The Journal of Mental Health Policy and Economics
J. Mental Health Policy Econ. **3**, 11–26 (2000)

Cost–Benefit Analysis of Drug Treatment Services: Review of the Literature†

William S. Cartwright*

Services Research Branch, Division of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, National Institutes of Health, 6001 Executive Blvd, room 4N-4222, MSC 9565 Bethesda, MD 20892-9565, USA

Abstract

Background: How valuable is public investment in treatment for drug abuse and dependency in the real world of everyday practice? Does drug abuse treatment provide benefits and how are they valued? What are the costs of obtaining outcomes and benefits? Cost–benefit analysis attempts to answer these questions in a standard analytic framework.
Aims: This paper reviews cost–benefit analyses with scientific merit so that analysts will have a current picture of the state of the research. It will also give public decision-makers information with regards to the available evidence for policy purposes.
Method: Bibliographic searches were performed. Studies were obtained through the assistance of the Parklawn Health Library system, a component of the US Public Health Service. Selected studies were from the scientific literature with the exception of eight studies published as governmental reports.
Results: Cost–benefit studies have fallen into the following categories: (i) planning models for delivery systems in states and cities; (ii) short-term follow-up studies of individuals, (iii) single individual programs and (iv) state system's monitoring of outcomes. In 18 cost–benefit studies, a persistent finding is that benefits exceed costs, even when not all benefits are accounted for in the analysis. Much variation is found in the implementation of cost–benefit methods, and this is detailed across discussions of effectiveness, benefits and costs. Studies have emphasized the cost savings to society from the reduction in external costs created by the behavioral consequences of addiction and drug use.
Discussion: Economic analysis of drug treatment requires sophisticated conceptualization and measurement. Cost–benefit analysis of drug treatment has been a significant analytical exercise since the early 1970s when the public drug treatment system was founded in the United States.
Conclusion: Drug abuse treatment services may be considered as contributing positive economic returns to society. However, considerable work needs to be done to standardize methods used in the studies. A striking area of omission is the absence of studies for adolescents and only one for women in treatment.
Implications for Health Care Provision and Use: Finding a positive net social benefit should assist policy-makers with decisions related to drug abuse treatment expenditures. Additional work on allocation of budget dollars across various drug treatment services will be needed.
Implications for Health Policy Formulation: Government agencies and other stakeholders in national health care systems must realize that cost–benefit studies are an important tool for decision-making. Rational strategies can only be addressed by examining alternatives for the efficient allocation and equitable distribution of scarce resources.
Implications for Further Research: Future research should focus on standardizing the methods used in the cost-benefit analysis. Extensions should examine methods related to the willingness-to-pay approach. Studies are needed for drug abuse treatment targeted to adolescents and women. More studies should be published in the scientific literature. Published in 2000 by John Wiley & Sons, Ltd.

Received 10 July 1999; accepted 15 January 2000.

Introduction

Cost–benefit analysis applies economic theory to public and private expenditure decisions that require detailed information about the merits of alternative treatment programs, modalities, behavioral therapies and pharmaco-therapies. As major stakeholders in the provision of treatment services, federal, state, local governments, insurance companies and managed care systems have a strong interest in developing such information. Stakeholders prefer to fund treatments for which net benefits are positive in comparison to alternative policies and strategies. Patients also have expectations on how drug treatment interventions will effectively alleviate symptoms of withdrawal, craving, loss of control, drug use problems, social dysfunction and ill health. This paper systematically examines 18 studies that have undertaken a cost–benefit analysis in a variety of decision-making frameworks.

Rational budgeting at the state level finds treatment funding competing with education, criminal justice, transportation and other worthy expenditures, as well as with the acceptable level of tax burden on the population. A typical budget planning approach would evaluate drug treatment system support and expansion as well as determine which types of treatment would be favored with enhanced resources. Such public health planning is especially relevant to large metropolitan areas that are suffering illicit drug pandemics. Decision-makers in the private sector with a narrower

*Correspondence to: William S. Cartwright, Ph.D., Health Economist, Services Research Branch, Division of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, National Instituite of Health, 6001 Executive Blvd, room 4N-4222, MSC 9565 Bethesda, MD 20892-9565, USA.
The author is responsible for all statements, and none should be construed as representing any position of his institution or the Federal government.
Source of funding: NIDA

viewpoint should use the cost–benefit framework to allocate resources rationally to the most effective alternatives. In either case, a systematic analysis of costs and benefits is undertaken to decide if the public or private investment should be made or if continued support is justified.

Benefits, costs, and effectiveness are reviewed for each study. Fundamental to benefit valuation is the social cost method that examines the reduction of the negative costs to society engendered by the adverse consequences of drug abuse and dependence. Therefore, cost-of-illness methods provide systematic accounting concepts to estimate the burden on society of the total social costs of drug abuse.[1–5] In fact, drug abuse cost-of-illness methods have pioneered in estimating many of the non-market, indirect costs, where standard burden of disease cost estimates would only focus on health care and productivity costs. In drug abuse, one could categorize three broad consequences: physical health, mental health and social problems. Unfortunately, such benefits can create up to 40 different subcategories, making estimation more complicated and expensive than standard calculus of disease burden.[6–8]

One may consider the social cost-of-illness analysis as the macroeconomic aggregate of interest, and the cost–benefit analysis as the microeconomic counterpart for finding investments to reduce costly social consequences. In the latest cost-of-illness estimate for drug abuse, the aggregate burden was 98 billion dollars in 1992 of which 59% was attributed to the related costs of criminal behaviors.[4] Scientific growth in both macro- and micro-economic methods has proceeded simultaneously and with close interaction in both avenues. Of course in the evaluation of drug abuse treatment it is the comparison of marginal benefits and costs that must be made.

In order to obtain the benefits or outcomes of treatment, resources must be consumed by society in drug treatment interventions. Resources may be consumed by providing direct treatment services and ancillary non-treatment services, as well as patient time. Direct treatment services are the resources expended in operating (e.g., counselors and medicines) expenses and overhead (e.g., administration and physical plant) expenses. Ancillary services may come from a host of social services that meet the human needs of the patient and include such services as occupational counseling, housing, case management, transportation and childcare. The analyst must sort out resources that are expended in treatment and those provided as transfers. Consistent with the cost-of-illness methodology, transfers are not considered a using up of society's resources, but rather a redistribution.[3,4,8] The patient may have to forego working during treatment, and this lost income would be counted as a cost of the treatment. Research is continuing on costing of the consequences of drug abuse for various target populations, which can be applied to cost–benefit studies of treatment services.[9]

The Review

Studies are reviewed in chronological order, and where possible, technical developments are referenced across studies. Depending on the study, benefits, costs and benefit–cost ratios are presented in the tables, and accompanied by a discussion. The preferred decision rule is to adopt all policies that have positive net benefits. Here, the benefit–cost ratios are reported to facilitate comparison across studies where no specific resource decision is going to be made. Strict comparability would require that numerators and denominators be consistently calculated across all studies to prevent manipulation. A benefit–cost ratio of 4.1 is interpreted to indicate that for each dollar society spends on treatment, there are 4.1 dollars in benefits. In the Appendix, a table presents, in chronological order, information on the study name, program under evaluation, design, sample and effectiveness assumptions as a further guide to the literature. Each study makes some positive assumption about effectiveness whether from outcome data in the study or outside information. A glance at this table will suffice to illustrate the heterogeneity in methods and assumptions used in these studies. A review of the 'cost-offset' approach has been given by Holder in a previous article in this journal.[10]

The Holahan study in **Table 1** attempts to develop the decision parameters for a new program, narcotic administration, in the District of Columbia.[11] The intervention included short-term commitment, methadone maintenance and/or withdrawal, group counseling, job placement and remedial education. The primary goals were to reduce social costs of addiction through reducing costs of crime and increasing gainful employment income.

Social costs of drug addiction and treatment costs over one year are estimated from interviews of police officials and program administrators. After year one, social costs are assumed to fall from $2000 per year per addict to $250 (1970 dollars). These are benefits attributable to addiction for drug purchases, earnings, police, courts, corrections, parole and probation. Assuming a $40 dollar per day heroin habit, 50 percent of property crime attributable to addicts, a 40 percent success rate and a 10 percent discount rate, the benefit–cost ratio is estimated to be 4.1 for one year of the program. Moving to an 11 year time horizon, the benefit–cost ratio improves substantially to 12.9 percent. In sensitivity analysis, even when the amount of drug use falls to $25 per day and a smaller amount of total city crime is

Table 1. Cost–benefit analysis of narcotics treatment for 1000 patients in Washington, DC, 1969

Program type	Cost ($)	Benefit ($)	Benefit/ cost ratio
Narcotic treatment administration—one year horizon	1 400 000	5 750 770	4.1
Narcotic treatment administration—11 year horizon	1 676 688	21 662 377	12.9

Source: Holahan J. 1970.[11]

explained by illegal drugs, the benefit–cost ratio remains high at 2.7 for one year and 8.5 for an 11 year horizon.

Treatment effectiveness is adjusted for successes and failures among the first year cohort of patients. Holahan assumes various one-period success rates among a 1000-person cohort treated in a given year, but settles on a success rate of 400 persons as a conservative estimate. Stretching the time horizon requires additional assumptions on the success rate and the rate of maturing out of addiction in these future years. Among failures, he assumes that 30 persons per year stop using drugs from year 2 to year 6, and 90 per year from 7 to 11 years and none remain addicted after 11 years. Among the successes, he assumes a re-addiction rate of 15% in year 2, 10% in year 3 and 5% in year 4. The addiction rate of this group remains at the 30% level until year 7 when they stop using drugs. In addition, for successes that had not resumed addiction, it is assumed that they would have matured out of addiction at the rate of 50 per year from year 2 to 6, and 150 per year from year 7 to 11. In spite of the assumptions on relapse and maturation rates, the benefit–cost ratios climbed substantially when multiple years are in the time horizon. Such an example is illustrative of the problems a multi-period time format that cost–benefit analysis must contend with because of the long natural history of treatment and addiction that a cohort of patients may experience. At the time Holahan did his study, there was little available treatment research on effectiveness, and many parameter values had to be assumed.

Based on planning techniques, the Leslie study in **Table 2** is an evaluation to develop a public strategy for New York City where the endpoint is the re-allocation of resources within the treatment system.[12] Leslie wishes to allocate funding across the ten approaches shown in **Table 2**, which required the author to extrapolate beyond the individual program cost–benefit analyses. A multi-program strategy was developed that took into account the size and nature of the addict population. In the end, Leslie established a plan that would encompass methadone maintenance, detoxification, Odyssey House and a hypothetical antagonist treatment technology. The major estimation problem is to project expected benefits of averting social costs by calculating: the benefit of an averted man year of heroin addiction multiplied by the success rate multiplied by the potential years of remaining addiction. Benefits of $13 710 per year are estimated for labor income, deaths, morbidity, crime, enforcement and housing stock lost. Costs are for a projected individual treatment episode, and there is no adjustment for lost income in treatment. Many subjective adjustments are made by Leslie to costs and benefits. No discounting across the addiction career is made in these calculations so the individual cost–benefit analysis ratios are not adjusted. However, discounting was used for the global strategies that were to be implemented over a long-term planning horizon.

Leslie bases his benefits on the social costs of averting one man year of addiction, after release from a treatment program. This is conservative since no benefits are assigned for the in-treatment period. The success rate is simply the proportion of patients who are no longer heroin addicted after treatment, with no dynamic adjustment for relapse or maturation. Success rates are generally obtained from program query, rather than empirical studies. Effectiveness is defined in terms of multiplying the success rate by the number of years of remaining addiction, where this later variable is dependent on the average age of entry into the type of treatment program. Leslie could obtain such information from age group data in treatment programs along with estimates of remaining addiction years. While one may criticize the technical failings of the study, it is still cast in an evaluation framework that emphasizes the utilization of cost–benefit analysis for resource allocation and strategy development on a system wide basis. If the strategy were indeed implemented, the author does not discuss performance measures needed to monitor the system, which is an important feature of resource management and program evaluation. Like Holohan, effectiveness assumptions are adopted with little scientific basis.

With the Maidlow and Berman study of **Table 3**, thefts are estimated to cost society $30 000 per addict year, and patients experience potential earnings of $5084 after the treatment period, which may be an over-estimate.[13] Even after throwing out such a large income gain, the benefit–cost ratios would be high although irrelevant. Thefts are a transfer of resources (except where property is damaged), rather than a consumption of them so that an incorrect concept has been used in the benefit valuation. In measuring

Table 2. Benefit–cost ratios in five programs, New York City

Program type	Cost ($)	Benefits ($)	Benefit–cost ratio
Detoxification	86	1764	20.5
Antagonists	5000	95 970	19.2
Methadone	9100	71 978	7.9
Odyssey House	12 500	81 437	6.5
Increased legal enforcement	10 000	34 275	3.4
Phoenix House	17 305	52 783	3.1
Heroin maintenance	18 000	50 590	2.8
State Narcotic Addiction Control Commission	16 000	44 558	2.8
Involuntary incarceration	55 000	93 502	1.7
Heroin legalization	35 000	44 146	1.3

Source: Leslie AC. 1971.[12]

Table 3. Cost–benefit analysis of heroin treatment for 100 patients with a 44 year treatment and addiction history

Program type	Cost ($)	Benefit ($)	Benefit/cost ratio
Therapeutic community	14 704	213 867	14.5
Methadone maintenance	13 231	247 967	18.7

Source: Maidlow ST, Berman H. 1972.[13]

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

the cost of treatment, the value of foregone income from work while in treatment was not imputed as a cost. The authors use a high discount rate of 8 percent over the long treatment history of the addict. In spite of shortcomings, this study has a clear presentation in an appendix of the assumptions and calculations that completely documents methods and should be emulated.

Effectiveness is related to dropout and relapse rates in the therapeutic community and the relapse rate in the methadone maintenance program. In the therapeutic community, a total of 19% drop out in the first 90 days. They assume that all who remain complete the program. After graduation four years later, they assume that 37.5% are re-addicted, and they distribute a relapse rate of 9.4% from year 5 through 8. For methadone maintenance, a relapse rate of 13.5% is distributed over year 1 through 6, 3% in year 1 and 2% in years 2 through 6. This implies very high success rates for both programs. Indeed, the authors had no information on the dropout rates among those who lasted longer than 90 days. This study is a good illustration of grafting information from effectiveness studies into the cost–benefit framework, of incorrect economic reasoning about benefits and of good use of mathematical modeling.

McGlothlin and his colleagues analyze six different treatment strategies in the United States (**Table 4**).[14,15] Benefit is measured as the foregone production of the addicts, costs of theft and increased anti-crime measures due to the addict population. As is illustrated in the table, the study introduces the notion of declining effectiveness as more patients are brought into treatment. Treatment costs increase and treatment benefits decrease, as additional patients who are sicker and more difficult to treat enter the treatment programs, but this effect is not empirically measured. For example, the methadone maintenance—strict control has benefits per addict fall from $13 980 to $8795 as addict years in treatment expand from 100 000 to 125 000. At the same time, treatment costs increase from $1350 to $2500. The benefit–cost ratio falls from 14.55 to 6.6. Across **Table 4**, net benefit is always positive, and the benefit–cost ratio is greater than one. As clinical trials are currently formulated, it would be impossible to capture such incremental effects on costs and benefits, but real world effectiveness studies might capture such marginal effects.

For a total addict population of 375 000 in 1971, they estimate that 268 000 addicts are on the street and that the rest are in treatment (69 100) or incarcerated (37 500). From this base, they estimate the potential number of years of addiction after adjusting for admission, retention and relapse in a subjective matter. For example, it is assumed that 125 000 addict years would be the maximum potential for a strict methadone maintenance program and 150 000 for a methadone program involving only dispensing and a few additional services. The civil commitment approach was estimated to have a maximum potential of 220 000 with the remaining 100 000 divided among those who have never been committed, those who absconded and those undetected who had relapsed after discharge. The therapeutic community had the smallest number of maximum addiction years of 40 000 because of the small retention rate. Discounting was done for the calculation of the productivity loss that patients sustain over their life course of addiction. A major draw back to this study is the *ad hoc* effectiveness assumptions on the reduction of addiction in the population, but many economic concepts are introduced.

Fuji employed economic analysis and pathbreaking work by Becker and Tullock to identify social benefits and measurement approaches (**Table 5**).[16–18] Benefits are derived from an increase in employment income following rehabilitation and reduction in the opportunity loss of addict crime. Here, addict crime costs are viewed in terms of labor and capital devoted to criminal activity that could have been

Table 5. Discounted net benefits for a heroin addict entering program at age 20

Program	Net benefit ($)
Methadone maintenance	10 639
Imprisonment and parole	8271
Civil commitment	4030
Detoxification	1387

Source: Fujii ET. 1974.[16]

Table 4. Cost–benefits in alternative addiction control programs for the United States

Program type	Addict years of treatment	Cost ($)	Benefit ($)	Benefit–cost ratio
Combination of civil commitment and other modalities	0–270 000	2000	11 020	5.51
Civil commitment	0–220 000	2400	11 750	4.90
Methadone maintenance—dispensing	0–100 000	875	12 735	14.55
	next 75 000	1125	7440	6.61
Heroin maintenance	0–100 000	1250	11 715	9.37
	next 100 000	1250	6085	4.87
	next 50 000	2000	2950	1.48
Methadone maintenance—strict control	0–100 000	1350	13 980	10.36
	next 25 000	2500	8795	3.52
Therapeutic community	0–40 000	2500	11 835	4.73

Source: McGlothlin WH, Tabbush VC, Chambers CD, Jamison K. 1972.[14]

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

used in other parts of the economy, as well as additional crime control costs incurred by governments. The crime benefits are estimated as agency cost reductions from enforcing heroin laws, policing of addict property crime and fencing and controlling female prostitution. Direct treatment costs and the employment wage loss for duration of treatment are the social costs of the treatment. The discount rate is 0.04 over the addiction career. Potential net benefits of approximately $4700 per addict per year are estimated. Heroin maintenance did not receive the increased labor income of $1100 because heroin consumption was observed to decrease labor force participation. Methadone maintenance did not have the same deleterious effects—a major rationale for its use. Estimates of addict crime receive a sensitivity treatment as well as addict age at program entrance and alternative discount rates.

The net benefit is reported instead of benefit–cost ratio since separate benefit and cost estimates were not reported by the author. Methadone maintenance has a higher net benefit than other approaches. Remarkably, Fujii concludes that heroin legalization would cost more than the benefits to be gained, given a 23-fold estimated increase in addiction in the United States, based on pre-Harrison Act levels of addiction. A British style heroin maintenance program is viewed as having more net benefits than the four other heroin treatment programs, but Fujii remarks that heroin maintenance has never gained political support and is not utilized as a treatment in the United States.

Fujii discusses the role of the elasticity of demand for heroin where an inelastic demand would result in a steep rise in price when there is effective supply-side restriction. In the short run, an increase in crime could take place as addicts seek additional illegal income to finance their consumption of heroin. However, one should make an additional caveat that in the long run choice might lead to a reduction in the number of addicts and smaller heroin dose levels that could reduce the amount of crime. Such effects remain unmeasured, but are also considered in Hannan (1975), and Rydell and Everingham (1994).[19,20]

Fujii uses a relapse rate to adjust downward the expected benefits of heroin treatment. For detoxification, methadone maintenance as well as imprisonment and parole, a 12 percent annual rate of decay (patients re-addicted) is used once patients are released into the community. No maturation adjustment is made for those that initially succeed in treatment. Civil commitment is also assumed to follow the same decay rate. For the policies of heroin legalization and heroin maintenance, a relapse or decay rate would presumably not be required, but at least for heroin maintenance there could still be maturing out and some reduction in the value attributed to treatment. One can see Fuji's work bear fruit in the later estimates by Rufener, Rachal and Cruze (1977), establishing a stronger economic basis for such studies.

In the Hannan study of **Table 6**, a full economic model of addict behavior is embedded in a Becker type model of crime and punishment.[19,21] Methadone treatment is found to be an optimal social policy where the benefit–cost ratio is greater than one by a large margin, given that government holds its anti-addict and anti-pusher enforcement policies constant. A pre-and-post comparison is made for patients in New York City with data collected by an independent evaluation group. For the most part, this study has received little attention which is unwarranted given its strengths.

Table 6. Cost–benefit analysis of methadone maintenance in New York City for 931 men from 1 September 1968 to 31 August 1969

Program type	Cost ($)	Benefit ($)	Benefit/ cost ratio
Methadone maintenance	1 784 000	8 164 000	4.58

Source: Hannan TH. 1975, 1976.[19,21]

Benefits are measured in terms of the resource savings to the economy. Savings are generated by: (i) reduction in crime related to physical injury and property damage; (ii) reduction in criminal justice resources; (iii) reduction in medical resources; (iv) increase in legal return to resources released from addict criminal activity and (v) savings in resources devoted to the production and distribution of heroin. For each factor, an operational definition of measures is developed. Averaging about $2000 (in 1970 dollars) per patient year, treatment costs are obtained from program data. In **Table 6**, benefits include the average legal earnings of working addicts and the full market value of the reduced heroin consumption. This latter benefit represents an estimate of the reduced resources in production and distribution of the drug and is subjected to sensitivity analysis regarding the proportion of consumption to include. Further work is necessary in this area to assure that double counting will not occur as well as correct characterization of the illegal market for drugs of abuse.

In the one year analysis, all benefit–cost ratios are greater than one, and this conclusion is robust after a number of sensitivity analyses. In the six year cohort study of 1230 patients, the benefit–cost ratios were all greater than one with the ratio of 4.40 comparable to the 4.58 reported in **Table 6**. Six years are used as the horizon cutoff because data did not exist beyond this time. A relatively high discount rate of 10 percent is used so that the ratio would be higher with a lower rate. When extrapolating to a 33 year time horizon, the benefit–cost ratio increases to 5.09. The author discusses a number of omissions and factors that lead to his conclusion that these estimates are biased downward, and yet benefits were still much higher than costs.

Sirotnik and Bailey conduct a benefit–cost study on 285 patients who received at least one day of treatment during the period 1 July 1971 to 31 December 1972 in one of five different drug treatment modalities (**Table 7**).[22] The basic research design is a pre-and-post outcome study of individual behavior change with no controls. Measurements are made of the changes in frequency of heroin use, cost of daily use, number of drug free weeks during treatment, number of drug free weeks after treatment and proportion of illegally obtained dollars to support heroin use.

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

Table 7. Cost–benefit analysis of heroin treatment for 285 patients in Venice and UCLA over a 1/2 year period

Program type	Cost ($)	Benefit ($)	Benefit/ cost ratio
Community-based heroin treatment	1272041	4631960	3.64

Source: Sirotnik KA, Bailey RC. 1975.[22]

The authors calculate the total benefit of averted theft as the adjusted cost of illegal drug consumption per week times the number of drug free weeks times the proportion with illegal activity. Benefits also are summed for decreased criminal justice systems costs from apprehension, court and incarceration as well as the value of increased earnings due to a reduction in unemployment. Treatment costs are summed from the total program funding over the $1\frac{1}{2}$ years with no adjustments for such categories as in-kind resources donated to the programs. There are a number of drawbacks to the economic analysis, but critical is that the effectiveness measurement is short term in nature from a pre–post research design.

Levine *et al.* (**Table 8**) evaluate the expansion of public drug treatment programs in Detroit during the four year period from 1970 to 1974.[23] This was a time of unprecedented increase in public funding of treatment slots for methadone maintenance. The monthly property crime data (the dependent variable) from the Detroit police is appended to the monthly enrollment data of the treatment programs. A simple regression model is estimated which takes into account a time trend and seasonality as well as heroin potency, unemployment rate and temperature. The treatment benefit is estimated from the coefficient of the treatment enrollment variable where a 23 percent reduction in property crime is found. Utilizing only property crime reduction of course ignores numerous other social benefits, but does indicate a one percent expansion in treatment is worth the cost with such limited focus.

The cost of treatment is estimated to be $1880 per additional patient. This average cost is found by dividing total fiscal year 1974 funding for all Detroit programs by average enrollment during the year. The figure includes some allowance for capital, outreach costs and other operating costs. A one percent increase implies that about 61 additional persons would enroll with a yearly turnover rate of 1.7 clients per slots. The average numbers are driven by the fact that 98 percent of the patients would be entering methadone treatment programs.

Table 8. Cost–benefit analysis of a 1% increase in Detroit public drug treatment, 1970–1974

Program type	Cost ($)	Benefit ($)	Benefit/ cost ratio
Public treatment	67680	129430	1.91

Source: Levine D, Stoloff P, Spruill N. 1976.[23]

Treatment effectiveness is based on the natural experiment of the public treatment enrollment expansion. Instead of using self-reported crime reduction of the patients, the analysis uses monthly property crime reported to the police. No measurement of actual clinical effectiveness is ever attempted. The regression analysis was robust to an alternative specification that takes into account potential endogeneity of the independent variables of the model. The alternative specification found a coefficient of -0.24 on treatment enrollment, not much different from the -0.23 coefficient of the single equation estimate that is used in the cost–benefit calculation. This empirical study is unique in its examination of a natural experiment, combined with regression analysis. The absence of similar studies may stem from a lack of such policy initiatives to evaluate.

In the study of Rufener *et al.* (**Table 9**), the Drug Abuse Reporting Program (DARP) data is used for a pre–post period of comparison with the individual as their own control.[24] Pre-treatment levels are obtained from the period two months before enrollment into treatment. This method has been criticized as too short a time period since individuals are at their bottom just before entering treatment and a rebound (regression to the mean) is expected regardless of treatment entry. The study made no adjustment for the characteristics of the patients, the quality of the programs and the environment in which they are located.

Benefits by modality are adjusted for relative effectiveness, using a companion cost–effectiveness analysis. Since all effectiveness units are expressed in days gained, a relative effectiveness ratio is established by summing days gained among all treatment programs and dividing into the specific days gained for each of the programs. Benefits are the present value of reductions in medical treatment costs, law enforcement, judicial system, corrections, non-drug crime, drug traffic control, prevention costs and housing stock lost. Productivity benefits stem from reductions in unemployment and work losses stemming from emergency room treatment, inpatient hospitalization, mental health hospitalization, drug related deaths, absenteeism and incarceration. Total benefits for one year were estimated to be $9824 (in 1975 dollars)

Table 9. Benefit–cost ratios in five programs based on DARP data, fiscal years 1970–1972

Program type	Discounted future cost ($)	Discounted future benefits ($)	Cost–benefit ratios
Outpatient drug free	2178	27922	12.82
Outpatient detox	6643	47431	7.14
Inpatient detox	11030	60996	5.53
Methadone maintenance	11874	52127	4.39
Therapeutic community	27451	61216	2.23

Source: Rufener BL, Rachal JV, Cruze AM. 1977.[24]

for one addict. Treatment costs include the present value of direct program costs and foregone wages while in treatment.

The cost–benefit methodology follows the approach earlier described by Fujii, and a clear presentation is provided of data sources, parameter assumptions and formulas used. Benefits are reduced by the wastage from the relapse rate, and they use the Fujii rate of 12 percent per year. For the relapse rate, they conducted a sensitivity analysis at 26 percent and 5 percent per year. Relapse rates were heroically assumed identical across modalities. The study makes a clear presentation of assumptions, formulas and parameters that should be emulated in other cost–benefit analyses.

Griffin assessed the costs and benefits of a therapeutic community, Gaudenzia House (**Table 10**).[25] The key effectiveness parameter was self-sufficiency and recovery in the community, assumed to occur at a rate of ten persons per year for an accumulation of 50 male graduates in five years. Griffin included benefits for treated addicts of tax payments ($3360), reduction in welfare benefits ($3000), costs of imprisonment ($1785) and criminality ($35 600). The study is marred by only costing out the treatment expenses of the successful completers of the program and not accounting for relapse from recovery. Benefits and costs are not discounted over the five year horizon of the analysis. Here estimates are geared to consideration of the local governmental budget, rather than a strict account of societal costs. Local decisions to keep open, expand or close the program would be facilitated, but at this level concern should also focus on quality issues at the clinic. The absence of a comparison group would hinder credibility, and evaluations funded by the program under review also would have diminished value in most payers' eyes. Emulation of such a study should not be encouraged because of methodological problems.

Tabbush studied the efficiency of publicly funded drug abuse treatment and prevention programs in California (**Table 11**).[26] He estimates the 1985 drug abuse prevalence by drug, sex, age and race, and then the number and percent of drug abusers in California to 1995 are projected. Effectiveness is associated with the change in social behavior of the drug abuser because of treatment. For criminal benefits, the change in arrest rates for opiates versus non-opiate drug abusers by outpatient and residential treatment modality is estimated. Savings per arrest are estimated from state data, and, for medical costs, the effectiveness rate is applied to the expected costs from overdoses, the incidence of AIDS and hepatitis B. The effectiveness rate is found by multiplying the percentage who satisfactorily complete treatment times the modality success rate of 0.83 for residential and 0.64 for outpatient. Similarly, property crime cost reductions are calculated.

Treatment costs are estimated from program data that are adjusted for inflation (in 1986 dollars) and include an 8 percent state administrative expense. Benefit calculations are for patients in treatment and out of treatment. No imputation is made for foregone earnings of patients while in treatment. Benefits are calculated for annual reduction in arrests and court costs, stolen property, medical costs and increase in earnings. Medical benefits for heroin addicts consist of expected savings from overdoses, AIDS costs and hepatitis B. In a pioneering calculation, the AIDS benefit is the probability a heroin abuser contracts AIDS (0.02) multiplied by average treatment cost for 1.5 years ($150 000) multiplied by the number of infections attributable to a given carrier (1.78). Per opiate abuser, the expected AIDS treatment cost is $5358. Similarly, for hepatitis B, the costs of medical treatment are expected to be $22 per addict. A discount rate of 3 percent is used as the difference between the 90 day Treasury bill rate of 7.5 percent and the inflation rate of 4.5 percent. The study viewpoint is the California taxpayer, rather than society.

Harwood *et al.* (1988, 1995) and Hubbard *et al.* (1989) report on the results of a cost–benefit study utilizing data from the Treatment Outcome Program Study (TOPS).[27–29] The focus of the analysis is on outcomes related to reduced crime costs that were measured in counts of specific criminal acts and then valued by cost per act. A pre–post design is used to evaluate treatment programs, and the benefits while in treatment and after treatment for the three types of program are summed and shown in **Table 12**. Built into this design is effectiveness based on measuring actual behavioral change outcomes before, during and after treatment. Only the short-term benefits are actually measured in this model with no attempt at a long-run extrapolation of costs and benefits.

The methadone maintenance benefit–cost ratio was 0.92, the lowest in all completed studies, and was due to the statistical insignificance found in total benefit after treatment. Inclusion of this benefit would raise the benefit–cost ratio to 1.66, which is consistent with other positive findings. Residential treatment benefits were $5910, and outpatient benefits were lower at $2595 (in 1981 dollars). Benefits were identified in a cost-of-illness study completed before the benefit–cost analysis. The authors point out that a substantial benefit is captured during the treatment phase for these populations.

The Hubbard study still receives a great deal of attention because of the empirical findings on treatment effectiveness that is determined by outcomes measured in a follow-up interview after treatment. In response to the criticism that the low patient status just before treatment admission is a biased baseline for effectiveness measurement, the pre-treatment baseline period was extended for one year. The

Table 10. Cost–benefit analysis for Gaudenzia House therapeutic community

Program type	Cost ($)	Benefits ($)	Cost–benefit ratios
Therapeutic community	727 165	6 561 750	9.02
Inclusion of in-treatment benefits	1 391 625	9 116 085	6.55

Source: Griffin KS. 1983.[25]

Table 11. Benefit–cost ratios of California residential and outpatient drug treatment: heroin and cocaine

	Length of stay (days)	Total treatment cost ($)	Total benefits ($)	Benefit–cost ratios
Heroin treatment				
Residential	103.4	2851	75044	26.3
Methadone maintenance	328.1	3869	53527	13.8
Outpatient drug free	85.7	875	21630	24.7
Cocaine treatment				
Residential	92.2	2543	14138	5.6
Outpatient drug free	95.8	978	22473	23.0

Source: Tabbush V. 1986.[26]

Table 12. Benefit–cost ratios of residential, outpatient methadone and outpatient drug free treatment, based on TOPS data

	Length of stay	Total treatment cost ($)	Total benefit while in treatment ($)	Total benefits after treatment ($)	Sum of total benefits ($)	Benefit–cost ratios
Residential	159	2942	2507	3403	5910	2.01
Outpatient methadone	267	1602	1479	2657*	1479	0.92
Outpatient drug free	101	606	771	1824	2595	4.28

Source: Harwood HJ, Hubbard RL, Collins JJ, Rachal JV. 1988.[27] The asterisk indicates statistical insignificance; not included in the ratio.

effectiveness measures are based on outcomes measured before treatment to the sum of in-treatment and one year after treatment benefits. Statistical adjustments with regression analysis are made to the crime benefits after treatment to adjust for confounding factors such as previous treatment episodes, pretreatment involvement in crime, criminal justice involvement at entry, sex, age, race, education, and pretreatment drug use. This study takes advantage of the naturalistic and nonexperimental data that can be collected in services research.

Mauser and colleagues conduct a study of the Treatment Alternatives Program (TAP) that is modeled on the Treatment Alternatives to Street Crime (TASC) (**Table 13**).[30] The study is conducted in three Wisconsin counties in 1990–91. There are 112 participants; 76 agreed to a baseline interview and only 25 completed the follow-up face-to face interview at approximately 20 months. In addition, a six month telephone survey is conducted after the baseline interview. The intervention is based on a case management model that includes assessments and referrals, treatment and monitoring of offender compliance. Services delivery organization varies in the three counties with one site providing intensive day treatment and the others outpatient treatment. The evaluators are independent of the program, but relied on reports from case managers.

Table 13. Cost–benefit analysis for Treatment Alternatives Program (TAP) in three counties of Wisconsin

Program type	Cost ($)	Benefits ($)	Cost–benefit ratios
Criminal justice benefit @ cost of jail $54 per day	6291	11324	1.80
Criminal justice benefit + medical expenses + earnings	6291	8807	1.40

Source: Mauser E, Van Steel KR, Moberg DP. 1994.[30] Cost is a weighted average of 68 clients.

Costs are measured for treatment, drug testing, overhead costs, case management, medical care expenses, screening and assessment. Treatment is from a variety of programs: outpatient; inpatient; residential; halfway houses; day treatment and mental health outpatient. Two benefit–cost ratios are reported. In the first, only criminal justice benefits are included, and in the second, medical costs, and client income change are added to the criminal justice cost. The benefit–cost ratio is lower for the more inclusive measure because of the increase in medical costs and the decrease in client income after treatment. Medical costs are biased upward since future averted cases of HIV/AIDS, or other medical costs are not counted as a benefit in such a short-term study.

This is not a pure treatment evaluation since treatment is only one ingredient in the intervention, and its contribution cannot be separated from the other services that were offered. Effectiveness is measured in the changed behaviors of the clients through the standard pre–post outcome comparisons of those exposed to the social program. No control group or comparison group was established, and so the individual change over time was the basic measure of effectiveness. A criminal justice study presents difficult choices in design tradeoffs because one can study a client population accessing a given broad intervention with little controls, or narrow the choice of target population and intervention, and improve control over factors that could bias the study. The criminal justice system is complicated, with many entry and exit points, and varying expected incentives for the clients caught up in it. This results in many potential selection biases that must be controlled. Needless to say, follow-up is risky for any study because of the instability of the population.

Gerstein and his colleagues conduct a cost-benefit analysis of the California treatment system (**Table 14**).[31] Benefits are from the expected reduced costs of crime, medical illness and lost wages. In a pre–post design, the authors estimate residential treatment benefits of $10 744, outpatient drug free treatment benefits of $2853, and methadone maintenance benefits of $10 833. The social model benefit is $6509 from a treatment approach focused on recovering in communal sober living and other peer support. The study is retrospective and uses self-report. The treatment providers eligible for inclusion in the study received funding from the California Department of Alcohol and Drug Programs. Treatment costs are estimated from treatment providers. The sample is representative of California and includes 83 providers in 16 counties, and 1850 interviewed patients who were discharged or in long-term treatment between 1 October 1991 and 30 September 1992. A follow-up interview is conducted on average 15 months after discharge from treatment.

Non-response was a problem in both the methadone maintenance patients (50%) and the other discharged patients (46%), which is just one of many factors creating technical problems for state evaluations on a retrospective basis. After analysis, the researchers concluded that the low response rate was due to the quality of the address information and tracking technology, rather than a bias that would affect outcome measures.

Effectiveness is measured for outcomes in drug use, criminality and health care utilization, and employment and welfare transfers. No statistical adjustments are made for previous exposure to drug treatment, relapse after treatment or additional treatment episodes. Treatment costs in treatment episodes after the initial treatment period are not included. These issues are not as important for those in long-term methadone maintenance where there is little relapse, and treatment costs are included for one year of treatment. The results are particularly useful in defending total state and county budgets for substance abuse treatment in the public system, but such studies of course are not tightly controlled with comparison groups.

Finigan studied drug and alcohol treatment in Oregon and found a benefit–cost ratio of 5.59 (**Table 15**).[32] His study uses a two year prior-to-treatment period and a three year post-treatment outcome period. The study develops a comparison group that entered and left treatment after minimal services. Administrative state agency databases are drawn upon rather than self-reported data, and such an innovative methodology requires further research and development. Benefits are measured in criminal justice, public assistance, victim losses and theft. These are compared to total state treatment program costs of the 1991–1992 cohort. Done specifically for the Oregon's Office of Alcohol and Drug Abuse Programs, this study focuses on a taxpayer framework, and the societal perspective is not used. Such studies seem to be useful to governmental decision-makers even though there are limitations due to the methodology.

Harwood and his colleagues do further analysis of the California Drug and Alcohol Treatment Assessment of 1992[33] by examining the differentials between women and men (**Table 16**). Women were 38% of the total treatment population and averaged $1381 per patient in treatment cost. Treatment for women was found to have a strong cost-beneficial outcome. However, in some modalities women had lower benefit–cost ratios than men did. This was due in part to the lower amount of direct criminal involvement

Table 15. Cost–benefit analysis for the state of Oregon: taxpayer perspective

Program type	Cost ($)	Benefits ($)	Cost–Benefit ratios
Substance abuse treatment	14 879 128	83 147 187	5.59

Source: Finigan M. 1995.[32]

Table 14. The California Drug and Alcohol Treatment Assessment (CALDATA)

Program type	Length of stay	Treatment costs per episode ($)	Total benefits ($)	Cost–benefit ratio
Residential	68.9	4405	10 744	2.44
Social model	79.2	2712	6509	2.40
Outpatient drug free	149.5	990	2853	2.88
Methadone detoxification	59.5	405	−1206	−2.98
Methadone maintenance	—	(2325)	(10 833)	4.66

Source: Gerstein DR, Johnson RA, Harwood HJ, Fountain K, Sutern N, Malloy K. 1994.[31] Parentheses indicate that methadone maintenance continues through the whole period under observation.

 J. Mental Health Policy Econ. **3**, 11–26 (2000)

Table 16. The California Drug and Alcohol Treatment Assessment: women and men

Program type	Length of stay (days)	Treatment costs per episode ($)	Total benefits ($)	Benefit–cost ratio
Residential				
Women	72	4405	10 744	2.4
Men	67	4391	27 093	6.2
Social model				
Women	74	2712	6509	4.0
Men	81	2794	12 435	4.5
Outpatient drug free				
Women	187	990	2853	7.4
Men	122	959	13 302	13.9
Methadone detoxification				
Women	64	405	1206	−3.7
Men	57	395	7057	17.9
Methadone maintenance				
Women	304	2325	10 833	5.3
Men	338	2115	11 637	5.5

Source: Harwood HJ, Fountain D, Carothers S, Gerstein D, Johnson R. 1998.[33]

reported for these women in the year before treatment. The perspective of the taxpayer is retained in the analysis with cost imputations for welfare and disability as well as theft costs in the estimated benefits of treatment.

In the study of Flynn *et al.* (**Table 17**), a pre-and-post comparison is made for patients in the Drug Abuse Treatment Outcome Study (DATOS).[34] The sample consists of 502 cocaine-dependent patients selected from a national and naturalistic non-experimental evaluation of community-based treatment. A 12 month follow-up is conducted after discharge. Effectiveness is based on reported reduction of crime behaviors from pre-treatment to in-treatment and after-treatment discharge behaviors. The analysis explicitly standardizes all monetary estimates on 1992 US dollars.

Benefits are measured in terms of societal savings that are generated from in-treatment and after-treatment crime costs. These crime costs are composed of crime victim, criminal justice, and crime career costs. In the low estimate adjusting for missing data, it was assumed that non-respondents engaged in illegal acts at the rate of the average of those who responded to questions about other illegal acts. Sensitivity analysis was conducted on two other non-response adjustments, and benefit–cost ratios remained over one in all cases. Costs are estimated from program data available in the National Drug Abuse Treatment Unit Survey (NDATUS) from the 19 treatment programs involved in the study. Treatment costs were based on the average daily costs of $72 per day and episode length of 154 days for long-term treatment and average daily costs of $9 per day and an episode length of 158 days.

Table 17. Cost–benefit analysis of cocaine treatment for cocaine addiction in DATOS

Program type	Cost ($)	Benefit ($)	Benefit/ cost ratio
Long-term residential	11 016	21 360	1.94
Outpatient drug free	1422	2217	1.56

Source: Flynn RM *et al.* 1999.[34] Table 5, low benefit estimate.

What is remarkable is that there is no specific cocaine treatment for patients in these programs, but rather an adaptation of then current treatment philosophies. Of course, the estimate is biased upward by the pre–post type of evaluation conducted; however, downward biases also exist because of the short-term nature of the benefit estimation and the limitation to only crime costs, a major external cost to society in the human capital estimation methodology. For example, the authors note that HIV/AIDs costs to society were not estimated in this study although risk reduction is an important outcome in treatment.

Hartz and her collaborators examine the health cost impact of contingency contracting as an enhancement to methadone detoxification treatment (**Table 18**).[35] This study is an example of a clinical trial with an expanded outcome space. This study was of 102 opioid addicted patients who were randomly assigned to 180 day detox and detox plus contingency contracting. The study focused on measured outcome changes over the 120 days of the interventions.

Table 18. Cost–benefit analysis of contingency contracting and health care offset

Program type	Mean difference in health cost savings ($)	Mean difference in treatment cost ($)	Benefit/ cost ratio
Contingency contracting versus standard treatment	932.18	191.37	4.87

Source: Hartz DT *et al.* 1999.[35]

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

Patients were stabilized on a daily dose of 80 mg during the first four months and then tapered off. The enhanced condition provided more drug-free urines and alcohol-free breath tests during the final month of treatment. Both treatments offered identical psychosocial interventions. The intervention provided cash credits for substance free status with a maximum of $755 for those who were completely successful over the 120 days.

The study introduced a new outcome after it was commenced which focused on health care costs. For the last 45 patients in the study, the analysts obtained cost data for at least three months of the study. The 120 days of treatment averaged $3160.27 for standard treatment and $3278.57 for the intervention, but the difference was not statistically significant. The contingency contracting vouchers averaged $119.99 and the remaining cost difference seemed to be related to additional consumption of services in the intervention. Cost of health care in the contingency group averaged $397.51 as compared to $1329.69 for the control, thus yielding $932.18 as illustrated in **Table 18**.

Dividing the mean difference in treatment cost resulted in an outcome of health care cost savings of $4.87 (statistically insignificant) for every dollar spent on treatment, and plaguing this study is the small sample size. Thus, the authors indicate a cautionary note for those who are engaged in clinical trial work and cannot obtain a larger sample. This is disappointing because obviously the intervention can be more closely specified and controlled in this research environment as opposed to the more naturalistic environments that have been used. One would also be concerned about the short-term nature of the outcome measures in the study where other studies may have longer follow-up data as well as a more extensive definition of benefits. Where statistically significant results can be found, such partial outcome data will have much credibility because of the randomization in the design.

Discussion and Conclusion

Economic analysis of drug treatment requires sophisticated conceptualization and measurement. First, drug treatment services are directed to rehabilitating individual behavior, and the analysis must have a measure of change in behavior and its impact on outcomes (effectiveness). Second, social benefits and costs must be estimated. The natural history of addiction and treatment careers can be long, requiring repeated measures that increase the difficulty and cost of the analysis.[36] Fortunately, benefits are so large that even in a typical short-run analysis, it is possible to find a benefit–cost ratio greater than one. In such analyses, effectiveness measures must be well established, and McLellan *et al.* (1996) provide a succinct discussion of why drug treatment may be considered effective, a necessary condition for developing a cost–benefit analysis.[37]

Fujii and Hannan established a conceptual standard for economic analysis with an explicit model of markets and social consequences. Companion cost-of-illness methods expanded benefit and cost measurements.[38,3,4] Reduced health care costs have often been neglected, but they have become more important with addiction related HIV/AIDS and other sexually transmitted diseases (STDs). Given the complications of comorbid medical and mental health problems with addiction, studies are needed to sort out comorbidity. For example in French *et al.* (1996), there is a focus on health outcomes.[39] In a new estimation approach, Rajkumar and French (1997) have applied jury compensation for a crime victim's intangible losses (pain and suffering) to overcome the lack of market values.[40] Employment and earnings have been further examined by French and Zarkin.[41,42]

With injecting drug use a major vector for HIV infection, not only the medical costs of treatment must be valued, but also the lives saved. If one treated the value of an addict's life as the same as a non-addicted individual, one could start with an estimate of $5 million dollars[39] and apply this to the benefits of avoiding acute hepatitis B, HIV/AIDS, hypertension, bacterial pneumonia, STDs and tuberculosis. French suggests such in an example by comparing the cost of methadone treatment at $4000 per year to HIV cost at $157 811. Such a 'cost offset' is a major benefit, but also is a great incentive for creamskimming in health plans under competitive markets.

In costing of drug treatment, a number of approaches have been taken. Asking programs for data on the treatment cost of an episode has been frequently used. Others have adjusted costs to make comparisons fair across treatment programs. There has been no effort to do unit costing of services in any of the reviewed literature. Treatment costs have focused on modalities that represent philosophical treatment orientations, rather than more neutral concepts such as inpatient versus outpatient, or intensive outpatient versus standard outpatient treatment. Modality information is collected in the administrative data systems of the state treatment systems, but has been very difficult to exploit for research because of the absence of outcome and cost information that could be matched to patients.

Effectiveness measures in the reviewed studies have also varied. Many analysts have assumed an overall success rate, less than 100 percent, and multiplied this rate times the benefits to obtain the expected benefit per person from a treatment intervention. In studies based on a pre-, during and post-treatment data collection, actual outcome measurements at specific points have been taken. Effectiveness then is included in the measurements plus the rate of attrition from the non-addiction state after treatment, but maturation issues have rarely been dealt with on an empirical basis. Little is known about the relapse distribution, the re-entry to treatment distribution and the spontaneous rate of change to a non-addicted state.[16,43] Sensitivity analysis can be done on different assumed rates to expand the robustness of the analysis.

Studies are completed from different viewpoints. Some studies focus on statewide planning, some on citywide planning and others on comparison of treatment modalities. Some studies alter their societal framework to calculate a cost to taxpayers. All studies should focus on the societal viewpoint and make adjustments from that viewpoint for other decision-makers. It would be useful for all studies to present a reference case analysis as suggested by Gold *et al.* (1996).[44] Reference case analysis would provide standard strategies to conducting a study so that cross study comparisons can be made to enhance rational clinical and management decisions.

Among these studies, research designs vary a great deal. One approach uses cost–benefit analysis as a planning model and takes parameter estimates from literature review and programs themselves. Some cost–benefit studies use evaluation frameworks of effectiveness with short-term outcome data collection. The long-term nature of addiction often is not adequately addressed. Indeed, it is costly to track patients over the natural history with custom designed data collection, and this data collection is hampered by modest budgets for the analysis. Information management systems must be designed to do a better job of identifying and tracking patients for outcome and cost measurements. While methodological work has been done, more rigorous approaches must be applied to these non-experimental research designs. A review of standard cost–benefit analysis methods is available, but more work needs to be done as well as an expansion of new methods.[8]

This review uncovered striking areas of omission. There are no cost–benefit studies on adolescents and only one on women in treatment. This is particularly disturbing because of the potential to avert high social costs for these two groups, as well as heightened ethical concern for vulnerable groups. Cost–benefit analysis on comprehensive treatment services has not been performed, and this is a central issue to drug treatment. With new treatment guidelines developed under sponsorship of the Center for Substance Abuse Treatment, it is imperative to evaluate the cost–benefit implications. The research community is beginning to redress information gaps by adding a component of cost–benefit analysis to protocols involving treatment and services research.

A major problem in health economics is how to value changes in health, and cost–benefit analysis is the operational tool that develops and uses monetary measures to estimate such value changes. One valuation approach, the direct measurement of the willingness to pay for drug treatment, has not been estimated for the general population.[40,45] Theoretical and empirical research must proceed on various approaches for the assessment of the value of health change in our society, and drug treatment interventions are a critical focus for such research.[46] Furthermore, scientific efforts in valuation must be joined with efforts in understanding substance abuse/treatment dynamics.[47] Researchers must also come to grips with patient valuation of drug abuse treatment that is ignored in the reviewed studies.

All societies face the growing dilemma that resources are limited and must be allocated over various competing goals for health, consumption, and investment. In 18 cost–benefit studies, a persistent finding is that the benefit–cost ratio is greater than one. These findings are compromised by many studies with weak research designs. However, the benefits of drug abuse treatment are so robust that it appears that the conclusion of positive economic returns to society will stand as better studies are implemented. Further research should contribute to narrowing the range of such estimates through standardization of the estimates and the implementation of stronger research designs.

References

1. Cruze AM, Harwood HJ, Kristiansen P, Collins JJ, Jones DC. *Economic cost to society of alcohol and drug abuse and mental illness: 1977*. Research Triangle Park, NC: Research Triangle Institute, 1981.
2. Harwood HJ, Napolitano DM, Christensen PL, Collins, JJ *Economic costs to society of alcohol and drug abuse and mental illness: 1980*, report to the Alcohol, Drug Abuse, and Mental Health Administration. Research Triangle Park, NC: Research Triangle Institute, 1984.
3. Rice DP, Kelman S, Miller LS, Dunmeyer S. *The Economic Costs of Alcohol and Drug Abuse and Mental Illness: 1985*, DHHS Publication No. (ADM) 90–1694, Alcohol, Drug Abuse, and Mental Health Administration, 1990.
4. Harwood HJ, Fountain D, Livermore G. *The Economic Costs of Alcohol and Drug Abuse in the United States 1992*, report for the National Institute on Drug Abuse, NIH publication 98–4327. Washington, DC: Government Printing Office, 1998.
5. Rice DP, Kelman S, Miller LS. Estimates of economic costs of alcohol and drug abuse and mental illness, 1985–1988. *Public Health Rep.* 1991; **106** (3): 280–292.
6. French MT, Rachal JV, Hubbard RL. Conceptual framework for estimating the social cost of drug abuse. *J. Health Soc. Policy* 1991; **2** (3): 1–22.
7. French MT. Economic evaluation of drug abuse treatment programs: methodology and findings. *Am. J. Drug Alcohol Abuse* 1995; **21** (1): 111–135.
8. Cartwright WS. Cost–benefit and cost–effectiveness analysis of drug treatment services. *Eval. Rev.* 1998; **22** (5): 609–636.
9. French MT, Martin RF. The costs of drug abuse consequences: a summary of research findings. *J. Substance Abuse Treatment* 1996; **13** (6): 453–466.
10. Holder HD. Cost benefits of substance abuse treatment: an overview of results from alcohol and drug abuse. *J. Mental Health Policy Econ.* 1998; **1** (1): 23–29.
11. Holahan J. *The Economics of Drug Addiction and Control in Washington, DC: a Model for the Estimation of Costs and Benefits of Rehabilitation*, special report to the Office of Planning and Research, Department of Corrections, District of Columbia, 1970.
12. Leslie AC. *A Benefit/Cost Analysis of New York City's Heroin Addiction Problems and Programs*. New York: Health Services Program, 1971.
13. Maidlow ST, Berman H. The economics of heroin treatment. *Am. J. Public Health* 1972; **62** (10): 1397–1406.
14. McGlothlin WH, Tabbush VC, Chambers CD, Jamison K. *Alternative Approaches to Opiate Addiction Control: Costs, Benefits, and Potential*. Washington, DC: US Department of Justice, 1972.
15. McGlothlin WH, Tabbush VC. Costs, benefits, and potential for alternative approaches to opiate addiction control. In: Inciardi JA, Chambers CD eds. *Drugs and the Criminal Justice System* Beverly Hills, CA: Sage, 77–124, 1974.
16. Fujii ET. Public investment in the rehabilitation of heroin addicts. *Soc. Sci. Q.* 1974; **55**: 39–50.
17. Becker GS. Crime and punishment: an economic approach. *J. Polit. Econ.* 1968; **76** (2): 169–217.
18. Tullock G. The welfare cost of tariffs, monopolies, and theft *Western Econ. J.* 1967; **5**: 224–233.
19. Hannan TH. *The Economics of Methadone Maintenance*. Lexington: Lexington, 1975.
20. Rydell CP, Everingham SS. *Controlling Cocaine, Supply Versus Demand Programs*, Santa Monica: RAND, 1994.
21. Hannan TH. The benefits and costs of methadone maintenance, *Public Policy* 1976; **24** (2): 197–226.
22. Sirotnik KA, Bailey RC. A cost–benefit analysis for a multimodality heroin treatment project. *Int. J. Addictions* 1975; **10** (3): 443–451.
23. Levine D, Stoloff P, Spruill N. Public drug treatment and addict crime. *J. Legal Studies* 1976; **5** (2): 435–62.

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

24. Rufener BL, Rachal JV, Cruze AM. *Management effectiveness measures for NIDA drug abuse treatment programs. Vol. I: Cost benefit analysis*. Rockville, MD: National Institute on Drug Abuse, 1977.
25. Griffin KS. The therapeutic community: an exploratory cost benefit analysis. *Int. J. Ther. Communities* 1983; **4**: 3–10.
26. Tabbush V. *The effectiveness and efficiency of publicly funded drug abuse treatment and prevention programs in California: a benefit–cost analysis*. Los Angeles: Economic Analysis Corporation, 1986.
27. Harwood HJ, Hubbard RL, Collins JJ, Rachal JV. The costs of crime and the benefits of drug abuse treatment: a cost–benefit analysis using TOPS data. In: Leukfeld CG, Tims FM eds. *Compulsory treatment of drug abuse: research and clinical practice*, NIDA monograph No. 86. (pp. 209–235). Rockville, MD: National Institute on Drug Abuse, 1988.
28. Harwood HJ, Hubbard RL, Collins JJ, Rachal JV. A cost benefit analysis of drug abuse treatment. *JAI Press 1995 Res. Annu. Law Policy Studies*, 1995; **3**: 191–214.
29. Hubbard RL, Marsden ME, Rachal JV, Harwood HJ, Cavanaugh ER, Ginzburg HM. *Drug abuse treatment: a national study of effectiveness*. Chapel Hill, NC: University of North Carolina Press, 1989.
30. Mauser E, Van Stelle KR, Moberg DP. The economic impact of diverting substance-abusing offenders into treatment. *Crime Delinquency* 1994; **40** (4): 568–588.
31. Gerstein DR, Johnson RA, Harwood HJ, Fountain K, Suter N, Malloy K. *Evaluating recovery services: the California Drug and Alcohol Treatment Assessment (CALDATA) general report*. Sacramento, CA: California Department of Alcohol and Drug Programs, 1994.
32. Finigan M. *Societal outcomes and cost savings of drug and alcohol treatment in the state of Oregon*, report to the Office of Alcohol and Drug Abuse Programs, Department of Human Resources, Oregon, 1995.
33. Harwood HJ, Fountain D, Carothers S, Gerstein D, Johnson R. Gender differences in the economic impacts of clients before, during, and after substance abuse treatment. *Drugs Soc.* 1998; **13** (1/2): 251–269.
34. Flynn PM, Kristiansen PL, Porto JV, Hubaard RL. Costs and benefits of treatment for cocaine addiction in DATOS. *Drug Alcohol Dependence* 1999; **57**: 167–174.
35. Hartz DT, Meek P, Piotrowski NA *et al.* A cost–effectiveness and cost–benefit analysis of contingency-enhanced methadone detoxification treatment. *Am. J. Drug Abuse* 1999; **25** (3): 207–318.
36. Hubbard RL, French MT. New perspectives on the benefit–cost and cost–effectiveness of drug abuse treatment. In WS Cartwright, JM Kaple eds. *Economic costs, cost–effectiveness financing and community-based drug treatment*, NIDA monograph No. 113. (pp. 91–113). Rockville, MD: National Institute on Drug Abuse, 1991.
37. McLellan AT, Woody GE, Metzger D, McKay J *et al.* Evaluating the effectiveness of addiction treatments: reasonable expectations, appropriate comparisons. *Milbank Q.* 1996; **74** (1): 51–85.
38. Rufener BL, Rachal JV, Cruze AM. *Management effectiveness measures for NIDA drug abuse treatment programs. Vol. II: Costs to society of drug abuse*. Rockville, MD: National Institute on Drug Abuse, 1977.
39. French MT, Mauskopf JA, Teague JL, Roland J. Estimating the dollar value of health outcomes from drug abuse interventions. *Med. Care* 1996; **34** (9): 890–910.
40. Rajkumar AS, French MT. Drug use, crime costs, and the economic benefits of treatment. *J. Quant. Criminol.* 1997; **13** (3): 291–322.
41. French MT, Zarkin GA. Effects of drug abuse treatment on legal and illegal earnings. *Contemp. Policy Issues* 1992; **10**: 98–110.
42. French MT, Zarkin GA, Hubbard RL, Rachal JV. The effects of time in drug abuse treatment and employment on posttreatment drug use and criminal activity. *Am. J. Drug Alcohol Abuse* 1993; **19** (1): 19–33.
43. Richman A. Cost/effectivness analysis of alcoholism and drug abuse treatment programs: the relevance of recidivism and resource absorption, *Evaluation Program Planning* 1983; **6**: 49–52.
44. Gold MR, Siegel JE, Russell LB, Weinstein MC, eds. *Cost–effectiveness in health and medicine*. New York: Oxford University Press, 1996.
45. Johansson P-O. *Evaluating health risks, an economic appraoch*. Cambridge: Cambridge University Press, 1995.
46. Sindelar JL, Manning WG Jr. Cost–benefit and cost–effectiveness analysis: issues in the evaluation of the treatment of illicit drug abuse. In *Treating drug abusers effectively*, JA Egerston, DM Fox, AI Leshner eds. 187–221. Malden, MA: Blackwell, 1997.
47. Zarkin GA, French MT, Anderson DW, Bradley CJ. A conceptual framework for the economic evaluation of substance abuse interventions. *Evaluation Program Planning* 1994; **17** (4): 409–418.

Appendix. Cost–Benefit Analyses

Author	Study	Programs under evaluation	Design	Sample	Effectiveness assumptions
Holahan, 1970[11]	The Economics of Drug Addiction and Control in Washington, D.C.: a Model for Estimation of Costs and Benefits of Rehabilitation	Narcotic treatment administration (short-term commitment, methadone maintenance plus additional services	Benefit–cost planning model	None, based on author's judgements	Assumed success rate of 40% for one year. Assumed multi-period relapse rates and success rate for first period treatment failures
Leslie, 1971[12]	A Benefit/Cost Analysis of New York City's Heroin Addiction Problem and Programs, 1971	Detoxification Antagonists Methadone Odyssey House Increased enforcement Phoenix House Heroin maintenance State NACC Involuntary incarceration Heroin legalization	Benefit–cost planning model for New York City	None, Based on literature review and author's judgement	Assumed long-term success rates: Detoxification, .013 Antagonists, .50 Methadone, .75 Odyssey House, .54 Increased enforcmeent, .25 Phoenix house, .35 Heroin maintenance, .41 State NACC, .25 Involuntary incarceration, .62 Heroin legalization, .23

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)

Appendix. Continued

Author	Study	Programs under evaluation	Design	Sample	Effectiveness assumptions
Maidlow and Berman, 1972[13]	The Economics of Heroin Treatment	Methadone maintenance Therapeutic community	Benefit–cost planning model for US	None, based on literature review and author's judgement	Dropout rate is 17% in first year for TC. Relapse rate (TC / MM): Year 1: 0 / 3 Year 2: 0 / 2 Year 3: 0 / 2 Year 4: 0 / 2 Year 5: 9.4 / 2 Year 6: 9.4 / 0 Year 7: 9.4 / 0 Year 8: 9.4 / 0 Year 9: 0 / 0 Year 10 to 45: none
McGlothlin *et al.*, 1972[14]	Alternative Approaches to Opiate Addiction Control: Cost, Benefits, and Potential	Methadone maintenance—strict control Methadone maintenance—dispensing only Heroin maintenance Therapeutic community Civil commitment Civil commitment and other program	Benefit–cost planning model for US	None, based on literature review and author's judgement	The maximum potential years of addiction averted in the total addict population, taking into account treatment and incarceration. As addict years increase benefits and costs are adjusted.
Fujii, 1974[16]	Public Investment in the Rehabilitation of Heroin Addicts	Detoxification Civil commitment Imprisonment and parole Methadone maintenance Heroin maintenance Heroin legalization	Benefit–cost planning model for US	None, based on literature review and author's judgement	Relapse rates were taken from the literature and an exponential decay function was estimated. For detoxification, methadone maintenance and imprisonment and parole a 12 percent decay rate of relapse is estimated. For those in civil commitment, a 12 percent decay rate is used after the conclusion of parole supervision. Heroin maintenance and legalization require no assumption about relapse and decay rates.
Hannan, 1975[19]	The Economics of Methadone Maintenance	Methadone maintenance treatment programs	Pre–post treatment program data from New York City	931 male patients	10% dropout rate, and outcome change for 1 year and 6 years
Sirotnik and Bailey, 1975[22]	A Cost-Benefit Analysis for a Multi-Modality Heroin Treatment Project	Central intake Therapeutic community Halfway house Detoxification Methadone maintenance	Pre–post outcome, no control	$N = 285$ heroin addicts who were treated for at least one day from 1 July 1971 to 31 December 1972 Only 25 in follow-up	Frequency of heroin use Cost of daily use Number of drug free weeks after treatment Number of drug free weeks after treatment Proportion of illegally obtained dollars to support heroin use
Levine *et al.*, 1976[23]	Public Drug Treatment and Addict Crime	Public treatment programs, methadone	Natural experiment of four year expansion of Detroit programs	Monthly public patient enrolment from 1970 to 1974	Regression coefficient on enrolment variable (–.23) with property crime in Detroit as dependent variable

 J. Mental Health Policy Econ. **3**, 11–26 (2000)

Appendix. Continued

Author	Study	Programs under evaluation	Design	Sample	Effectiveness assumptions
Rufener *et al.*, 1977[24]	Management Effectiveness Measures for NIDA Drug Treatment Programs	Outpatient drug free Outpatient detoxification Inpatient detoxification Methadone maintenance Therapeutic community	CB and CE with pre-and-post comparison using DARP data. One year calculation	Used DARP and economic cost study of drug abuse	In CEA, the number of days gained for each modality for opiate free days, non-opiate free days, days of legitimate support, days of legitimate employment In BCA, the elapse rate of 12 percent was used from Fujii. Benefits are adjusted for relative program effectiveness with the DARP data on outcomes
Griffin, 1983[25]	The Therapeutic Community: a Cost–Benefit Analysis	Therapeutic community	Hypothetical five year program data.	Literature review, local data, Pennsylvania state data	Success rate of .67 per year or 10 patients per year in Gardenzia house
Tabbush, 1986[26]	The Effectiveness and Efficiency of Publicly Funded Drug Abuse Treatment and Prevention Programs in California: a Benefit–Cost Analysis	Residential Methadone Outpatient	Cost–benefit planning model of California data during and post-treatment benefits	Literature review, California criminal justice and program data	Residential success rate of 83 percent Outpatient success rate of 64 percent
Harwood *et al.*, 1988[27]	The Costs of Crime and the Benefits of Drug Abuse Treatment: a Cost–Benefit Analysis Using TOPS	Residential treatment Outpatient methadone Outpatient drug free	Comparison of individual pre-, during and post-treatment using TOPS data and regression adjustment of after treatment crime benefits	Prospective study of 11 000 drug users, from 41 programs and 10 cities. Non-random sample	Effectiveness measures based on outcomes of criminal behavior counts and the national estimate of the average cost per count
Hubbard *et al.*, 1989[29]	Drug Abuse Treatment: a National Study of Effectiveness				
Mauser *et al.*, 1994[30]	The Economic Impact of Diverting Substance Abuse Offenders into Treatment	Treatment Alternatives Program consisting of case management assessment and referrals, coordinate care, monitor compliance. Mainly outpatient and day treatment	Pre–post outcome, no control	$N = 76$, clients admitted to program from June 1990 through May 1991	Criminal justice costs productivity losses Cost of health services not related to addiction. Cost–effectiveness measured on per jail day saved
Gerstein *et al.*, 1994[31]	Evaluating Recovery Services: the California Drug and Alcohol Treatment Assessment	Residential programs Social model Outpatient programs Outpatient methadone	Pre–post treatment comparison of patients. Follow-up survey conducted on average 15 months after treatment	3 stage random sampling: 16 counties, 110 providers, 3055 patients, 1859 interviewed	Outcome measures for drug and alcohol, criminality, health and health care utilization, employment and income
Finigan, 1995[32]	Societal Outcomes and Cost Savings of Drug and Alcohol Treatment in the State of Oregon	State substance abuse programs	Pre–post with non-random comparison group	Random sample drawn from 1991–1992 fiscal year from outpatient and residential patients. All methadone patients were included	Outcome measures in three year period after treatment for arrests, incarceration, convictions, earnings, food stamps, children's services, medical costs and emergency room visits and costs

Appendix. Continued

Author	Study	Programs under evaluation	Design	Sample	Effectiveness assumptions
Harwood *et al.*, 1998[33]	Gender Differences in the Economic Impacts of Clients Before, During, and After Substance Abuse Treatment	Residential programs Social model Outpatient programs Outpatient methadone	Pre–post treatment comparison of patients. Follow-up survey conducted on average 15 months after treatment	3 stage random sampling: 16 counties, 110 providers, 3055 patients, 1859 interviewed	Outcome measures for drug and alcohol, criminality, health and health care utilization, employment and income
Flynn *et al.*, 1999[34]	Costs and Benefits of Treatment for Cocaine Addiction in DATOS	Long-term residential Outpatient drug free	Pre–post comparison of patients Follow-up survey at 12 months after discharge	Naturalistic and non-experimental sample of 502 patients in 19 programs	Outcome measures collected from pre-, during, and post-treatment for illegal acts
Hartz *et al.*, 1999[35]	A Cost–Effectiveness and Cost–Benefit Analysis of Contingency Contracting-Enhanced Methadone Detoxification Treatment	Methadone detoxification and treatment	Comparison of standard treatment to contingency contracting enhancement	Randomization of 102 opioid addicted patients into two arms of trial	Outcome measures for urine samples, alcohol samples and health care utilization over 120 days of episode for 45 patients

Published in 2000 by John Wiley & Sons, Ltd. *J. Mental Health Policy Econ.* **3**, 11–26 (2000)