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Demographics and the Cost of Pharmaceuticals in a Private Third-Party Prescription Program

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RESEARCH

Demographics and the Cost of Pharmaceuticals in a Private Third-Party Prescription Program

OBJECTIVE: To compare variance in the cost of pharmaceuticals attributable to demographic variables with variance explained by plan characteristics, using prescription claims data within various therapeutic categories, and to examine differences in average cost of pharmaceuticals among demographic variables after controlling for covariates.

DESIGN: Retrospective, cross-sectional study.

DATA COLLECTION: Data for this study were obtained from 1996 prescription claims information for the commercial population administered by a Rhode Island–based pharmacy benefit management (PBM) company. Six therapeutic categories with the highest expenditures were analyzed. Information on claims for six drug categories was extracted using database management software. Statistical analyses using multiple regression and analysis of covariance were carried out.

RESULTS: Plan characteristics outperformed demographic variables sixteenfold for all drug categories combined in explaining variance in cost of pharmaceuticals among plan enrollees. Average cost of pharmaceuticals differed among demographic variables such as age, gender, location, and place of employment after controlling for average wholesale price and days supply.

CONCLUSIONS: The results obtained in this study have practical significance in the determination of capitation rates when utilization history of prospective members is not available. In this situation, managed care organizations (MCOs) or PBMs may have to set capitation rates based solely on eligibility data. Significant differences in average drug costs among the members based on place of employment suggest that benefit managers should consider differentiating capitation rates according to their clients' businesses. Finally, the data from this study indicated that commercial members residing in Tennessee had the lowest average cost of pharmaceuticals among all states evaluated. The fact that one PBM manages more than 80% of the TennCare prescription program along with a significant commercial client base suggests that a "spillover effect" may exist.

KEYWORDS: Cost of pharmaceuticals, demographics, plan characteristics, utilization, confounding variables, prescription claims data, capitation rate, pharmacy benefit

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by Soyal R. Momin, E. Paul Larrat, David P. Lipson, Rita M. Marcoux, and Lisa L. Harlow

Prescription drug prices have escalated rapidly over the past few decades. These increases can be explained in large part by therapeutic innovations, increased utilization related to demographics, and increased coverage under drug benefit programs. Prescription drugs are an essential part of current medical treatment technology, which is why virtually all private insurance plans, managed care organizations (MCOs), and state Medicaid programs cover prescription drugs for their enrollees.

The emergence of pharmacy benefit management companies (PBMs) was a major structural change in the distribution of pharmaceuticals during the 1990s.[1] Because monitoring, managing, and implementing a pharmacy benefit requires a considerable commitment of time and resources, many MCOs and self-insured employers have turned to PBMs to help manage all or part of their pharmacy benefit programs. PBMs provide a variety of services designed to influence outpatient prescription drug utilization and costs. Employers and insurers contract with PBMs in an effort to provide accessible and cost-effective benefits to their members.

MCOs and PBMs sometimes offer risk-based capitation payment programs as an alternative to fee-for-service (FFS) for a variety of population groups and benefit packages. Contracts based on capitation reimbursement limit the payor's financial risk by setting a fixed dollar amount per member per unit of time. The MCOs or PBMs must provide all the contracted services for the specified amount of money or suffer a financial loss.

With capitation payments linked to MCO premiums and MCOs under pressure from employers to keep premiums as low as possible, MCOs are under increased financial pressure to reduce their costs. Capitation rates must accurately reflect actual drug utilization if the reimbursement is to be fair to both the provider and the payor. Previous research has found that factors affecting use of health services are not limited to the characteristics of the service but often extend to the characteristics of the user.[2] Those who price, sell, and administer prescription drug benefit programs should be aware of the effects of member demographics on their prescription benefit costs. Amendments to HMO laws in 1981 allowed the adjustment of capitation rates for demographic variables of the subscribers.[3] Whether the usual underwriting factors such as age, sex, occupation, and residence are sufficient for establishing annual premiums is a matter of debate.[4] A study examining demographic variables as predictors of annual outpatient expenditures con-

cluded that demographic characteristics perform very poorly as underwriting factors.[5]

Still, the extent of drug use by patients of all ages is an important issue. Age-specific utilization rates have proved to be important determinants of overall expenditures on prescription drugs.[6] Cross-sectional studies have consistently indicated that prescription drug use increases with age.[7] For example, one study assessing the relationship of demographics to prescription drug use among elderly Pennsylvanians enrolled in the Pharmaceutical Assistance Contract for the Elderly program found that prescription utilization rises with age.[8] In another study, annual drug expenditures varied significantly by age and sex categories.[9] These qualitative differentials have been validated in national data that show mean expenditures for women to be 54% greater than those for men, and children's expenditures only half that of adult males.[10]

Gender differentials in prescription drug use have been reported to persist even after controlling for disease severity, the nature of the medical problem (acute or chronic), age, and other factors considered to be medically relevant.[11] Specifically, both age and sex appear to be strongly associated with antihypertensive, antidepressant, and histamine H2 antagonist (H_2-blocker) drug use.[12-14]

Employment is associated with a lower incidence and prevalence of drug use for men, but not for women.[15] Although employment has a differential effect on men's and women's drug use, it does not affect the extent of prescription drug use.[15] As risk factors for cardiovascular disorders, depression, and ulcers differ among occupational groups, further research is needed to determine how people in different occupations differ in their prescription drug use.

In 1993, Smith found that the cost of pharmaceutical services was correlated with geographic region.[16] However, other studies have found little regional variation in drug use based on age/gender-adjusted prescription costs.[17]

Interest is increasing in the assessment of ambulatory health care databases. Much of this interest exists among health-system administrators who wish to better understand their cost structures in an attempt to control costs and improve quality of care.[18] Also, research has shown that outpatient services are generally more predictable than inpatient services.[5]

Claims data can provide accurate information on drugs dispensed. In addition, claims data are not subject to the recall problems that are found with self-reported data and can provide a more representative picture of drug utilization than provider-based studies.[19] Although these data are somewhat limited in that they often do not consistently identify the prescribing physician and do not have accurate diagnosis information, they do provide excellent population profiles of drug utilization. These profiles, once created, can be easily supplemented with additional information to improve their utility.

Using prescription claims data, the objectives of this study were: (1) to compare the proportion of variation in cost of pharmaceuticals that could be explained by available demographic variables and plan characteristics within various therapeutic categories; and (2) to determine whether the average cost of pharmaceuticals differed with various demographic variables after controlling for appropriate covariates.

Methodology

Study Description

Data for this study were obtained from prescription claims information compiled during 1996 for the commercial population administered by MIM Health Plans, Inc., a Rhode Island–based PBM. These data were collected from pharmacies at the point of service during the routine filling of members' prescriptions. Data elements conformed to National Council on Prescription Drug Processing standards for pharmacy claims adjudication. Algorithms to assure data accuracy were applied at the point of service and retrospectively by the PBM. All data were blinded as to patient name, assuring confidentiality of medical information. The study was approved by the University of Rhode Island Institutional Review Board on Human Subjects.

Measures

Each record in a claims file represented a prescription dispensed to a member. The information in the record included National Association of Boards of Pharmacy (NABP) pharmacy identification number, date of service, national drug code for the medication, Generic Product Identifier, generic name, number of prescriptions, quantity dispensed, amount paid by the member (copayment), amount reimbursed to the pharmacy provider, member identification number, gender, age, carrier name, account name, group name, and number of days supply.

The NABP number was used to link claims files with pharmacy files to find the name and location of the pharmacy. The unique combination of carrier, account, and group representing a particular plan was used to determine place of the member's employment. Based on the National Occupational Classification, members were assigned to one of the following employment categories: management, commerce, health, social sciences, lawyers and educators, art, sales and services, trade and transport, primary industries, manufacturing, and contractors.[20]

The database contained no information on the member's place of residence, race/ethnicity, educational level, or income, so measuring the effect of these demographic variables on the cost of pharmaceuticals was not possible. However, pharmacy location was used as a proxy variable for residence, because members are likely to present their prescriptions to pharmacies near their homes.

In addition to demographic information, a file on member eligibility contained each member's enrollment history. Each member was identified by a member number and might have

been the original enrollee (subscriber) or a dependent. Questions on continuity of coverage can be answered from the information in this file, which maintains a temporal view of the member's activity within the system. Member identification numbers were used as a common field to link claims files with eligibility files to determine the member's eligibility.

Because claims data were never structured to answer the specific questions of this study, algorithms were designed for extracting appropriate subsets of claims using database management software (Dbase 2.6). The Generic Product Identifier codes (Medispan, Inc.) were used to divide prescription drugs into major therapeutic categories. Claims files were indexed with reversed claims, marked manually, and deleted to ensure that the data for analysis did not include any denied or reversed claims. A claim reversal occurs when a pharmacist must resubmit a claim because of a coding error, a missing drug identification code, or other inaccurate information. The error is corrected by entering a claim identical to the first claim but with negative financial values. The third record reflects the correct information.

The six therapeutic categories with the highest expenditures during fiscal year 1996 were selected for the analysis. These were calcium channel blockers, angiotensin converting enzyme (ACE) inhibitors, lipotropics, antidepressants, H_2-blockers, and beta-adrenergic blocking agents (beta blockers).

Member-specific prescription data were extracted from the computerized records for the period January 1, 1996–December 31, 1996. All members who received at least one prescription in one of these therapeutic drug categories were included in the analysis. The total value of claims used in the analysis was $1.5 million with an average of $0.15 per member per eligible day. For the purpose of this study, cost of pharmaceuticals/drug costs was defined as the dollar expenditure for prescription drugs per member per eligible day.

Outline of Statistical Analysis

The SAS program for Windows (version 6.12) was used for all statistical analyses. Frequency analysis for categorical variables and univariate analysis for continuous variables were carried out. PROC UNIVARIATE and PROC PLOT were used to assess the assumptions of normality, linearity, and homoscedasticity.

Because not all members were eligible during the entire fiscal year 1996, in some cases utilization data did not reflect a full year's experience. To adjust for this, the cost of prescriptions was divided by eligible days, resulting in an estimate of the amount that members cost the plan per day. Therefore, the cost per member per eligible day was used as the dependent variable for statistical analyses. Frequency analysis revealed relatively few claims in states other than Tennessee. To avoid the problem of small numbers and unstable estimates, claims from states other than Tennessee were combined to form one category of "other states." Depending upon the drug category that was reviewed, the same strategy was followed for place of employment. For example, claims for calcium channel blockers for members employed in management, commerce, social sciences, law, education, art, primary industries, and trade and transport businesses were combined to form one category of "other," and compared with those employed in manufacturing, contracting, health, and sales and services businesses.

Claims for calcium channel blockers, lipotropics, ACE inhibitors, and beta-blockers were combined and designated as claims for cardiovascular drugs. Claims for antidepressants and H_2-blockers were also combined. Finally, claims for all drug categories were combined, resulting in nine sets of claims for analysis after considering each drug category individually.

Two sets of multiple regression analyses were carried out. The first set using PROC REG was performed to determine the proportion of variation in the cost of pharmaceuticals that could be explained by age, gender, location, and place of employment for the six drug categories and their combinations. For these analyses, dummy variables were used for gender, location, and place of employment.

The gender variable was dummy coded as male=1 and female=0. Location was dummy coded as Tennessee=1 and other states=0. Dummy coding for place of employment differed for some drug categories. For example, four dummy variables were used (X1, X2, X3, X4) for place of employment in calcium channel blockers: Manufacturing (X1=1, X2=0, X3=0, X4=0); Health (X1=0, X2=1, X3=0, X4=0); Sales and Services (X1=0, X2=0, X3=1, X4=0); Contractors (X1=0, X2=0, X3=0, X4=1); and Other (X1=0, X2=0, X3=0, X4=0). Interaction terms were added to determine whether the explained variance could be significantly improved by accounting for interaction effects between the independent variables. Variance inflation factor tests were used to seek out multicollinearity problems.

The second set of multiple regression analyses was carried out to examine the proportion of variation in the cost of pharmaceuticals that could be explained by plan characteristics. The independent variables included in the analyses were number of days eligible, number of members eligible, average wholesale price (AWP), out-of-pocket expense, number of days supply, and quantity dispensed. Variance inflation factor tests were used to find any problems with multicollinearity.

To ensure a valid comparison, analyses of covariance (ANCOVA) were used to evaluate the differences in average cost of pharmaceuticals among demographic variables. ANCOVA allowed us to hold constant factors that might influence the cost of pharmaceuticals and to observe the differences only attributable to patient demographics. The last two digits of the member identification number facilitated the separation of claims of subscribers from their dependents. For testing our hypotheses about place of employment and cost of pharmaceuticals, only claims by subscribers were selected. Age was analyzed after being categorized into five groups: 1–5, 6–20, 21–40, 41–64, and more than 64 years old.

The control variables were member age, group size, AWP, and number of days supply. Changes in the AWP that manufacturers charge for each unit of product is an indicator of price inflation, while days supply reflects the quantity dispensed. In some cases we found significant interaction between variables of interest (grouping variables) and the covariate, indicating violation of the assumption of homogeneity of regression. Effect sizes of interactions between grouping variables and the covariate were calculated. To understand the relative differences between groups, we also computed least square adjusted means, which held the covariates constant. A value of $p \leq 0.05$ was chosen as the a priori level of significance.

Results

Sample Description

During fiscal year 1996, 29,211 subscribers representing 64,815 enrollees were eligible (see Table 1, right). This study evaluated 33,131 prescription records for six drug categories. The mean age of enrollees was 31.5 years. Females made up 52.8% of the eligible population and males accounted for 47.2%. Subscribers were mainly employed in health (39.8%), sales and services (17.7%), and manufacturing (10.3%). Of all members, 58.2% were in capitated plans; the rest were in FFS plans. Members were mostly enrolled in a plan with an open formulary (79%), followed by mandatory generic substitution (19.6%), and closed formulary (1.4%).

Results of Multiple Regression Models

Table 2 (see page 399) summarizes results of the multiple regression using cost per member per eligible day as a dependent variable and age, gender, location, and place of employment as independent variables. The regression models were significant at the 0.001 level for all drug categories and their combinations. The explained variance in the cost of pharmaceuticals by therapeutic category ranged from 1.6%–13.7%. This variance was lowest for antidepressants and highest for H_2-blockers.

Interactions among independent variables were added in the models to improve the explained variance. For example, interactions among gender, location, and place of employment were included. Addition of interaction terms did not significantly improve the explained variance with the exception of all drug categories combined. Explained variance for all drug categories combined in presence of the interaction terms was 9.6% compared with 3.9% without the addition of interaction terms. The improvement in explained variance was associated with multicollinearity problems as indicated by variance-inflation factors and high standard errors of beta coefficients. Regression analyses were carried out excluding interaction terms to address problems of multicollinearity.

Age was positively associated with the cost of pharmaceuticals for all drug categories except for beta-blockers and antidepressants. Males were positively associated with the cost of pharmaceuticals for calcium channel blockers and beta-blockers and negatively associated with lipotropics and antidepressants. The relationship was not significant for ACE inhibitors and H_2-blockers. Residence in the state of Tennessee, which made up the majority of our population, was negatively associated with cost of pharmaceuticals for all drug categories.

Cost of pharmaceuticals was positively associated with manufacturing employees compared to employees of other businesses for calcium channel blockers, lipotropics, and H_2-blockers, and was negatively associated for antidepressants. The relationship was not significant for ACE inhibitors and beta-blockers. Cost of pharmaceuticals was negatively associated with employment in the health professions for calcium channel blockers, ACE inhibitors, and beta-blockers. The relationship was insignificant for lipotropics, H_2-blockers, and antidepressants.

TABLE 1 Characteristics of Enrollees in a Private Third-Party Prescription Program

	Number of Participants (%) (N= 64,815)
Member age[a]	
1–5	5,666 (8.8)
6–20	13,947 (21.6)
21–40	23,739 (36.8)
41–64	18,788 (29.1)
>64	2,352 (3.6)
Mean	31.5
Member gender[b]	
Female	34,145 (52.8)
Male	30,584 (47.2)
Place of Employment of Primary Cardholder	**(N=29,211)**
Management	1,236 (4.2)
Manufacturing	3,018 (10.3)
Contractors	1,374 (4.7)
Commerce	2,043 (7.0)
Health	11,634 (39.8)
Social sciences, lawyers, and educators	2,579 (8.8)
Art	671 (2.3)
Sales and services	5,156 (17.7)
Trade and transport	682 (2.3)
Primary industries	818 (2.8)

Note: As of December 31, 1996.
[a]*323 records missing age information.*
[b]*86 records missing gender information.*

TABLE 2 Multiple Regression Model of Cost of Pharmaceuticals for Various Drug Categories (Regression Coefficients [Standard Error] for Cost of Pharmaceuticals by Member Demographics)

Variable	Drug Category								
	1	2	3	4	5	6	7	8	9
Intercept	—	—	—	—	—	—	—	—	—
Member age	0.0813*	0.0769*	0.0855*	-0.0323**	0.1288*	-0.0736*	0.0660*	0.0126	0.0135**
	(0.0003)	(0.0006)	(0.0003)	(0.0008)	(0.0004)	(0.0005)	(0.0003)	(0.0003)	(0.0002)
Member gender	0.0603*	-0.0623*	0.0159	0.0445*	0.0104	-0.0297*	0.0073	0.0241*	0.0128**
	(0.0085)	(0.0134)	(0.0089)	(0.0215)	(0.0124)	(0.0170)	(0.0070)	(0.0116)	(0.0062)
Member location	-0.3294*	-0.3464*	-0.2774*	-0.2669*	-0.3351*	-0.0846*	-0.2444*	-0.1582*	-0.1947*
	(0.0116)	(0.0162)	(0.0127)	(0.0259)	(0.0170)	(0.0244)	(0.0092)	(0.0166)	(0.0086)
Place of employment									
Manufacturing/other	0.0748*	0.0409**	-0.0044	-0.0113	0.0472*	-0.0379*	0.0206**	-0.0287*	0.0245**
	(0.0145)	(0.0221)	(0.0160)	(0.0393)	(0.0232)	(0.0290)	(0.0121)	(0.0206)	(0.0167)
Health/other	-0.0375**	-0.0399	-0.1089*	-0.2220*	0.0017	0.0273	-0.1177*	-0.0075	-0.0103
	(0.0120)	(0.0182)	(0.0127)	(0.0310)	(0.0182)	(0.0217)	(0.0098)	(0.0155)	(0.0153)
Sales & services/other	-0.0315**	-0.0455**	-0.1004*	-0.0524**	-0.0021	-0.0253**	-0.0742*	-0.0275*	0.0204**
	(0.0164)	(0.0232)	(0.0167)	(0.0381)	(0.0247)	(0.0323)	(0.0128)	(0.0225)	(0.0173)
Contractors/other	0.0548*	—	—	—	—	—	—	—	0.0408*
	(0.0195)	—	—	—	—	—	—	—	(0.0196)
Commerce/other	—	0.0121	—	—	—	0.0435*	—	0.0023	0.0235*
		(0.0278)	—	—	—	(0.319)	—	(0.0241)	(0.0188)
Management/other	—	—	0.0365**	-0.0417	0.0900*	—	-0.0020	—	0.0218*
	—	—	(0.0193)	(0.0455)	(0.0271)	—	(0.0157)	—	(0.0189)
N	6,763	3,462	5,783	3,631	4,297	8,690	19,642	13,488	33,131
F	150.87*	76.45*	93.43*	61.30*	110.47*	21.47*	236.80*	53.11*	151.46*
R2	0.1352	0.1341	0.1017	0.1059	0.1390	0.0170	0.0778	0.0268	0.0395
ADJ.R2	0.1343	0.1324	0.1006	0.1042	0.1377	0.0162	0.0775	0.0263	0.0393

*1: Calcium channel blockers. 2: Lipotropics. 3: Angiotensin-converting enzyme inhibitors. 4: Beta-blockers. 5: H_2-blockers 6: Antidepressants. 7: Combining cardiovascular drugs (1, 2, 3, and 4). 8: Combining H_2-blockers and antidepressants (5,6). 9: Combining all six drug categories. *Significant at 0.001. **Significant at 0.05.*

Cost of pharmaceuticals was negatively associated with sales and services employment for all drug categories except H_2-blockers, where the relationship was not significant. Cost of pharmaceuticals was positively associated with contracting and commerce employment for calcium channel blockers and antidepressants, respectively. Cost of pharmaceuticals was positively associated with management employment for ACE inhibitors and H_2-blockers.

Table 3 (see page 400) provides the results of multiple regressions using cost per member per eligible day as a dependent variable and plan characteristics as independent variables for six drug categories and their combinations. Regression models were significant at the 0.001 level. Explained variance ranged from 34%–87%. Explained variance was lowest for beta-blockers and highest for antidepressants. Small variance inflation factors indicated absence of multicollinearity.

Results of Analyses of Covariance

Average wholesale price and days supply were selected as covariates because controlling for age and number of members eligible did not significantly improve the model fit (R2). In some cases, interactions between AWP and grouping variables,

TABLE 3 Multiple Regression Model of Cost of Pharmaceuticals for Various Drug Categories (Regression Coefficients [Standard Error] for Cost of Pharmaceuticals by Plan Characteristics)

Variable	Drug Category								
	1	2	3	4	5	6	7	8	9
Intercept	—	—	—	—	—	—	—	—	—
Days eligible	-0.4589* (0.0000)	-0.3722* (0.0000)	-0.4697* (0.0000)	-0.2053* (0.0001)	-0.3726* (0.0000)	-0.2547* (0.0000)	-0.3105* (0.0000)	-0.2670* (0.0000)	-0.2785* (0.0000)
Members eligible	0.0228* (0.0033)	0.0557* (0.0054)	0.0629* (0.0036)	-0.0452* (0.0160)	0.0236** (0.0062)	0.0146* (0.0040)	0.0042* (0.0035)	0.0185* (0.0045)	0.0059 (0.0029)
Average wholesale price	0.6216* (0.0043)	0.6764* (0.0042)	0.3327* (0.0305)	0.3291* (0.0390)	0.3940* (0.0073)	0.9571* (0.0089)	0.6376* (0.0083)	0.7164* (0.0092)	0.6405* (0.0027)
Out-of-pocket expense	0.0018 (0.0097)	0.0493* (0.0165)	-0.1721* (0.0105)	0.2076 (0.0412)	0.1695* (0.0170)	-0.0258* (0.0160)	0.0824* (0.0097)	0.1171* (0.0150)	0.1284* (0.0084)
Days supply	0.1324* (0.0170)	0.2761* (0.0238)	0.0306* (0.0001)	0.1210* (0.0091)	0.0535* (0.0043)	-0.0143* (0.0028)	0.0696* (0.0023)	-0.0116 (0.0029)	0.0453* (0.0018)
Quantity dispensed	0.4721* (0.0144)	0.2101* (0.0186)	0.6542* (0.0147)	0.2673* (0.0557)	0.5520* (0.0271)	0.4293* (0.0145)	0.3792* (0.0141)	0.4765* (0.0157)	0.3937* (0.0105)
N	6,519	3,343	5,651	3,184	4,462	7,809	18,700	12,372	31,073
F	3,800.21*	1,752.17*	2,993.54*	278.68*	1,251.00*	9,361.93*	5,058.47*	5,032.43*	9,109.77*
R2	0.7778	0.7591	0.7609	0.3448	0.6275	0.8780	0.6188	0.7094	0.6376
ADJ.R2	0.7776	0.7586	0.7606	0.3435	0.6270	0.8779	0.6187	0.7093	0.6375

*1: Calcium channel blockers. 2: Lipotropics. 3: Angiotensin-converting enzyme inhibitors. 4: Beta-blockers. 5: H_2-blockers. 6: Antidepressants. 7: Combining cardiovascular drugs (1, 2, 3, and 4). 8: Combining H_2-blockers and antidepressants (5, 6). 9: Combining all six drug categories. *Significant at 0.001. **Significant at 0.05.*

as well as days supply and grouping variables, were significant. Effect sizes of these interactions were calculated. Values of these effect sizes, which approached zero, allowed the use of AWP and days supply as covariates without violating the assumptions of ANCOVA. Least square means (LSMEANS) adjusted for AWP and days supply were examined.

There were significant differences in average drug costs among age groups. Members in the 65-and-older group were associated with the highest average drug costs for all drug categories except beta-blockers and antidepressants. Significant differences in average cost of pharmaceuticals also existed between males and females. Males showed higher average drug costs for all drug categories except for lipotropics and antidepressants. For these two categories, females showed significantly higher average drug costs (see Table 4, page 401).

Significant differences in average cost of pharmaceuticals existed among members residing in Tennessee and those residing in other states. Compared to all of the states together except Tennessee, residents of Tennessee had the lowest average drug costs for all drug categories (see Table 5, page 402).

Significant differences in average drug costs existed among members by occupation. For the six drug categories combined, members employed in contracting were associated with the highest average drug costs and members employed in health care were associated with the lowest average drug costs. Members employed in art, trade and transport, primary industries, and social sciences had the highest average cost of pharmaceuticals for cardiovascular drugs, while those employed in health care had the lowest. Combining H_2-blockers and antidepressants, members employed in art, trade and transport, primary industries, and

TABLE 4 Analysis of Covariance of Cost of Pharmaceuticals by Member Age and Gender for Various Drug Categories

	Drug Category								
	1	2	3	4	5	6	7	8	9
Member age									
ANCOVA									
F (*p*)	1,151.32 (0.0001)	945.07 (0.0001)	492.97 (0.0001)	148.17 (0.0001)	320.56 (0.0001)	2,674.27 (0.0001)	2,469.39 (0.0001)	2,164.83 (0.0001)	4,481.56 (0.0001)
R^2	0.4584	0.6203	0.2976	0.1689	0.2845	0.6506	0.4286	0.4890	0.4465
LSMEANS									
1–5	—	—	—	—	0.1429	—	—	0.1000	0.0785
6–20	0.0901	0.1288	0.0466	0.0336	0.1737	0.0657	0.0638	0.1058	0.0809
21–40	0.0876	0.1260	0.0647	0.0159	0.1427	0.1014	0.0624	0.0974	0.0782
41–64	0.0932	0.1274	0.0645	0.0261	0.1521	0.0805	0.0700	0.1041	0.0821
>64	0.1042	0.1355	0.0745	0.0219	0.2224	0.0519	0.0728	0.1391	0.0899
Member gender									
ANCOVA									
F (*p*)	1,893.35 (0.0001)	1,887.08 (0.0001)	802.65 (0.0001)	227.09 (0.0001)	584.34 (0.0001)	5,253.35 (0.0001)	4,897.30 (0.0001)	4,160.03 (0.0001)	8,851.10 (0.0001)
R^2	0.4559	0.6205	0.2936	0.1576	0.2662	0.6473	0.4273	0.4796	0.4441
LSMEANS									
Female	0.0919	0.1335	0.0648	0.0230	0.1571	0.0867	0.0689	0.1015	0.0810
Male	0.0973	0.1245	0.0665	0.0247	0.1612	0.0784	0.0701	0.1164	0.0848

1: Calcium channel blockers. 2: Lipotropics. 3: Angiotensin-converting enzyme inhibitors. 4: Beta blockers. 5: H_2-blockers. 6: Antidepressants. 7: Combining cardiovascular drugs (1, 2, 3, and 4). 8: Combining H_2-blockers and antidepressants (5,6). 9: Combining all six drug categories.

social sciences showed the highest average drug costs, while those employed in commerce showed the lowest.

Two-way analyses of covariance were conducted using cost per member per eligible day as a dependent variable, with place of employment and gender as the independent variables. For the six drug categories combined, males employed in contracting demonstrated the highest average cost of pharmaceuticals and females employed in health care demonstrated the lowest. Looking at cardiovascular drugs as a combined category, females employed in art, trade and transport, primary industries, and social sciences were associated with the highest average drug costs, and males employed in health care were associated with the lowest. Combining antidepressants and H_2-blockers, males employed in health care showed the highest average cost of pharmaceuticals, while males employed in manufacturing showed the lowest.

TABLE 5 Analysis of Covariance of Cost of Pharmaceuticals by Member Location and Place of Employment for Various Drug Categories

	Drug Category								
	1	2	3	4	5	6	7	8	9
Member location									
ANCOVA									
F (*p*)	1,894.45 (0.0001)	1,883.16 (0.0001)	808.52 (0.0001)	240.93 (0.0001)	591.26 (0.0001)	5,272.03 (0.0001)	4,912.06 (0.0001)	4,176.50 (0.0001)	8,875.28 (0.0001)
R^2	0.4558	0.6194	0.2947	0.1659	0.2697	0.6477	0.4278	0.4809	0.4448
LSMEANS									
Other	0.1734	0.2111	0.1086	0.0477	0.3402	0.1559	0.1193	0.2121	0.1460
Tennessee	0.0838	0.1126	0.0599	0.0198	.1388	0.0802	0.0618	0.0960	0.0743
Place of employment									
ANCOVA									
F (*p*)	608.03 (0.0001)	617.01 (0.0001)	281.24 (0.0001)	103.04 (0.0001)	197.29 (0.0001)	1,675.61 (0.0001)	1,625.96 (0.0001)	1,366.68 (0.0001)	2,248.52 (0.001)
R^2	0.4609	0.6251	0.2992	0.2125	0.2637	0.6373	0.4286	0.4734	0.4484
LSMEANS									
Management	—	—	0.0736	0.0264	0.1904	—	0.0737	—	0.0941
Manufacturing	0.0944	0.1313	0.0654	0.0190	0.1923	0.0914	0.0692	0.1144	0.0834
Health	0.0812	0.1197	0.0604	0.0159	0.1493	0.0858	0.0590	0.1047	0.0756
Sales and services	0.0995	0.1194	0.0621	0.0361	0.1703	0.0857	0.0730	0.1186	0.0877
Commerce	—	0.1336	—	—	—	0.0884	—	0.0993	0.0861
Contractors	0.1250	—	—	—	—	—	—	—	0.1135
Others	0.0938	0.1342	0.0725	0.0402	0.1563	0.1226	0.0835	0.1338	0.0929

1: Calcium channel blockers. 2: Lipotropics. 3: Angiotensin-converting enzyme inhibitors. 4: Beta blockers. 5: H_2-blockers. 6: Antidepressants. 7: Combining cardiovascular drugs (1, 2, 3, and 4). 8: Combining H_2-blockers and anitdepressants (5, 6). 9: Combining all six drug categories.

Discussion

Several limitations should be considered before discussing the results of this study. The major limitation relates to the comprehensiveness of the data. The database includes only drug products covered by the drug benefit plans. Thus, nonprescription drugs, drug samples, and nonformulary drugs (when paid for with cash by members) are typically not included. In addition, if a prescription drug is less expensive than the member's copayment, the member may pay cash and a claim may not be recorded. Underreporting, which occurs with most third-party

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prescription databases, may be a limitation in this study.[21] In addition, prescriptions filled from out-of-network pharmacies were not captured.

The study may also be limited in terms of generalizability. The general population may behave differently from the study population. Therefore, careful consideration should be used before extrapolating these findings beyond the study population. Although our data are cross-sectional and do not allow causal inferences, several possible explanations exist for the findings of the study.

One of the objectives of the study was to examine the proportion of variation in cost of pharmaceuticals that could be explained by demographic variables. In effect, we wanted to evaluate whether demographic variables could be used to determine capitation rates for new enrollees. Place of employment was selected as one of the independent variables in the regression models. MCOs or PBMs provide prescription drug benefits to employees of commercial clients irrespective of members' occupation. As a result, place of employment becomes a more relevant variable to evaluate than occupation.

In spite of the large sample size (N=33,131), available demographic variables only explained 3.9% of variance in cost of pharmaceuticals for all drug categories combined. A study that used multiple regression analysis to determine the proportion of variance in aggregated clinic, referral, and hospital costs found that 20% of variation in cost could be explained by sex and coverage type of the enrollees.[3] The lowest explained variance among all therapeutic categories was for antidepressants (1.6%). This result may be attributable in part to the availability of relatively new products, increased public awareness, acceptance of depression as a disease, physician education programs, and mass media attention.[22]

Our study demonstrated that plan characteristics accounted for most of the variance unexplained by demographic variables. These plan characteristics consisted of number of days eligible, number of members eligible, AWP of drugs dispensed, out-of-pocket expense, number of days supply, and quantity dispensed. When taking only plan characteristics into account, the explained variance for antidepressants increased to 87%. These results strongly indicate that data on service use and cost experience of individuals to be covered by a risk-based capitation payment program are much better predictors of costs of pharmaceuticals than simple demographics. Wouters in 1991 found that prior-year outpatient drug expenditures were the strongest predictors of future annual outpatient drug expenditures, and thus should be considered important information to include in determination of capitation rates.[5]

Effect of Member Demographics on Costs of Pharmaceuticals

Age. Members over the age of 65 had the highest average drug costs for all drug categories except for beta-blockers and antidepressants. This finding is consistent with previous studies that show prescription drug use often increases with age.[23,24] A study assessing the importance of demographics in the selection of antihypertensives concluded that calcium channel blockers were more effective in patients over 60 years of age.[25] Nichol et al., in a study of factors associated with antihypertensive prescribing, found that elderly patients (over 65 years) were 78% more likely and patients between the ages of 40 and 65 years were nearly 50% more likely to receive an antihypertensive than those younger than 40 years.[26]

Younger members were associated with high average cost of pharmaceuticals for antidepressants and beta-blockers. This was somewhat surprising, as increasing age has been reported to be associated with a higher rate of depressive symptoms.[27] The results for beta-blockers may be explained in part by results of previous studies that show beta-blockers to be more effective in younger patients than elderly patients.[28]

Gender. Males showed higher average drug costs than females for all drug categories except for lipotropics and antidepressants. These results contradict the findings of a study that shows that females use more types of medications and use them to a greater extent than males do.[29]

The average cost of pharmaceuticals for H_2-blockers is consistent with results of a study examining the prescribing of antacids and ulcer-healing drugs in primary care in the north of England.[14] That study found that prescribing rates of H_2-blockers were higher in males than in females. The disparity between the sexes was attributable to males being prescribed H_2-blockers for the treatment of ulcers.

Higher average drug costs for beta-blockers may be explained by previous studies. Fewer data are available, but beta-blockers have been shown to be less effective in females than males.[25] Akoki et al. found that beta-blockers were among the few drug categories clearly prescribed more often for males.[30]

Many studies have shown that females are more likely than males to receive prescriptions for antidepressants.[31–33] Rosholm et al., in a study of outpatient utilization of antidepressants using a prescription database, found that women constituted a disproportionately large percentage of antidepressant users.[34] High utilization of lipotropics among females was not found in the literature and therefore needs further research.

Location. Of all the states evaluated, members residing in Tennessee were associated with the lowest average cost of pharmaceuticals for all six therapeutic categories. These results may be explained by location characteristics. Tennessee is well known for TennCare, the health-care-system reform plan implemented on January 1, 1994. The program was developed with the dual objectives of controlling rapidly rising costs of the state's Medicaid program and extending health insurance coverage to Tennesseans who did not have access to employer-sponsored or other government-sponsored health insurance.[35] More than a quarter of the total population of Tennessee is currently

enrolled in TennCare and the program has been successful in controlling costs in the Medicaid program. The state claims that in the first 18 months, TennCare saved about $1.6 billion in state and federal funds based on the expected growth rate in conventional Medicaid expenditures.[35] MIM Health Plans, Inc. (TennCare's primary PBM) provides prescription benefit services for about 80% of Tennessee's Medicaid prescriptions.

MIM Health Plans' strong presence in the TennCare Program, along with the provision of pharmacy benefits for commercial clients in Tennessee, may be related to a "spillover effect" that arises from the application of the transfer of learning theory to health care providers. Spillover occurs when a health care provider's behavior transfers from one patient population to another. The prescribing habits of physicians that affect the TennCare population may be transferred to the Tennessee commercial population. Cost consciousness of pharmacy providers in Tennessee and the staff at the PBM resulting from their association with TennCare might have resulted in changes in their professional behavior. These changes might have benefited the commercial population administered by the PBM in Tennessee.

The transfer of learning from the Medicaid to the non-Medicaid sector has been shown in the Iowa Capitation Study, which demonstrated spillover of generic substitution habits from Medicaid to non-Medicaid prescriptions. The study concluded that non-Medicaid patients benefited from pharmacists' cost-containment approach in the Medicaid drug program.[36]

Place of employment. Members employed in art, trade and transport, primary industries, and social sciences had the highest average drug costs for cardiovascular drugs. This high average drug cost may be explained by high morbidity, prevalence, and mortality rates for cardiovascular disease among workers in the transportation industry, which has been known for its low level of physical activity, irregular work schedules, and high level of psychological stress.[37]

Members employed in sales and services had the lowest average drug costs for antidepressants. This finding is contradictory to the results of a study that assessed crude prevalence rates for major depression and demonstrated that people employed in sales had high rates of depression.[38]

Members employed in art, trade and transport, primary industries, and social sciences demonstrated the highest average cost of pharmaceuticals for beta-blockers. Beta-blockers are widely used in post-myocardial infarction (MI) patients. The only research that was found to support or refute these results was a case-referent study estimating the relative risk of MI, which found increased incidence of MI among males employed in transport work.[39]

Conclusion

The results obtained in this study have practical significance in the determination of capitation rates when the utilization history of prospective members is not available. In this situation, MCOs or PBMs may have to set capitation rates based solely on eligibility data. Furthermore, if utilization data are available, the temptation exists to manipulate these data to influence capitation rates. In this scenario, enrolling members initially under an FFS arrangement is a viable option. Data collected under an FFS arrangement may then be used to set capitation rates.

In addition to highlighting the importance of utilization history in setting capitation rates for new enrollees, the study results have other ramifications. MCOs or PBMs contract with commercial clients to provide pharmacy benefits to their employees irrespective of occupation. Significant differences in utilization among the members based on place of employment may be a relevant finding for management of the pharmacy benefit. The implications are that MCOs or PBMs should consider differentiating capitation rates according to their clients' businesses. Finally, the unique dynamics of the Tennessee marketplace suggest that a spillover effect may exist due to transfer of learning from the Medicaid to the commercial population.

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