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Benefit–Cost in the California Treatment Outcome Project: Does Substance Abuse Treatment "Pay for Itself"?

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Objective. To examine costs and monetary benefits associated with substance abuse treatment.

Data Sources. Primary and administrative data on client outcomes and agency costs from 43 substance abuse treatment providers in 13 counties in California during 2000–2001.

Study Design. Using a social planner perspective, the estimated direct cost of treatment was compared with the associated monetary benefits, including the client's costs of medical care, mental health services, criminal activity, earnings, and (from the government's perspective) transfer program payments. The cost of the client's substance abuse treatment episode was estimated by multiplying the number of days that the client spent in each treatment modality by the estimated average per diem cost of that modality. Monetary benefits associated with treatment were estimated using a pre–posttreatment admission study design, i.e., each client served as his or her own control.

Data Collection. Treatment cost data were collected from providers using the Drug Abuse Treatment Cost Analysis Program instrument. For the main sample of 2,567 clients, information on medical hospitalizations, emergency room visits, earnings, and transfer payments was obtained from baseline and 9-month follow-up interviews, and linked to information on inpatient and outpatient mental health services use and criminal activity from administrative databases. Sensitivity analyses examined administrative data outcomes for a larger cohort ($N = 6,545$) and longer time period (1 year).

Principal Findings. On average, substance abuse treatment costs $1,583 and is associated with a monetary benefit to society of $11,487, representing a greater than 7:1 ratio of benefits to costs. These benefits were primarily because of reduced costs of crime and increased employment earnings.

Conclusions. Even without considering the direct value to clients of improved health and quality of life, allocating taxpayer dollars to substance abuse treatment may be a wise investment.

Key Words. Substance abuse treatment, costs, cost-offset

In spite of advances in treatment and technology, successfully treating those addicted to alcohol and drugs and helping them maintain abstinence remains a challenge. Traditional health services research on these topics has focused on the effectiveness of treatments and access to treatment. In recent years, however, there has been greater focus on assessing the societal impact of addiction and substance abuse treatment. A substantial body of empirical evidence suggests that in addition to the cost of substance abuse treatment itself, drug and alcohol abuse are associated with increases in a wide range of costs (Harwood et al. 1998; Holder 1998a; French, Salome, and Carney 2002; McCollister and French 2003; Salome et al. 2003; Sindelar et al. 2004), including those associated with crime and the criminal justice system (Wall et al. 2000; Vencill and Sadjadi 2001); medical care, especially hospital and emergency room (ER) (French, Salome, Krupski et al. 2000; Wall et al. 2000; Hunkeler et al. 2001; Office of National Drug Control Policy 2001; Palepu et al. 2001; Sturm 2001, 2002); infectious diseases such as HIV/AIDS, hepatitis, and tuberculosis (Daley et al. 2000; Mark et al. 2001); pre- and postnatal care (Mark et al. 2001); mental disorders (Harwood et al. 1998); and government and private transfer payments and other social programs (Gresenz et al. 1998; Merrill and Fox 1998; Cook and Moore 2000; Mark et al. 2001), including unemployment benefits, welfare payments, disability benefits, and food stamps. Evidence on the effects of substance abuse on unemployment and impaired work productivity is somewhat more mixed, with some suggestion that drinking may not have the same adverse effects as alcohol or drug abuse (Mullahy and Sindelar 1998; Cook and Moore 2000; Wall et al. 2000; Feng et al. 2001; Mark et al. 2001; Vencill and Sadjadi 2001).

Successful substance abuse treatment can have an extraordinarily important impact on lives; yet, in many instances, these programs are needed by those who are indigent and hence dependent on services that are publicly financed. In a cost-cutting environment, public funding for substance abuse treatment competes more broadly with other uses of limited societal resources for improving population health. Given the stigma associated with substance abuse and perhaps an underlying skepticism about the value of rehabilitation, financing for

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substance abuse treatment may not be readily provided in the current policy climate. Pressure therefore exists for advocates to demonstrate that the benefits of substance abuse treatment can be explained not only in human terms but also in monetary terms. Policymakers are generally more inclined to support treatment programs if they "pay for themselves" through reductions in other types of costs, e.g., health care, criminal justice costs, etc. With one notable exception (Alexandre et al. 2002), the literature in this area has consistently suggested that substance abuse treatment is associated with net benefits.

Previous studies were, however, subject to certain limitations, including the inability to compare the benefits with the cost of the treatment; small sample sizes; potential lack of generalizability beyond randomized-controlled trial settings, populations, and interventions; inability to measure a comprehensive array of costs, including both health care and crime; and age of the data. For example, Holder's (1998a, b) reviews of the older literature identify the cost savings resulting from substance abuse treatment, but did not provide information on the cost of the treatment itself, so estimates of the benefit:cost ratio were not available. In the more recent literature, several studies looked at reductions in health care costs or use only (Zywiak et al. 1999; Goodman et al. 2000; Parthasarathy et al. 2001); conversely, other studies looked only at reductions in crime (Flynn et al. 1999; Daley et al. 2000; Aos et al. 2001). One study (Mauser et al. 1994) adopted a more comprehensive approach in exploring the monetary benefits associated with substance abuse treatment, including savings related to both health care and crime, but had a relatively small sample size that made detection of statistically significant differences challenging. Other studies incorporated multiple outcome measures like criminal activity, health services utilization, and employment status but were performed with narrowly defined populations (Daley et al. 2000; French et al. 2002b, 2003; Logan et al. 2004) or were focused on particular treatment modalities (Barnett and Hui 2000; French, Salome, and Carney 2002), or insured populations (French, Salome, Krupski et al. 2000; Goodman et al. 2000; Humphreys and Moos 2001; Parthasarathy et al. 2001).

A number of the other studies assessed the cost–benefit of one treatment modality only relative to another modality. For example, Flynn et al. (1999) compared long-term residential and outpatient drug-free treatment, while Salome et al. (2003) compared the results of one outpatient modality that initiated with inpatient treatment with another that did not. Weisner et al. (2000) compared outcomes from day hospital treatment to traditional outpatient regimens, and Holder et al. (2000) compared outcomes of cognitive behavior therapy, motivational enhancement therapy, or a Twelve-Step facilitation treatment.

Still other studies compare enhanced interventions with standard ones. Hartz et al. (1998) evaluated the value of contingency contracting, while Avants et al. (1999) compared outcomes from a standard versus an enhanced treatment. Koenig et al. (2000a, b) looked at the marginal costs and benefits associated with increased treatment duration and intensity; French, McCollister et al. (2002a) compared a modified therapeutic community to treatment-as-usual for homeless mentally ill substance abusers; and Fleming et al. (2002) examined the benefit–cost of a brief intervention for problem drinkers.

In the present study, we address the benefit–cost question using data from the California Treatment Outcome Project (CalTOP), a large demonstration project that collected outcomes data on clients admitted to 43 substance abuse treatment providers in 13 counties in California. CalTOP was the successor to the California Drug and Alcohol Treatment Assessment Program (CalDATA), a large-scale study of the effects of alcohol and drug treatment on participant behavior, treatment costs, and economic benefits to society (Gerstein et al. 1994) that suggested that substance abuse treatment was associated with a 7:1 ratio of benefits to costs. CalDATA was conducted 10 years earlier than CalTOP, prior to a number of changes in the California substance abuse treatment system and treatment population, such as increased methamphetamine users, decreases in the average length of treatment, and concomitant increases in the number of prior treatment episodes (Urada 2000). CalTOP also improved upon other aspects of CalDATA, including its reliance on a discharge sample and 50 percent response rate; its lack of a baseline survey, which meant that analyses were based on self-reports of events occurring up to 3 years earlier; its reliance on self-reported crime; and its comparison of benefits with the cost of the initial treatment episode only (35 percent of clients reentered treatment during follow-up).

METHODS

Study Design

As detailed in the CalTOP Final Report (Hser et al. 2002, 2003), the 43 CalTOP providers administered the ASI-Lite (McLellan et al. 1980, 1992) to all of their clients at intake. CalTOP subjects were comparable at intake to those entering treatment statewide, except that CalTOP had slightly fewer criminal justice clients, slightly more patients with a secondary drug problem, and fewer methadone programs. A consecutive census of intake clients was then asked to participate in follow-up surveys at 3 and 9 months, using the

same instrument. At intake and 9 months post-intake, self-reported information was collected from clients on ER visits and hospital nights for medical problems during the past 30 days and 6 months, as well as money received from employment, unemployment, disability/retirement, and welfare during the past 30 days. Of the 3,314 clients targeted for the 3-month follow-up, 86 percent were interviewed, 8 percent were not found, 3 percent were incarcerated, 2 percent refused the interview, less than 1 percent were deceased, and less than 1 percent were not interviewed for other reasons. Of the 3,715 clients targeted for the 9-month follow-up, 73 percent were interviewed, 20 percent were not found, 5 percent were incarcerated, less than 1 percent refused the interview when contacted, less than 1 percent were deceased, and less than 1 percent were not interviewed for other reasons. An attrition analysis showed that clients who did and did not complete each follow-up interview were not statistically different in terms of age, ethnicity, marital and educational status, employment, primary drug, treatment history, and legal status at admission. The only significant difference was that 50 percent of the clients who completed the follow-up interviews were female, compared with 43 percent of those who did not.

To determine the ratio of costs to monetary benefits associated with substance abuse treatment, the estimated average direct cost of substance abuse treatment ("treatment cost") was compared with the average change in nontreatment costs associated with treatment (hereinafter referred to as the "monetary benefits"). Substance abuse treatment costs were calculated using a combination of cost data collected from providers and administrative data on days in treatment. Monetary benefit measures were derived from survey and administrative data, and depending on the study perspective taken, included medical care, mental health services, criminal activity, earnings, and government transfer payments. To estimate the monetary benefits, we compared nontreatment costs before and after admission with treatment, i.e., each client served as his or her own "control." All costs and benefits were adjusted to 2001 using the appropriate Consumer Price Index component. To the extent possible, the analyses follow the benefit–cost guidelines outlined in French, Salome, Sindelar et al. (2002). The main perspective adopted was that of the "social planner," in which all costs and benefits are included, regardless of the party to whom they accrue.

Study Cohort and Follow-up Period

The main analyses were based on the cohort of clients entering substance abuse treatment between January 4, 2000 and May 31, 2001, who also

completed a 9-month follow-up survey ($N = 2{,}567$). These analyses utilized 3- and 9-month follow-up ASI data and administrative data. Because the follow-up period was only 9 months, the "look-back" period for the pre-admission data was also 9 months. Sensitivity analyses were conducted using all clients entering substance abuse treatment between January 4, 2000 and May 31, 2001 ($N = 6{,}545$), using only administrative data and a 1-year follow-up period. The second cohort was larger and had a longer follow-up period, but the first cohort had more complete data on the benefits of substance abuse treatment.

Sources of Data

Drug Abuse Treatment Cost Analysis Program (DATCAP). CalTOP providers were asked to fill out the DATCAP, a standardized economic cost instrument developed by Dr. Michael French and colleagues (see www.datcap.com), for the fiscal year running from July 1, 2000 through June 30, 2001. DATCAP measures economic rather than accounting costs by capturing all resources used to provide treatment, including the "fair market value" of donated or discounted resources (e.g., buildings rented at less than market value) and the opportunity costs of volunteer time. Site visits were made to assist programs, and DATCAPs were reviewed for quality assurance purposes. Programs were paid $200 for completed DATCAPs. The final cost estimates were based on data from three methadone maintenance (MM) programs, 19 outpatient drug-free programs, and nine residential programs, for a response rate of 72 percent. Possible explanations for the incomplete response are that the forms were administered just after sites were instructed to implement a large-scale outcome monitoring system, increasing the perceived burden, and some programs did not have an accountant or cost data in a format that easily allowed disaggregation.

California Alcohol and Drug Data System (CADDS). CADDS collects basic information from substance abuse treatment providers receiving public funding about all clients (publicly funded or not), including sociodemographics, substance abuse history, treatment modality, admission, and discharge date. The CADDS data were used to construct the total number of client-days provided by each CalTOP program, to serve as the denominator for total costs when estimating the per diem costs of substance abuse treatment. (The DATCAP asks for the same information, but to minimize response time, we did not require providers to fill out this section.)

California Department of Mental Health Client and Service Information (CSI) database. The CSI provides information on the use and costs of inpatient- and community-based mental health services for all clients treated by providers receiving any public funding.

California Automated Criminal History System (ACHS). The ACHS is a Department of Justice database that provides information on arrests, including date of arrest and offense codes. Offense codes were aggregated into categories to which costs could be assigned (classification available upon request from the authors). Crimes likely to have similar costs were aggregated together, as the purpose of this analysis was to assign a dollar value to changes in crime rates.

California Office of State Health Planning and Development (OSHPD). Hospital discharge data from the OSHPD public use files were used to construct hospital per diem reimbursement rates to apply to client-reported hospital nights from the ASI-Lite.

Estimating the Cost of Substance Abuse Treatment

The total cost of each client's treatment was estimated by multiplying the client's number of days in each treatment modality (during the 9 months postadmission for the intake+follow-up cohort and the 1 year postadmission for the intake cohort) by the average per diem cost of the modality and adding up the costs across all modalities used. The number of days in treatment was calculated by subtracting the date of admission from the date of discharge and adding one, i.e., clients admitted and discharged on the same day were assigned an episode length of 1 day. To estimate average per diem costs of treatment, the total costs of each program were divided by the total number of client-days served by that program. We calculated both weighted and unweighted average per diem treatment costs. The latter is equivalent to adding up total costs across all programs in the modality and dividing by the total number of client-days served by all of these programs. The former weights each program's costs by its number of client-days to obtain the average.

Estimating the Monetary Benefits

Construction of Monetary Benefits. We used the self-reported ASI data and administrative databases to estimate the pre–postadmission changes in total

benefits, composed of the reduction in the costs of hospital nights for medical problems; ER visits; inpatient- and community-based mental health services; days incarcerated; and the victimization, law enforcement, and court costs of all crimes for which the person was arrested. Confidence intervals were bootstrapped using a normal approximation and 10,000 replicates. As the taxpayer perspective was also of interest, we separately report changes in welfare, disability/retirement, and unemployment benefits.

The number of arrests served as a proxy for the number of crimes actually committed. Although some persons arrested for a crime may be innocent, information on whether the arrest led to a conviction was not uniformly available in the ACHS, and use of reported convictions generally underestimates true crime rates, because offenders are not always prosecuted or incarcerated (Beck and Shipley 1997). Thus, unless the rate of actual crimes to arrests changes substantially between baseline and follow-up, our use of arrest data to proxy for actual crimes committed should lead to a conservative bias. This issue is explored further in sensitivity analyses.

For crime and mental health care expenditures, we used data corresponding to the exact measurement period. For ASI outcomes, however, data were not available for the entire 9-month period before or after treatment admission. We therefore interpolated the data to "fill in" the missing months. For example, for hospital nights and ER visits, we had data only for the 6 months prior to intake, the 30 days prior to the 3-month interview, and the 6 months prior to the 9-month interview. Thus, we used data from the 6-month pre-intake period to impute the data for the missing period from 9 months to 7 months prior to intake; to be conservative, data from the 6-month pre-intake period were combined with data from the third month to impute the data for the missing 2-month period following intake (i.e., using the estimated trajectory to interpolate). For earnings income, days incarcerated and welfare, unemployment, and disability/retirement benefits, we had data only for the 30 days prior to intake and prior to the 9-month interview, so we multiplied the 30-day amounts by nine to estimate what the 9-month figures would have been. These figures may overstate the true changes if there was a lag in response to treatment; alternatively, they may understate the true changes over the 9-month period if clients showed the largest improvement immediately following admission to treatment and then regressed.

Derivation of Unit Prices. To assign a price to hospital nights for medical problems, we used OSHPD hospital stays with a nonpsychiatric primary

diagnosis to estimate a regression model for the log of per diem costs, adjusting for sex, age categories, race/ethnicity, and the county of the patient's residence. We then used an appropriate retransformation algorithm to assign per diem costs. The average per diem rate across all medical hospitalizations of CalTOP clients was $1,182 (SD = $276). The estimated average cost of an ER visit was obtained from the literature (French and Martin 1996) and updated to 2001 dollars using the Consumer Price Index, yielding an estimate of $660 for each "bundled" visit, i.e., including ancillary services. The estimated average cost per prison day in California was also obtained from the literature (California State Auditor 1998) and updated to 2001 dollars, resulting in a per diem rate of $74.36.

An appendix summarizing the unit costs associated with each type of crime, including law enforcement, court, and victimization costs, is available from the authors. Law enforcement and court costs associated with criminal activity, as well as the cost per conviction of Superior Court and county prosecutors, were obtained from a published report on the marginal resource operating cost of police and sheriff's offices per arrest (Aos et al. 2001), inflated to 2001 dollars and added to the average fixed capital cost of crime. As our data were for arrests and not convictions, the cost per conviction was multiplied by the probability of conviction, conditional on arrest (Aos et al. 2001). Probation and parole costs were not available.

Estimates of the (tangible plus intangible) victim costs associated with each type of crime were obtained from Miller, Cohen, and Wiersama (1996) and Cohen (2001). Total cost figures in both studies included victim costs in the areas of productivity, medical care/ambulance, mental health, police/fire services, social/victim services, property loss/damage, and quality of life. Inclusion of quality-of-life costs reflects the latest thinking in crime costing and accounts for a high proportion of the total victim costs for some types of crime (e.g., rape). The social planner perspective should ideally exclude victimization costs that are pure transfers between the perpetrator and the victim, but property loss represented only a small part of overall victimization costs and it was not possible to determine how much was pure transfers.

To calculate victim costs, we used all offenses listed for a single arrest. For law enforcement and court costs, however, we used only the most expensive offense listed for each arrest, as the person is only caught once per arrest. This procedure is conservative, as an arrest and court costs are likely to be more expensive for multiple offenses than for a single offense.

RESULTS

Per Diem Substance Abuse Treatment Costs

On a per diem basis, outpatient treatment was the least expensive modality and residential treatment was the most expensive. The unweighted mean per diem costs was \$13.62 (SD = \$2.40) for MM, \$12.08 (SD = \$14.70) for outpatient treatment, and \$81.70 (SD = \$60.68) for residential treatment. Weighting by the number of client-days served by each program made little difference to MM (weighted mean of \$14.16) but made a substantial difference to outpatient and residential treatment (\$6.84 and \$33.56, respectively), suggesting that there may be economies of scale in the provision of substance abuse treatment. The weighted figures are probably more representative of what one would expect substance abuse treatment to cost on average, because less expensive providers treat more of the clients.

Average Cost and Benefits Associated with Substance Abuse Treatment (Table 1)

The average cost of treatment over the 9 months postbaseline was \$1,583 (\$3,336 unweighted) and the corresponding benefits were \$11,487 (CI = \$9,784, \$13,180), for a benefit–cost ratio of more than 7:1, or 3:1 using unweighted costs. For clients whose initial treatment modality was outpatient or residential, the average treatment costs were \$838 and \$2,791, respectively (\$1,505 and \$6,745 unweighted). Comparing with estimated benefits of \$9,049 and \$16,257, benefit–cost ratios were about 11:1 and 6:1 (6:1 and 2:1 using the unweighted costs). Thus, among these modalities, substance abuse treatment appears to more than pay for itself. For MM clients, we could not reject the hypothesis that benefits were zero, although the point estimate (\$5,313) was larger than the average treatment cost (\$2,737).

Pre–Post Changes in the Individual Sources of Monetary Benefit (Table 2)

Reductions were seen in hospital inpatient, ER, and mental health services costs, but only the \$223 reduction in ER costs was statistically significant. Victimization costs dropped by \$3,019 and other costs of criminal activities were reduced by \$2,657, for a total reduction in crime costs of \$5,676 over 9 months. Incarceration costs dropped by another \$1,788 and earnings increased by \$3,352. The pattern of changes in social costs appeared similar when the cohort was stratified by treatment modality. For each subcohort, reductions were seen in each cost category and employment income went up, although levels of statistical significance varied. The estimates suggested that the associations of substance abuse treatment with hospital and ER costs may

Table 1: Summary of Costs and Benefits Associated with Substance Abuse Treatment (Based on the Social Planner Perspective)

	All Treatment Modalities (N= 2,567)	*Methadone Maintenance (N= 115)*	*Outpatient Treatment (N= 1,585)*	*Residential Treatment (N= 867)*
Average cost per substance abuse treatment episode (based on weighted per diem prices)	$1,583 ($1,506, $1,660)	$2,737 ($2,469, $3,004)	$838 ($806, $871)	$2,791 ($2,600, $2,984)
Average cost per substance abuse treatment episode (based on unweighted per diem prices)	$3,336 ($3,150, $3,524)	$2,867 ($2,440, $3,290)	$1,505 ($1,443, $1,567)	$6,745 ($6,282, $7,215)
Average benefits	$11,487 ($9,784, $13,180)	$5,313 (−$2,418, $8,265)	$9,049 ($6,864, $11,225)	$16,257 ($13,482, $19,078)
Net benefits (benefits minus cost of treatment, based on weighted per diem prices)	$9,903 ($8,205, $11,592)	$2,575 (−$321, $5,529)	$8,211 ($6,028, $10,385)	$13,467 ($10,706, $16,269)
Cost–benefit ratio (based on weighted per diem cost estimates)	7:1	No statistically significant benefits	11: 1	6: 1

Note: The follow-up period is 9 months. Ninety-five percent confidence intervals (shown in parentheses) were bootstrapped using normal-based methods and 10,000 replicate samples.

Table 2: Mean Change per Person in Individual Benefit Measures from Pre- to Postadmission

	All Treatment Modalities (N = 2,567)	*Methadone Maintenance (N = 115)*	*Outpatient Treatment (N = 1,585)*	*Residential Treatment (N = 867)*
Cost of hospital nights for medical problems*	– $372 (SE = $248) ($p = .13$)	– $2,796 (SE = $1,551) ($p = .07$)	– $83 (SE = $ 141) ($p = .56$)	– $551 (SE = $613) ($p = .37$)
Cost of emergency room visits†	– $223 (SE = $44) ($p < .0001$)	– $440 (SE = $237) ($p = .06$)	– $89 (SE = $54) ($p = .10$)	– $414 (SE = $78) ($p < .0001$)
Cost of inpatient and outpatient mental health services	– $77 (SE = $52) ($p = .14$)	– $125 (SE = $ 265) ($p = .63$)	– $58 (SE = $ 58) ($p = .32$)	– $105 (SE = $ 107) ($p = .33$)
Victimization cost of criminal activities‡	– $3,019 (SE = $550) ($p < .0001$)	– $297 (SE = $ 259) ($p = .25$)	– $3,383 (SE = $760) ($p < .0001$)	– $2,712 (SE = $824) ($p = .001$)
Other cost of criminal activities‡	– $2,657 (SE = $263) ($p < .0001$)	– $744 (SE = $544) ($p = .17$)	– $2,357 (SE = $317) ($p < .0001$)	– $3,459 (SE = $508) ($p < .0001$)
Total cost of incarceration§	– $1,788 (SE = $116) ($p < .0001$)	– $28 (SE = $215) ($p = .90$)	– $827 (SE = $109) ($p < .0001$)	– $3,566 (SE = $253) ($p < .0001$)
Money received from employment	$3,352 (SE = $410) ($p < .0001$)	$882 (SE = $602) ($p = .14$)	$2,251 (SE = $591) ($p = .0001$)	$5,450 (SE = $602) ($p < .0001$)

*Per diem cost of $1,182 is based on a regression model estimated using data from the California Office of State Health Planning and Development (OSHPD); see detailed description in methods section.

†Per-visit cost of $660 is based on an estimate from French and Martin (1996) and updated to 2001 dollars using the Consumer Price Index.

‡Detailed information on the unit costs of crime is in an appendix available from the authors upon request.

§Per diem cost per prison day of $74.36 is based on data from the California State Auditor (1998) and updated to 2001 dollars using the Consumer Price Index.

Note: Ninety-five percent confidence intervals were bootstrapped using normal-based methods and 10,000 replicate samples. *p*-values are from Wilcoxon tests. The follow-up period is 9 months. The social planner perspective is adopted.

be larger for MM and residential clients than for outpatient clients. In contrast, treatment appeared to be associated with smaller reductions in crime costs and smaller increases in earnings among the MM clients than among outpatient and residential clients, explaining the lack of statistical significance for the estimated total benefit among the MM clients.

Sensitivity Analyses

Benefits to the Government. No significant changes were seen among the overall cohort in unemployment ($-\$59$, $p = .42$) or disability/retirement benefits ($86, $p = .35$). However, welfare payments actually increased slightly ($101, $p = .02$), perhaps because of increased referrals to public aid programs by social service workers associated with substance abuse treatment facilities.

"Inflating" the Arrest Data. As explained above, the reliance on arrest data as a proxy for actual crimes committed is likely to understate the true benefits of substance abuse treatment, as most crimes do not ever result in an arrest. To determine the sensitivity of our estimates to this underestimation, we inflated the number of arrests among the study cohort by the ratio of crimes to arrests in the general population (http://caag.state.ca.us/cjsc/statisticsdatatabs) for each type of crime for which crime and arrest data were available. Among all modalities, the average benefit of substance abuse treatment with regard to reductions in the victimization and other costs of criminal activities rose to $3,986 (SE = $957; $p < .0001$) and $4,687 (SE = $1,061; $p < .0001$), respectively, compared with the original figures of $3,019 and $2,657 described above, suggesting that our estimates of the cost–benefit ratios are conservative.

Multiple Regression Models. To examine the extent to which the net benefits associated with substance abuse treatment vary across client subgroups, we estimated a linear regression of net benefits (total costs minus total benefits) as a function of the client's age; sex; marital, employment, and homelessness status; education; treatment modality; primary substance abused; and ASI subscale scores. The net benefits associated with substance abuse treatment were $4,888 lower among women than men ($p = .007$). Clients who abused alcohol had $8,185 ($p = .02$) more in net benefits than those who abused substances other than alcohol, methamphetamines, cocaine, heroin, or marijuana. Several ASI subscales were significantly associated with net benefits, with greater severity on the alcohol and drug subscales associated with lower net benefits, and greater severity on the employment and legal

subscales associated with higher net benefits. However, all of these effects were small (between $355 and $113 in absolute terms).

Cohort. Among all clients admitted to treatment, the average weighted cost of treatment was $1,483 ($2,878 unweighted) and the corresponding benefits were $2,630 (CI = −$6,924 to $1,667) over a 12-month follow-up period. The magnitude of the overall benefits is smaller for this cohort because we are unable to measure any sources other than reduced crime and mental health services use and the benefit estimate does not reach statistical significance. Compared with the results for the main cohort, the reduction in the cost of mental health services was similarly small and insignificant (−$63; $p = .10$), and the reduction in the nonvictimization cost of criminal activities was large and significant (−$2,643; $p < .0001$). The difference in the overall findings for the two cohorts was because of the insignificant change in the victimization cost of criminal activities ($75; $p = .97$) among all clients admitted to treatment. Further investigation of this finding showed that it was because of small, nonstatistically significant increases in very rare, high-cost crimes (e.g., the average number of murders increased by 0.0006, $p = .36$) offsetting larger, significant decreases in more common but lower-cost crimes (e.g., the average number of assaults decreased by .04, $p < .001$). Thus, the results for the two cohorts appear to be substantially consistent.

Varying Treatment Intensity across Providers. Ideally, each client's days in treatment would be multiplied by the per diem cost of the program treating that client, rather than the average across all providers within the modality. Provider nonresponse precluded the use of this approach for the main analyses, but sensitivity of the results was examined by restricting the sample to clients treated by programs that did submit DATCAP data and calculating average treatment costs in three ways: (1) using the average unweighted per diem cost of all providers within the modality, (2) using the average weighted per diem cost of all providers within the modality, and (3) using the per diem cost of the actual provider. All three methods yield similar results for MM clients, but for outpatient and residential treatment clients, use of provider-specific per diem costs yields estimates halfway between the weighted and unweighted figures.

DISCUSSION

Our best estimate is that on average, substance abuse treatment costs $1,583 and is associated with a societal benefit of $11,487, representing a 7:1 ratio of

benefits to costs (9:1 when arrest data are "inflated" to proxy for actual crimes committed). This ratio is based on weighted average treatment costs, which reflect expected costs of treatment; 9-month follow-up of clients in all modalities with follow-up survey data, so that as many sources of benefit as possible could be included in the analysis; and benefit measures that demonstrate significant change, so that the estimates are robust to rare events. Sixty-five percent of the total benefit was attributable to reductions in crime costs, including incarceration. Twenty-nine percent was because of increased employment earnings, with the remaining 6 percent because of reduced medical and behavioral health care costs.

A review of 11 studies (McCollister and French 2003) found that the benefit–cost ratios associated with substance abuse treatment ranged from 1.33 to 23.33 and that benefits were overwhelmingly because of reductions in criminal activity, with smaller contributions of earnings, and averted health care. Our conclusion is similar, especially when inflating the arrest data. Our benefit–cost ratio is also similar to the CalDATA estimate, despite differences in study design and methodology. However, our estimates of substance abuse treatment costs tend to be lower than those in previous studies. An earlier literature review by Roebuck, French, and McLellan (2003) suggested that the average cost per treatment episode was $7,358 for MM, $1,944 for standard outpatient, and $9,426 for residential. Our estimates were $2,737, $838, and $2,791, respectively, based on weighted per diem estimates. The lower episode costs in CalTOP were because of shorter lengths of treatment for MM and residential, as the weekly cost of treatment was actually higher ($99 and $235, respectively, in CalTOP, compared with $91 and $194 in Roebuck et al.). For outpatient, lower episode costs were also attributable to lower weekly costs, around $48 versus $121 in Roebuck et al. These discrepancies might reflect geographic differences in the intensity and duration of treatment.

Our findings should be interpreted with caution, given a number of study limitations. The results may not generalize to non-CalTOP providers, especially those in other states. Attrition may have biased the estimated cost–benefit ratio among the "intake+follow-up" cohort if the clients who were women, incarcerated, or could not be located were more costly on average than the clients who were successfully tracked. Compared with the statewide data, the CalTOP sample slightly underrepresented methadone clients, although statewide methadone clients only account for 10 percent of the total treatment population. We may have slightly overestimated benefit–cost ratios if they were based on the average across CalTOP programs of all modalities. Reductions in nontreatment costs may be overstated because of regression to

the mean, i.e., persons entering substance abuse treatment often have hit the bottom and "have nowhere to go but up." A related issue is whether clients who were court-mandated to enter treatment were deterred in the short run from committing further criminal activities. Unfortunately, randomization to treatment is neither logistically nor ethically possible in a large-scale, "real-world" study of this type, plus randomized-controlled studies lack the external validity of observational studies. The pre–post study design has strong advantages over observational studies comparing substance abusers who do and do not enter treatment, because of the selection bias inherent in the latter. The high ratio of benefits to costs makes it less plausible that the cost of substance abuse treatment would have outweighed its benefits if regression to the mean and deterrence effects could have been taken into account. Although it was not possible to study these effects using CalTOP data, we analyzed studies including a "no-treatment" control group from a published meta-analysis of drug abuse treatment outcomes (Prendergast et al. 2002). These analyses suggested that the controls had pre–post differences in outcomes that were about half as large as those in the treatment group. Applying this ratio to CalTOP, the $1,583 in treatment costs would be compared with a benefit of $5,744 ($11,487/2).

The relatively short 9-month follow-up period may understate the monetary benefits associated with treatment if its effects persist over the longer run; alternatively, the additional benefits accrued beyond the 9-month window might be offset by additional costs if the patients relapse and require further treatment. Most of the other study limitations are likely to lead to conservative biases, e.g., the inability to cost out certain crimes (especially those related to drug manufacture and sales, which showed the largest reductions following treatment) and to measure probation and parole costs and costs imposed on family members and friends. Systematic underreporting of hospitalizations, ER use, days incarcerated, and employment income would tend to understate the benefits of treatment as long as the under-reporting was similar for a given client before and after treatment. The lack of comprehensive outpatient medical care data could have induced either a conservative or liberal bias, depending on whether engagement in substance abuse treatment increased referrals to medical providers or primarily improved physical health so that less medical care was needed. Treatment costs may have been slightly underestimated because providers estimated the depreciated costs of their furniture to be zero.

The CalTOP study provided a number of important lessons for conducting future analyses of the cost–benefit of substance abuse treatment.

Given concerns about respondent burden, use of a shorter version of the DATCAP is desirable and we do not believe much critical information would be lost. A brief version of the DATCAP has been pilot tested (French, Roebuck, and McLellan 2004) and is available for download and use by researchers at www.datcap.com. Similarly, the ASI-6 will be better suited for economic evaluation studies than the older version used for CalTOP. The most important sources of monetary benefits (crime, hospitalizations, and earnings) occurred in domains that can be measured using administrative data. As omission of many other sources of monetary benefit induces only a conservative bias, a reasonable cost–benefit analysis might be conducted without the time and expense of primary data collection from clients. Use of administrative data only has the added advantage of allowing the entire client population to be included in the analysis. Long administrative data lags suggest that cost–benefit analyses may need to be based on older data, but lags pose less of a threat to the validity of the findings if treatment systems or client populations do not change rapidly over time. If primary data collection is used as the primary or a supplementary source of information, an instrument designed specifically for cost–benefit analyses should be administered. For example, the most recent version of the Addiction Severity Index (the forthcoming ASI-6) has been redesigned to permit economic evaluation.

Nontrivial differences by treatment modality were observed. Although the benefits associated with outpatient treatment were lower than for residential treatment, the costs were also lower, so the net return on investment was actually higher for outpatient than for residential treatment. No statistically significant monetary benefits were identified among the MM clients, likely because of the small sample size and low power. Alternatively, benefits may be smaller for the MM clients, because of the long-term nature of methadone treatment. The strongest effects of treatment are likely to occur soon after the client becomes drug-free. The overwhelming majority of MM clients had prior treatment admissions, suggesting that many may have been on methadone for a long time and hence already realized any reductions in crime in past years. The baseline level of crime costs was much lower for MM clients than for either outpatient or residential clients, suggesting little room for additional improvement. In other words, our "pre" admission measurement period may not actually precede the receipt of treatment for these clients, but rather, reflect a phase in ongoing treatment. Again, however, the lack of precision in the estimates when looking separately at MM clients precludes us from drawing firm conclusions about the relative magnitudes of the effects for methadone versus outpatient or residential clients. In general, caution must be exercised in

making comparisons across modalities, because substance abusers tend to move in and out of treatment and across treatment modalities during their life course. Furthermore, the modality comparisons were based on initial treatment modality, so attribution of benefits to a single modality may be misleading.

Taken as a whole, our findings suggest that even without considering the health and quality-of-life benefits to the clients themselves, spending taxpayer dollars on substance abuse treatment may be a wise investment. Further research is needed to establish a link between the monetary benefits of treatment and the duration and intensity of treatment. Challenges in identifying this relationship include collecting reliable data on the services received by clients and addressing selection bias (i.e., more acute clients probably receive more intensive services, at least to begin with, but more motivated clients are likely to have higher retention rates). Despite these challenges, such an analysis would seem to be the logical next step in building on the CalTOP findings.

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Erratum

Correction to "Benefit–Cost in the California Treatment Outcome Project: Does Substance Abuse Treatment 'Pay for Itself'?"

Susan L. Ettner, David Huang, Elizabeth Evans, Danielle Rose Ash, Mary Hardy, and Yih-Ing Hser. Article originally published in HSR, Volume 41, Number 1, February 2006.

On p. 196, the last sentence should have read:

The main analyses were based on the cohort of clients entering substance abuse treatment between April 1, 2000 and May 31, 2001 who also completed a 9-month follow-up survey ($N = 2{,}567$).

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Ettner, S. L., D. Huang, E. Evans, D. R. Ash, M. Hardy, and Y.-I. Hser. 2006. "Benefit–Cost in the California Treatment Outcome Project: Does Substance Abuse Treatment 'Pay for Itself'?" *Health Services Research* 41 (1): 192–213.