Association of Outpatient Alcohol and Drug Treatment with Health Care Utilization and Cost: Revisiting the Offset Hypothesis*

SUJAYA PARTHASARATHY, PH.D., CONSTANCE WEISNER, DR.PH.,† TEH-WEI HU, PH.D.,† AND CHARLES MOORE, M.D.†

Division of Research, Kaiser Permanente Medical Program (Northern California), Oakland, California

ABSTRACT. *Objective:* This study examines the hypothesis that treatment reduces medical utilization and costs of patients with substance use problems. *Method:* Adult patients (N = 1,011; 67% men) entering the outpatient chemical dependency recovery program at Sacramento Kaiser Permanente over a 2-year period were recruited into the study. Medical utilization and costs were examined for 18 months prior and 18 months after intake. To account for overall changes in utilization and cost, an age, gender and length-of-enrollment matched nonpatient control group (N = 4,925) was selected from health-plan members living in the same service area. Multivariate analyses controlling for age and gender were conducted using generalized estimating equation methods, allowing for correlation between repeated measures and nonnormal distributions of the outcome variable. *Results*: The treatment cohort was less likely to be hospitalized (odds ratio [OR] = 0.59; $p < .01$) and there was a trend for having spent fewer days (rate ratio [RR] = 0.77; $p < .10$) in the hospital in the posttreatment period compared to pretreatment period. These patients were also less likely to visit the emergency room (ER) (OR = 0.64; $p < .01$) and had fewer ER visits (RR = 0.81; $p < .01$) following treatment. Inpatient, ER and total medical costs declined by 35%, 39% and 26%, respectively ($p < .01$). Reductions in cost were greater for the treatment cohort when compared with the matched sample ($p < .05$). Among women, there were significant reductions ($p < .05$) in inpatient, ER and total costs for the study cohort when compared with the matched sample; among men, the reductions in inpatient and ER cost (but not total cost) were significantly larger ($p < .05$) for the study cohort when compared with the matched sample. For the treatment cohort, the change in medical cost was not significantly different by gender. Changes in cost were significantly different across the various age groups ($p < .05$) for the study cohort and the matched sample. Among those in the group aged 40-49 years, the decline in cost for study cohort was significantly larger ($p < .05$) than for the matched sample. *Conclusions:* For patients with substance use disorders entering treatment, there was a substantial decline in inappropriate utilization and cost (hospital and ER) in the posttreatment period. The disaggregated pattern of posttreatment decline in utilization and cost is suggestive of long-term reductions that warrant a longer follow-up. (*J. Stud. Alcohol* **62:** 89-97, 2001)

RAPIDLY INCREASING health care costs in the face of scarce resources have focused health services research on the economics of medical care. In the addictions field, previous findings from studies indicate that substance abuse treatment reduces the medical costs of patients with alcohol and drug use disorders, who utilize health care services at much higher rates than other patients (Blose and Holder, 1991; Goodman et al., 1991, 1992; Holder and Blose, 1986, 1991, 1992; Holder and Hallan, 1986; Holder et al., 1985; Lennox et al., 1992; Reiff et al., 1981). This is the so-called "offset effect." Traditionally, cost research in the substance use disorders field has focused on alcohol treatment (Holder, 1987; Holder et al., 1992; Jones and Vischi, 1979; Luckey, 1987) and, on the whole, these studies found reduced utilization and cost after treatment for alcohol dependent patients. Estimates of reductions in utilization range from 26% to 69% with a median of 40%, and the reduction in health care cost ranges from $0.41 to $1.10 for every dollar spent on treatment. Recent studies that have examined treatment for drug dependencies other than alcohol (Alterman et al., 1994; Burke et al., 1995; French and Zarkin, 1993; French et al., 1996; Goodman et al., 1994; Harwood et al., 1988; Stein et al., 1993) have found cost offset effects as well.

Several limitations characterize the research to date. With few exceptions (Blose and Holder, 1991; Holder and Blose, 1986), earlier studies did not control for patients' demographic and epidemiological characteristics. The Holder and Blose studies found that cost offsets did not differ by gender but did differ by age: cost offsets were less likely in older patients. Much of the offset research was conducted prior to the widespread change from inpatient to outpatient treatment and prior to the introduction of managed care. Even the more recent offset studies, however, have not addressed outpatient modalities or the current organization of medical care. In addition, alcohol and drug cost studies have primarily focused on overall change in medical treat-

Received: March 14, 2000. Revision: September 11, 2000.

*This research is supported by National Institute on Alcohol Abuse and Alcoholism grant R37AA10359 and National Institute on Drug Abuse grant RO1DA08728.

†Correspondence and reprint requests to Constance Weisner, Dr.PH., Division of Research, Kaiser Permanente, 3505 Broadway Avenue (12th Floor), Oakland, CA 94611. Constance Weisner is also with the Department of Psychiatry, University of California, San Francisco, CA. Teh-wei Hu is with the School of Public Health, University of California, Berkeley, CA. Charles Moore is with the Chemical Dependency Recovery Program, Kaiser Sacramento, Sacramento, CA.

ment costs, with little attention to change in particular types of medical cost (e.g., emergency room [ER] or inpatient services). Epidemiological and health services research suggests that, prior to treatment, the excess utilization of medical services by substance use disorders populations is largely attributable to costly emergency room and inpatient care rather than preventive, outpatient care (Parthasarathy and Walter, 1998; Parthasarathy et al., 1998, 1999; Schmittdiel et al., 1997; Stein et al., 1993). We anticipate that, in the posttreatment period, outpatient care will be maintained or even increase. Therefore, we expect to find reductions in emergency room and hospital utilization and cost in the first 18 months after treatment, although not an overall offset.

In this study, we examine the hypothesis that use of specialized outpatient treatment for substance use disorders reduces cost by reducing inappropriate and avoidable health care services (e.g., medical hospitalizations and ER services). Using data from a large, private, group model managed-care organization, we examine change in cost by major utilization type—ER, inpatient and outpatient—focusing on the relationship between patient characteristics (particularly gender and age) and medical utilization and cost.

Method

Study design and sample characteristics

The treatment cohort was drawn from a larger study conducted to assess the impact of treatment intensity on outcomes and cost. A sample of adult patients meeting DSM-IV (American Psychiatric Association, 1994) criteria for drug or alcohol abuse or dependence and entering the outpatient Chemical Dependency Recovery Program (CDRP) at the Sacramento Kaiser Permanente (KP) facility between April 15, 1994 and April 15, 1996 were recruited into the study. The CDRP is an abstinence-based program; the treatment staff includes a psychiatrist, internists, licensed social workers, psychologists, registered nurses and certified alcohol and drug counselors. All patients who came in for an intake appointment during the study window and had not had a visit to the CDRP in the preceding 6 months were eligible to participate. As described elsewhere, other criteria for inclusion were continuous enrollment in the health plan for at least 6 months prior to intake and an age at intake of at least 18 years (Weisner et al., 2000). Patients must have undergone detoxification (if necessary) prior to entering the outpatient CDRP treatment program.

We divided utilization data for all patients into pre- and posttreatment periods based on the treatment intake date, examining utilization and cost by 6-month windows and in aggregate. For multivariate analyses, the pre-intake period consisted of the 18 months prior to intake (TIME = 0), and the posttreatment period (TIME = 1) consisted of the 18 months subsequent to treatment, excluding a 2-month treatment window. The study used a conservative intent-to-treat model and all individuals who had an intake were included regardless of whether they had a follow-up visit or not. Changes in membership status, which may have occurred during the study window, were accounted for by using member months as denominators in computing utilization rates and average costs.

An age, gender and length-of-enrollment matched control group (a maximum of five controls for each substance abuse patient) was selected from the health-plan membership database residing in the Sacramento service area. A small number of cases (n = 126) had less than five controls because appropriate matches could not be found (Schmittdiel et al., 1997). The matched group was also screened for prior utilization of services for substance use disorders and those who were positive were excluded from the sample, thus creating a nonequivalent group, pretest-posttest design (Cook and Campbell, 1979). The matched sample allows us to compare the utilization of a substance-misusing treatment cohort to that of a nonpatient population, and account for possible changes in utilization for the treatment cohort during the study window that may be a reflection of overall trends in utilization.

The final sample consisted of 1,011 study participants and 4,925 matched health-plan members. Sixty-seven percent (n = 674) of the sample were men, 75% (n = 757) were white and the mean (SD) age of the treatment cohort was 38.4 (11.5) years. About half (47%) were married and 57% were employed; 25% of the treatment cohort had some college education. Almost half (42%) were alcohol dependent only, 28% were drug dependent only and 17% met criteria for alcohol and drug dependence; 12% of the patients had a diagnosis of abuse only (i.e., not dependent). Drug-dependent patients were most likely to be dependent on stimulants (25.9%), marijuana (14.6%) and cocaine (8.1%). The mean (SD) length of enrollment for the treatment sample was 17.2 (2.4) months for the pre-intake period and 15.3 (5.2) months for the posttreatment period. A majority of study participants had continuous membership pre- and posttreatment (over 85% in the pretreatment and 70% in the posttreatment period) as well as for the entire duration of the study (64%). Since the matched sample was obtained by matching on age, gender and pretreatment length of enrollment, there were no significant differences between the two groups on these measures.

Measures

Information on age, gender and length of enrollment for the treatment cohort and the matched sample were obtained from KP's membership database. The intake questionnaire provided information for the treatment cohort on demographic characteristics (e.g., race, income, education, marital status and primary substance of choice). Baseline measures of severity in several domains (alcohol, drug, legal, social, medical, psychiatric and employment) were also obtained from the intake questionnaire, which included the Addiction Severity Index (ASI; McLellan et al., 1992) and the Symptom Distress Checklist, short form (SCL-66; Derogatis et al., 1973). The ASI score for each domain ranges from 0 to 1.0, with higher scores indicating higher levels of severity.

Utilization. Inpatient and outpatient utilization data were obtained from KP's automated databases (Selby, 1997), focusing on episodes of hospitalizations (measured as discharges as well as days) and outpatient visits. The former were classified into medical hospitalizations (excluding labor and delivery), those related to detoxification, and other psychiatric/substance use disorder related hospitalizations, based on the International Classification of Diseases, Version 9 (ICD-9-CM; Department of Health and Human Services, 1980). However, due to the small numbers of hospitalizations in some subgroups, all such services, excluding detoxification, labor and delivery, were aggregated in the final analysis, with inpatient utilization measured in terms of averages per 1,000 member months. Visits were classified into ER and non-ER categories (excluding mental health and substance-related problems). Outpatient rates were expressed as average number of visits per member month.

Costs. The costs for services provided within KP were obtained from the Cost Management Information System (CMIS) which is an automated accounting system that allocates general ledger costs to visits based on standard "step-down" accounting principles. The payroll general ledger provides information on direct costs (e.g., physician and other staff salaries, taxes and benefits) as well as indirect costs (e.g., building rent, equipment depreciation, office supplies, headquarters administration and maintenance). The CMIS integrates hospital, laboratory, radiology and outpatient utilization databases and generates fully allocated costs by department.

CMIS costs were not available for the entire study period since this system became operational only in 1995. However, detailed utilization data were available for the entire pretreatment period. Therefore, cost estimates for 1995 were applied to utilization data for the period from 1992 through 1994. Average per diem costs for 1995 for specific Diagnosis Related Group (DRG) and categorical length-of-stay combinations (1 day, 2-3 days, 4-6 days, 7 or more days) were multiplied by the number of hospital days to obtain inpatient costs for the pre-1995 period. Average cost/visit (by department) were used to compute outpatient costs for the pre-1995 period.

Costs for authorized services delivered outside of the KP delivery system (referred services) were obtained from an administrative database that records billed and paid costs for referrals. In addition to the type of service received (outpatient vs inpatient), this system provided the ICD-9-CM diagnoses (principal diagnosis and up to five additional diagnoses), where applicable. Information about procedures and services was also recorded as required for any billing agency by the Health Care Financing Authority. Costs for unauthorized emergency services provided at non-KP facilities were obtained from a separate data system that included diagnosis and procedures as well as charges and paid amounts.

All costs were converted to constant (1998) dollars using the Medical Care component of the Consumer Price Index. Three cost measures were examined: (1) inpatient cost, (2) ER cost and (3) medical cost (comprising inpatient, ER and nonemergency outpatient visit cost). Costs were summarized for each patient for the 18-month periods before and after treatment. To account for varying lengths of membership during this time, average utilization rates and costs were calculated using member month denominators.

Statistical analysis

Comparison of baseline data. To compare baseline utilization rates and cost between the treatment cohort and the matched sample, we used logistic regression to examine the odds of dichotomous outcomes (e.g., hospital use and any ER visit for treatment cohort vs the matched comparison group). The odds ratio (OR) for the group variable (= 1 if in treatment cohort) represents the odds of patients being hospitalized in the treatment cohort relative to the matched sample (a ratio larger than 1 implies a greater likelihood of hospitalization).

We used Poisson regression (McCullagh and Nelder, 1989) for count data, (e.g., total hospital days and number of ER visits). This method was appropriate since many individuals had zero events in the time period of interest, thereby violating the normality assumption of ordinary least squares (OLS) regression. In these models, the exponent of the coefficient on the indicator variable for group represents a rate ratio (RR) and gives a measure of the utilization rate for the cases relative to the controls. For example, in the regression model, in which the dependent variable is the number of hospital days, a ratio greater than 1 for the group variable indicates a higher inpatient day-rate for the treatment cohort.

In multivariate regression models for inpatient, ER and medical costs, we added \$1 to all cost measures and used logarithmic transformation to reduce the skewness of the distribution and analyze the linear model on the log scale (Duan et al., 1983). This did not substantially alter the average costs. Since a majority of individuals (over 90%) had nonzero total costs (including inpatient, outpatient and ER costs), this did not affect the analyses of medical costs in any significant way. In these regression models, the exponent of the coefficient on the indicator variable for the group represents the ratio of costs for a given group relative to the reference group. A ratio greater than 1, for example, implies that the study cohort has a higher cost, on average, when compared to the matched sample.

Changes in utilization and cost over time. The McNemar's test to examine the change in hospital and ER use over time was used as a first step for each group. For continuous measures (e.g., inpatient, ER and total cost), we defined the change score as the difference between posttreatment and pretreatment values of the outcome variable. Some proposed methods for analyzing change scores when there are only two time points include t tests, regressing posttreatment values on pretreatment values and repeated-measures analysis. Several limitations of using the change score have been noted (Cronbach and Furby, 1970). For instance, t tests are not applicable in the case of nonnormal distributions of the outcome variables and, as mentioned earlier, many of our outcomes measures are either dichotomous (e.g., hospital use) or count data (inpatient days). Even continuous measures (e.g., costs) have positively skewed distributions. We used the nonparametric Wilcoxon rank-sum test in these cases.

In multivariate regression models, using change scores as the outcome variable requires assumptions about the joint distribution of pre- and posttreatment measures that cannot easily be verified. Regression of change scores or posttreatment values on pretreatment values might result in spurious regression, especially if the change score is highly correlated with initial values (Nieto-Garcia and Edwards, 1990). In addition, when comparing two groups with different pretreatment distributions of the outcome variable, merely adjusting for observed initial value might give biased results (Vollmer, 1988). Therefore, we used the generalized estimating equation (GEE) method (Liang and Zeger, 1986), which is an extension of the repeated-measures analysis for general linear models. This method allows us to examine baseline differences between groups, as well as change within and between groups using a single analytic framework, and has the flexibility to allow nonnormal distributions of the error terms. In these models, each observation represents a person at a given time, using two records per person as representing the two measurement points. The correlation between repeated measures is accounted for but treated as a nuisance parameter. Therefore, we model the marginal distribution of outcome for each time period rather than the conditional distribution of posttreatment values given baseline data.

We analyzed changes in utilization and cost within the treatment cohort and the matched sample as well as between groups. For models analyzing change in utilization and cost within each group, we examined the significance of the coefficients of the indicator variable for observation window (TIME: posttreatment = 1). A statistically significant, negative coefficient for TIME indicates a significant decrease in the respective utilization measure from the prior period. Logistic, Poisson and multivariate OLS regression models were used as appropriate.

We compared the change in utilization and cost for the treatment cohort to the matched sample to determine if the changes observed in the study sample were a reflection of an overall trend not associated with treatment. In these models, we included indicator variables for group (treatment cohort vs matched controls) and time (pre- vs posttreatment), as well as a two-way interaction term for group-time combination. The coefficient of the interaction term allows us to determine whether treatment cohort patients show greater or smaller reduction (if any) in the posttreatment period than the matched sample. A significant, negative coefficient would imply a greater reduction in utilization (or cost) for the treatment cohort in the posttreatment period. Dummy variables for age/gender categories were included to determine if, after accounting for these characteristics, there were significant changes in utilization and/or cost between the two groups.

The multivariate analyses on medical costs were replicated for subgroups of patients including men, women and patients in different age groups to assess whether patient characteristics were related to reductions in cost.

Results

Baseline utilization and cost

Of the treatment cohort, 19% had an inpatient encounter and 45% had an ER visit in the 18 months prior to intake (not shown). The corresponding rates for the matched sample were 5.6% and 21.8%, respectively. Unadjusted utilization rates and average costs by a 6-month window for the treatment cohort and matched sample are shown in Table 1. For the treatment cohort, there was a sharp increase in the inpatient discharge rate from 13.48/1,000 to 27.04/1,000 in the 6 months prior to intake. The average number of inpatient days almost doubled (from 55.45/1,000 to 106.5/1,000), and ER visits increased from 0.05 per member month to 0.08 during this period. Non-ER office visits also increased slightly in this period (from 0.45 visits to 0.57 visits). Increases in cost mirrored the increases in utilization.

For multivariate analyses, we classified age into four categories: 18-29, 30-39, 40-49 and 50 years and over, and used 18-29 years as the reference age group. Comparing the treatment cohort to the matched sample, controlling for age and gender, we found that for the 18-month pretreatment period, patients entering treatment were more likely to have had a hospitalization (OR = 4.1; $p < .01$) and an ER visit (OR = 3.0; $p < .01$). They were also likely to spend substantially more days in the hospital (RR = 4.7;

TABLE 1. Utilization and cost by 6-month window

	Pretreatment			18-month	Posttreatment			18-month
	13-18 months	7-12 months	1-6 months	pre-treatment	1-6 months	7-12 months	13-18 months	post-treatment
Treatment cohort (n = 1,011)								
Utilization								
Inpatient discharges/1,000 member month	15.12	13.48	27.04	18.73	16.49	11.29	12.36	13.49
Inpatient days/1,000 member month	56.59	55.45	106.50	73.65	58.97	64.21	50.68	58.16
ER visit/member month	0.04	0.05	0.08	0.06	0.05	0.04	0.04	0.05
Non-ER visit/member month	0.49	0.45	0.57	0.50	0.53	0.50	0.49	0.51
Costs ($)								
Average inpatient cost/member month	137	90	148	125	104	123	69	101
ER cost/member month	15	18	41	25	18	19	15	18
Non-ER cost/member month	86	79	99	89	93	88	87	89
Average medical cost/member month[a]	239	187	289	239	215	231	171	208
(standard errors in parentheses)	(36)	(34)	(34)	(21)	(35)	(37)	(38)	(23)
Matched sample (n = 4,925)								
Utilization								
Inpatient discharges/1,000 member month	4.15	4.28	4.40	4.28	4.38	4.01	4.31	4.23
Inpatient days/1,000 member month	16.81	16.73	15.83	16.44	23.17	14.65	16.35	18.18
ER visit/member month	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Non-ER visit/member month	0.35	0.34	0.34	0.34	0.36	0.35	0.36	0.36
Costs ($)								
Average inpatient cost/member month	36	44	45	42	40	39	32	37
ER cost/member month	7	8	8	8	8	6	6	7
Non-ER cost/member month	62	58	57	59	61	57	58	59
Average medical cost/member month[a]	105	110	110	109	109	102	97	103
(standard errors in parentheses)	(12)	(11)	(11)	(5)	(12)	(12)	(12)	(6)

[a]Costs may not add up exactly due to rounding errors.

$p < .01$; not shown). These higher utilization rates translate to higher costs. From Table 1, we find that the average inpatient cost for the treatment cohort was 3.2 times higher ($125 versus $42) than that of the matched sample; ER costs were three times higher ($25 vs $8); and non-ER costs were 1.5 times higher ($89 vs $59). The average medical cost for study participants was $239 compared to $109 for the matched sample. In regression models, using log-transformed costs as the dependent variable, the differences in pretreatment costs between the treatment cohort and the matched sample were statistically significant ($p < .01$).

Posttreatment utilization and cost

For the treatment cohort, there was a steep decline in inpatient discharges (from 27.04/1,000 to 16.49/1,000) and days (from 106.50/1,000 to 58.97/1,000) in the 6-month period immediately after treatment (Table 1). Inpatient days increased slightly in the next 6-month period but decreased to their lowest level (50.68 days per 1,000) by 18 months posttreatment. ER use also declined sharply in the posttreatment period and continued to decline beyond the first 6 months after treatment. Thus, while the treatment cohort continued to use inpatient and ER services at much higher rates than the matched sample, their use was less than before treatment. Inpatient and ER costs followed a pattern similar to utilization, whereas non-ER outpatient costs were virtually unchanged. The medical cost for the treatment cohort decreased from $239 to $208/person in the posttreatment period but was still twice that of the matched sample ($103).

Changes in utilization and cost

The McNemar's test of pre-post comparison in hospital and ER use showed that there were significant reductions in both measures ($p < .01$) for both groups. The Wilcoxon rank-sum test of the differences in various costs showed that the differences between groups were significant ($p < .01$). We conducted multivariate analysis using GEE methods outlined earlier. The multivariate models, controlling for age and gender, showed that the treatment cohort was less likely to be hospitalized (OR = 0.59; $p < .01$) and spent marginally fewer days (RR = 0.77; $p < .10$), on average, in the hospital in the 18-month posttreatment period when compared to the 18-month pretreatment period (Table 2A). They were also less likely to have an ER visit (OR = 0.64; $p < .01$) and had fewer ER visits (RR = 0.81; $p < .01$), on average, than during the prior 18 months. There was a declining trend in hospitalization rate (OR = 0.83; $p < .05$) and ER use (OR = 0.81; $p < .01$) among the matched sample individuals as well (Table 2B). However, the pre-post differences in inpatient days and ER visits were not statistically significant. In the full model, comprising both

TABLE 2. Multivariate analyses of changes in utilization and cost (pretreatment versus posttreatment)

Variable	Inpatient use: Yes/no (OR)	Hospital days (RR)	Log(inpatient cost)[a] (CR)	ER use: Yes/no (OR)	No. ER visits (RR)	Log(ER cost)[a] (CR)	Log(medical cost)[a] (CR)
A. Treatment cohort (n = 1,011)							
Time[b]	0.59†	0.77§	0.65†	0.64†	0.81†	0.61†	0.74†
Gender[c]	1.63†	1.99†	1.71†	1.19	1.42†	1.38§	2.94†
Age 30-39	0.98	0.71	0.87	1.04	0.83	0.94	1.43†
Age 40-49	1.47*	1.10	1.34	1.01	0.79	0.88	2.22†
Age 50 and over	1.93†	1.37	1.95*	1.05	0.91	0.92	2.86†
B. Matched sample (n = 4,925)							
Time[b]	0.83*	1.09	1.04	0.81†	0.94	0.95	0.89†
Gender[c]	1.12	0.97	1.04	1.11§	1.22†	1.10	2.97†
Age 30-39	1.59†	1.13	1.04	0.88§	0.89	0.78†	1.27†
Age 40-49	2.34†	1.51	1.15†	0.87§	0.79†	0.72†	1.79†
Age 50 and over	4.22†	2.76	1.67†	1.05	0.84§	0.82*	3.68†
C. Full sample							
Case[d]	4.12†	4.38†	3.23†	3.01†	2.78†	4.63†	3.52†
Time[b]	0.83*	1.10	1.04	0.81†	0.94	0.95	0.89†
Case × Time	0.71†	0.70§	0.62†	0.79†	0.86	0.64†	0.82*
Gender[c]	1.28†	1.35*	1.14†	1.13†	1.29†	1.15†	2.99†
Age 30-39	1.29*	0.90	1.01	0.92	0.87§	0.81†	1.30†
Age 40-49	1.90†	1.28	1.18†	0.91	0.80†	0.75†	1.87†
Age 50 and over	3.15†	2.03†	1.72†	1.05	0.87	0.84§	3.57†

[a]Percentage change = (1-coefficient)*100; [b]1 if posttreatment; [c]1 if women; [d]1 if study cohort.
§$p < .10$; *$p < .05$; †$p < .01$.

the treatment and matched cohorts (Table 2C), the odds ratio for the Group × Time interaction term showed that the excess reductions in hospitalization and ER use rates for the treatment cohort, over time, were statistically significant ($p < .01$). The decline in inpatient days was marginally significant ($p < .08$) whereas the decline in ER visits for the two groups was not statistically different.

As shown in Table 2A, inpatient and ER costs (cost ratio [CR]) declined by 35% (1-0.65) and 39% (1-0.61), respectively ($p < .01$), for the treatment cohort. There were no significant reductions in the corresponding average costs for the matched sample (Table 2B). Medical costs declined for the treatment cohort (26%; $p < .01$) as well as the matched sample (11%; $p < .01$). As can be seen from Table 2C (coefficient of Case × Time) the reductions in inpatient, ER and medical costs were greater for the treatment cohort when compared to the matched sample ($p < .05$).

We used the smearing method described by Duan (1983) to retransform the cost variable in terms of the original units of analysis. The least-squares adjusted estimates of average ER costs for the study cohort were $35.44 and $21.50 for pre- and post-intake (not shown) and $7.68 and $7.29 for the matched sample. The estimates for inpatient costs were $122.71 and $79.12, and total costs were $446.96 and $330.15 (study cohort); the corresponding costs for the matched sample were $38.28 and $39.63 (inpatient costs) and $129.19 and $116.28 (total costs).

Analysis of offset for selected subgroups

As a next step, we examined the reductions in medical costs by gender. Our results showed that women had higher average costs than men (treatment cohort and matched sample) both for pre- and posttreatment. In the pretreatment period, this difference was significantly larger for the treatment cohort ($293 for women, $212 for men; $p < .05$); it was marginally higher for the matched sample ($123 and $102, respectively; $p < .10$). There was a decrease in cost for both men and women in the treatment cohort (7.5% and 19.7%, respectively). These decreases were due primarily to reduction in inpatient and ER costs. In the matched sample, there was a corresponding decrease among men (8%); the costs for women were unchanged. Among women in the study cohort, compared to those in the matched sample, we found significant reductions ($p < .05$) in inpatient, ER costs and total medical costs over time. A similar comparison among men showed that there were reductions in inpatient and ER costs for the male study cohort ($p < .05$) but not in total cost. Comparison of men and women in the treatment cohort showed that the difference between genders in decline in total cost was not statistically significant ($p = .19$).

The distribution of medical costs by age categories is given in Table 3. Overall, age was positively related to pretreatment medical cost ($p < .01$) for both samples,

TABLE 3. Distribution of average medical cost (dollars) by age

Age group (% distribution)	Treatment cohort (n = 1,011) Pretreatment	Posttreatment	Pre-post difference	Matched sample (n = 4,925) Pretreatment	Posttreatment	Pre-post difference
18-29 (22)	193 (43)[a]	237 (54)	-44	62 (12)	77 (12)	-15
30-39 (35)	173 (33)	154 (41)	19	96 (10)	82 (9)	14
40-49 (29)	315 (36)	230 (44)	42	108 (11)	115 (10)	-7
50 and over (14)	311 (52)	252 (62)	59	209 (15)	157 (13)	52
F statistic	3.81	0.92	1.98	21.12	9.81	13.98
p value	<.01	.43	.05	<.01	<.01	<.01

[a]Standard errors in parentheses.

although the relationship was not strictly monotonic for the treatment cohort. The average medical cost for the youngest age group (18-29) increased by about 25% in the treatment cohort and the matched sample. Average costs decreased for all individuals in the 30-39 age group (11% for the treatment cohort and 15% for the matched sample). Medical costs declined by 24% among treatment cohort individuals in the 40-49 age group, whereas it was unchanged among matched sample members in the same age group. Average medical costs declined for individuals over 50 (19% for the treatment cohort and 25% for the matched sample). Comparison between age groups over time showed that for both the treatment cohort and the matched sample the changes were significantly different across the various age groups ($p < .05$). The reduction in medical costs for study cohort patients in the 40-49 age group was statistically significant ($p < .05$) when compared to individuals in the matched sample in the same age group.

Discussion

This study is the first to compare the offset effects by type of medical care use (inpatient, emergency room and outpatient) for patients with substance use disorders treated primarily in an outpatient setting. As in previous studies on medical offset, we observed that a group of adult, chemical dependency (CD) patients have substantially higher utilization of medical services and medical costs prior to entry in treatment when compared to other, non-CD, members who are similar in terms of age, gender and length of enrollment. We found that the most significant reductions were observed in inpatient use and likelihood of ER use, but other measures (e.g., inpatient days and number of ER visits) also showed substantial decreases. Pretreatment non-ER outpatient visits were greater than expected and did not increase in the posttreatment period. For the treatment cohort, we found a 26% reduction in medical costs after treatment ($p < .01$), adjusting for age and gender.

Our analysis by gender showed that women had higher costs than did men in the pretreatment period but had larger reductions in the posttreatment period. When comparing the study cohort to the matched sample by gender, we found that study-cohort women had substantial reductions in inpatient and ER costs; whereas, among men, the reductions were in inpatient and ER costs only. As in the Blose and Holder (1991) study, the differential offset effect between genders was not statistically significant.

The effect of age on utilization and cost was as expected, with older age being associated with higher cost. The reduction in cost for individuals over 50 years of age was contrary to that observed in earlier studies (Blose and Holder, 1991; Holder and Blose, 1986). Whereas these reductions were also observed among a demographically matched random sample of general health-plan members, these data are not available for the Blose and Holder (1991) study.

In this study, we presented medical offset in terms of the ratios between groups over time. We refer the readers to Goodman et al. (1997, 2000) for an alternate way of presenting medical offset in terms of utilization and cost effects. The significantly higher estimates of some retransformed costs are not surprising since deviations from normality persisted even after log-transformation. Such distributions are not unusual in analysis of costs and have been one of the reasons for the predominance of the literature focusing on utilization rather than direct measures of cost.

This study uses an intent-to-treat design and all patients who had intakes were included. We have not examined the effect of completing treatment or retention in treatment as predictors of outcome. These are known to have significant impact on longitudinal patterns of health care utilization and cost (Booth et al., 1997). Further analysis of offset effects by patient characteristics is warranted. This would include type of problem substance (alcohol vs drug), treatment retention, treatment completion status and baseline severity measures. Some of these factors (retention and completion) are themselves outcomes influenced by type of drug and severity.

Although pre- and postintake lengths of enrollment were similar for the study cohort and matched sample, the study cohort had a slightly lower proportion of patients who were continually enrolled for the duration of the study (64% vs 68%; $p < .05$). In the short run, this may not affect our cost-offset results substantially; however, this will have to be addressed as we follow the two groups over longer periods of time.

The analytic method (GEE) used in this study makes use of the fact that there is likely to be correlation between repeated observations on the same individuals. This method has previously not been used in analyzing data in pretest-posttest studies. Our use of Poisson regression to examine such count data as ER visits and hospital days is new and adds to our understanding of the various components of offset. Analysis of cost offset may fail to show statistically significant reduction or a lower reduction in the posttreatment period due to the complex nature of cost and its highly skewed distribution. Being able to analyze utilization measures in conjunction with cost will enable us to obtain a clearer picture of offset.

An important issue in offset studies is that of regression-to-the-mean (RTM), the argument that individuals observed when their utilization/cost is unusually high will regress to average levels regardless of treatment. Although the only reliable method to rule this out would be to use an equivalent sample of "untreated" patients, this was not feasible in our study. This has also been noted as a limitation in earlier studies. The only estimate of utilization and cost in the absence of treatment (Holder and Shachtman, 1987) suggests that the trajectories of untreated patients would continue to be on an upward trend. More recent approaches to finding appropriate control groups use individuals with other chronic disorders (e.g., depression and diabetes) (Fortney et al., 1999). At the time of this study, we did not have diagnostic information on outpatients that would have allowed us to select such a cohort. The recent investment by KP in an outpatient clinical information system will enable us to select patients with other medical conditions for future studies. Although the results of this study do not rule out RTM, we believe that the pattern of posttreatment decline in utilization and cost observed among the treatment cohort in this study (decreases continuing beyond the first year as well as utilization and cost averages that are at or even below the lowest pretreatment levels), suggests that if these reductions continue beyond 18 months, a true offset effect would be observed. The follow-up time of 18 months is relatively short to detect a full offset effect. However, the results of this study are encouraging and warrant further study of the treatment cohort over a longer period of time. Five- and seven-year follow-ups of these cohorts are currently underway.

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