OUTPATIENT MARIJUANA TREATMENT FOR ADOLESCENTS

Economic Evaluation of a Multisite Field Experiment

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An economic evaluation of five outpatient adolescent treatment approaches (12 total site-by-conditions) was conducted. The economic cost of each of the 12 site-specific treatment conditions was determined by the Drug Abuse Treatment Cost Analysis Program (DATCAP). Economic benefits of treatment were estimated by first monetizing a series of treatment outcomes and then analyzing the magnitude of these monetized outcomes from baseline through the 12-month follow-up. The average economic costs ranged from $90 to $313 per week and from $839 to $3,279 per episode. Relative to the quarter before intake, the average quarterly cost to society for the next 12 months (including treatment costs) significantly declined in 4 of the 12 site-by-treatment conditions, remained unchanged in 6 conditions, and increased in 2 treatment conditions (both in the same site). These results suggest that some types of substance-abuse intervention for adolescents can reduce social costs immediately after treatment.

Keywords: *benefit-cost analysis; adolescent cannabis use; addiction treatment*

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Cannabis use (including marijuana, hashish, and other tetrahydrocannabinol [THC]-containing products) has received considerable attention by policy makers and researchers in the United States because it continues to be the most widely used and treated illicit drug in the nation. Based on data from the 2000 U.S. National Household Survey on Drug Abuse (Epstein 2002), 2.8 million (3.3%) of American adolescents met criteria in the past year for cannabis dependence (1.6 million) or abuse (1.2 million). Such cannabis disorders are associated with higher rates of emergency room admissions, health problems, emotional problems, family problems, legal problems, and violence. Cannabis is now the most commonly reported illicit substance cited in adolescent substance-abuse treatment admissions, emergency room admissions, and autopsies (e.g., Dennis, Babor, et al. 2002; Dennis and McGeary 1999). Evidence suggests that only 1 in 10 adolescents in need of substance-abuse treatment actually receives any services. For those who do enter treatment, payment sources include (not mutually exclusive) family (63%), public funding (59%), private health insurance (24%), court programs (14%), civilian employers (8%), and military/veteran programs (6%) (Clark et al. 2002). About 80% of these adolescents are seen in outpatient treatment, 50% are in treatment for 6 weeks or less, and 80% are in treatment for 90 days or less (Dennis et al. 2003; Hser et al. 2001).

Despite the widespread social consequences and costs of cannabis use and the overwhelming need for expanding effective treatment, little research has examined the economic costs and benefits to society of treatment for cannabis disorders, particularly those of short-term outpatient settings, which represent the modal care for cannabis abusers. We know of no study to date that has examined the association between such treatments and reductions in cost to society overall or relative to other treatments. To address these and other research gaps, the Cannabis Youth Treatment (CYT) study was launched in 1997. CYT is the largest randomized field experiment ($N = 600$) of adolescent cannabis users, the first to include rigorous economic cost and benefit estimates, and relatively unique in terms of its high follow-up rate (more than

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90% in quarterly waves through 12 months) and its inclusion of follow-up measures that can be valued in economic terms.

Previous reports described the research design (Dennis, Babor, et al. 2002), clinical interventions (Diamond et al. 2002), and outcomes (Dennis, Titus, et al. 2002) of CYT. The primary purpose of this article is to present the findings of a benefit-cost analysis of the five interventions as implemented in the four CYT sites. In the following section, a brief review of the literature indicates a need for economic evaluations of adolescent treatment. The literature review is followed by a summary of the CYT study design and the methodology used for the benefit-cost analysis. Next, cost and benefit estimates are presented by treatment condition (both by site and overall). This is followed by a comparison of the relative effectiveness of the interventions and a random-effects regression analysis of treatment benefits over time and by arm to evaluate other client and treatment factors that might be related to the costs of drug-abuse consequences. In the Discussion section, the results are interpreted and compared with the existing literature on the economic costs and benefits of adult substance-abuse treatment programs. Finally, limitations, future directions, and policy implications are addressed.

BACKGROUND

OVERVIEW OF ECONOMIC EVALUATIONS

Significant advances have been made in adolescent drug-abuse treatment in the past two decades, yet the adolescent drug abuse treatment field lags behind the adult substance-abuse treatment field in examining economic questions. Little is known about the economic costs or benefits of adolescent substance abuse or treatment, despite numerous published studies on adult programs (e.g., Barnett, Zaric, and Brandeau 2001; French, Dunlap, et al. 1997; French and McGeary 1997; French, Salomé, et al. 2000, 2002; French, Salomé, and Carney 2002; French, McCollister, Sacks, et al. 2002; French, McCollister, Cacciola, et al. 2002; Zarkin et al. 2001). One notable economic study of adolescent treatment examined the costs and effectiveness of a multisystemic intervention with a sample of juvenile offenders who met the diagnostic criteria for substance abuse/dependence (Schoenwald et al. 1996). This study compared the incremental costs of multisystemic therapy, an intensive in-home community- and family-based treatment approach, to those of the commonly utilized outpatient substance-abuse services of a local state agency. They related these treatment costs to reductions in days of incarceration, hospitalization, and residential treatment 1-year postreferral. Multisystemic therapy significantly reduced adolescents' involvement with the legal system within 6 months of the intervention, and this decrease was not offset by an increase in the use of other out-of-home placements.

In the current sociopolitical climate of accountability, researchers and providers are justly being asked to determine the economic effect of adolescent interventions. Because young adults bring unique needs to the therapeutic process, separate economic evaluations of adolescent addiction interventions are warranted. Such studies are also timely, given the national debate over whether to include adolescent substance-abuse treatment benefits under the Children's Health Insurance Program (CHIP) (see Center for Substance Abuse Treatment 1999; Dennis, Godley, and Titus 1999; Dennis and McGeary 1999).

Economic evaluation of substance-abuse treatment is an evolving science with a collection of different techniques and methodologies (e.g., Cartwright 1998, 2000; Drummond et al. 1997; French 1995, 2000). Any full, proper economic evaluation must include an assessment of the costs of treatment delivered. Accounting costs of treatment services typically include money spent to operate a program (e.g., personnel, supplies) and depreciation of equipment and facilities, whereas economic costs are the value of all resources used in the treatment process, including resources received either in-kind or at below-market rates (i.e., opportunity costs) (Salomé and French 2001). It should be noted, however, that reimbursement rates for treatment services are often set by government agencies or managed care organizations and may be unrelated to either accounting or economic costs of individual programs.

In addition to defining costs, it is important to emphasize that the perspective one takes in estimating treatment costs can dramatically affect the results. For example, the cost to the employer (e.g., treatment provider) of an unpaid volunteer worker (e.g., graduate student) is zero. However, from the point of view of society, which includes the graduate student worker, the opportunity cost is equal to the amount the person could have earned elsewhere (i.e., the resource's next highest and best use). Because the affect of drug abuse is felt broadly, economic evaluation of drug-abuse treatment is generally conducted from the comprehensive societal perspective (Drummond et al. 1997; French 2000; Gold et al. 1996).

The Drug Abuse Treatment Cost Analysis Program (DATCAP) applies the economic (opportunity) cost approach to determine the cost of treatment for an entire program or modality (French 2001a, 2001b) (www.DATCAP.com). The DATCAP yields statistics such as the total annual opportunity cost of treatment and the labor cost per client, each pertaining to a single treatment program during a particular fiscal year. To date, the DATCAP has been administered at more than 70 adult programs, ranging from intensive residential modalities to methadone maintenance and outpatient drug-free programs (e.g., Bradley, French, and Rachal 1994; Bray et al. 1996; French et al. 1994; French, Dunlap, et al. 1996, 1997; French and McGeary 1997; McCollister and French 2002; Salomé and French 2001). The DATCAP has made important contributions to the addiction-treatment evaluation literature by providing reliable and comparable cost estimates for numerous treatment modalities and programs (Roebuck and French 2002).

Once economic costs have been identified, they can be paired with appropriate outcome data for more advanced analyses such as cost-effectiveness and benefit-cost studies (Barnett, Zaric, and Brandeau 2001; Drummond et al. 1997; French 2000; French, McCollister, Sacks, et al. 2002; French, McCollister, Cacciola, et al. 2002; French, Salomé, et al. 2000, 2002; French, Salomé, and Carney 2002; Gold et al. 1996; McCollister et al. forthcoming; Zarkin et al. 2001). Cost-effectiveness analysis compares the incremental opportunity cost of a project to the incremental nonmonetary health outcome, such as "quality-adjusted life-years saved" or "cases of disease avoided," which is common to competing projects (Barnett et al. 2001; Drummond et al. 1997; Gold et al. 1996; Zarkin et al. 2001). A major barrier to using cost-effectiveness analysis in substance-abuse treatment research has been the lack of a single focal outcome and the multidimensionality of occurring outcomes. Benefit-cost analysis compares the opportunity cost of an intervention to its total benefit, while expressing both in a common monetary metric. Benefit-cost measures often include a benefit-cost ratio (i.e., benefit divided by cost) or simply a net benefit estimate (i.e., cost subtracted from benefit). In this sense, an intervention is usually considered cost beneficial, and from an economic point of view, scarce resources are being used efficiently if the benefit-cost ratio exceeds unity or if net benefit is positive. Benefit-cost analysis is applied less frequently than cost-effectiveness analysis but is more comprehensive and has a broader spectrum of applications (Kenkel 1997).

The differences between cost-effectiveness analysis and benefit-cost analysis are fundamental. Benefit-cost analysis may be preferred to cost-effectiveness analysis when diverse outcomes of the treatment intervention need to be included and programs with different goals or effects must be compared (Rundell and Paredes 1979; Sindelar and Manning 1997; Swint and Nelson 1977). Furthermore, benefit-cost analysis may be more appropriate when outcomes beyond those of the patients' perspective need to be quantified (Drummond et al. 1997). A detailed description of economic evaluation techniques is beyond the scope of this article. However, several useful works on economic evaluation methods for the health care industry are available for further consultation (e.g., Drummond et al. 1997; French 1995, 2000; Gold et al. 1996; Johanneson 1996; Lave and Satish 1996; Tolley, Kenkel, and Fabian 1994; Yin and Forman 1995; Zarkin et al. 1994). Regardless of which type of analysis is performed, the process of identifying and estimating the economic costs and benefits for the CYT study provides critical economic information on different substance-abuse treatment approaches for adolescents.

OVERVIEW OF CYT DESIGN

As part of the Secretary of Health and Human Service's Youth Initiative (Health and Human Service Press Office 1998), the Center for Substance Abuse Treatment (CSAT) implemented the CYT study to (a) identify promising short-term outpatient approaches to treating cannabis abuse among adolescents from research, best practices, and/or expert consensus panels; (b) adapt these approaches for use in actual practice; (c) evaluate their effectiveness, cost, and economic effect; and (d) explore how well they work with different subgroups of adolescents and in different programs/environments (Dennis, Titus, et al. 2002). The CYT study is the largest experimental study of outpatient adolescent treatment to date ($N = 600$ adolescents and their families), representing a collaboration between CSAT, two large adolescent treatment providers (Chestnut Health Systems in Illinois, and Operation PAR in Florida), and two of the nation's major medical centers (University of Connecticut Health Center and Children's Hospital of Philadelphia). The study manualized and evaluated five promising approaches to outpatient treatment for adolescents who use marijuana, alcohol, and some limited amount of other drugs. These treatments (described in the next subsection) varied in terms of total resources used and approach.

In the so-called incremental arm of the study, CYT started with a brief intervention (five sessions over 6 to 7 weeks) consisting of two initial individual sessions followed by three group sessions. CYT examined the effect of adding seven group sessions to the brief intervention (12 to 13 weeks total) to form the second intervention of the incremental arm. The third intervention of the incremental arm added family treatment to the second intervention (12 to 13 weeks total).

In the so-called alternative arm, CYT started with the same five-session/ 6- to 7-week brief intervention. Instead of adding more treatment/resources to the existing dosage, however, two treatment alternatives were employed: a 12- to 13-week individual counseling approach and a 12- to 13-week integrated family counseling approach. Although these two alternative interventions were increased dosages (beyond the brief intervention) in terms of duration and sessions, both required less weekly contact time and resources on average relative to the brief intervention.

In each arm, three interventions were replicated at two sites (one of the large adolescent providers and one of the medical centers). Within each site, eligible adolescents were randomized to one of the arm's three conditions. Thus, treatments can be compared experimentally within arm or quasi-experimentally across arms (for a further discussion of this issue, see Dennis, Titus, et al. 2002).

Adolescents were recruited from schools, the juvenile justice system, and the normal caseflow for outpatient treatment in these agencies. To be included in CYT, the adolescents had to (a) be between the ages of 12 and 18, (b) meet one or more lifetime criteria for *DSM-IV* (American Psychiatric Association 1994) diagnosis of cannabis abuse or dependence, (c) have used marijuana in the past 90 days (or 90 days prior to being in a controlled environment), and (d) meet the American Society of Addiction Medicine (1996) patient placement criteria for level I (outpatient) or level II (intensive outpatient). For safety and logistical reasons, participants were excluded if they met any of the following criteria: (a) used alcohol 45 or more of the 90 days prior to intake (or prior to being in a controlled environment, where relevant); (b) used other drugs 13 or more of the 90 days prior to intake (or prior to being in a controlled environment, where relevant); (c) had an acute medical condition that required immediate treatment or was likely to prohibit full participation in treatment; (d) had an acute psychological condition that required immediate treatment and/or was likely to prohibit full participation in treatment; (e) appeared to have insufficient mental capacity to understand the consent and/or participate in treatment; (f) were living outside the program's catchment area or expected to move out within the next 90 days; (g) had a history of violent behavior, severe conduct disorder, predatory crime, or criminal justice system involvement that was likely to prohibit full participation in treatment (e.g., pending incarceration); (h) lacked sufficient ability to use English to participate in treatment; (i) had a significant other (usually a parent) who lacked sufficient ability in English to understand the collateral consent form and participate in research assessments and potentially in treatment; and/or (j) had previously participated in the study. Participants were not excluded just because they had an alcohol or other substance diagnosis, co-occurring mental disorder, nontraditional family structure, or were bilingual. Participation was voluntary, under the supervision of local institutional review boards, and protected under a federal certificate of confidentiality.

The first CYT subject was recruited in June 1998, and the last 12-month follow-up assessment was completed in February 2001. The economic cost data were collected during the middle 6 months (January 1 to June 30, 1999) of the CYT study to minimize the effect of start-up or wind-down costs (for a further discussion of this issue, see French, Roebuck, et al. 2002).

OVERVIEW OF CYT INTERVENTIONS

Each of the interventions was guided by a published manual, and we have previously published detailed comparisons of their components, actual dosage, and costs (Diamond et al. 2002; French, Roebuck, et al. 2002). What follows is a brief summary of each intervention.

Motivational enhancement treatment/cognitive behavior therapy, 5 sessions (MET/CBT5) (Sampl and Kadden 2001). The primary goals of this treatment are to enhance participants' motivation to change their marijuana use and develop necessary basic skills to achieve abstinence or gain control over their marijuana use. The first and second individual sessions employ the MET approach and concentrate on enhancing motivation and identifying high-risk situations that may increase the likelihood of relapse. A therapist explores an individual participant's reasons for seeking treatment, prior treatment/quit attempts, goals, self-efficacy, readiness for treatment, and problems associated with marijuana use. A personal feedback report compares the participant's marijuana use and related problems to national norms. In all sessions, the therapist reinforces any indications of motivation to change. The three subsequent CBT group sessions teach participants basic skills for refusing offers of marijuana, establish a social network supportive of recovery, and develop a plan for pleasant activities to fill free time formerly spent engaging in marijuana-related activities. These sessions also address strategies for coping with unanticipated high-risk situations, problem solving, and relapse prevention. Delivered at all four sites, MET/CBT5 is designed to resemble what many parents and insurers seek as a basic, first-tier intervention for low-severity adolescent marijuana abusers.

Motivational enhancement treatment/cognitive behavior therapy, 12 sessions (MET/CBT12) (Webb et al. 2002). MET/CBT12 combines the first 5 sessions of MET/CBT5 with 7 additional sessions of cognitive-behavioral therapy, thus providing a higher dose of treatment than MET/CBT5 alone. The primary goals of this treatment are to enhance participants' motivation to change their cannabis use and to develop coping skills for dealing with events and personal situations that, by past association, become functional cues or reinforcers for cannabis use. MET/CBT12's first 5 sessions are identical to those for MET/CBT5. Seven additional group sessions teach adolescents coping skills in place of cannabis use as an alternative response to interpersonal problems, negative affect, and psychological dependence. Group sessions address problem solving, anger awareness, anger management, communication, resistance to craving, depression management, and management of thoughts about marijuana. With its longer duration and greater breadth, MET/CBT12 is closer in process and content to most adolescent treatment programs.

Family support network (FSN) (Hamilton et al. 2001). The FSN is an intensive, family-focused approach designed to improve family engagement, cohesion/closeness, parenting skills, and parental support, which are presumed to increase the likelihood of both initial and sustained change. Designed to wrap these additional services around the MET/CBT12 therapy over a 12-week period, the FSN is composed of case management (to promote parent engagement in the treatment process), 6 parent education group meetings (to improve parent knowledge and skills relevant to adolescent problems and family functioning), 4 therapeutic home visits, and referral to self-help support groups. These additional services are designed to affect several external factors, including (a) helping staff gain a better understanding of the adolescent's home/family environment; (b) providing the parent(s) with knowledge about problems and skills and how to deal with them; (c) bringing the family into the treatment process rather than having treatment remain external to the family; (d) tailoring home visits to fit the family's specific home situation; (e) supplying links with ongoing groups for providing parents with social/emotional support; and (f) helping the family deal with the logistical issues related to coming to treatment. The FSN provides a more comprehensive treatment model in line with CSAT *Treatment in Protocol Series* (Center for Substance Abuse Treatment 1992, 1993).

Adolescent community reinforcement approach (ACRA) (Godley et al. 2001). ACRA's primary focus is helping the adolescent identify reinforcers incompatible with drug use and rearranging environmental contingencies so that abstinence from marijuana becomes more rewarding than use. The program is a modification of the Community Reinforcement Approach (CRA) that was initially developed for the treatment of adult alcoholics (Meyers and Smith 1995). The ACRA modifications address the special issues and needs of adolescents. The ACRA is composed of 10 individual sessions with the adolescent and 4 meetings with caregivers. Two of the caregiver sessions are with the caregiver(s) only, and 2 are with both the adolescent and caregiver. Mediating variables targeted by the ACRA include (a) treatment participation, (b) increased motivation to quit, (c) awareness of the link between behavior and use, (d) increased engagement in prosocial activities, (e) improved problem-solving skills, (f) improved communication skills, and (g) a relationship between the adolescent and caregiver that is improved and more supportive of abstinence.

Multidimensional family therapy (MDFT) (Liddle 2002). MDFT is an intensive, family-focused, developmental, ecological, multiple systems approach for treating adolescent substance abuse. The model targets adolescent and parent individual functioning, family interaction patterns, and the extended social system (Liddle 1999). MDFT is composed of 12 to 15 family-focused treatment sessions over the course of 12 weeks. In addition to family sessions, time is spent alone with the adolescent and parent(s) and supplemented with phone contact for the purpose of engagement, reworking treatment themes, and case/crisis management. MDFT attempts to improve the adolescent's cognitive states (e.g., perceived harmfulness of drugs), emotional regulation/distress (e.g., expression of anger, depression), and perceived role in the family/peer network. MDFT emphasizes establishing multiple therapeutic alliances with improved communication between the adolescent, parent(s), other family members, and others outside the family via several specific tasks (e.g., relationship formation, agenda establishment, definition of change and motivation to attempt it, renewal of parents' connection to the adolescent or vice versa, conflict-resolution skills, developing authoritative parenting style). It also targets behavior improvement (e.g., school attendance), peer network (e.g., identification of prosocial activities), parental distress (e.g., depression or marital conflict), parenting practices (e.g., behavior management, attachment to the adolescent), and the influences of other social systems (e.g., school, juvenile justice, work). MDFT is a multisystemic treatment approach broadly targeted at changing the individual's relationships with family, peers, and social systems.

COORDINATING CENTER AND TREATMENT SITES

Chestnut Health Systems, Coordinating Center (CHS-CC). Chestnut Health Systems is a privately held, nonprofit organization. Based out of its Bloomington and Chicago offices, the CYT Coordinating Center was supported by subcontracts to the University of Connecticut for oversight of the MET/CBT5 intervention and to the University of Miami for conducting the economic analyses. In addition, the CHS-CC site was responsible for the operation of the Web site, data management, and reporting for the entire CYT consortium. Although it did not directly deliver treatment in the study, the CC (via the University of Connecticut subcontract) was responsible for the supervision of the MET/CBT5 condition and its associated costs.

University of Connecticut Health Center (UCHC). UCHC is located at the University of Connecticut in Farmington, Connecticut, 10 miles from the city of Hartford. For more than 25 years, UCHC—a large, public, nonprofit organization—has been an active center of research and development for addiction treatment, clinical subtyping, and assessment technologies for the treatment of substance-use disorders. The UCHC CYT treatment site recruits from juvenile/adult court-affiliated offices, youth service organizations, and schools located within a 20-mile radius of the health center.

Operation PAR, Inc. (PAR). Operation PAR is the largest community-based treatment provider in the state of Florida and the state's largest adolescent treatment provider. Serving participants from the St. Petersburg area and/or recruits from the county's juvenile justice assessment center (a secure facility, operated by Operation PAR, Inc.), Operation PAR offers a full range of accredited programs for both adolescent and adult outpatient and inpatient care. The organization operates as a private, nonprofit entity.

Chestnut Health Systems, Madison County, Illinois (CHS-MC). Operated by Chestnut Health System's Adolescent Services Program, CHS-MC serves a catchment area of more than 800 square miles in the northeast corner of the St. Louis metropolitan area that includes all of Madison County and East St. Louis. Chestnut Health Systems is one of the largest community-based substance-abuse treatment providers in Illinois and the state's largest adolescent provider. It offers a full range of accredited adolescent substance-abuse treatment services, including prevention, early intervention, outpatient, intensive outpatient, day treatment, and residential treatment. Staff provide services and commute between facilities located in both Granite City and Maryville (30 miles apart). CHS-MC's financial structure is private and nonprofit.

Children's Hospital of Philadelphia (CHOP). The Children's Hospital of Philadelphia primarily serves participants from Philadelphia's inner city. CHOP is a leading pediatric care hospital providing a full range of inpatient and outpatient medical and psychiatric services. The CYT program operated by CHOP was housed within the Child, Adolescent, and Family Treatment Unit, which is a program in the Department of Psychiatry. Organizationally large, CHOP maintains a private, nonprofit financial structure.

METHODS

INSTRUMENTATION

Drug Abuse Treatment Cost Analysis Program (DATCAP). The DATCAP is a data-collection instrument and interview guide designed to measure both the accounting and opportunity costs of a substance-abuse treatment program based on standard economic principles (French 2001a, 2000b) (www.DATCAP.com). Now widely used by several different types of service providers, the DATCAP is appropriate for economic cost evaluation of most treatment modalities in most social service settings. The instrument is intended to collect and organize detailed information on resources used in service delivery and their associated costs. Resource categories include personnel, supplies and materials, contracted services, buildings and facilities, equipment, and miscellaneous items. In addition, the DATCAP gathers data on program revenues and client caseflows. Administration of the DATCAP is generally a collaborative effort involving an economist and various members of the treatment program's staff (e.g., administrators, therapist coordinators, and accounting/finance personnel). Despite the growing list of DATCAP studies, the CYT project represents the first time the instrument has been used to estimate the economic cost of adolescent substance-abuse treatment.

Service contact logs (SCLs). SCLs were developed specifically for each intervention. Each log contained the same basic components describing who, when, where, and what was done throughout the interventions, but codes for intervention components were specific to each intervention. SCLs were completed daily by all therapists involved in the study to ensure that each session held with a client and/or a family member was documented. These data were collected and maintained by CHS-CC on an ongoing basis.

Global Assessment of Individual Needs (GAIN). The core intake and follow-up (i.e., 3, 6, 9, and 12 months postintake) data used in this article come from the Global Appraisal of Individual Needs (GAIN) (Dennis 1999; Dennis, Titus, et al. 2002), a standardized clinical assessment that has been normed on both adults and adolescents (Dennis, Scott, et al. 1999, 2000). The GAIN has the following eight main sections: background, substance use, physical health, risk behaviors, mental health, environment, legal, and vocational. It provides more than 100 symptom, change score, and utilization indices and is designed to map onto American Society of Addiction Medicine, *DSM-IV*, and several public data sets. In both this and other data sets with adolescents and adults, outpatient and inpatients, the GAIN's main scales have alphas over .9, the subscales have alphas over .7, and the test-retest on core measures of change have alphas of .7 to .9 (Dennis, Babor, et al. 2002; Dennis et al. 2003; Dennis, Scott, and Funk forthcoming; Dennis, Scott, et al. under review). In a meta-analysis of 2,968 adults and adolescents entering substance-abuse treatment in 61 clinics in 17 cities, the GAIN produced a stable four-factor solution (substance problems, internal distress, external behavior problems, crime/violence) with a second-order factor (general severity) that was invariant across level of care and age (comparative fit index of .97 constrained vs. .98 unconstrained; root mean square error of approximation of .04 vs. .04) (Dennis, Scott, et al., under review). Self-reported substance use on the GAIN in this sample was consistent with collateral reports ($\kappa = .92$), on-site urine tests ($\kappa = .81$), and GCMS confirmation ($\kappa = .90$). Diagnoses based on the GAIN have been shown to have good test-retest reliability for substance-use disorders ($\kappa = .6$ to .7) (Dennis, Babor, et al. 2002; Dennis et al. forthcoming) and to accurately predict independent and blind staff psychiatric diagnoses of co-occurring psychiatric disorders, including attention deficit/hyperactivity disorder (ADHD) ($\kappa = 1.00$), mood disorders ($\kappa = .85$), conduct disorder/oppositional defiant disorder ($\kappa = .82$), adjustment disorder ($\kappa = .69$), or the lack of a nonsubstance-use diagnosis ($\kappa = .91$) (Shane, Jasiukaitis, and Green forthcoming). Self-reported data from the GAIN has been found to be largely consistent with agency records ($r = .78$) (Godley et al. 2002).

Specifically for this article we validated our core quarterly cost to society measure by comparing the value based solely on reports from the adolescent with estimates based solely on reports from a parent or other collateral over the first three data collection waves (collaterals were not interviewed at 9 or 12 months). Although the distributions were right skewed, they were largely consistent at intake (Spearman's rho = .56; Cohen's [1988] effect size $d = -.13$), 3 months ($\rho = .55$, $d = -.09$), and 6 months ($\rho = .53$, $d = .10$).

DATA COLLECTION PROCEDURES

Shortly after the start of the CYT study, principal investigators and other program personnel were issued copies of the *DATCAP User's Manual* (French 2001b) and the DATCAP program instrument (French 2001a). After taking adequate time to review these materials, DATCAP collaborators participated in several conference calls with health economists from the University of Miami to formulate strategies for preliminary data collection and to answer questions regarding completion of the DATCAP. Generally, program personnel were offered guidance as to the type and source of information to gather for administration of the DATCAP. When all four treatment sites had reached a relatively stable point in their client randomization and treatment processes, they were asked to make an initial attempt at completing a separate DATCAP questionnaire for each of the therapies they were administering at their respective CYT study sites. Two study arms, each with three treatment approaches, were implemented in two sites. Thus, a total of 12 DATCAPs were completed.

Although the DATCAP is intended to cover a full fiscal year, the 6-month time frame ending June 30, 1999, was selected as the period of study. This half-year window was necessary to minimize the inclusion of costs associated with the start-up and wind-down of subject randomization and other research-specific activities. Furthermore, for comparability with other treatment programs, investigators were also instructed to exclude all costs attributed to the research component of the study. Finally, because some interventions involved shared resources across two or more sites, program personnel were instructed to estimate cross-site costs according to how they were consumed. For example, if the therapist coordinator for a certain treatment intervention contributed 20% time (i.e., 8 hours per week) supervising a counselor at another site via telephone, then 20% of the cost of the therapist coordinator would be allocated to the remote site for that therapy.

After preliminary DATCAPs were completed, a health economist (the second author) from the University of Miami's Health Services Research Center visited each of the treatment sites. The purpose of the site visits was to tour the facilities and observe the intervention processes to ensure that all resources were properly accounted for in the economic cost analysis. Program personnel were questioned about their level of effort (i.e., time) on each of the respective therapies. Physical office space was measured and allocated to the intervention it served. Equipment costs were determined based on the percentage of time a unit was used by each therapy. Preliminary DATCAPs were reviewed for quality and consistency.

Following the site visits, the CYT-CC computed average weekly census and length of stay measures from the SCL database. These measures are critical in determining the average weekly and episode costs of treatment and in ensuring consistency across sites. They were calculated as follows:

- Average weekly census (i.e., average active caseload) was calculated as the average number of clients that participated in treatment during the weeks from January 1 to June 30, 1999.

- Client length of stay (i.e., weeks retained in treatment) was calculated as the number of weeks in treatment for each client from the baseline assessment to the last service received.

After completion of all 12 DATCAPs, hard-copy data were entered into a Microsoft Excel (version 2000) spreadsheet designed specifically for the DATCAP instrument and the cost analysis. This spreadsheet program employs economic principles and cost-calculation techniques (e.g., Drummond et al. 1997) to generate a 2-page results summary. The summary document reports the total accounting and economic costs, average weekly cost (per client), average cost per treatment episode, and total cost distributed across resource categories.

To measure client characteristics and treatment outcomes, the GAIN was administered at the following five different times throughout the study: intake, or assignment to treatment, and 3, 6, 9, and 12 months postintake. The outcome measures at each assessment point correspond to the prior 3 months. Thus, for those subjects who completed all assessments, continuous data are available over 15 months, beginning 3 months prior to study assignment and ending 12 months after intake. Of the 600 adolescents randomized, follow-up interviews were completed with 98% of the participants at 3 months, 97% at 6 months, 96% at 9 months, and 94% at 12 months (with 85% completed within ±1 week of their target dates) (for more details, see Dennis, Babor, et al. 2002).

COST ESTIMATION

As noted earlier, all economic cost estimates were generated through analysis of data collected with the DATCAP.[1] The DATCAP results were developed and presented for each of the CYT interventions by treatment delivery site. Although accounting costs are reported along with economic costs (see Table 2), they generally differed by just 2% to 10%, so only the latter estimates are discussed in the body of this article because they are the most important estimates for the full economic evaluation and the societal perspective we are using. Cost estimates are presented by condition and by site. For each intervention, all aggregate costs were summed across sites, as were average weekly census estimates. Average length of stay estimates, by site and intervention, were calculated as the mean length of stay for all clients who were assigned to a particular site and intervention. The (economic) cost per treatment episode for each client was calculated as the product of average weekly cost and length of stay in treatment (weeks). Average episode costs

TABLE 1a: Variable Means at Baseline: Incremental Arm

	Incremental Arm			
Variable	*MET/CBT5*[a] *(n = 102)*	*MET/CBT12*[b] *(n = 96)*	*FSN*[c] *(n = 102)*	*Total (N = 300)*
Demographics and personal characteristics				
Age	15.79	15.54	15.51	15.62
% male	.81	.86	.84	.84
% White	.79	.71	.70	.73
% Black	.09	.14	.15	.12
% Hispanic	.05	.06	.07	.06
% more religious than most	.20	.14	.16	.16
% less religious than most[†††]	.50	.69	.61	.60
% excellent health	.15	.19	.18	.17
% very good health	.31	.31	.30	.31
% fair health	.17	.15	.17	.16
% poor health	.01	.03	.01	.02
% two-parent household	.38	.35	.28	.34
Number of people in household	3.70	3.14	4.08	3.65
Number of children	.01	.02	.03	.02
% substance dependence during past year	.43	.41	.49	.44
% conduct disorder during past year	.52	.51	.47	.50
% acute mental distress during past year	.22	.20	.27	.23
Health services utilization (past 90 days)				
Inpatient hospital days (for mental health or physical problems)	.13	.00	.07	.07
Emergency room visits (for mental health or physical problems)	.17	.16	.14	.15
Outpatient clinic/doctor office visits (for mental health or physical problems)	1.67	1.81	1.44	1.64
Days bothered by health/medical problems	3.45	2.51	2.60	2.86
Days bothered by psychological problems	2.47	3.17	1.36	2.31
Substance-abuse treatment utilization (past 90 days)				
Days in detoxification program	.69	.81	1.01	.84
Days in inpatient treatment program	.54	.70	.27	.50
Days in long-term residential program	1.00	.00	.00	.34

(continued)

TABLE 1a (continued)

	Incremental Arm			
Variable	*MET/CBT5*[a] *(n = 102)*	*MET/CBT12*[b] *(n = 96)*	*FSN*[c] *(n = 102)*	*Total (N = 300)*
Intensive outpatient program visits	1.01	.67	.88	.86
Regular outpatient program visits	.29	.28	.89	.49
Education and employment (past 90 days)				
Days missed school or training	6.86	6.46	8.28	7.22
$ personal income	303.19	214.01	251.57	257.10
Days stressful for parent	36.58	33.06	40.21	36.68
Days missed work or school by parent	3.44	2.07	2.89	2.81
Criminal activity (past 90 days)				
Number of arrests	.51	.53	.62	.55
Days on probation	15.01	18.92	14.46	16.08
Days on parole	.00	.00	.00	.00
Days in prison/jail	.14	.05	.02	.07
Days in juvenile detention	.98	1.34	.75	1.02

a. MET/CBT5 = Motivational Enhancement Treatment/Cognitive Behavior Therapy 5 session.
b. MET/CBT12 = MET/CBT5 + Cognitive Behavior Therapy 7 session.
c. FSN = MET/CBT12 + Family Support Network
†††Statistically significant difference in variable means across treatment conditions within incremental arm, $p = .06$ (Kruskal-Wallis equality of populations rank test).

for each site (intervention) were computed as the mean episode cost for all clients in a particular site (intervention).

BENEFIT ESTIMATION

The benefits analysis was considerably more involved. The first step was to select outcome measures from the GAIN that could be converted to monetary values. These measures included items within broad outcome categories such as health services utilization, substance-abuse treatment utilization, education and employment, and criminal activity. Next, reliable monetary conversion factors were either obtained from the existing literature or estimated with available data and simulation models. A total of 19 distinct outcomes required monetary conversion factors. Whenever possible, four different monetary conversion factors were obtained or estimated for each of the four sites in the study so that the estimates would be geographically specific (French, Salomé, et al. 2002).

TABLE 1b: Variable Means at Baseline: Alternative Arm

	Alternative Arm			
Variable	*MET/CBT5*[a] (*n = 100*)	*ACRA*[b] (*n = 100*)	*MDFT*[c] (*n = 100*)	*Total* (*N = 300*)
Demographics and personal characteristics				
Age	15.91	15.78	16.00	15.90
% male	.79	.80	.85	.81
% White	.47	.53	.47	.49
% Black	.50	.44	.47	.47
% Hispanic	.02	.01	.01	.01
% more religious than most	.26	.12	.25	.21
% less religious than most	.53	.55	.56	.54
% excellent health	.16	.20	.11	.16
% very good health	.21	.16	.22	.20
% fair health	.12	.20	.23	.19
% poor health	.03	.03	.04	.03
% two-parent household	.28	.27	.30	.28
Number of people in household	4.05	3.96	3.99	4.00
Number of children	.05	.00	.06	.04
% substance dependence during past year	.48	.48	.49	.48
% conduct disorder during past year	.56	.54	.58	.56
% acute mental distress during past year	.36	.29	.26	.30
Health services utilization (past 90 days)				
Inpatient hospital days (for mental health or physical problems)	.00	.18	.12	.10
Emergency room visits (for mental health or physical problems)	.13	.15	.12	.13
Outpatient clinic/doctor office visits (for mental health or physical problems)	.85	1.87	1.11	1.27
Days bothered by health/medical problems	2.52	1.62	1.46	1.87
Days bothered by psychological problems	3.23	.87	.96	1.69
Substance-abuse treatment utilization (past 90 days)				
Days in detoxification program	.99	.08	.00	.36
Days in inpatient treatment program	.14	.33	1.00	.49
Days in long-term residential program	3.49	1.42	2.24	2.38
Intensive outpatient program visits	.21	.06	.12	.13
Regular outpatient program visits	.42	.21	.35	.33

(continued)

TABLE 1b (continued)

	Alternative Arm			
Variable	*MET/CBT5*[a] *(n = 100)*	*ACRA*[b] *(n = 100)*	*MDFT*[c] *(n = 100)*	*Total (N = 300)*
Education and employment (past 90 days)				
Days missed school or training	9.04	10.82	8.70	9.52
$ personal income	167.30	139.67	285.13	197.37
Days stressful for parent	36.60	39.54	36.38	37.51
Days missed work or school by parent	2.99	2.97	2.25	2.75
Criminal activity (past 90 days)				
Number of arrests	.24	.36	.21	.27
Days on probation	49.67	39.32	46.40	45.13
Days on parole	.01	.00	.90	.30
Days in prison/jail	.17	.47	.04	.23
Days in juvenile detention	4.69	2.07	3.46	3.41

NOTE: No statistically significant differences in variable means across treatment conditions within alternative arm, $p < .10$ (Kruskal-Wallis equality of populations rank test).
a. MET/CBT5 = motivational enhancement treatment/cognitive behavior therapy 5 session.
b. ACRA = adolescent community reinforcement approach.
c. MDFT = multidimensional family therapy.

The third phase of the benefits calculations was a descriptive analysis of the mean cost of drug-abuse consequences by arm, treatment condition, and site. By monetizing each treatment outcome and including the cost of CYT treatment during the first follow-up period, we were able to calculate the cost of drug-abuse consequences for each individual over all five assessment periods. Deriving an average value for site, condition, and arm provides a clear summary picture of the pattern of social costs from intake through the last follow-up. If the interventions were economically successful, then the average cost over the follow-up periods would be significantly lower relative to baseline values.

Finally, the cost of drug-abuse consequences over time was further investigated through cross-sectional time-series analysis. Specifically, we estimated several generalized least squares (GLS) random-effects models of the following form (Greene 2003; StataCorp 2001):

$$C_{it} = \beta_0 + \beta_1 t + \beta_2 Tx_i + \beta_3 S_i + \beta_4 X_i + \nu_i + \varepsilon_{it} \qquad (1)$$

TABLE 2: Treatment Cost Estimates by Arm, Treatment Condition, and Site (1999 dollars)

Arm/Treatment Condition/Site[a,b]	*$ Total Accounting Cost*[c]	*$ Total Economic Cost*[c]	*Average Weekly Census*	*$ Average Weekly Cost per Client*[d]	*Average Length of Stay (Weeks)*	*$ Average Cost per Treatment Episode*[e]
Incremental arm***						
MET/CBT5[f,g]	40,932	42,439	10.3	158	6.9	1,113
UCHC	24,579	25,214	6.6	147	7.6	1,112
PAR	16,353	17,225	3.7	179	6.2	1,114
MET/CBT12[f]	45,009	47,593	17.5	105	11.8	1,185
UCHC	27,924	28,899	9.5	117	10.1	1,187
PAR	17,085	18,694	8.0	90	13.1	1,183
FSN[f]	98,969	104,295	16.5	243	13.4	3,246
UCHC	46,236	47,290	7.6	239	13.4	3,200
PAR	52,733	57,005	8.9	246	13.2	3,279
Alternative arm††						
MET/CBT5[f,g]	56,169	57,680	10.6	209	6.9	1,558
CHS-MC	15,929	16,240	5.5	114	7.4	839
CHOP	40,240	41,440	5.1	313	6.6	2,078
ACRA[f]	62,483	64,201	19.6	126	11.6	1,408
CHS-MC	23,915	24,870	9.6	100	12.4	1,237
CHOP	38,568	39,331	10.0	151	10.6	1,608
MDFT[f]	73,878	76,005	17.9	163	12.9	2,012
CHS-MC	23,182	23,855	8.2	112	12.7	1,426
CHOP	50,696	52,150	9.7	207	13.0	2,697

SOURCE: French, Roebuck, et al. (2002).
NOTE: Numbers may not correspond exactly because of rounding.
a. Conditions are: MET/CBT5 = motivational enhancement treatment/cognitive behavior therapy 5 session. MET/CBT12 = MET/CBT5 + cognitive behavior therapy 7 session. FSN = MET/CBT12 + family support network; ACRA = adolescent community reinforcement approach. MDFT = multidimensional family therapy.
b. Sites are: UCHC = University of Connecticut Health Center, Farmington, CT. PAR = Operation PAR, St. Petersburg, FL. CHS-MC = Chestnut Health Systems, Madison County, IL. CHOP = Children's Hospital of Pennsylvania, Philadelphia, PA.
c. For the period January 1, 1999, to June 30, 1999.
d. Calculated as the total economic cost divided by the product of 26 weeks and the average weekly census.
e. Calculated as the mean of average weekly cost per client times the length of stay for each client.
f. Total accounting cost, total economic cost, and average weekly census summed across the two sites; average weekly cost and average cost per treatment episode calculated as noted above.
g. Average cost of MET/CBT5 across study arms/sites is $1,333; however, these cost differences are confounded with site differences (randomization was only within arm) and allow for only quasi-experimental comparisons.
***Statistically significant differences in cost per treatment episode across treatment conditions within incremental arm, $p < .01$ (Kruskal-Wallis equality of populations rank test).
††Statistically significant differences in cost per treatment episode across treatment conditions within alternative arm, $p < .01$ (Kruskal-Wallis equality of populations rank test).

where i corresponds to individuals ($i = 600$), t corresponds to time periods ($t = 5$), C_{it} is the cost of drug-abuse consequences for individual i in period t, Tx_i represents indicator variables for treatment conditions, S_i represents indicator variables for treatment sites, X_i is a vector of client characteristics, the βs are parameters to estimate, and $\nu_i + \varepsilon_{it}$ is the residual. Specifically, ν_i is the individual-specific residual, and ε_{it} is the conventional least squares residual with usual properties. The random-effects estimator is a weighted average of the estimates produced by the between and within estimators (StataCorp 2001). Four hierarchical specifications of this general model were estimated, starting with C and t only and then incrementally adding the other groups of independent variables. These random-effects models are conceptually appropriate for the CYT study because treatment outcomes vary across individuals and time periods. Nevertheless, two empirical tests were conducted to assess the validity of the specifications. Specifically, each of the random-effects models was subjected to a Lagrange multiplier test (*xttest0*; $\chi^2[1]$) for random effects (i.e., test that the variance of the random effects is zero) (Breusch and Pagan 1980) and Hausman's (1978) specification test (*xthausman*; $\chi^2[k-1]$) that the model is correctly specified. All calculations were performed in Stata (StataCorp 2001) using variations of the *xtreg* routine.

RESULTS

ECONOMIC COSTS

In the incremental arm, as summarized in Table 2, average economic costs per treatment episode were $1,113 for MET/CBT5, $1,185 for MET/CBT12, and $3,246 for FSN. In the alternative arm, average economic costs per treatment episode were $1,558 for MET/CBT5, $1,408 for ACRA, and $2,012 for MDFT. Although the longer and/or more intensive interventions usually had higher total costs, the results suggest more site-to-site variation in the cost estimates than existed between conditions (for a further discussion, see French, Roebuck, et al. 2002).

ECONOMIC BENEFITS

Table 3 reports monetary conversion factors for the 19 treatment outcome measures by treatment location, when possible. Many of the outcome measures (e.g., inpatient hospital days, outpatient treatment visits) had readily available and acceptable monetary conversion factors, whereas other outcomes (e.g., days bothered by health/medical problems, days of schooling or training missed) required various assumptions and calculations to determine monetary values. These calculations and data sources are explained at the bottom of Table 3. Additional details on the calculation of monetary conversion factors can be found in French, Salomé, and Carney (2002), French, Salomé, et al. (2000), and French, McCollister, Sacks, et al. (2002).

The costs of drug-abuse consequences from baseline to the 12-month follow-up by arm, treatment condition, and site are presented in Table 4. Note that the estimates pertaining to the 3-month follow-up also include the costs of CYT treatment because treatment can be viewed as a consequence of substance misuse. Substance-abuse interventions that are economically beneficial will show a statistically significant decline in the cost of consequences from baseline to follow-up.

The analysis shows that the cost of drug-abuse consequences significantly declined from baseline to follow-up for all the conditions and sites in the incremental arm ($p < .01$). Despite of the inclusion of CYT treatment cost, the MET/CBT5 intervention (in both sites) and the MET/CBT12 intervention (at PAR) achieved a drop in cost of drug-abuse consequences from intake to the 3-month follow-up. Thereafter, all three conditions generated a relatively large dip in cost, which lasted for the remainder of the follow-up period (see Figure 1). Quantitatively, the average cost of drug-abuse consequences at follow-up was significantly lower than the baseline values for MET/CBT5 ($1,386 vs. $2,318; $p < .01$), MET/CBT12 ($1,273 vs. $1,978; $p < .01$), and FSN ($2,041 vs. $2,317; $p < .05$). The PAR site started with lower average costs at baseline, and these costs declined over the 12-month follow-up period. Within-site (where statistical power is lower), all three of the cost reductions at PAR were large enough to reach statistical significance (i.e., reliably measured), although those at UCHC were not.

In the alternative arm, all three conditions had statistically significant differences in the cost of drug-abuse consequences over the baseline and follow-up periods ($p < .01$), but the changes were more erratic and less pronounced than they were in the incremental arm. Indeed, the 3-month follow-up cost was higher than the baseline cost for each of the conditions, and the trends were generally flat or increasing during the subsequent follow-up periods. Figure 2 displays the variable trend in cost for the three conditions averaged across the two sites in the alternative arm. Averaging across sites, there were no statistically significant changes in the average cost of drug-abuse consequences at follow-up relative to the baseline value. Within the CHS site, the MET/CBT5 condition significantly reduced costs to society from baseline to

TABLE 3: Monetary Conversion Factors for Treatment Outcome Measures (1999 dollars)

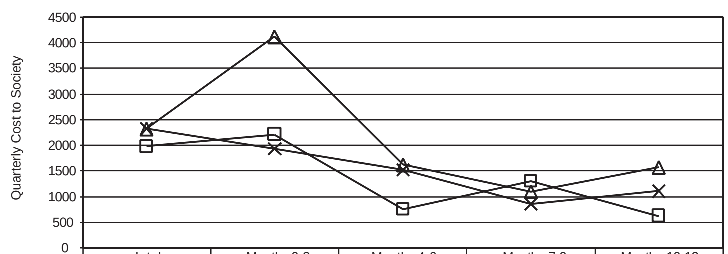
Outcome Measure	*Farmington, CT (UCHC)*	*St. Petersburg, FL (PAR)*	*Madison County, IL (CHS)*	*Philadelphia, PA (CHOP)*
Health services utilization				
Inpatient hospital day[a]	1,347.55	1,113.99	859.11	1,238.77
Emergency room visit[b]	210.39	189.24	190.65	203.05
Outpatient clinic/doctor's office visit[c]	69.20	62.80	63.48	67.06
Day bothered by health/ medical problems[d]	19.73	19.73	19.73	19.73
Day bothered by psychological problems[e]	7.62	7.62	7.62	7.62
Substance-abuse treatment utilization[f]				
Day in detoxification program	244.30	244.30	244.30	244.30
Day in inpatient treatment program	93.01	93.01	93.01	93.01
Day in long-term residential program	95.26	95.26	95.26	95.26
Intensive outpatient program visit	55.04	55.04	55.04	55.04
Regular outpatient program visit	22.86	22.86	22.86	22.86
Education and employment				
Day missed of school or training[g]	14.15	14.15	14.15	14.15
Personal income	NA	NA	NA	NA
Day stressful for parent[h]	7.62	7.62	7.62	7.62
Day missed of work or school by parent[i]	141.82	99.75	135.38	129.57
Criminal activity				
Arrest	1,635.92	1,635.92	1,635.92	1,635.92
Day on probation	4.44	4.44	4.44	4.44
Day on parole	14.31	14.31	14.31	14.31
Day in prison/jail[j]	62.38	62.38	62.38	62.38
Day in juvenile detention	87.42	87.42	87.42	87.42

a. Geographic-specific cost of 1 inpatient day in a community hospital (American Hospital Association 2001).
b. Geographic-specific physician fee for the first hour of critical care, evaluation, and management of the unstable critically ill or unstable critically injured patient, requiring the constant attendance of the physician (American Medical Association 1999).
c. Geographic-specific fee for an office consultation with a new or established patient, which requires a detailed history, a detailed examination, and medical decision making of low complexity (American Medical Association 1999).

(note continues on next page)

TABLE 3 (continued)

d. Estimated by summing the dollar-equivalent decrement in a quality-adjusted life day (QALD) associated with medical problems related to drug abuse (value of statistical life = $1 million) (see French, Salomé, et al. 2000).
e. Estimated by summing the dollar-equivalent decrement in a quality-adjusted life day (QALD) associated with psychiatric problems related to drug abuse (value of statistical life = $1 million) (see French, Salomé, et al. 2000).
f. Calculated using results from numerous DATCAPs (French, Dunlap, et al. 1996,1997; French, Salomé, et al. 2000; and various unpublished data).
g. Calculated using Light's (2001) estimated coefficient for the wage premium of an additional year of schooling (.1325) times the average hourly rate in her sample ($6.20), inflated from 1986 dollars to 1999 dollars, annualized, and then divided by a 180-day school year.
h. Estimated by summing the dollar-equivalent decrement in a quality-adjusted life day (QALD) associated with psychiatric problems related to drug abuse (value of statistical life = $1 million) (see French, Salomé, et al. 2000).
i. Geographic-specific average hourly wage in 1999 for all occupations multiplied by 7 hours.
j. Estimated using *2000 Corrections Yearbook* (Criminal Justice Institute, Inc. 2001).



	Intake	Months 0-3	Months 4-6	Months 7-9	Months 10-12
MET/CBT5; p<0.01	2318	1936	1517	858	1105
MET/CBT12; p<0.01	1978	2209	752	1299	624
FSN; p<0.05	2317	4108	1619	1094	1567

Figure 1: Average Cost of Drug-Abuse Consequences Over Time by Condition: Incremental Arm

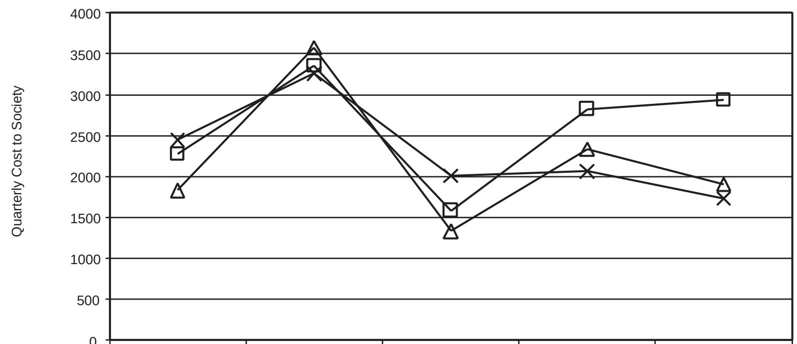
follow-up ($3,191 vs. $1,335). Within the CHOP site, statistically significant increases in the costs to society occurred for MET/CBT5 ($1,919 vs. $3,088) and MDFT ($2,138 vs. $4,021).

Graphically displaying these trends by site (Figure 3) rather than aggregate by condition reveals important underlying site differences in cost. Three of the four sites had parallel trends in cost from baseline to follow-up, demonstrating similar costs at baseline and at the 3-month follow-up and then a relatively large and comparable drop during the ensuing months. CHOP was an outlier site in that baseline costs were similar to the other three sites, but

TABLE 4: Cost of Drug-Abuse Consequences by Arm, Treatment Condition, and Site (1999 dollars)

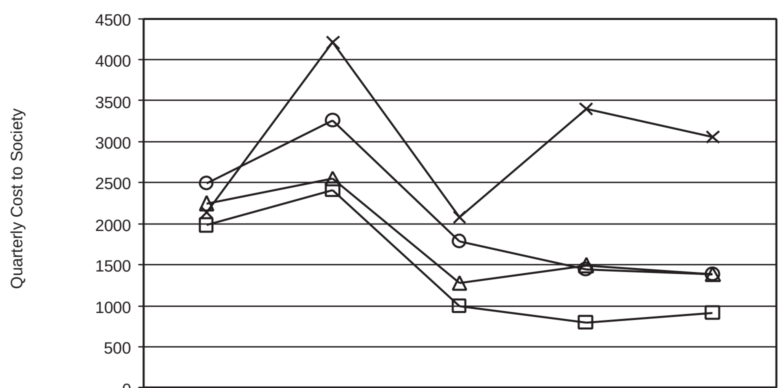
Arm/Treatment Condition/Site[a,b]	*Baseline*	*3-Month Follow-Up*[c]	*6-Month Follow-Up*	*9-Month Follow-Up*	*12-Month Follow-Up*	*Average Cost at Follow-Up*[d]
Incremental arm†††						
MET/CBT5***	2,318	1,936	1,517	858	1,105	1,386†††
UCHC***	2,639	2,294	1,940	1,045	1,042	1,649
PAR***	2,046	1,641	1,152	699	1,159	1,153†††
MET/CBT12***	1,978	2,209	752	1,299	624	1,273†††
UCHC***	2,005	3,045	1,649	2,121	1,160	1,992
PAR***	1,958	1,642	194	654	197	726†††
FSN***	2,317	4,108	1,619	1,094	1,567	2,041††
UCHC***	2,837	4,576	1,707	1,220	1,976	2,266
PAR***	1,950	3,809	1,571	1,007	1,290	1,884†
Alternative arm†						
MET/CBT5***	2,446	3,256	2,009	2,065	1,731	2,344
CHS-MC***	3,191	1,950	1,277	1,351	657	1,335††
CHOP***	1,919	4,166	2,530	2,591	2,516	3,088†††
ACRA***	2,275	3,351	1,587	2,826	2,939	2,822
CHS-MC***	2,150	2,749	1,771	2,137	2,626	2,396
CHOP***	2,419	3,992	1,359	3,642	3,317	3,323
MDFT***	1,833	3,575	1,332	2,336	1,905	2,553
CHS-MC***	1,560	2,822	799	954	645	1,329
CHOP***	2,138	4,511	2,306	4,294	3,480	4,021†††

a. Conditions are: MET/CBT5 = motivational enhancement treatment/cognitive behavior therapy 5 session; MET/CBT12 = MET/CBT5 + cognitive behavior therapy 7 session; FSN = MET/CBT12 + family support network; ACRA = adolescent community reinforcement approach; MDFT = multidimensional family therapy.
b. Sites are: UCHC = University of Connecticut Health Center, Farmington, CT; PAR = Operation PAR, St. Petersburg, FL;. CHS-MC = Chestnut Health Systems, Madison County, IL; CHOP = Children's Hospital of Pennsylvania, Philadelphia, PA.
c. Includes the cost of CYT treatment (see Table 2).
d. Calculated as the mean of 3-, 6-, 9-, and 12-month follow-up.
*Statistically significant differences in the cost of drug-abuse consequences across the baseline and follow-up periods, $p < .10$ (Kruskal-Wallis equality of populations rank test). **Statistically significant differences in the cost of drug-abuse consequences across the baseline and follow-up periods, $p < .05$ (Kruskal-Wallis equality of populations rank test). ***Statistically significant differences in the cost of drug-abuse consequences across the baseline and follow-up periods, $p < .01$ (Kruskal-Wallis equality of populations rank test). †Statistically significant differences in baseline and average follow-up cost of drug-abuse consequences, $p < .10$ (Wilcoxon test of equality of matched-pairs signed-rank test). ††Statistically significant differences in baseline and average follow-up cost of drug abuse consequences, $p < .05$ (Wilcoxon test of equality of matched-pairs signed-rank test). †††Statistically significant differences in baseline and average follow-up cost of drug-abuse consequences, $p < .01$ (Wilcoxon test of equality of matched-pairs signed-rank test).



	Intake	Months 0-3	Months 4-6	Months 7-9	Months 10-12
MET/CBT5	2446	3256	2009	2065	1731
ACRA	2275	3351	1587	2826	2939
MDFT	1833	3575	1332	2336	1905

Figure 2: Average Cost of Drug-Abuse Consequences Over Time by Condition: Alternative Arm



	Intake	Months 0-3	Months 4-6	Months 7-9	Months 10-12
UCHC; p<0.01	2493	3255	1783	1444	1383
PAR; p<0.01	1983	2413	996	796	910
CHS; p<0.01	2246	2551	1276	1496	1384
CHOP; p<0.01	2139	4209	2083	3400	3057

Figure 3: Average Cost of Drug Abuse Consequences Over Time by Site

follow-up costs were much higher during every follow-up period. In addition, CHOP was the only site in which the average cost of drug-abuse consequences at follow-up was significantly higher than the baseline cost.

To check for the possibility that other moderators were driving these findings, we conducted a cross-section time-series analysis, the results of which are reported in Tables 5a (incremental arm) and 5b (alternative arm). As noted earlier, generalized least squares (GLS) random-effects models were estimated with the cost of drug-abuse consequences as the dependent variable in all specifications. The first specification included only time dummies for each of the follow-up periods. The second specification included time dummies and indicator variables for treatment condition. The third specification supplemented time and treatment variables with an indicator variable for site. The last specification added numerous demographic and environmental controls to form the fully expanded model.

As discussed earlier, two tests were conducted for each specification. The Breusch and Pagan (1980) Lagrange multiplier test determined whether random effects were present (i.e., $Var[\nu_i] = 0$). The null hypothesis ($Var[\nu_i] = 0$) was rejected for every specification in each arm, suggesting that random effects was a valid assumption. Hausman's (1978) specification test examines whether the model is correctly specified. These tests produced opposite results in each arm. Specifically, the specification tests were (not) significant in the (incremental) alternative arm, indicating that the random effects and explanatory variables were (not) significantly correlated. Although an insignificant test result in the alternative arm would lend more support for the random effects specification, this finding does not necessarily imply that the random-effects model is less desirable than the fixed-effects or between-effects models (StataCorp 2001).

Several noteworthy results can be observed from the estimates pertaining to the incremental arm (Table 5a). Relative to the 3-month period before treatment, each of the three follow-up periods after the 3-month follow-up was associated with significantly lower costs of drug-abuse consequences. Costs at the 3-month follow-up were significantly higher than the baseline costs due mainly to the inclusion of CYT treatment costs during the initial follow-up. This result endured across all four specifications. The FSN treatment condition was associated with significantly higher costs of drug-abuse consequences (approximately $575 higher) relative to MET/CBT5 in two of the three specifications, and the PAR site was associated with significantly lower costs (approximately $662 lower) in one of the two specifications. Among the demographic measures, household size (positive), substance-abuse severity (positive), and acute mental distress (positive) were all significantly related to the cost of drug-abuse consequences.

TABLE 5a: Generalized Least Squares Random-Effects Models of Cost of Drug-Abuse Consequences: Incremental Arm (*N* = 300)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
3-month follow-up	547.67**	546.80**	553.77**	587.15**
	(254.84)	(254.76)	(254.70)	(258.81)
6-month follow-up	–893.40***	–894.94***	–884.26***	–885.95***
	(256.14)	(256.07)	(256.03)	(260.39)
9-month follow-up	–1,151.17***	–1,154.00***	–1,153.45***	–1,242.06***
	(252.25)	(252.18)	(252.11)	(257.30)
12-month follow-up	–1,109.17***	–1,113.99***	–1,113.90***	–1,180.50***
	(254.31)	(254.24)	(254.17)	(260.31)
Treatment condition: MET/CBT12		–179.63	–155.14	–308.89
		(316.76)	(314.15)	(303.55)
Treatment condition: FSN		551.11*	592.64*	227.07
		(311.06)	(308.75)	(302.02)
Treatment site: PAR			–661.52**	–346.29
			(257.23)	(271.24)
Age				2,268.94
				(2,131.76)
Age squared				–88.05
				(69.02)
Male				561.80
				(359.51)
White				–122.20
				(449.45)
Black				403.85
				(558.53)
Hispanic				–397.55
				(662.41)
More religious than most				231.42
				(292.40)
Less religious than most				–91.20
				(237.66)
Excellent health				469.52
				(365.19)
Very good health				15.28
				(308.93)
Fair health				454.02
				(375.84)
Poor health				797.88
				(962.30)
Two-parent household				–6.94
				(265.53)

(continued)

TABLE 5a (continued)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Number of people in household				48.40***
				(14.05)
Number of children				–69.81
				(518.61)
Substance problem index				508.90*
				(289.75)
Conduct disorder				35.58
				(268.99)
Acute mental distress				727.47**
				(362.79)
Constant	2,229.50***	2,099.99***	2,449.31***	–12,540.86
	(204.37)	(272.25)	(302.94)	(16,445.86)
Hausman specification test (χ^2)	1.33	1.05	.83	8.19
Breusch and Pagan Lagrange multiplier test for random effects (χ^2)	140.35***	130.56***	121.29***	46.30***

NOTE: Numbers in parentheses are standard errors.
*Statistically significant, $p < .10$. **Statistically significant, $p < .05$. ***Statistically significant, $p < .01$.

Like the descriptive analysis of substance-abuse costs, the GLS random-effects models revealed important differences between the incremental and alternative arms. Specifically, relative to the 3-month baseline period, costs were significantly higher during the 3-month follow-up, but no significant differences were found thereafter. None of the treatment conditions were significantly related to cost. Similar to the descriptive analysis, the costs of drug-abuse consequences were significantly higher at CHOP (approximately $1,235 higher) compared to CHS-MC in one of the two specifications. Finally, male gender (positive), health status, and household size (positive) were all significantly related to costs.

DISCUSSION

LIMITATIONS

Despite the programmatic and policy value of these original results, certain limitations pertaining to the data collection and analysis must be addressed. First, several implementation decisions and assumptions were

TABLE 5b: Generalized Least Squares Random-Effects Models of Cost of Drug-Abuse Consequences: Alternative Arm (*N* = 300)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
3-month follow-up	1,242.60***	1,242.91***	1,244.37***	1,119.73***
	(329.04)	(329.09)	(328.62)	(339.67)
6-month follow-up	–393.58	–395.85	–370.65	–653.71*
	(336.01)	(336.07)	(335.65)	(346.87)
9-month follow-up	243.30	240.99	257.76	66.04
	(331.52)	(331.58)	(331.12)	(342.40)
12-month follow-up	19.97	18.87	29.07	–136.17
	(331.60)	(331.66)	(331.18)	(347.63)
Treatment condition: ACRA		335.38	481.35	503.07
		(395.73)	(390.62)	(367.61)
Treatment condition: MDFT		–55.41	116.28	90.80
		(399.97)	(395.58)	(380.85)
Treatment site: CHOP			1,234.90***	516.26
			(321.79)	(419.29)
Age				1,807.52
				(2,690.18)
Age squared				–69.13
				(85.96)
Male				681.58*
				(392.17)
White				–120.17
				(960.94)
Black				852.61
				(953.17)
Hispanic				60.71
				(1,558.61)
More religious than most				287.80
				(345.09)
Less religious than most				–298.01
				(294.29)
Excellent health				766.20*
				(463.67)
Very good health				–251.23
				(410.90)
Fair health				–278.54
				(425.73)
Poor health				2,002.03**
				(867.62)
Two-parent household				434.07
				(331.47)

(continued)

TABLE 5b (continued)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Number of people in household				84.45***
				(13.93)
Number of children				353.97
				(455.63)
Substance problem index				30.10
				(340.85)
Conduct disorder				137.76
				(337.33)
Acute mental distress				248.29
				(356.05)
Constant	2,183.01***	2,088.11***	1,360.72***	–10,870.63
	(261.07)	(346.90)	(391.81)	(20,922.71)
Hausman specification test (χ^2)	33.92***	37.20***	65.60***	20.03**
Breusch and Pagan Lagrange multiplier test for random effects (χ^2)	133.28***	132.21***	118.55***	58.62***

NOTE: Numbers in parentheses are standard errors.
*Statistically significant, $p < .10$. **Statistically significant, $p < .05$. ***Statistically significant, $p < .01$.

necessary to use the DATCAP in the CYT study, including the choice of a 6-month rather than a 12-month analysis period, the proper exclusion of research costs, and the allocation of shared resources across sites. These issues were carefully explained in French, Roebuck, et al. (2002) and therefore are not repeated here. The primary shortcoming of the benefits analysis was the differential reliability associated with the monetary conversion factors. In particular, the process for valuing intangible or quality-of-life outcomes is not standardized in the literature at this time, particularly not for adolescents. Such outcomes include days bothered by physical and psychological problems, days missed of school or training, and days stressful for parents. We always used published valuation methods and the best available data to derive monetary conversion factors for these measures, but opportunities abound for method and data improvements in these areas. Nevertheless, a sensitivity analysis using various alternative monetary conversion factors did not alter the qualitative results and had very little effect on the quantitative findings.

The second major limitation of this study was the lack of data on the number of times adolescents committed specific crimes. This forced us to rely on measures such as the number of arrests and days on probation or in detention. Although criminal justice contacts are concrete and time bound, we know that these adolescents were committing many more crimes than their apprehensions would suggest (Webb et al. 2002). Thus, if a substantial reduction in these crimes occurred during the follow-up periods, then a major cost savings to society was unvalued. Fortunately, this issue will not be present in future studies because the current version of the GAIN instrument was modified to collect detailed information on criminal activity regardless of whether the crimes resulted in arrests.

The third limitation of the study was the lack of a no-treatment control group. Although ethical concerns prevented the formation of a no-treatment control group (see discussion in Dennis, Titus, et al. 2002), from a scientific perspective, it is difficult to judge the economic value of these interventions against doing nothing. Assuming that the baseline quarterly cost to society would continue into the follow-up period, three of the four sites and three of the five conditions generated a positive economic return. However, to the extent that these adolescents were on a trajectory to impose even greater costs to society postbaseline, such a no-treatment control group might have shown simply holding down the rate of increase via these interventions to be economically beneficial. We are currently working with other colleagues to address this issue with data from several ongoing longitudinal studies of untreated adolescents.

A fourth limitation is the lack of power to reliably measure the observed effects. CYT was designed to detect an effect size of $f = .25$ with 80% power. It only had 30% to 40% power to detect the observed effects of .13 to .14 and would have required more than twice the sample size to reach 80% power.

Other limitations are also present in the benefits analysis. These include the lack of a full 12-month preassignment data-collection period to coincide with the 12-month follow-up period, uncertainty about outcomes beyond the 12-month follow-up, and the absence of data and/or valuation methods for some potentially important outcomes (e.g., sexual activity, other risky behaviors, family problems, school problems). The investigative team will address and possibly resolve these limitations in future economic evaluations of adolescent addiction treatment.

RESEARCH AND POLICY SIGNIFICANCE

The combined cost and benefit estimates presented in this article are the first published figures for outpatient adolescent substance-abuse treatment using standardized economic methods. Although the DATCAP has now been used to estimate the economic cost of addiction services in numerous studies (e.g., French, Dunlap, et al. 1997; McCollister and French 2002; Salomé and French 2001), and similar benefits-estimation models have been applied in other addiction studies (e.g., French, Salomé, et al. 2002; French, Salomé, and Carney 2002; French, Salomé, et al. 2000; French, McCollister, Sacks, et al. 2002; French, McCollister, Cacciola, et al. 2002), only the CYT project involved interventions specifically designed for adolescents. Because marijuana is the drug of choice among adolescents, and more than 80% of adolescent treatment for cannabis dependence is delivered in outpatient settings, this benefit-cost analysis of the CYT experiment is both timely and important (Dennis, Godley, and Titus 1999; Dennis, Babor, et al. 2002; Dennis and McGeary 1999).

The present results have several important research and policy implications. For instance, the results demonstrate that outpatient adolescent treatment for marijuana dependence is similar in cost to outpatient adult treatment. The average economic costs of the five types of outpatient treatments ranged from $90 to $313 per week and from $839 to $3,279 per episode. The average weekly and episode cost estimates from adult outpatient programs that completed the DATCAP amounted to $172 and $2,614.

More important, the cost of drug-abuse consequences significantly declined from baseline through the 12-month follow-up for all conditions in the incremental arm but for none of the conditions in the alternative arm. Assuming that in the absence of treatment these adolescents would have generated costs over the follow-up period at a rate similar to the baseline estimates, three of the five treatments resulted in net economic benefits to society. Net economic benefits in this context refer to the fact that CYT treatment costs were included in the benefit calculations. Although these comparisons are aggregate and unadjusted, they still demonstrate that the short-run economic benefits of some types of adolescent treatment were greater than the costs of delivering those treatments.

Some rather unexpected findings included the lack of significant net benefits for two of the interventions (ACRA and MDFT), the large cost differences between sites testing the same interventions (as was the case in the alternative arm), and the lack of significant differences by condition in the net benefit when comparing them experimentally (vs. within-group as done above). Across all sites and conditions, a large number of adolescents continued to use drugs and generate high costs to society. This behavior also suggests that continuing care, boosters, or some other form of intervention might further improve outcomes. As new economic data for adolescent drug treatment emerges, these results can be further studied and assessed.

CONCLUSION

The economic evaluation of the CYT project was planned as a two-stage process. First, data were collected and the opportunity costs of adolescent treatment were estimated and interpreted (French, Roebuck, et al. 2002). This article reports on the second stage of the economic analysis of CYT, which combined the cost estimates with client-specific data on treatment outcomes over the 12-month follow-up to conduct benefit-cost analyses and to compare the relative effectiveness of the CYT interventions in reducing costs to society. Comprehensive research findings from both phases of the economic evaluation provide CYT investigators, policy makers, substance-abuse researchers, and treatment providers with the first full set of economic estimates for adolescent programs. This information will facilitate a better understanding of the economics of addiction, especially pertaining to the unique needs and challenges of adolescent substance abusers. Clearly, more research is still needed, but these initial cost and benefit estimates suggest that the CYT treatment protocols are feasible in community-based programs and that most of the protocols generated positive economic benefits that equaled or exceeded treatment costs.

NOTE

1. It should be noted that the present version of the program DATCAP does not estimate the client costs of treatment. A new instrument (client DATCAP) is being developed and tested to estimate the costs that clients incur to attend treatment such as travel, lost work time, and dependent care.

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