

Managed Care Outcomes Project: Study Design, Baseline Patient Characteristics, and Outcome Measures

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Abstract

The study design, baseline patient characteristics, and outcome measures from the Managed Care Outcomes Project are discussed, and correlates of resource utilization and patient severity of illness described. The Managed Care Outcomes Project was an observational, cross-sectional, longitudinal study of 12,997 patients, eligible by having one or more of five diseases (hypertension, otitis media, arthritis, ulcers, and asthma) in a managed care setting. The data sources were six health maintenance organizations from six states, three in the eastern United States and three in the western United States. Between 1,876 and 2,663 patients at each health maintenance organization were studied. For each disease, there were between 1,309 and 3,938 patients, for a total of 12,997 patients across all diseases. Data on the disease-specific severity of illness were collected at each visit. Resource utilization included more than 99,000 office visits, 480 emergency department visits, 1,000 hospitalizations, and 240,000 prescriptions. The study found that significant differences in resource utilization and severity of illness exist across age categories, disease groups, and organization characteristics. The results identify important differences in patient mix, diseases, and organization structural factors and cost-containment methods that must be considered when examining outcomes of care.

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Managed care organizations have used various methods to contain the costs of the care they provide to their beneficiaries. The effects of different cost-containment practices have been analyzed by researchers attempting to evaluate whether these practices actually decrease utilization.¹⁻²² One also should ask, however, whether managed care organizations are affecting the quality of care or the overall utilization of medical resources.

Many of the cost-containment studies performed to date have had limitations. The analyses were performed at the aggregate, rather than the patient, level; an isolated portion of healthcare costs (eg, pharmacy costs) was the only factor studied; or health outcomes were not assessed.²⁻¹⁶ Moreover, most of the studies did not control for severity of illness.

Assessing the effectiveness of a particular intervention requires a system of intensive surveillance that can provide monitoring, analysis of variations, feedback, and education.²³ The methodology known as clinical practice improvement (CPI) creates a clinical laboratory, built into the everyday practice setting, to test medical processes. A CPI study is an analysis of the content and timing of the individual steps of a medical care process the goal of which is improved clinical outcomes at the lowest cost over the continuum of a patient's care.^{24,25} This integrated approach to assessing healthcare utilization includes development of a comprehensive database linking patient characteristics, disease characteristics, medical processes, outcomes, and costs in order to examine simultaneously all the factors that influence utilization. If decision makers could identify and measure the factors that contribute to better patient outcomes, then cost-containment efforts could focus on the dual objectives of achieving optimal care at the lowest cost.

The Managed Care Outcomes Project (MCOP) is a recent multisite CPI study. It examined patients' healthcare utilization at six HMO sites over a 9- to 12-month period and assessed clinical changes by measuring patient physiologic severity at each visit.

The main objective of the study was to explore the relationship between cost-containment practices and health outcomes and costs in the ambulatory setting. Elsewhere, we have reported the marginal effects of various cost-containment practices on utilization of healthcare services and patient outcomes.²⁶⁻²⁸ In this report, we lay the groundwork for those and future analyses by describing differences in patient factors, process variables, and patient outcomes in the MCOP database. Without all three data types, one cannot determine whether outcomes are achieved as a result of the process or as a result of differences in the severity levels of patients' diseases.

... METHODS ...

The MCOP was a longitudinal, prospective study that examined variations in clinical and resource-use outcome measures over a 1-year period among patients of health maintenance organizations (HMOs) who had at least one of five specified conditions, controlling for severity of illness. Key elements of the design included assessment of patients diagnosed with specified diseases, assessment of disease severity for all existing conditions at each patient encounter with providers, and use of multivariate statistical methods to control for observed differences when interpreting the results. (Multivariate results are reported in subsequent papers.²⁸)

Study Sites

Six HMOs (three for-profit and three not-for-profit) participated in the MCOP study. They were geographically diverse, with three located in the eastern United States (one each in the New England, Mid-Atlantic, and South Atlantic regions), and three in the western United States (one in the Mountain region and two in the Southwest region). The sites were selected on the basis of willingness to participate; research data capabilities, such as ability to pro-

vide patient-level, computerized diagnosis and financial data; geographic diversity; and variation in levels of cost-containment practices, such as levels of formulary limitations and level of visit copayment. In addition, participating HMOs were required to have computerized information systems capable of merging data from drug claims, visits, emergency department (ED) visits, and hospitalizations at the patient level; consequently, they were not representative of all HMOs in the United States during the study year (1992).

The six participating sites differed in several ways. They had been in existence for 7 to 19 years and had enrollments of 32,000 to 310,000 members. Very few of the total number of members were Medicaid patients. Formulary limitation varied from no formulary in one site (0% limitation) to a site in which only 24% of the drugs available in the US indicated for the treatment of asthma were on the formulary (ie, 22 of 92 possible asthma drugs). Formularies were not newly instituted at most of the sites; at the time of data collection, years of implementation ranged from 1 to 12 years at the five sites with formularies.

Other cost-containment/management techniques included various visit copayment amounts (from \$2 to \$10 per visit); various levels of gatekeeper strictness, case management, and requirements for a second opinion; and various physician-reimbursement methods (Table 1).²⁹ To enhance our ability to collect patient-severity data for all visits during the study year, the HMOs studied were staff or group models, not independent practice associations.

Study Diseases

Five diseases typically managed on an outpatient basis were selected by the participating HMOs to be studied at each site. The five disease groups and their ICD-9-CM codes were: (1) otitis media (381.00-382.9); (2) atraumatic joint pain or arthritis (710.0-710.9, 711.1-716.9, 720.0-720.9, 721.0-721.6,

Table 1. HMO Cost-Containment/Management Techniques, by Site

Site	Formulary Limitation Rank	Visit Copayment	Gatekeeper	Case Management	Second Opinion	Physician Affiliation	For Profit/ Not for Profit
3	(6)	\$5.00 (2.5)	Strict (5)	Loose (1)	None (2)	Salaried	+
5	(5)	\$5.00 (2.5)	Moderate (2)	Medium (3.5)	None (2)	Salaried	-
2	(4)	\$8.50 (4)	Moderate (2)	Medium (3.5)	Moderate (5.5)	Contracted	+
6	(3)	\$10.00 (5.5)	Strict (5)	Medium (3.5)	None (2)	Contracted	+
1	(2)	\$2.00 (1)	Strict (5)	Strict (6)	Loose (4)	Salaried	-
4	(1)	\$10.00 (5.5)	Moderate (2)	Medium (3.5)	Moderate (5.5)	Contracted	-

Data on organization characteristics are found in reference 29.

The sites are listed in order of formulary limitation, from most limited (rank 6) to least limited (no formulary) (rank 1). Ranks are given in parentheses.

721.8-721.9, 724.1-724.2, 724.5); (3) epigastric pain or ulcers (530.0-530.3, 530.5-530.6, 531.0-535.6, 536.0-536.9, 537.81, 787.0-787.3); (4) hypertension (401.0-401.9); and (5) asthma (493.0-493.9). The diseases were selected because of their high prevalence and degree of variation among patients in number of office visits and drug utilization.

A *disease group* was assigned to each patient on the basis of the study disease for which the patient had the largest number visits during the year. For example, if a patient's initial visit during the study period was for the treatment of otitis media, but most of the other visits included treatment of asthma, then that patient was assigned to the asthma disease group.

Study Population

Patients were eligible for the study if they had an ambulatory visit for any one of the five study diseases during a 4-month enrollment period. All patients meeting this eligibility requirement were accepted into the study. After patients were enrolled, all their healthcare utilization data, including data on all ambulatory visits for any reason, drug use, procedures, hospitalizations, and ED visits, were tracked on an individual basis. Severity data were collected at the patient's first visit and at each subsequent visit, regardless of the reason for the visit.

Patients were followed up for the remainder of a 12-month data collection period (approximately calendar year 1992). Patients who did not disenroll during the study period were followed up for a maximum of 12 months after the initial visit (if they entered in month 1) and for a minimum of 9 months after the visit (if they entered in month 4). The number of months in the study was controlled for in the analysis of resource utilization. Three percent of patients dropped out before the end of the study. The 1-year study period provided an enrollment period long enough for each site to enroll 500 to 600 patients per study disease, enough time for data collection at the sites and consistency across diseases, and a useful follow-up period to determine a variety of outcomes (eg, for chronic conditions, such as hypertension, long-term sequelae like stroke were unlikely to be detected within 1 year, but blood pressure control could be assessed).

All patient drug-utilization information was obtained from computerized pharmacy claims records. Variables in the pharmacy claims database included name, dose, and amount of drug dispensed; number of days' supply; date prescription was filled; therapeutic category, National Drug Code numbers; copayment amount; and whether a drug was a multisource

(generic) drug. We were unable to obtain data on out-of-plan drug use but were informed by staff of all six HMOs that the extent of such use was small because drugs were a covered benefit for all enrollees in our study. None of the sites in this study covered the cost of nonprescription drugs.

Study patients in each disease group were heterogeneous in many ways (eg, age, gender, and disease complexity); assessment of patient severity of illness was used to account for much of the variability in presenting patients. Although the MCOP was not a randomized clinical trial, by taking into account the severity of illness, which includes both psychological dimensions and physiologic criteria, the study enabled us to explain types of patient variation for which previous studies had not controlled.

Patient Severity-of-Illness Measures

Specially trained raters abstracted patient severity-of-illness data for each ambulatory visit, using the Ambulatory Patient Severity (APS[®]) instrument, and for each inpatient admission (for patients who were hospitalized at any time during the study period), using the Computerized Severity Index (CSI[®]).^{25,30-33} APS software was used to collect severity and outcome information about each patient visit, quantifying the patient's total burden of illness and the complexity of the ambulatory encounter.

Two global dimensions of severity of illness in the ambulatory setting were included in the APS. The biophysical dimension captured the derangements of physiologic signs and symptoms and physical findings of the patient *for all diagnoses and problems brought to the visit*, rather than for the five study diseases only; thus, the severity of all comorbidities was captured at each visit. The behavioral dimension, which includes physical functioning, psychological functioning, social situation, communication, and compliance, captured patient characteristics that are believed by clinicians to increase or decrease the difficulty of managing treatment and, therefore, to affect the severity of the diagnoses or problems and the complexity of the visit.

To evaluate a patient for APS or CSI, raters first abstracted abnormal signs and symptoms from the patient's chart. They then matched these signs and symptoms with the criteria listed for each disease in the CSI/APS systems. At the completion of this process, all abnormalities identified in a record should have been matched with requested disease criteria. If the ICD-9 codes for a visit failed to ask for all abnormal signs and symptoms, data collectors were expected to ask ICD-9 coding specialists to review the

case and to add codes. Thus, ICD-9 coding was verified during CSI/APS data collection.

The APS instrument organizes physiologic signs and symptoms by body system (eg, circulatory, respiratory). The levels of the physiologic criteria were defined as follows:

- Level 1: Normal to mild
- Level 2: Moderate severity; may require some diagnostic testing
- Level 3: Severe; requires work-up
- Level 4: Catastrophic; provider is considering hospital admission

The biophysical severity criteria in the APS were determined from organ and disease-specific information in the literature, as well as through consultation with medical specialists, who provided input on inclusiveness and appropriate leveling of severity criteria. Appendix A presents an example of the applicable biophysical criteria assessed for respiratory illness.

The behavioral factors describe characteristics of the patient or visit believed to affect management of the patient in the ambulatory setting and, therefore, resource consumption. They are rated by the provider at the time of the visit according to information known to the provider. Each behavioral factor can be assigned to one of four levels:

- Level 1: Normal functioning
- Level 2: Problem does not interfere with patient management
- Level 3: Problem interferes with patient management
- Level 4: Problem results in lack of ability to function independently

The APS can be quantified in several ways. The physiologic and behavioral dimensions can be quantified separately, or the two dimensions can be combined into a single weighted score. In our study, both a categorical APS score (on a scale of 1 to 5) and a

Table 2. Mean Healthcare Utilization and Overall Severity, by Measure of Baseline Patient Mix

	VISITCT	RXCT	RXCOSTS	HSPCNT/100	SUMSSCP	SUMSSCP2
Age (yr)						
0-17	6.13	7.56	139.95	1.75	54.91	--
18-64	6.35	21.0	648.96	7.36	49.60	--
65+	9.34 [†]	26.3 [†]	798.77 [†]	18.19 [†]	75.72 [†]	--
Disease Group						
Hypertension	6.93	24.10	672.82	8.85	59.15	--
Otitis media	6.24	7.5	124.16	1.66	52.36	--
Arthritis	7.75	20.90	536.60	11.3	53.11	--
Ulcers	6.89	18.88	625.05	9.8	44.58	--
Asthma	7.09 [†]	25.05 [†]	630.17 [†]	12.5 [†]	71.71 [†]	--
First-Visit Discrete Severity Level						
Age 0-17 yr						
APS = 1	5.84	7.31	153.26	1.82	32.83	31.48
APS = 2	6.36	7.35	124.68	1.45	52.69	42.40
APS = 3	6.42	8.17	137.96	1.68	67.99	49.15
APS = 4	5.83	8.68	168.42*	2.71	90.43 [†]	57.54 [†]
Age 18-64 yr						
APS = 1	6.41	21.38	655.12	8.01	32.26	30.33
APS = 2	6.36	20.30	648.03	5.85	47.87	38.28
APS = 3	6.10	19.50	631.52	6.67	64.92	46.51
APS = 4	6.44	20.81 [†]	647.97*	9.75*	102.22 [†]	68.08 [†]
Age 65+ yr						
APS = 1	8.91	25.55	764.06	19.76	54.26	52.27
APS = 2	9.46	25.99	778.98	14.14	78.24	68.32
APS = 3	9.88	27.09	852.29	16.76	100.31	81.76
APS = 4	10.23*	28.99	931.81*	25.76*	126.42 [†]	93.15 [†]

*Differences in means for strata groups significant (ANOVA) at the 0.05 level.

[†]Differences in means for strata groups significant (ANOVA) at the 0.0001 level.

APS = ambulatory patient severity; VISITCT = patient ambulatory visits during study period; RXCT = patient prescription drugs used for study disease and nonrelated diseases; RXCOSTS = patient total prescription expenditures; HSPCNT/100 = hospital admissions per 100 patients during study period; SUMSSCP = patient sum of severity scores for all ambulatory visits; SUMSSCP2 = patient sum of severity scores for all ambulatory visits after first visit.

continuous APS score were produced for each dimension and for each patient visit. The APS measure and its validation are discussed in greater detail elsewhere.^{25,30}

The *severity sum* for a patient was defined as the sum of the continuous APS scores for all of a patient's visits over the year. By taking into account global severity of illness, including psychosocial and physiologic criteria, we explained patient variation that was not controlled for in previous studies. *First-visit severity* is the continuous APS score at the first visit. It was used as an alternative to the severity sum in our analyses.

Reliability checks were conducted to ensure accuracy in all aspects of data collection. Reliability for data abstractors was assessed by using case scenarios and by re-rating a random sample of 25 patient charts to ensure accurate abstraction of APS criteria. Abstractors who were found to have less than 95% agreement on the APS questions were given additional training until 95% reliability was achieved. The abstractors then redid their previous work.

The CSI was used for hospital admissions. This disease-specific severity indexing system has been described fully elsewhere.^{25,31-33}

Patient and System Variables

Our analyses are based on a sample design in which many patients from the same site are selected, and repeated observations are made on the same patient over time. We controlled for patient and organizational characteristics that potentially are related to utilization. The patient characteristics included disease-specific severity, age, gender, number of primary care and specialist providers seen during the study period, number of months in the study, percentage of multisource (generic) drugs dispensed, and average drug copayment. Characteristics of the HMO that were controlled for included profit status, drug formulary limitations, visit copayment, presence and strictness of a gatekeeper, intensity of case management, and second-opinion requirements. These HMO structural variables were obtained to measure potential influences that might affect resource utilization.

Statistical Analyses

All patients were summarized and characterized by demographics, disease groups, severity-of-illness factors, and HMO characteristics. We analyzed six dependent variables: (1) total ambulatory visits; (2) prescription counts; (3) prescription costs; (4) hospitalizations; (5) overall severity of patient illness; and

(6) patient severity of illness after the initial visit. Prescription counts and costs relate to the count and cost of all drugs in the claims data for each patient (ie, prescription transactions related to the disease group plus prescription transactions unrelated to the disease group).

One way analysis of variance (ANOVA) was used to compare each dependent variable by demographic, disease, and severity/age characteristics. In cases in which a significant ANOVA F value ($P < 0.05$) was observed, pairwise comparisons of means were made, using Tukey's studentized range test. Pairwise correlations between all patient variables, HMO site variables, and outcome variables were performed. Finally, to determine statistical differences in the dependent variables between the two levels of various HMO characteristics, a *t* test for differences in the means of two samples was used.

... RESULTS ...

Between 1,876 and 2,663 patients were studied per HMO. For each disease studied, 1,309 to 3,938 patients were available for analysis across the six HMOs, for a total of 12,997 patients across all study diseases.

Service utilization by the study population included more than 99,000 office visits, 480 ED visits, 1,000 hospitalizations, and 240,000 prescriptions during the year. In Table 2, annual utilization measures for the total study population are stratified by age groups, disease groups, and first-visit discrete severity levels (APS) within age groups. The table presents the mean visit count, prescription count, prescription cost, hospital admissions per 100 patients, and annual severity sum scores, as well as the severity sum minus the first-visit severity mean scores.

Many significant differences among the groups were found. Older age (65 years or older) clearly is associated with higher healthcare resource use for all utilization variables ($P < 0.0001$). Increasing age is not associated with increasing overall severity (respective means of severity sum for the three age categories: 54.91, 49.60, and 75.72). However, all three severity sum means are significantly different from each other in pairwise comparisons ($P < 0.0001$). The different disease groups in Table 2 also were associated with significantly different utilization and annual severity ($P < 0.0001$). For example, mean visit count ranged from 6.24 visits per year for otitis media to 7.75 visits per year for arthritis; mean prescription count ranged from 7.5 prescriptions per year for otitis media to 25.05 prescriptions per year for asthma; and mean

Table 3. Mean Overall Patient Severity for All Visits After the First Visit (SUMSSCP2)

	Hypertension (N = 3,548)	Otitis Media (N = 3,938)	Arthritis (N = 2,664)	Ulcers (N = 1,538)	Asthma (N = 1,309)	Total (N = 12,997)
APS = 1	37.16 (45.0)	30.99 (19.5)	35.56 (53.2)	30.46 (57.7)	45.02 (40.9)	34.66 (41)
APS = 2	45.12 (35.5)	40.38 (45.2)	51.07 (33.0)	37.08 (32.3)	53.94 (25.3)	44.34 (36)
APS = 3	56.28 (14.2)	46.27 (27.5)	61.15 (10.7)	40.31 (7.4)	63.93 (17.4)	52.60 (16)
APS = 4	75.08 (5.3)	52.25 (7.8)	73.23 (3.1)	58.88 (2.7)	87.00 (16.3)	68.58 (6)
F	46.61	27.44	39.84	10.12	21.12	146.05
P Value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Numbers in parentheses are column percents. Total column percents may not sum to 100% because of rounding
APS = ambulatory patient severity

prescription costs ranged from \$124.16 per year for otitis media to \$672.82 per year for hypertension.

Within the age group 65 years or older, stratified by the discrete first-visit severity (APS) levels 1 through 4, ANOVA differences in means for visit count, prescription costs, and hospital admissions per 100 patients were significant at the 0.05 level. For the age group 18 to 64 years, differences in means were significant at the 0.0001 level for prescription count and at the 0.05 level for hospital admissions per 100 patients and for prescription costs. For each age group, first-visit severity (APS) levels were significantly associated with overall severity and total severity after the first visit. Correlation analyses indicate that, *for each age group*, the first-visit continuous severity score was significantly associated ($P < 0.0001$) with future severity for all disease groups ($r = .36$ for patients aged 17 years or younger, $.38$ for patients aged 18 to 64 years, and $.31$ for patients aged 65 years or older; data not shown).

For each age group, as the first-visit APS level increased, we found a monotonically increasing annual severity after the first visit. In Table 3, we show the distribution of baseline first-visit APS levels for each disease, presented as column percents in parentheses. Note that asthma and otitis media had the highest percentage of sickest patients (APS level 4) on the first visit (16.3% and 7.8%, respectively). Compared with the other three disease groups, otitis media is an acute condition, and asthma patients periodically experience acute flare-ups. Correlation analyses show that, *for each disease*, the first-visit continuous severity measure was significantly associated ($P < 0.0001$) with future severity ($r = .36$, hypertension; $.33$, otitis media; $.33$, arthritis; $.31$, ulcers; and $.38$, asthma).

We next examined the differences in patient severity and utilization of services across the six HMO sites. Table 4 presents a comparison, by disease group, of the mean overall severity sum score for the study population at each site. For each disease, significant differences in severity of illness were observed across the six study sites ($P < 0.0001$).

Table 4. Comparison of Mean Overall Severity Sum (SUMSSCP) Score, by Disease Group and Site

	Hypertension	Otitis Media	Arthritis	Ulcers	Asthma	Total N
Site 1	57.33 (609)	54.52 (770)	87.75 (546)	40.73 (304)	64.22 (434)	2,663
Site 2	60.47 (616)	69.19 (623)	52.29 (280)	36.68 (184)	86.86 (224)	1,927
Site 3	66.51 (547)	50.59 (674)	54.91 (429)	50.39 (347)	72.11 (360)	2,357
Site 4	60.24 (435)	42.58 (676)	38.98 (386)	49.90 (216)	49.21 (163)	1,876
Site 5	71.53 (612)	69.68 (590)	48.22 (497)	46.39 (355)	74.55 (58)	2,112
Site 6	37.23 (729)	26.65 (605)	24.63 (526)	22.98 (132)	76.73 (70)	2,062
Total N	3,548	3,938	2,664	1,538	1,309	12,997
F	26.04	65.23	60.77	6.35	6.09	--
P Value	0.0001	0.0001	0.0001	0.0001	0.0001	--

Numbers of patients are in parentheses.
SUMSSCP = patient continuous sum of severity scores for all ambulatory visits during the study period

On the basis of the mean yearly continuous severity sum score, patients in site 6 had the lowest severity for four of the five study diseases. The magnitude of the severity rank for all the other sites differed for each disease. Thus, patient severity was significantly different across our six study sites.

Because patient severity was significantly different at the six HMO sites, we present severity-adjusted mean utilization variables in Table 5. This table shows the mean se-

verity-adjusted values for the annual utilization measures of visit count, prescription count, and prescription costs, by disease group and site. Because drug-claims data at site 2 could not be matched with the patient-visit data, the site was dropped from analyses that refer to drug counts and costs but was included in analyses of visit count and severity measures. After adjusting for severity of illness of their patients, the six sites differed significantly in utilization patterns for visits, number of prescriptions, and prescription costs. Sites 3 and 5 had the highest mean number and mean cost of prescriptions for all five diseases. Sites 2 and 4 had the lowest mean number of ambulatory visits for all study diseases. The ratio between the highest and lowest severity-adjusted utilization of service for each disease ranged from 1.67 to 2.12 for visit count; 1.97 to 3.14 for number of prescriptions; and 2.07 to 2.75 for prescription costs.

To understand the reasons for these observed severity-adjusted utilization differences, we sought to evaluate a variety of organizational and cost-containment factors that might contribute to the differences. In Table 6, we compare the patient mix between the three for-profit and three not-for-profit HMOs to determine whether profit status attracted different kinds of patients. The for-profit HMOs had a higher percentage of patients older than age 65 years and a higher average patient age ($P < 0.0001$). There were no gender differences between the for-profit and not-for-profit HMOs. The for-profit HMOs recorded significantly lower first-visit continuous severity scores than did the not-for-profit HMOs ($P < 0.0001$). Thus, on study admission, patients belonging to the for-profit HMOs appeared to be less severely ill than those of the not-for-profit HMOs, even though they also generally were older.

We compared the for-profit and not-for-profit HMOs for each type of annual healthcare utilization. The for-profit HMOs continued to have less-severely ill patients both at the first visit and throughout the year ($P < 0.02$). However, the for-profit HMOs had significantly higher prescription counts, prescription costs, and hospital admissions per 100 patients ($P < 0.0001$). Thus, although they had lower severity of illness, patients in for-profit HMOs were hospitalized more frequently and used more drugs. These analyses were repeated by disease group, with essentially the same results (data not shown).

In addition to profit status, several of the HMOs' cost-containment/management techniques were examined. These techniques, which include second-opinion requirements, the intensity of case management, and the strictness of a gatekeeper, dif-

Table 5. Comparison of Severity-Adjusted Mean Utilization Variables, by Disease Group and Site

	VISITCT	RXCT	RXCOSTS
Hypertension			
Site 1	6.81	15.79	522.25
Site 2	5.42	--	--
Site 3	7.84	30.45	860.86
Site 4	4.20	15.44	511.79
Site 5	7.43	28.18	1058.04
Site 6	6.60	22.56	616.42
Otitis Media			
Site 1	6.28	6.61	134.97
Site 2	4.00	--	--
Site 3	7.07	11.91	250.97
Site 4	4.93	5.09	109.84
Site 5	7.36	11.93	226.54
Site 6	7.18	8.27	148.16
Arthritis			
Site 1	8.93	15.17	513.08
Site 2	5.36	--	--
Site 3	9.05	25.67	813.93
Site 4	4.90	10.95	341.49
Site 5	7.69	26.57	730.90
Site 6	8.48	23.85	602.19
Ulcers			
Site 1	6.61	12.38	503.13
Site 2	5.10	--	--
Site 3	7.32	22.45	893.70
Site 4	3.81	8.59	347.91
Site 5	8.07	26.99	870.21
Site 6	6.60	19.53	590.27
Asthma			
Site 1	7.54	21.10	608.33
Site 2	6.42	--	--
Site 3	7.87	35.37	1035.54
Site 4	5.26	13.29	376.63
Site 5	8.33	38.34	988.89
Site 6	8.81	27.87	571.65

Because drug claims data at site 2 could not be matched with the patient-visit data, the site was dropped from analyses that refer to drug counts and costs but was included in analyses of visit count and severity measures

VISITCT = patient ambulatory visits during study period; RXCT = patient prescription drugs used for study disease and nonrelated diseases; RXCOSTS = patient total prescription expenditures.

fered across the sites. As seen in Table 6, the techniques were associated with significant differences in resource utilization. Usually, the stricter the practice, the lower the resource use.

... DISCUSSION ...

In future analyses of the MCOP data, we will examine the marginal effects of alternative cost-containment practices on selected resource utilization in managed care organizations.²⁸ Here, we present a de-

scription of the study and some baseline univariate and bivariate results.

All our analyses must be interpreted within the constraints of the study design. For some sites, only incomplete data were available for some potentially significant resources (eg, laboratory tests and diagnostic tests). Thus, the impact of cost-containment interventions will include analysis of the effects on the selected resource utilization variables collected. However, our database is more extensive than all previous studies in that measures of patient physiologic severity were recorded at each visit. Therefore, this study is an important resource for developing information required for the design of cost-containment programs for systems-based disease-management practices.

Patient severity of illness is an important independent variable that controls for differences in physiologic derangements of patient populations that can affect resource use in HMOs. We have found that first-visit severity predicted total severity for the remainder of the study period but was less useful for predicting resource use for the whole study period. However, patients in the highest baseline severity level (APS = 4) tended to have the highest utilization within each age category (Table 2). The fact that first-visit APS does not strongly predict annual utilization is not surprising. After one visit, many unpredictable events can occur. Elsewhere, we show that the annual sum severity is a very strong predictor of annual resource use.²⁸

The data collected in the MCOP study will permit "economic profiling" of diseases, with descriptions of the relative costs of selected services at various stages in the course of a disease to identify points of greatest "economic leverage." In addition, patterns of drug prescribing associated with the best (and worst) outcomes for patients with different disease subtypes and severity of illness can be identified. These patterns include the selection of individual agents and combinations, and the timing and intensity of treatment.

Our data also are consistent with previous studies that have found higher utilization and expenditures in for-profit organizations than in not-for-profit organizations.³⁴⁻³⁷ In addition, we found that patients at the for-profit sites were less severely ill than were those at the not-for-profit sites.

... CONCLUSIONS ...

These results have three principal implications. First, adjusting for differences in patient mix is essential for valid interpretation of utilization and outcomes data. Second, the definition of patient mix must be comprehensive, including demographic characteristics, disease-specific physiologic severity, and patient complexity. Third, differences exist in resource use among the patient groups and in patient mix and resource use across organizational variables (eg, ownership). Regardless of the reasons, the mix of patients in different HMOs varies, and these variations must be addressed when examining the impact of cost-

Table 6. Differences in Severity and Resource Utilization, by HMO Characteristics

	APSC	SUMSSCP	SUMSSCP2	RXCT	RXCOSTS	VISITCT	HSPCNT/100
Ownership Status							
Not for profit	11.75	57.61	45.86	16.00	492	6.84	4.67
For profit	9.85	53.20	43.35	20.58	579	6.74	10.7
P value	0.0001	0.0001	0.0155	0.0001	0.0001	NS	0.0001
Second Opinion							
Moderate	14.77	56	41	8.85	276	4.94	5.09
Loose/none	9.19	55	45	19.78	580	7.53	8.72
P value	0.0001	(0.25)	0.0002	0.0001	0.0001	0.0001	0.0001
Case Management							
Strict	11.64	65.4	53.7	15.11	468	8.06	7.21
Medium	10.58	52.8	42.2	18.79	547	6.45	7.79
P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	(0.42)
Gatekeeper							
Strict	10.95	49.6	38.7	13.90	400	6.27	7.19
Moderate	10.65	61.3	50.6	23.66	712	7.32	8.17
P value	(0.11)	0.0001	0.0001	0.0001	0.0001	0.0001	(0.10)

HMO = health maintenance organization; APSC = first-visit severity; SUMSSCP = patient sum of severity scores for all ambulatory visits; SUMSSCP2 = patient sum of severity scores for all ambulatory visits after first visit; RXCT = patient prescription drugs used for study disease and nonrelated diseases; RXCOSTS = patient total prescription expenditures; VISITCT = patient ambulatory visits during study period; HSPCNT/100 = hospital admissions per 100 patients

containment measures. Further analyses of the MCOP data will provide critical information needed to understand variations in utilization and outcomes, and to design systems-based disease-management programs.

Although a CPI study is difficult to perform (and points to the need for vastly improved automated records systems), it can uncover important, statistically significant, surprising, and even cost-saving results. In continuing to search for ways to provide high-quality, cost-effective care, managed care organizations and insurers would be wise to consider similar research efforts that include, simultaneously, details about the patients' severity, process of care, and outcomes.

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APPENDIX A

RESPIRATORY

487-487.8, 494-519.9, 782.5, 786-786.4, 786.50-786.9, 793.1, 794.2, 799-799.1, 998.81

Category	C Indicator	Level 1	Level 2	Level 3	Level 4
Cardiovascular	• EKG ectopy		Chronic atrial fibrillation with rate ≤ 90 Rare PACs or PVCs ($\leq 2/\text{min}$)	Chronic atrial fibrillation with rate 91-125 New-onset atrial fibrillation any rate < 125 Occasional PACs or PVCs (3-5/min) Trigeminy or bigeminy or	Ventricular fibrillation Ventricular tachycardia Triplets or couplets Frequent PACs or PVCs ($\geq 6/\text{min}$) Atrial fibrillation with rate ≥ 125
Lab—ABGs	• Highest blood pH • Lowest blood pH • Lowest PO ₂ • O ₂ saturation	7.35 - 7.45 7.35 - 7.45 >90	7.46 - 7.48 7.32 - 7.34	7.49 - 7.51 7.29 - 7.31 88 - 90	≥ 7.52 ≤ 7.28 ≤ 70 ≤ 87
Lab—Hematology	• Highest WBC • Highest bands	≤ 11.0 K/cu mm $< 6.0\%$	11.1 - 12.4 K/cu mm 6.0 - 9.9%	12.5 - 15.0 K/cu mm 10.0 - 14.9%	≥ 15.1 K/cu mm $\geq 15.0\%$
Neurology	• Neurologic status	Chronic confusion Dizziness Unsteady on feet No neurologic abnormality			Unresponsive Acute confusion
Respiratory	• Cough • Sputum production • Hemoptysis • Cyanosis • Dyspnea • PND • Rales/rhonchi • Breath sounds • Wheezes • Prolonged expiratory phase	Nonproductive cough Cough NOS	Productive cough White or yellow sputum Expiratory wheezing	Persistent cough Barking cough Green, purulent sputum Hemoptysis NOS Peripheral cyanosis Dyspnea on exertion; shortness of breath PND Rales/rhonchi $\leq 50\%$ of lung fields or < 3 lobes Decreased breath sounds in $\leq 50\%$ of lung fields or < 3 lobes Inspiratory wheezing Prolonged expiratory phase; I:E $> 1:3$	Whooping cough Frank hemoptysis; coughing up bright red blood Central cyanosis Apnea Dyspnea at rest; labored respirations Rales/rhonchi $> 50\%$ of lung fields or ≥ 3 lobes Decreased breath sounds in $> 50\%$ of lung fields or ≥ 3 lobes Diffuse inspiratory/ expiratory wheezing

APPENDIX A (continued)

Category	C Indicator	Level 1	Level 2	Level 3	Level 4
	· Infiltrates/consolidation on CXR	No abnormal CXR results	Diffuse, patchy infiltrates Peribronchial cuffing Hyperinflation of lungs	Infiltrate and/or consolidation in ≤1 lobe Pleural effusion	Infiltrate and/or consolidation in >1 lobe Cavitation or necrosis of lung Abscess of lung
	· Fremitus		Fremitus		
	· Respiratory pain			Pain on inspiration	
	· Stridor			Splinting Inspiratory stridor	Inspiratory and expiratory stridor Laryngospasm; bronchospasm
Vitals	· Highest pulse	55 - 99 bpm	100 - 117 bpm	118 - 124 bpm	≥125 bpm
	· Lowest pulse		50 - 54 bpm	45 - 49 bpm	≤44 bpm
	· Highest systolic BP	100 - 140 mmHg	141 - 150 mmHg	151 - 180 mmHg	≥181 mmHg
	· Lowest systolic BP			80 - 94 mmHg	≤79 mmHg
	· Orthostasis	No orthostasis		Orthostasis	
	· Highest diastolic BP	50 - 90 mmHg	91 - 95 mmHg	96 - 105 mmHg	≥106 mmHg
	· Highest temperature	98.6 - 99.9°F	100.0 - 101.9°F	102.0 - 102.8°F	≥102.9°F

EKG = electrocardiogram; PAC = premature atrial contraction; PVC = premature ventricular contraction; ABG = arterial blood gases; WBC = white blood cell (count); NOS = not otherwise specified; PND = paroxysmal nocturnal dyspnea; CXR = chest x-ray; BP = blood pressure