.39	967	982.97	212.89
Urban	423	980.98	190.25	899	1,053.66	441.50	678	878.49	195.60
P Value		0.0221	0.1075		0.1510	0.2418		0.6124	0.4197
All	1,281	1,210.51	184.30	2,572	1,134.79	480.31	1,904	945.89	207.17

Panel B: Cancer Costs across Races

	Prostate Cancer			Breast Cancer			Colorectal Cancer		
	N	Mean*	Median**	N	Mean*	Median**	N	Mean*	Median**
Black	710	1,067.24	174.76	1,251	1,079.30	449.47	888	1,028.34	220.03
White	427	1,412.50	215.89	1,129	1,209.90	536.49	837	849.34	198.30
P Value		0.1021	0.1245		0.2093	0.0083		0.0962	0.3454
All	1,137	1,196.9	189.62	2,380	1,141.25	489.37	1,725	941.49	207.59

Panel C: Cancer Costs across Genders

	Breast Cancer			Colorectal Cancer		
	N	Mean*	Median**	N	Mean*	Median**
Male	59	671.80	215.80	675	1,054.91	211.53
Female	2,517	1,144.66	484.94	1,233	891.73	205.74
P Value		0.1531	0.0238		0.6517	1.0000
All	2576	1,133.83	480.37	1,908	949.46	207.19

* P Value based upon Analysis of Variance; ** P Value based upon Wilcoxon Test.

D. Data Availability

	Prostate Cancer	Breast Cancer	Colorectal Cancer
Cases	1,281	2,576	1,908
No county id		4	4
Cases missing county identifier were dropped from Panel A.			
Race not Identified as black or white	144	196	183
Cases with race identifier other than black or white were dropped from Panel B (see methods).			

Data Analysis

The aggregate data on the use and cost for various treatments and the recipient's enrollment time were used to compute an annualized cost for each patient. The stratified costs for each cancer were calculated by region, gender and race. Each person was categorized to a geographic region (urban, suburban or rural) based on his/her county of residence on January 1, 2000. We defined geographic region as urban (Baltimore city), rural (Allegany, Garrett, Washington, Kent, Queen Anne's, Caroline, Talbot, Dorchester, Somerset, Wicomico and Worchester counties) and suburban (the rest of Maryland) based upon the proportion of agricultural populations in the total population in the regions. There were three racial groups: black, white and other. The racial group "other" was comprised of Hispanics, Asian, Native American, Pacific Islanders/Alaskan and those of unknown ethnicity/race, an extremely heterogeneous category. Since each of these racial groups accounted for less than 4% of total Maryland Medicaid population, there were insufficient numbers for analysis, and they are excluded from the tabular analysis by race. The differences in means of the subgroups were tested using Analysis of Variance. The differences in medians of the subgroups were tested using the Wilcoxon test when there were two subgroups and the Kruskal-Wallis Test when there were three subgroups.

In understanding the determinants of cancer spending, it may be misleading to think of the cost of treating an "average" patient. A tool frequently used by economists for investigating inequality is a Lorenz curve, which shows how expenses are distributed along a continuum—in this case, a continuum of patients.[11] To produce a Lorenz curve, we ordered our study population by each person's level of spending, expressed the size of the population up to that level as a percentage and expressed the associated spending as a percent of total spending. The resulting curve relates shares of the population to shares of spending. Associated with this curve is a number, called a Gini coefficient, which represents the area between the Lorenz curve and the line representing equality.[11] If spending were totally equal, the Lorenz curve would be a straight line with a slope of 1 and a Gini coefficient equal to 0. This would imply that the first 10% of the population accounts for 10% of spending, the first 20% accounts for 20% of spending, etc. Unequal spending will always produce a curve below the "equality line." With greater disparity in spending across individuals, the curve is farther from the "equality" line, and the Gini coefficient increases. If all costs are associated with a single patient, the Gini coefficient will be equal to 1.

RESULTS

The results of differences in costs across regions, racial groups and genders are presented in Table 3. The distribution of cancer cases within a cancer and across the demographic variables is governed by the interaction of cancer risk, Maryland demographics and Medicaid enrollment criteria. Using per-patient costs as our outcome variable simplifies the analysis, as the impact of eligibility criteria on the size of the Medicaid population by region, race and gender is excluded from the analysis.

Table 3 Panel A shows mean and median costs for a patient in different regions. We did not find a

Figure 1. ICD-9 CM Diagnosis Codes for Cancers Included in Study

A three-digit code followed by x (e.g., 174.x) indicates that all four-digit codes matching the specified three-digit code are included.

Colorectal Cancer	Primary:	153.x, 154.x
	Secondary:	196.x, 197.x, 198.x
	In situ:	230.3, 230.4, 230.5, 230.6, 230.7
Breast Cancer	Primary:	174.x, 175.x
	Secondary:	196.x, 197.x, 198.x
	In situ:	233.0
Prostate Cancer	Primary:	185, 189.3
	Secondary:	196.x, 197.x, 198.x
	In situ:	233.4, 233.9

consistent trend in the point estimates for all three cancers, and the only results significant at the 5% level are the means for prostate cancer. Suburban patients are never the lowest cost group, otherwise there are few conclusions we can draw about central tendency. The medians are always much lower than the means, implying that the distributions are highly right skewed, those with high costs are further from the mean than those with low costs. For rural, suburban and urban patients, respectively, the median as a percentage of the mean is 17%, 14% and 19% for prostate cancer, 22%, 22% and 22% for colorectal cancer, and 51%, 40% and 42% for breast cancer.

The costs were compared between whites and blacks in Table 3 Panel B. Again, only one comparison shows a statistically significant difference, the medians for breast cancer. The ratios of medians to means are low and similar to those found in Panel 3a.

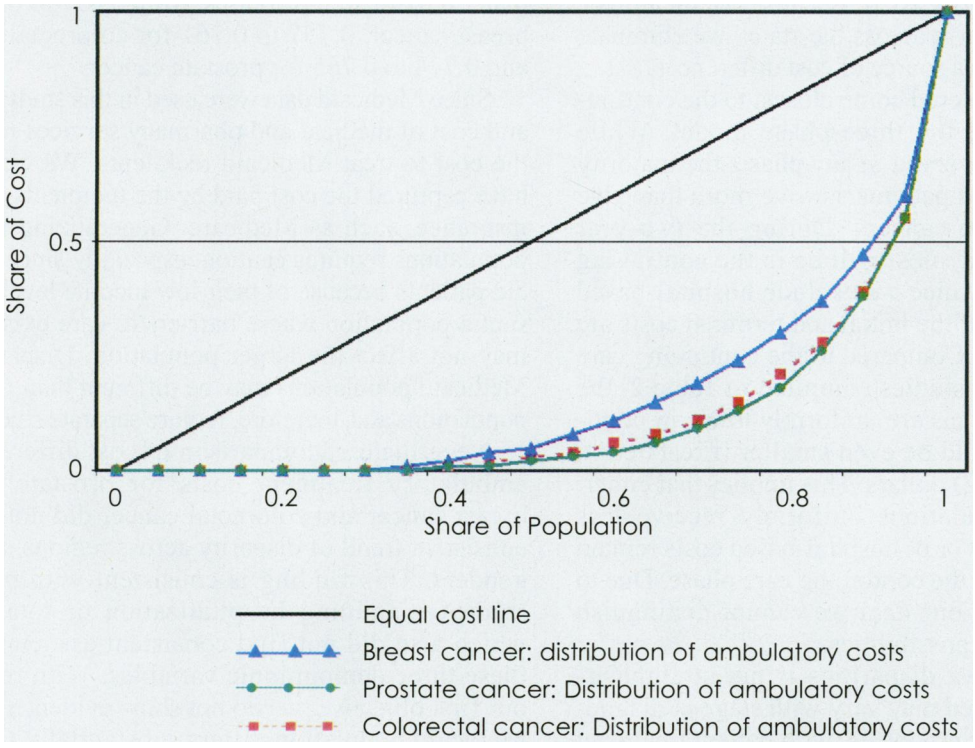
For two of the three cancers (breast and colorectal) comparisons were made by gender in Table 3 Panel C. Only the difference in median costs of breast cancer treatment reached statistical significance at the 0.05 level. The median as a share of the mean for breast cancer is 32% for males and 42% for females; for colorectal, the figures are 20% and 23%, respectively.

Despite the paucity of statistically significant differences by demographic categories, Lorenz curves for each of the three cancer types show costs very unequally distributed (Figure 2). For all cancers studied, the 10% of patients with the highest costs account for approximately 50% of spending, the 50% with the lowest costs account for less than 10% of spending. The Gini coefficients associated with each Lorenz curve are 0.687 for breast cancer, 0.757 for colorectal cancer and 0.774 for prostate cancer.

DISCUSSION

This study addresses two inter-related research issues: 1) the extent of regional, racial or gender disparities in a population with similar socioeconomic status and insurance entitlement and 2) the extent of inequalities in treatment expenditure generally. By examining the first issue, we shed some light on the extent to which apparent racial, regional and gender disparities are markers for socioeconomic differences. By examining the second within populations with similar medical conditions we document

Figure 2. Lorenz Curves of Ambulatory Costs for Maryland Medicaid Patients with Breast, Colorectal or Prostate Cancer



Annualized costs for nonhospital-based treatment January 1999–December 2000. Costs are amounts paid by Medicaid fee-for-service patients. Associated Gini coefficients are 0.687 for breast cancer, 0.774 for prostate cancer and 0.757 for colorectal cancer.

whether the demographic disparities are large within the overall variation in treatment costs.

We begin by noting that the Maryland Medicaid population appears generally similar to the overall Maryland population with respect to cancer prevalence.[10,12,13] The distribution of cancer cases is generally proportional to the number of Medicaid enrollees in the relevant population, which is quite different from the statewide share in the general population. Maryland's population is largely suburban, but the suburbs are wealthier than the urban and rural areas, so only 59,000 of the 116,000 Medicaid recipients reside in the suburbs. Maryland's population is 28% African-American, but the over-40 Medicaid population is 45% African-American. The Medicaid population is two-thirds female, while the state population is 53% female. Such differences account for the relatively high number of breast cancer cases relative to prostate (2,572 vs. 1,281), and the relatively high number of cases among African Americans. An exception is prostate cancer, where the sizes of the black and white male Medicaid populations are approximately equal (16,811 for 40+ blacks, 16,686 for 40+ whites), but the number of cases of prostate cancer is higher for African Americans (Table 3 Panel B). By using per-case costs as our outcome variable we separate issues of Medicaid eligibility from the investigation of treatment cost distribution *within* the Medicaid population. Also, because Medicaid fee schedules are uniform across the state[13] we eliminate price differences as a source of cost differences.

The costs considered come closest to the continuing care phase of the three-phase model. While patients may be observed in any phase, the majority of newly diagnosed patients survive more than five years for all three cancers. During the two-year observation period, most will be in the continuing care phase. Also, since we exclude hospital-based charges, the bulk of the initial and terminal costs are not in the data set. Compared to the continuing care costs for previous studies compiled in Table 2, the present study's means are uniformly lower in nominal terms and would be even smaller if restated in baseline year (1992) dollars. This implies that either: a) Medicaid populations uniformly receive less intensive treatment or b) hospital-based costs remain substantial even in the continuing care phase. Due to the limitations of our data we cannot distinguish between these two possibilities.

Interpreting cost disparities is not straightforward. Costs incurred may vary with stage at diagnosis and consequent prognosis, with patient treatment preferences or with access to treatment. Costs might be lowered by early detection, making radical treatment unnecessary or by very late diagnosis, at which time there are no therapies available beyond the palliative. Low costs do not necessarily signal less access to care, but they might. *A priori* we might suspect that ambulatory care might present greater nonmedical obstacles to care due to difficulties with transportation and family responsibilities.[9] Therefore, disparities might be more easily identified in an ambulatory setting. The objective of the present study is to document the extent of disparity within an indigent population with similar insurance status. Since members of the study population must meet income guidelines to receive Medicaid benefits, we exclude income as a source of disparity. The paper investigates how equal spending is in the overall study population and whether the differences that exist are associated with the race, gender or geographic location of the patients.

Because we used annualized costs, there is some bias attributable to mortality in the Lorenz curves, those who die soon after qualifying for Medicaid will show high annualized costs because the number of Medicaid eligible days is shortened. However, the pattern is similar across the three cancers despite the fact that these cancers have different mortality rates, indicating that the bias from annualizing is small. We tested this proposition by excluding patients with fewer than 50 days of Medicaid eligibility from our results. This led to only slight changes in the Lorenz curves. The Gini coefficients changed less than ±0.01 in all three cases, from 0.687 to 0.678 for breast cancer, 0.757 to 0.761 for colorectal cancer, and 0.774 to 0.765 for prostate cancer.

Since Medicaid data were used in this study, the use and cost of medical and pharmacy services reflected the cost to treat Medicaid recipients. We would not have captured the cost paid by the recipients or other insurance, such as Medicare. Generalizing to other populations requires caution, especially since Medicaid patients because of their low income levels represent a population where barriers to care exist which may not affect the larger population. Disparities in Medicaid populations may be different than for other populations and, therefore, require separate study.

Nevertheless, comparison of cost differences in ambulatory treatment costs for prostate cancer, breast cancer and colorectal cancer did not show a consistent trend of disparity across regions, races or genders. This finding is consistent with previous studies examining hospitalization or total costs, which also did not find consistent associations in these three demographic variables. With regard to our first objective, we do not show evidence that the Medicaid population differs substantially from the overall population with respect to demographic disparities in ambulatory cancer treatment costs. This does not necessarily imply that all Medicaid patients have access to a high standard of ambulatory care.

Turning to our second objective, there was a very unequal distribution of costs for each of the three cancers studied. While medical costs are in general unevenly distributed, our findings come from a population of whom all have a diagnosis of cancer. Differences in treatment costs for this population are potentially the result of different therapeutic choices. For the three cancers studied patients who are treated primarily through surgery will not have large ambulatory expenses but should have between one and four physician visits per year, depending on the time since treatment.[14,15] Patients who receive substantial chemotherapy are indicated to also receive adjunct medications—hematologics, analgesics and antiemetics—to increase tolerance to therapy.[16,17] Long-term use of tamoxifen is generally indicated for breast cancer treatment.[18,19] The bulk of spending in our data is in chemotherapy and adjunct drugs, with the adjunct drugs representing more than three-quarters of spending associated with chemotherapy. While not all chemotherapy patients receive all adjuncts, those who do not receive chemotherapy have very low nonhospital costs. If fewer than half the patient population received chemotherapy during the two years of the study then the median patient will be one that at present receives relatively little ambulatory treatment. However, the expenditures associated with more than 50% of cancer patients fall below even what would be generated by guidelines for routine follow-up care.[14-19] Whether the very low ambulatory expenditure most patients receive is clinically satisfactory is beyond the scope of this study, but it is not entirely reassuring. The entire study population has a history of serious, life-threatening illness for which continuing follow-up care is recommended. We cannot exclude the possibility that Medicaid patients are receiving less continuing care than is desirable, and this would seem to be a topic that deserves additional study, especially given the spread of capitated Medicaid payments which lower incentives for providers to encourage routine visits.[20]

When therapy becomes standardized, we would expect expenditures to become more evenly distributed. For example, the consistent trend in the ratio of median to mean costs is that breast cancer patients have a higher ratio than do prostate or colorectal patients. We would, therefore, expect the Lorenz curve for breast cancer to be closer to the equality line (Figure 2). The cause may be greater use of long-term drug therapies, such as tamoxifen, for breast cancer patients. If similar therapies were to become widespread in treating prostate and colorectal cancer, we would expect a similar pattern of greater equality. However, it is still true that a large percentage of breast cancer patients have costs too low to be consistent with continuing tamoxifen therapy.

Our analysis suggests that the means reported for continuing care in previous studies do not represent "typical" patients. We document that mean treatment costs are amalgams of patients receiving relatively little therapy and those receiving fairly expensive therapy. We find large differences in ambulatory treatment costs, but these differences are not strongly associated with the traditional demographic variables—race, gender and region—of the disparities literature. This does not mean that all is well with respect to continuing treatment within this indigent population. Without the availability of clinical data, we could not assess the severity of cancer in our study cohort. But this is not a study of the general population. This is a study of patients being treated for three prevalent types of cancer and we might expect more equality of expenditure that was found. Our results suggest the need to go beyond traditional categories in investigating disparities. If the variation does not occur across groups, it must occur within groups. A more complete understanding of the source of these within-group disparities is a topic for future research.

We have extended the existing literature in three ways. First, we confirm previous studies that did not show consistent disparities with respect to demographic variables and show that this applies to nonhospital based costs, such as drug therapy. Second, we establish that substantial inequality in costs exists within a population with similar economic status and insurance entitlement. Third, we analyze this inequality using Lorenz curves, which make clear the extent to which this inequality is driven by relatively high expenditure by a small percentage of patients.

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