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The Cannabis Youth Treatment (CYT) Study: Main findings from two randomized trials

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Abstract

This article presents the main outcome findings from two inter-related randomized trials conducted at four sites to evaluate the effectiveness and cost-effectiveness of five short-term outpatient interventions for adolescents with cannabis use disorders. Trial 1 compared five sessions of Motivational Enhancement Therapy plus Cognitive Behavioral Therapy (MET/CBT) with a 12-session regimen of MET and CBT (MET/CBT12) and another that included family education and therapy components (Family Support Network [FSN]). Trial II compared the five-session MET/CBT with the Adolescent Community Reinforcement Approach (ACRA) and Multidimensional Family Therapy (MDFT). The 600 cannabis users were predominately white males, aged 15–16. All five CYT interventions demonstrated significant pre-post treatment improvements during the 12 months after random assignment to a treatment intervention in the two main outcomes: days of abstinence and the percent of adolescents in recovery (no use or abuse/dependence problems and living in the community). Overall, the clinical outcomes were very similar across sites and conditions; however, after controlling for initial severity, the most cost-effective interventions were MET/CBT5 and MET/CBT12 in Trial 1 and ACRA and MET/CBT5 in Trial 2. It is possible that the similar results occurred because outcomes were driven more by general factors beyond the treatment approaches tested in this study; or because of shared, general helping factors across therapies that helped these teens attend to and decrease their connection to cannabis and alcohol.

Keywords: Marijuana; Manual-guided therapy; Adolescents; Treatment effectiveness; Cost-effectiveness

1. Introduction

Cannabis (including hashish, marijuana, blunts, and other forms of tetrahydrocannabinol) is the most prevalent psychoactive substance used by adolescents in the U.S. (Office of Applied Studies [OAS], 2000b). In 1998, 6.8% of U.S. 18-year-olds met criteria for past-year cannabis

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dependence (OAS, 2000b). Cannabis is now the leading substance found during drug screens after adolescent arrests (primarily for property or violent offenses—*not* simple possession), emergency room admissions and autopsies. It is also the leading substance mentioned during adolescent treatment admissions (Bureau of Justice Statistics, 2000; Dennis, Babor, Roebuck, & Donaldson, 2002; OAS, 2000a, 2000c). There has been increasing interest in the development of effective outpatient treatments for adolescents with cannabis use disorders, partially due to the growing volume of literature on the social, medical, and psychological consequences of cannabis use (American Academy of Pediatrics, 1999; Fergusson, Lynskey, & Horwood, 1996).

Evaluations of existing outpatient treatment programs for U.S. adolescent cannabis users have produced mixed results. Some studies reported increases of 3 to 13% in cannabis use following outpatient drug abuse treatment (Hubbard, Cavanaugh, Craddock, & Rachel, 1985; OAS, 1995; Sells & Simpson, 1979), whereas more recent studies (Hser et al., 2001) have reported decreasing cannabis use by 12 to 25%. Among the 445 adolescents followed up after a median of 42 days of outpatient treatment in the Drug Abuse Treatment Outcome Study-Adolescents (Grella, Hser, Joshi, & Rounds-Bryant, 2001; Hser et al., 2001) in the mid to late 1990s, there was a 21 to 25% reduction in cannabis use between the year before and the year after treatment.

In addition to the large studies of existing practice, numerous randomized and quasi-experimental field studies have evaluated a wide variety of outpatient treatment approaches for adolescents with alcohol or other drug use problems during the past 10 years. These have included cognitive behavior therapy alone and in combination with a motivational interviewing approach (Kaminer, Burleson, & Goldberger, 2001, 2002; Waldron, Slesnick, Brody, Turner, & Peterson, 2001); family education and therapy approaches (Azrin et al., 2001; Henggeler et al., 1991; Henggeler, Clingempeel, Brondino, & Pickrel, 2002; Joanning et al., 1992; Lewis, Piercy, Sprenkle, & Trepper, 1990; Liddle et al., 2001; Szapocznik, Kurtines, Foote, Perez-Vidal, & Hervis, 1983; Waldron et al., 2001); group psychoeducational approaches (Kaminer et al., 2002; Liddle et al., 2001; Waldron et al., 2001); individual behavior therapy approaches (Azrin et al., 1994, 2001; Godley, Godley, Dennis, Funk, & Passetti, 2002); engagement approaches (Szapocznik et al., 1988); and 12-step based or Minnesota Model therapy (Winters, Stinchfield, Opland, Weller, & Latimer, 2000). Although literature reviews (Ozechowski & Liddle, 2000; Williams & Chang, 2000) and a meta-analysis (Stanton & Shadish, 1997) based on pre-1997 treatment studies suggested there might be a clear advantage to family therapy approaches, a more recent study suggests other interventions can be just as efficacious (Waldron et al., 2001). Taken as a whole, these studies suggest there may be many effective types of treatment for this population. Yet to date, no published treatment studies have specifically targeted adolescent cannabis/marijuana users or provided readily disseminable manuals for replicating them.

Studies evaluating clinical effectiveness, cost, cost-effectiveness, and benefit-cost of different interventions are all critical to improving practice (Dennis, Perl, Huebner, & McLellan, 2000; Gold, Siegel, Russell, & Weinstein, 1996). Cost-effectiveness analysis combines information on the "societal" cost of the interventions (i.e., market value of goods and services) with the clinical outcomes. Treatments that are more "efficient" in achieving outcomes are considered better (whether they cost more or not). As in the clinical research literature, we know of no prior economic evaluations of treatments designed specifically for treating adolescent cannabis users.

In 1997, the Center for Substance Abuse Treatment (CSAT) created the Cannabis Youth Treatment (CYT) cooperative agreement in response to the expanding population of adolescent cannabis users and the lack of short-term (less than 3 months) outpatient treatment models targeting adolescents with cannabis-related problems (Clark, Horton, Dennis, & Babor, 2002). The objectives of CYT were to (a) develop several promising models of short-term outpatient treatment that could be readily disseminated to the field, and (b) conduct a field trial to estimate the cost, effectiveness and cost-effectiveness of these interventions. CYT was designed to be an initial effectiveness study to allow comparison of treatment alternatives that could be readily used by outpatient treatment providers. Though a no-treatment control might have provided more evidence about generic efficacy, it was considered unethical in light of previous research showing lack of improvement in untreated or minimally treated samples (Henggeler, Pickrel, Brondino, & Crouch, 1996; Henggler, Pickrel, & Brondino, 1999; Kaminer, Burleson, Blitz, Sussman, & Rounsaville, 1998; Kaminer & Burleson, 1999; Kaminer et al., 2002; Latimer, Winters, D'Zurilla, & Nichols. 2003; Szapocznik & Kurtines, 1993; Winters et al., 2000).

A national competition was held with awards going to four site grantees (University of Connecticut Health Center, Operation PAR, Inc., Chestnut Health Systems, and Children's Hospital of Philadelphia) and a coordinating center at the research division of Chestnut Health Systems. A 35-member steering committee composed of clinicians and researchers from each grant, other research collaborators, CSAT staff, and an independent advisory board reviewed the 22 interventions originally proposed by the grantees and chose five short-term interventions to implement and compare. These interventions were selected because they (a) could be readily manualized and field tested within the 4-year time frame of the study, (b) were promising based on previously published studies or studies in progress, (c) were demonstrated to be effective with related populations, and (d) were recommended by expert panels as best practices for adolescent treatment. The steering committee then charged five teams with developing treatment manuals and designed a detailed research plan.

The CYT collaborative has published articles on the study's design, implementation, and the reliability and validity of the measures (Dennis, Titus, et al., 2002), the characteristics and needs of the adolescents (Diamond, Leckrone, & Dennis, in press; Petry & Tawfik, 2001; Tims et al., 2002; Webb, Scudder, Kaminer, Kadden, & Tawfik, 2002), the five treatment manuals (Godley, Meyers et al., 2001; Godley, White, Diamond, Passetti, & Titus, 2001; Hamilton, Brantley, Tims, Angelovich, & McDougall, 2001; Liddle, 2002; Sampl & Kadden, 2001; Webb et al., 2002), a comparison of their rationale/components (Diamond et al., 2002), the reactions of clinical staff to using them (Godley, White, et al., 2001), the relative cost of the interventions (French et al., 2002), and the impact of the interventions on costs to society (French et al., 2003). This paper summarizes earlier results on the clinical characteristics and costs, then presents the main findings in terms of the relative clinical- and cost-effectiveness of the five CYT interventions in the two multi-site field trials.

2. Materials and methods

2.1. Overview of research design and questions

During a 2-year period, 600 adolescents and their families were recruited and randomized from sequential admissions to four treatment sites: University of Connecticut Health Center (UCHC), Operation PAR, Chestnut Health Systems (CHS), and Children's Hospital of Philadelphia (CHOP). It was not logistically feasible to implement all five conditions in any one site because of the limits of case flow and resources. Therefore, adolescents were randomly assigned within each site to one of three treatment conditions, and the interventions were evaluated in two trials. In Trial 1 (at UCHC and PAR), adolescents were randomly assigned to one of three treatment conditions: Motivational Enhancement Treatment/Cognitive Behavior Therapy 5 Sessions (MET/CBT5), Motivational Enhancement Treatment/Cognitive Behavior Therapy 12 Sessions (MET/CBT12), or Family Support Network (FSN). In Trial 2 (at CHS and CHOP), adolescents were randomly assigned to MET/CBT5, Adolescent Community Reinforcement Approach (ACRA), or Multidimensional Family Therapy (MDFT). Adolescents were interviewed with the Global Appraisal of Individual Needs (GAIN; Dennis, 1999) and a battery of other measures at intake and then 3, 6, 9, and 12 months later (see Dennis, Titus, et al., 2002 for a detailed description). Data was obtained from collateral informants, records, and urine tests to validate the self-report data collected at intake, 3, and 6 months. Of the eligible adolescents, 85% agreed to participate. Data for the analyses presented here were available from one or more follow-up interviews for 99% of the adolescents (94 to 98% per observation).

The analyses presented in this paper focus on answering the following two core questions addressed by CYT:

1. Are there significant differences in the relative clinical outcome effectiveness of these treatment approaches in terms of (a) the days of abstinence over the followup period and (b) the percent of adolescents in recovery (no use or abuse/dependence problems while living in the community) at the end of the followup study?
2. Are there significant differences in the relative cost-effectiveness of these treatment approaches in terms of their (a) cost per day of abstinence over the followup period, and (b) cost per person in recovery at the end of the study?

Analyses were conducted by site and across sites for each of the two trials with baseline measures as covariates to allow for individual differences, nesting conditions within site to control for site differences, and using restricted maximum likelihood estimation to use all of the available data without biasing condition estimates.

2.2. Sites and participants

2.2.1. Sites

The UCHC site, located in Farmington, CT, is a major academic medical center that has been involved in multiple substance abuse treatment trials. The Operation PAR site, located in St. Petersburg, is Florida's most comprehensive adolescent treatment provider and also offers behavioral healthcare services in three additional Florida counties. The CHS site in Madison County is Illinois' largest community-based adolescent treatment provider and also operates other programs in the state. CHOP, located in Philadelphia, PA, is a leading pediatric research center and has been involved in numerous substance abuse treatment and family therapy trials. The sites differed in their catchment areas, with CHS serving a rural and small urban population at three facilities located 30 miles apart, CHOP primarily targeting the inner city of Philadelphia, and UCHC and PAR serving suburban areas. When an intervention included a group component, only study participants were included in the group sessions.

2.2.2. Target population and inclusion/exclusion criteria

The target population for this study was adolescents with cannabis related disorders who would be appropriate for and typically present to publicly funded outpatient treatment. Participants were eligible for CYT if they were aged 12 to 18, self-reported one or more DSM-IV (American Psychiatric Association, 1994) criteria for cannabis abuse or dependence, had used cannabis in the past 90 days or 90 days prior to being sent to a controlled environment, and were appropriate for outpatient or intensive outpatient treatment (American Society of Addiction Medicine, 1996). Because the goal of the study was to generalize to adolescents who present for publicly funded outpatient treatment in the

United States, we included adolescents with alcohol and other drug diagnoses and co-occurring psychiatric disorders (as long as they could be managed at the outpatient level), as well as those with only cannabis abuse diagnoses, and/or less than weekly substance use. Adolescents were excluded if they were inappropriate for short-term outpatient treatment or would be unable to participate in the study. The exclusion criteria were: (a) reported use of alcohol 45 or more of the 90 days prior to intake; (b) reported use of other drugs 13 or more of the 90 days prior to intake; (c) reported an acute medical or psychological problem that was likely to prohibit full participation in treatment; (d) had insufficient mental capacity to understand and provide informed consent or participate in treatment; (e) lived outside of the program's catchment area; (f) had a history of repeated, violent behavior or severe conduct disorder that might put other participants at risk; or (g) lacked sufficient ability to use English to participate in the consent process, treatment, or research interviews. Assuming that they met the inclusion and exclusion criteria, both the adolescent and the parent or other collateral were asked to participate in the study. The study was conducted with the informed consent of the participants, under a federal certificate of confidentiality.

2.2.3. Participant characteristics

As shown in Table 1, participants were primarily male (83%), white (61%) or African American (30%), enrolled in school (87%), and currently involved in the juvenile justice system (62%). Half were from single parent families. Most of the adolescents began using alcohol or other drugs before the age of 15 (85%) and used cannabis weekly or daily (71%). Many reported engagement in risky behaviors such as multiple sexual partners (39%), sex without barrier protection (23%), and substance use in hazardous situations (54%). Only about a quarter of these adolescents had participated in substance abuse or mental health treatment previously. There were no differences between treatment conditions within site or across sites within the same trial on any of these variables. Adolescents in the Trial 2 sites were more likely than those in the Trial 1 sites to be African American, female, and to be sexually active, as well as less likely to be employed. All of the analyses presented here were computed by trial, without any pooling of data across the two trials.

As shown in Table 2, most participants had serious substance-related disorders and a wide range of co-occurring disorders. Based on self-report only, 86% met criteria for a cannabis related disorder, and this percentage increased to 100% after considering additional information from parents, juvenile justice, treatment records or other objective sources. Over 95% self-reported one or more other problems (84% had three or more) such as alcohol use disorders (37%), other substance use disorders (12%), internalizing disorders (18% major depression, 23% generalized anxiety, 9% suicidal thoughts or actions, 14% traumatic stress disorders), and externalizing behavioral disorders (53% conduct disorder, 38% attention deficit-hyperactivity disorder, including 30% with both). Over half (60%) reported a history of physical, sexual, or emotional victimization (including 37% with extensive patterns of victimization). A high percentage of participants also reported illegal activity other than just drug possession or use (83%) and 66% reported engaging in acts of physical violence such as assault. There were no differences between treatment conditions within either trial on any of these variables. There were, however, a few significant differences by condition within site (Operation PAR on cannabis disorders; CHS on major depression, any illegal activity, property and drug crime; and CHOP on weekly alcohol use in the home by others and having sex without protection). These differences were found for less than 3% of the 224 tests (based on 56 variables × 4 sites) or less than expected by chance if using the .05 probability level for alpha.

2.2.4. Generalizability

Comparisons with national admission data for adolescents presenting for public outpatient treatment of cannabis use problems suggest that the CYT adolescents were more likely to be male (83% vs. 73%), non-white (39% vs. 30%), 15 years or older (85% vs. 68%), and similar in terms of the percent "referred" by the criminal justice system (52% vs. 51%). Clinically, they were more likely to have first used under the age of 15 (85% vs. 78%), be using weekly at intake (71% vs. 47%), and similar in their rates of being dependent (46% vs. 45%) and having prior treatment episodes (26% vs. 27%). See Tims et al. (2002) for more detail.

2.3. Interventions

Below is a description of the five interventions and the rationale underlying their selection. More detailed comparisons of them can be found elsewhere (Diamond et al., 2002).

2.3.1. Motivational Enhancement Treatment/Cognitive Behavior Therapy, 5 Sessions (MET/CBT5)

MET/CBT5 (Sampl & Kadden, 2001) consisted of two individual MET sessions and three group CBT sessions, with the total duration of treatment lasting 6 to 7 weeks. Evaluated in both trials, MET/CBT5 was an inexpensive first tier intervention specifically designed for the 6-week median length of stay that occurs in much of the U.S. treatment system. The MET component proceeds from the assumptions that adolescents need to: (a) resolve their ambivalence about whether they have a problem with cannabis and other substances, and (b) increase their motivation to stop using cannabis. Therapists using MET seek to help adolescents see the relationship between cannabis use and its consequences so they will conclude that the costs of cannabis use outweigh its benefits. Several studies with adult cannabis users had demonstrated that one or two sessions of MET were more effective in reducing substance use than a no-treatment control group (Copeland, Swift, Roffman, & Stephens, 2001;

Babor et al., in press; Stephens, Roffman, & Curtin, 2000) and that MET plus CBT was better than a control group or MET alone (Copeland et al., 2001; Babor et al., in press). CBT sessions were added out of concern that problem recognition and motivation alone would not be sufficient for adolescents who had yet to develop the necessary coping skills to initiate and sustain change. Waldron et al. (2001) tested a similar combination of MET and CBT with adolescents. CBT strategies have been found to be effective for cannabis problems in adults (Stephens, Roffman, & Simpson, 1993). CBT also has a history of being well received by community practitioners (Morgenstern & McCrady, 1992). The CBT component of this particular intervention teaches basic skills for (a) refusing offers of cannabis, (b) establishing a social network supportive of recovery, (c) developing a plan for pleasant activities to replace cannabis-related activities, and (d) coping with unanticipated high-risk situations, problem solving, and recovering from relapse, should one occur.

2.3.2. Motivational Enhancement Treatment/Cognitive Behavior Therapy, 12 Sessions (MET/CBT12)

This treatment condition supplemented MET/CBT5 with seven additional CBT sessions (CBT7; Webb et al., 2002) in a group format, with the combined duration lasting 12 to 14 weeks. Evaluated in Trial 1, MET/CBT12 was designed to more closely approximate group interventions used in many community-based treatment programs. The additional CBT sessions were designed to teach adolescents coping skills they could use for resolving interpersonal problems and negative affect and for addressing triggers for cannabis use and psychological dependence. The additional sessions address problem-solving, anger awareness, anger management, communication skills, resistance to craving,

Table 1
Participant characteristics by condition and overall

	Trial 1			Trial 2			
	MET/CBT5 (n = 102)	MET/CBT12 (n = 96)	FSNM (n = 102)	MET/CBTS (n = 100)	ACRA (n = 100)	MDFT (n = 100)	Total CYT (n = 600)
Demographics							
Female	19%	14%	16%	21%	20%	15%	79%
Caucasian/White	79%	71%	70%	47%	53%	47%	61%
African American/Black	9%	14%	15%	50%	44%	47%	30%
Hispanic/Latino	5%	6%	7%	2%	1%	1%	4%
Other/Mixed	7%	9%	9%	1%	2%	5%	6%
Aged 13-14	15%	16%	23%	11%	14%	13%	15%
Aged 15-16	54%	64%	52%	57%	56%	48%	55%
Aged 17-18	31%	21%	26%	32%	30%	39%	30%
Single parent family	44%	42%	49%	53%	59%	52%	50%
In school in the past 90 days	92%	94%	86%	79%	86%	85%	87%
Employed in the past 90 days	62%	60%	47%	37%	39%	36%	47%
Ever homeless/runaway	5%	10%	8%	9%	5%	5%	7%
Current CJS Involvement	58%	60%	54%	72%	62%	67%	62%
Pattern of substance use							
Age of first use under 15	81%	82%	85%	80%	89%	89%	85%
Any weekly or daily substance use	72%	76%	76%	76%	73%	80%	75%
Weekly or daily marijuana use	67%	70%	74%	75%	68%	74%	71%
Weekly or daily alcohol use	22%	17%	11%	19%	15%	18%	17%
Weekly or daily use of other drugs	2%	0%	1%	0%	0%	1%	1%
Weekly or daily tobacco use	75%	68%	72%	74%	73%	78%	73%
Weekly alcohol use by others in home	31%	26%	28%	13%	26%	16%	23%
Weekly drug use by others in home	11%	6%	13%	9%	16%	10%	11%
Other risk behaviors in 90 days before intake							
Sexually active	68%	60%	64%	81%	78%	81%	72%
Multiple sexual partners	32%	24%	37%	50%	47%	42%	39%
Had sex without barrier protection	21%	12%	19%	29%	23%	37%	23%
Any needle use	1%	1%	0%	0%	3%	0%	1%
Used at work, school, or while baby sitting	47%	35%	41%	27%	36%	29%	36%
Used in hazardous situation[1]	52%	53%	49%	53%	60%	55%	54%
Lifetime history of behavioral interventions							
Substance abuse treatment	30%	23%	28%	30%	19%	25%	26%
Mental health treatment	30%	25%	28%	23%	16%	15%	23%
Juvenile justice system involvement	86%	83%	84%	86%	80%	80%	83%

Note. Within each Trial, the differences between condition were not statistically significant.
[1] Such as when driving car, using a machine, playing sports, or where the adolescent might have been forced into sex.

depression management, and management of thoughts about cannabis. In addition to producing a treatment stay and intensity closer to existing adolescent treatment practice (at least as intended), this dosage of MET/CBT was closer to the combined dosage used in earlier adult studies that had proven to be more effective than MET alone (Copeland et al., 2001; Babor et al., in press). A key assumption underlying the group format for CBT delivery is that adolescent skill deficits are typically inter-personal and more healthy behaviors can be learned in a safe, social context.

2.3.3. Family Support Network

FSN (Bunch, Hamilton, Tims, Angelovich, &, McDougall, 1998) used MET/CBT12 to provide adolescent-focused substance abuse treatment and added six parent education group meetings (to improve parent knowledge and skills relevant to adolescent problems and family functioning), four therapeutic home visits, referral to self-help support groups, and case management (to promote adolescent/parent engagement in the treatment process). Evaluated in Trial 1, FSN was designed to more closely

Table 2
Clinical Characteristics by Condition and Overall[1]

	Trial 1			Trial 2			
	MET/CBT5 (n = 102)	MET/CBT12 (n = 96)	FSNM (n = 102)	MET/CBT5 (n = 100)	ACRA (n = 100)	MDFT (n = 100)	Total CYT (n = 600)
Substance use disorder							
Any marijuana disorder[2]	86%	85%	97%	81%	80%	85%	86%
Marijuana dependence	44%	40%	46%	47%	47%	52%	46%
Marijuana abuse	42%	46%	51%	34%	33%	33%	40%
Any alcohol disorder	32%	35%	28%	41%	41%	42%	37%
Alcohol dependence	10%	6%	7%	7%	13%	12%	9%
Alcohol abuse	22%	29%	22%	34%	28%	30%	28%
Other substance use disorders	16%	6%	14%	13%	9%	13%	12%
Other substance dependence	3%	2%	4%	1%	1%	1%	2%
Other substance abuse	13%	4%	10%	12%	8%	12%	10%
Past year psychological problems							
Any internal disorder	30%	30%	36%	41%	34%	30%	33%
Major depression	19%	18%	16%	27%	16%	11%	18%
Generalized anxiety disorder	19%	16%	22%	34%	21%	25%	23%
Suicidal thoughts or actions	8%	10%	10%	10%	7%	7%	9%
Any traumatic distress disorder[3]	14%	11%	16%	17%	14%	12%	14%
Any external disorder	62%	55%	59%	63%	61%	64%	61%
Conduct disorder	52%	51%	47%	56%	54%	58%	53%
Attention deficit-hyperactivity disorder	41%	32%	44%	34%	38%	38%	38%
Physical, sexual or emotional victimization							
Lifetime history of victimization	66%	55%	49%	63%	66%	61%	60%
Past year	42%	33%	35%	37%	40%	32%	37%
Past 90 days	20%	19%	19%	22%	26%	18%	20%
Extensive victimization[4]	34%	30%	34%	42%	46%	37%	37%
Violence and illegal activity (other than possesion/use)							
Acts of physical violence[5]	66%	64%	63%	66%	64%	71%	66%
Any illegal activity	87%	81%	86%	84%	74%	84%	83%
Property crimes[6]	61%	52%	60%	56%	41%	59%	55%
Interpersonal crimes[7]	43%	44%	41%	48%	41%	50%	45%
Drug related crimes[8]	66%	59%	69%	66%	57%	70%	65%
Number of substance psychological, behavioral or legal problems[9]							
One	2%	5%	6%	3%	8%	3%	5%
Two	14%	14%	10%	11%	9%	8%	11%
Three to twelve	84%	81%	84%	84%	81%	87%	84%

[1] Within each Trial, the differences between condition were not statistically significant, such as when driving a car, using a machine, playing sports, or where the adolescent might have been forced into sex or hurt.

[2] Of the remaining 84 included in the study, 82 do meet criteria for lifetime cannabis (54) or abuse (30) if we also considered their answers to other questions the reports of their parents treatment records, and other objective information.

[3] Post traumatic distress, acute traumatic distress or disorders of extreme stress not otherwise specified.

[4] Reporting 4 or more of the following types of victimization, traumagenic factors (e.g., multiple people, someone they trusted, fearing for life sexual penetration people didn't believe them for continuing fear it will reoccur.

[5] Physical assault of another person within the past year.

[6] Self report of or arrests related to vandalism, forgery, bad checks, shop lifting, theft, robbery, auto theft.

[7] Self report of or arrests related to assault, aggravated assault with a weapon, rape, murder, and arson.

[8] Self report of or arrests related to driving under the influence, manufacture or distribution, prostitution, gang involvement.

[9] Counting each individual drug diagnosis and psychological problem, whether they have been victimized in the past year, whether they are physically violent and whether they have had any illegal activity (other than just possession or use) during the past year.

approximate the kind of "comprehensive treatment" recommended by adolescent treatment experts (CSAT 1992a, 1992b, 1993) for adolescents. The parent education groups provided information on (a) adolescent development and parents' role, (b) substance abuse/dependence, (c) recovery process and relapse signs, (d) family development and functioning, (e) family organization and communication, and (f) family systems and roles. The home visits focused on (a) initial assessment and motivation-building, (b) family roles and routines, and (c) assessing progress and building commitment to change. Case management was used to facilitate treatment attendance (reminders, transportation, childcare), assess family needs, and make referrals to other community services. The family component of FSN was based on evidence that treatment outcomes were improved when parent education was provided to at-risk adolescents, family support interventions were added to treatment (Brown, Myers, Mott, & Vik, 1994), and families were actively engaged in treatment (Henggeler et al., 1991, 2002; Liddle et al., 2001). The key assumption underlying the FSN manual-guided approach is that in addition to problem recognition, motivation, and improved coping skills, family education and case management are needed to help the adolescent achieve recovery.

2.3.4. The Adolescent Community Reinforcement Approach

ACRA (Godley, Meyers, et al., 2001) is composed of 10 individual sessions with the adolescent, four sessions with caregivers (two of which are with the whole family) and a limited amount of case management provided by the therapist over a period of 12 to 14 weeks. Evaluated in Trial 2, ACRA incorporates elements of operant conditioning, skills training, and a social systems approach. Three core procedures used in ACRA sessions are (a) functional analyses to identify the antecedents and consequences of substance use and pro-social behaviors; (b) identifying and reviewing clear, simple and obtainable "goals of counseling," and (c) using a rating scale to track the adolescent's satisfaction in multiple life areas to inform further goal planning. Other procedures include identifying and reinforcing pro-social behaviors that compete with substance use and skills training related to relapse prevention and problem solving. Four parent sessions are devoted to (a) an overview of the ACRA approach; (b) a review of important parenting practices for helping adolescents stay alcohol and drug free; (c) increasing positive communication in the family, and (d) problem-solving. Two of the four sessions bring the parents and adolescents together for practice of communications and problem-solving. Community Reinforcement Approaches have been effective with adult substance users (Meyers, Miller, Hill, & Tonigan, 1999; Meyers & Godley, 2001), have been recommended as one of the most promising approaches to treatment by several expert panels from the Institute of Medicine (1989, 1998) and have been successfully combined with other approaches including contingency contracting (Azrin et al., 1994; Budney & Higgins, 1998) and family therapy (Henggeler et al., 2002; Randall, Henggeler, Cunningham, Rowland, & Swenson, 2001; Sisson & Azrin, 1993). The ACRA approach also drew on other work related to effective parenting practices (Ary, Duncan, Duncan, & Hops, 1999; Bry, Catalano, Kumpfer, Lochman, & Szapocznik, 1998).

2.3.5. Multidimensional Family Therapy

As implemented in CYT, MDFT (Liddle, 2002) is composed of 12 to 15 sessions (typically six with the adolescent, three with parents, and six with the whole family) and case management provided over a period of 12 to 14 weeks. Evaluated in Trial 2, MDFT proceeds in three phases: (a) setting the stage (engaging adolescents, engaging parents, building alliances with all members of the system, identifying goals of treatment), (b) working the themes for adolescents (trust/mistrust, abandonment and rejection, disillusionment and past hurts, motivation and self-agency, hope or lack of hope for the future, credibility) and families (preparing for adolescent-parent communications, managing conversation, shifting from high conflict to affective issues, developing positive experiences/interactions with each other, tying conversation and themes to drug use), and (c) sealing the changes (preparing for termination, reviewing treatment work, preparing for future challenges). MDFT is based on research linking reductions in adolescents' drug and problem behavior to changes in parenting practices (Schmidt, Liddle, & Dakof, 1996), therapist-adolescent alliance (Diamond & Liddle, 1996), and the use of culturally specific themes to engage African American males (Jackson-Gilfort, Liddle, Tejeda, & Dakof, 2001) and females (Dakof, 2000). Unlike FSN, where family therapy was added to an adolescent-focused treatment component, MDFT integrates treatment for substance use into family therapy. A key assumption of MDFT is that adolescents are involved in multiple systems (e.g., family, peers, school, welfare, legal) that produce multiple risk factors that can best be addressed in a family-based, developmental-ecological, multiple systems approach. MDFT had promising data from studies conducted prior to and concurrent with CYT and has been demonstrated to be more effective than multi-family education, adolescent group therapy, or CBT only (Liddle, 2001; Liddle et al., 2001; Liddle, Rowe, Henderson, Dakof, & Ungaro, in press). It has also been identified as a Best Practice by the U.S. Department of Health and Human Services (http://phs.os.dhhs.gov/ophs/BestPractice/mdft_miami.htm), a SAMHSA Model Program (http://modelprograms.samhsa.gov), and an effective drug abuse treatment approach by NIDA's Behavioral Therapies Development Program (http://www.nida.nih.gov/BTDP/Effective).

2.3.6. Staff characteristics

Therapists employed in this study had a range of educational backgrounds (20% doctorates, 50% masters, 30% bachelors) and averaged 7 years of clinical experience.

Though most of the therapists were experienced clinicians, this was the first time most had used a manual-guided therapy (Godley, White, et al., 2001).

2.3.7. Staff training and supervision of clinical staff

After training for the intervention they were to deliver, clinical staff taped their sessions for review. Each treatment clinical coordinator reviewed audio or videotapes of all sessions provided by each therapist until he or she was certified as proficient in that intervention. Weekly supervision continued throughout the study and included review of at least two therapy tapes per month to prevent therapist drift. During tape reviews, the clinical coordinators completed treatment-specific rating forms to monitor adherence and provide feedback to therapists. Since sites and the clinical coordinators were geographically distanced from each other, the group supervision meetings occurred during frequent conference calls. These meetings provided clinical coordinators the means of ensuring consistency in the delivery of an intervention across disparate locations.

2.3.8. Treatment received by condition

Table 3 shows the type and quantity of services received by conditions based on the daily service logs completed by each therapist. These data demonstrate that the conditions differed significantly and as planned with regard to modality of services (e.g., participant only, multiple participant groups, multi-family groups, parent/collateral only, family counseling, case management), hours of contact, length of stay, days of contact, and treatment completion. In Trial 1, the conditions were designed to compare a range of dosages and modalities. When compared to MET/CBT5 participants, MET/CBT12 participants were provided more group treatment, days of contact, and had longer lengths of stay. FSN was the only intervention to provide multi-family, collateral, family therapy, and case management services and provided the most total hours of service. In Trial 2, each condition focused on different modalities. MET/CBT5 was the briefest individual and group approach without any family involvement, while ACRA was primarily provided on an individual basis to the adolescent with some parent only and family sessions, and case management. MDFT provided the most hours of family therapy. Of the adolescents assigned to one of the four 12- to 14-week treatment interventions, 52% had lengths of stay that reached 90 days and 86% stayed 6 or more weeks. For the 6- to 7-week MET/CBT5 condition, 62% stayed in treatment for 6 or more weeks. The steering committee agreed that treatment completion would be defined as having completed 75% of the planned dosage for a given treatment. This was defined as at least 200 min of therapy for MET/CBT5, at least 400 min of therapy for MET/CBT12, ACRA and MDFT, and at least 800 min for FSN. Based on this definition, 71% of the adolescents completed treatment, 22% received a partial dosage (i.e., less than the standard above), and 5% were randomized but never participated in any hours of their assigned treatment.

The bottom of Table 3 also repeats the average societal cost per episode of care as estimated by French and colleagues (2002). This estimate considers the market value of all direct program resources (e.g., personnel, supplies and materials, contracted services, buildings and facilities, equipment, and miscellaneous items) after partialling out the research costs and dividing the remaining costs among the three interventions within a given site. There were significant differences in the costs of treatment by conditions across and within each site in Trial 1. In Trial 2, the differences were significant across and within sites, but in a different order by site. For example, MET/CBT5 cost the least at Site 3, but ACRA cost the least at Site 4. It is also interesting to note that the average cost across conditions was much higher at Site 4 than Site 3 ($2,118 vs. $1,194). Below in the data source section is a summary of how costs were estimated; see French et al., 2002 for a detailed discussion of the method as well as other geographical and management factors that may also explain these differences.

It is important to acknowledge that the cost estimates do not reflect potential changes in other costs to society (e.g., subsequent treatment, missing school, dentition) discussed elsewhere (French et al., 2003). We have previously demonstrated that the direct costs of the CYT interventions (reported in Table 3) were largely offset by changes in other costs to society in 12 to 30 months (see Dennis, 2003; French et al., 2003). However, these savings came from important but tertiary outcomes (e.g., reductions in service utilization, arrests, days in detention), occur in only a fraction of the cases, and were often related to multiple other co-occurring problems. No value could be placed on the core clinical outcomes (e.g., days of abstinence or percent in recovery) that are the focus of this paper and an value could not be econometrically modeled because the changes in costs society (from the tertiary outcomes) were *not* significantly correlated ($r < .10$, n.s.d.) with the changes in clinical outcomes. In other words, while knowledge about benefit costs is useful in its own right, it is not sufficient to evaluate the clinical effectiveness or cost-effectiveness of the interventions.

2.4. Data and measures

2.4.1. Data source

Data were collected from several sources including participant interviews, collateral interviews, urine tests, service logs, and other process measures (see Dennis, Titus, et al., 2002 for a complete list). The participant characteristics, diagnoses, and primary outcomes were measured with the GAIN (Dennis, 1999; www.chestnut.org/li/gain). The GAIN is a standardized semi-structured interview with 8 main sections (background, substance use, physical health, risk behaviors, mental health, environment, legal, vocational) that is designed to support diagnosis,

placement, outcome monitoring, and economic analysis. Self-reports of cannabis use were consistent at intake and various followup waves (kappa of .7 to .9) with family/collateral reports, on-site urine tests, and gas chromatography/mass spectrometry tests for delta-9-tetrahydrocannabinol (Δ^9-THC; Buchan, Dennis, Tims, & Diamond, 2002). A test-retest reliability study of key GAIN measures with 210 adolescent outpatients revealed consistent reports of days of cannabis use (rho = .7), days of alcohol use (rho = .7), lifetime abuse/dependence symptoms (rho = 2.7), and lifetime dependence diagnosis (Kappa = .6; Dennis, Titus, et al., 2002). The GAIN has also been found to accurately predict diagnoses of co-occurring psychiatric disorders that were made by independent staff blind to GAIN findings (kappas ranging from .69, adjustment disorder, to 1.0, ADHD; Shane, Jasiukaitis, & Green, 2003). The GAIN's dimensional measures of psychological problems using parent report data correlated .56 to .68 with their counterparts in the Child Behavior Checklist; Achenbach & Edelbrock, 1983; Diamond et al., in press). Self-reported treatment utilization data from the GAIN have also been found to be largely consistent with staff/agency records (r = .78; Godley et al., 2002).

Cost estimates are based on data collected with the Drug Abuse Treatment Cost Analysis Program (DATCAP; French, 2001; www.DATCAP.com). Designed to measure both the accounting and opportunity costs of a substance-abuse treatment program based on standard economic principles, DATCAP has been widely used with adult treatment, but this was its first use with adolescent programs. It is used to collect data on program resources (e.g., personnel, supplies and materials, contracted services, buildings and facilities, equipment, and miscellaneous items), program revenues and client case flow. In CYT, the DATCAP was supplemented with service contact logs completed by therapists and case managers (see Dennis, Titus, et al., 2002). A more detailed discussion of the use of DATCAP in CYT has been reported elsewhere (see French et al., 2002, 2003).

2.4.2. Clinical outcomes

The two clinical outcomes used were (a) days of abstinence between the randomization date and the 12-month followup interview and (b) whether the adolescent was in recovery at the end of the study. Days of abstinence (from cannabis, alcohol and other drugs) were summed across all four quarterly followup waves, using the adolescent's average days abstinent to fill in any missing data. Being in recovery at the end of the study was defined as living in the community (vs. incarceration, inpatient treatment, or other controlled environment) and reporting no past month substance use, abuse or dependence problems at the 12-month interview. For the 6% of the adolescents who

Table 3
Treatment dosage by condition within each trial

	Trial 1			Trial 2			
	MET/CBT5 (n = 102)	MET/CBT12 (n = 96)	FSNM (n = 102)	MET/CBT5 (n = 100)	ACRA (n = 100)	MDFT (n = 100)	Total
Mean Hours							
Participant only[b]	1.8	1.9	1.8	1.8	5.2	2.8	2.5
Multiple participant group[a,b]	3.1	7.3	7.8	2.1	0.0	0.0	3.4
Multi-family group[a]	0.0	0.0	7.8	0.0	0.0	0.0	1.3
Parent/collateral only[a,b]	0.1	0.0	0.4	0.0	1.4	1.3	0.5
Family counseling[a,b]	0.0	0.0	3.8	0.0	1.4	5.4	1.8
Total therapy sessions hours[a,b]	5.0	9.2	21.6	3.8	7.9	9.5	9.5
Case management[a,b]	0.5	0.5	1.8	1.0	2.8	4.6	1.9
Total of any service hours[a,b]	5.5	9.7	23.4	4.8	10.7	14.2	11.4
Length of stay (mean days)[a,b,d]	44.4	78.4	89.7	41.1	73.4	77.5	67.4
Percent with 6+ weeks[a,b]	65%	83%	89%	59%	85%	85%	78%
Percent with 90+ days[a,b]	2%	55%	73%	1%	39%	40%	35%
Days of contact							
Days of 1+ Therapy Sessions[a,b]	4.2	7.7	11.6	3.4	7.9	9.7	7.4
Days of Any Contact[a,b]	5.5	9.3	18.9	7.8	13.6	24.2	13.2
Treatment completion[a,c]							
Completed (column %)	87%	67%	79%	60%	61%	70%	71%
Partial (column %)	11%	31%	15%	31%	35%	26%	25%
None (column %)	2%	2%	6%	9%	4%	4%	5%
Treatment Episode cost[a,b,e,f]	$1,113	$1,185	$3,246	$1,558	$1,408	$2,002	$1,758

[a] Significant differences ($p < .05$) by condition in Trial 1.
[b] Significant differences ($p < .05$) by condition in Trial 2.
[c] Based on 0 minutes for none, and the percent below (partial) and equal or above (Full) the following amount of therapy treatment: 200 minutes for MET/CBT5, 400 for MET/CBT12, ACRA and MDFT, and 800 for FSN.
[d] Based on days from randomization to last therapy session of treatment.
[e] Significant difference ($p < .05$) by site and condition within site 0 but in different directions (see Appendix at http://www.chestnut.org/li/downloads/Dennis_et_al_in_press_CYT_MF_Appendix.pdf).
[f] Economic cost from a societal perpective as reported in French et al. 2002.

did not complete their 12-month interview, data from their previous followup interview was used to determine their recovery status.

2.4.3. Cost effectiveness

The two economic outcomes used were the (a) cost per day of abstinence (CPDA) over the 12-month followup period and (b) cost per person in recovery at the end of the study. The economic costs of each episode of care was estimated in 1999 dollars from a societal perspective (i.e., market value of goods and services used) and previously reported (French et al., 2002). Overall estimates were made for each of the three conditions within each of the four sites (12 total). Within site and condition, these costs were prorated based on the hours of therapy sessions received by a given adolescent, divided by the average hours for all individuals in the same condition and site. CPDA was then calculated by dividing the adolescent's prorated costs (PC) by his or her total days abstinent (TDA; i.e., for individual *i,* $CPDA_i = PC_i / TDA_i$). Since it is impossible to divide by a 0/1 measure, CPPR was calculated as the individual's prorated costs divided by the percent of individuals for the same therapy condition (within site) that were in recovery (PR); that is, for individual *i,* in therapy condition *t* and site *s*, $CPPR_i = PC_i / PR_{t\ s}$.

2.5. Procedures

2.5.1. Staff training and supervision of research staff

All field staff were centrally trained to use the GAIN interview by its developer and supervised by both a cross-site and a local research coordinator. The cross-site research coordinator reviewed and certified each of the on-site research coordinators using taped interviews; then the local coordinator reviewed and certified the site's research staff through tape review or direct observation. Questions related to data collection and research procedures were addressed by local site coordinators and the cross-site coordinator conducted an annual review of all research materials to maximize adherence to the study's research methods. Data analysts regularly reviewed raw data to identify any implementation problems that could be addressed with additional training (Dennis, Titus, et al., 2002). Economic data was collected by an independent team under the direction of Dr. French (a health economist and author of the DATCAP).

2.5.2. Recruitment

Participants were recruited from the existing case flow of the sites and through outreach to the juvenile justice system, schools, doctors and public service announcements from 1998 to 2000. Of the 1244 adolescents screened, 44% were ineligible based on the inclusion and exclusion criteria (20% being too severe for outpatient treatment, 24% not being severe enough). Of the 702 who were eligible, 600 (85%) agreed to participate. See Dennis, Titus, et al., (2002) for more details.

2.5.3. Randomization

Within each site, eligible adolescents were assigned to one of the three local conditions using a randomly ordered list that was generated by independent research staff at the coordinating center using Microsoft Excel. To prevent any bias in the assignment process, research staff were only able to assign an adolescent after he or she was determined eligible and had completed the intake assessments. Since clinical staff needed to be trained in the specific intervention they were providing, they could not be blind to a participant's assignment. Assignment logs were kept in a locked file cabinet and were never accessible to clinical staff. To prevent bias at followup, tracking and followup logs were maintained separately from assignment logs. Unique identification numbers were assigned to every adolescent screened and used by the coordinating center to audit the randomization process.

2.5.4. Data collection and processing

Intake and 3-, 6-, 9- and 12-month followup interviews were conducted by research staff. While participation in the study was voluntary, participants were compensated ($25 to $50 depending on site) for each followup assessment, and to maximize followup completion rates, an extensive tracking protocol was used (see Dennis, Titus, et al., 2002; Scott, in press). Of the 600 adolescents randomized, one or more followup interviews were completed on 99% ($n = 597$), including 98% at 3 months, 97% at 6 months, 96% at 9 months, and 94% at 12 months.

2.5.5. Analytic procedures

Following the Consolidated Standards of Reporting Trials (Moher, Schultz, & Altman, 2001), all analyses were conducted with an "intent-to-treat" approach. Thus, all adolescents were included in analyses as assigned, including approximately 5% who did not actually receive any treatment. Analyses were conducted with SPSS (2001) by site and across sites for each of the two trials. The baseline clinical measures (days of abstinence or % in recovery) were included as covariates to allow for individual differences. Within each trial, site differences were modeled with a dummy variable. Reflecting the randomized block design, conditions were modeled as nested within site, which produces a statistic for the significance of site effects, conditions across site effects, and conditions within site effects. Logistic regression was used to analyze differences for the percent in recovery at 12 months, as this is a dichotomous outcome. Where there were significant differences by condition, Tukey multiple range tests were conducted to verify which condition or conditions were different in pair-wise comparisons. Statements about the size of an effect or trends are based on Cohen's (1988) effect size f (for multiple groups), with 0.10 being considered small, 0.20 moderate, and 0.40 or more large.

In CYT, about one in five adolescents report no use in the month immediately preceding intake. Review of these

cases suggests that this most likely was due to a combination of recent arrest/urine monitoring, or because an adolescent entered treatment from a controlled environment (e.g., following residential treatment; detention, hospital discharge). Several alternative analysis were conducted with past 90 day scales as covariates to verify that these findings held with alternative approaches and measures. They did not change the overall pattern of results and are available from JSAT in an on-line appendix at http://www.chestnut.org/LI/downloads/Dennis_et_al_CYT_MF_Appendix.pdf).

Since there was no control or treatment as usual condition, cost and cost-effectiveness measures were compared to the average for a given site or trial as recommended by Gold and colleagues (1996). In both of the cross-site analyses and three of the four site analyses, the results show that one condition economically "dominates" the others (i.e., it is both the most effective and least expensive), so cost-effectiveness ratios are neither necessary nor appropriate (Gold et al., 1996). For the remaining site, we have reported a cost-effectiveness ratio (CER) in the text to evaluate the return of increased costs in terms of increased effectiveness. This ratio is calculated as the difference between the condition's cost and the site average (ΔC) over the difference in the condition's outcomes and the site's average outcome (ΔO; i.e., for treatment t in site s, $CER = (C_t - C_s) / (O_t - O_s) = \Delta C / \Delta O$). Conditions with lower ratios are considered to be the more "cost-effective," which means that further investment in them has a higher than expected rate of return in terms of the changes in outcomes.

3. Results

3.1. Clinical outcome analysis

Fig. 1 shows the general pattern of clinical outcomes across sites and conditions by quarter. The days of abstinence per quarter (the solid line on top) increased from 52 (of 90) in the quarter before intake to an average of 65 days per quarter (+24%) across the four followup periods. The overall change occurred during active treatment (from intake to month 3) and was stable across followup, though individuals did vary (intraclass correlation coefficient [ICC] = .47). The percent of adolescents in recovery at each interview increased from 3% at intake to an average of 24% across the four followup periods. Again, across conditions and sites, change occurred during active treatment, was stable across followup waves, and individual adolescents continued to move in and out of recovery (ICC = .33). Fig. 2, summarized below, shows the difference by condition for each trial in the total days of abstinence. Abstinence is summed across the four followup waves and the percent in recovery at the end of the study in month 12. (Site level data is available from JSAT in an on-line appendix at http://www.chestnut.org/LI/downloads/Dennis_et_al_CYT_MF_Appendix.pdf).

In Trial 1, the total days of abstinence (summed across the four followup waves) was not significantly different by site or condition (within or across sites). The percent in recovery at the end of the study was significantly different by condition overall (Cohen's $f = 0.12$, $p < .05$) with MET/CBT5 (27%) having the highest percent in recovery, followed by FSN (22%) and MET/CBT12 (17%). However, the pair-wise differences were not large enough to reach significance using a Tukey multiple range test. These findings held both across and within sites.

In Trial 2, the total days of abstinence were not significantly different by site or condition (within or across sites). The percent in recovery was not significantly different by condition across sites, though there was a small trend (Cohen's $f = 0.16$) for ACRA (34%) to have a slightly higher percent of participants in recovery than MET/CBT5 (23%) and MDFT (19%). This finding was driven by site 3 (CHS), where within site there was a moderate sized significant difference by condition (Cohen's $f = .20$, $p < .05$)

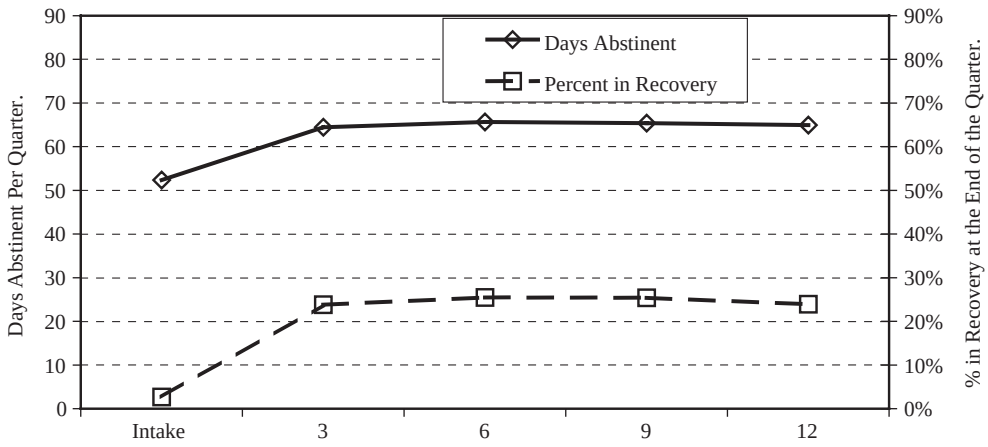
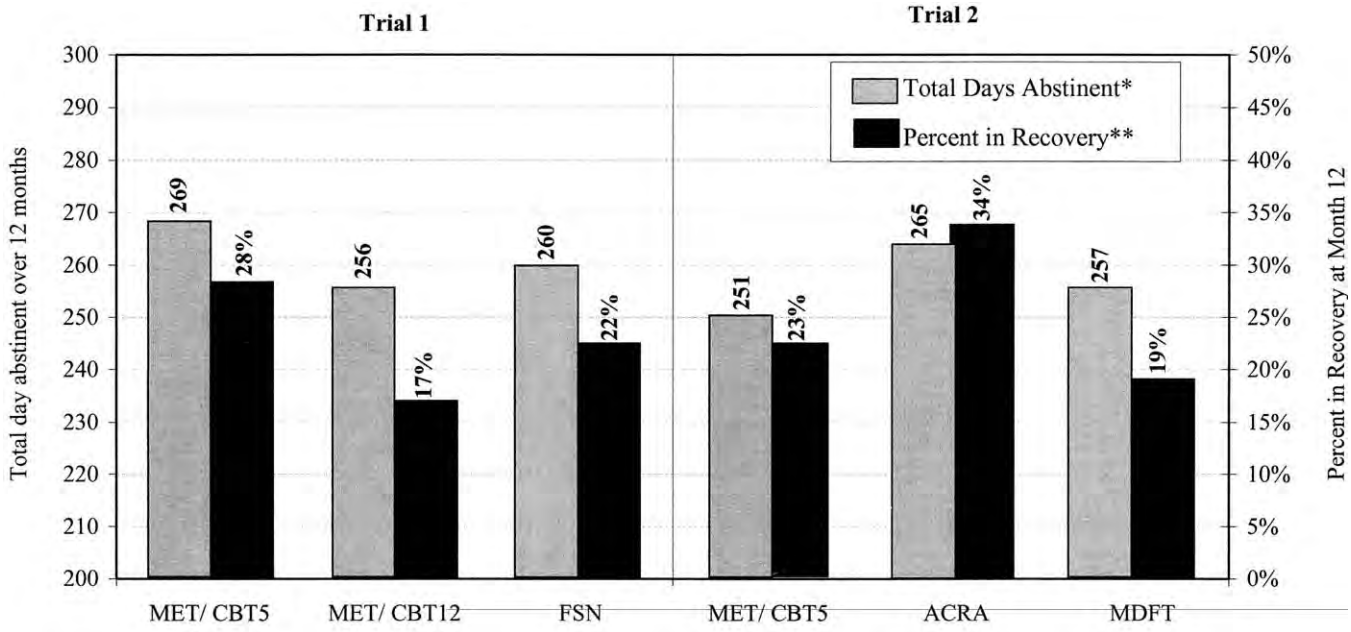


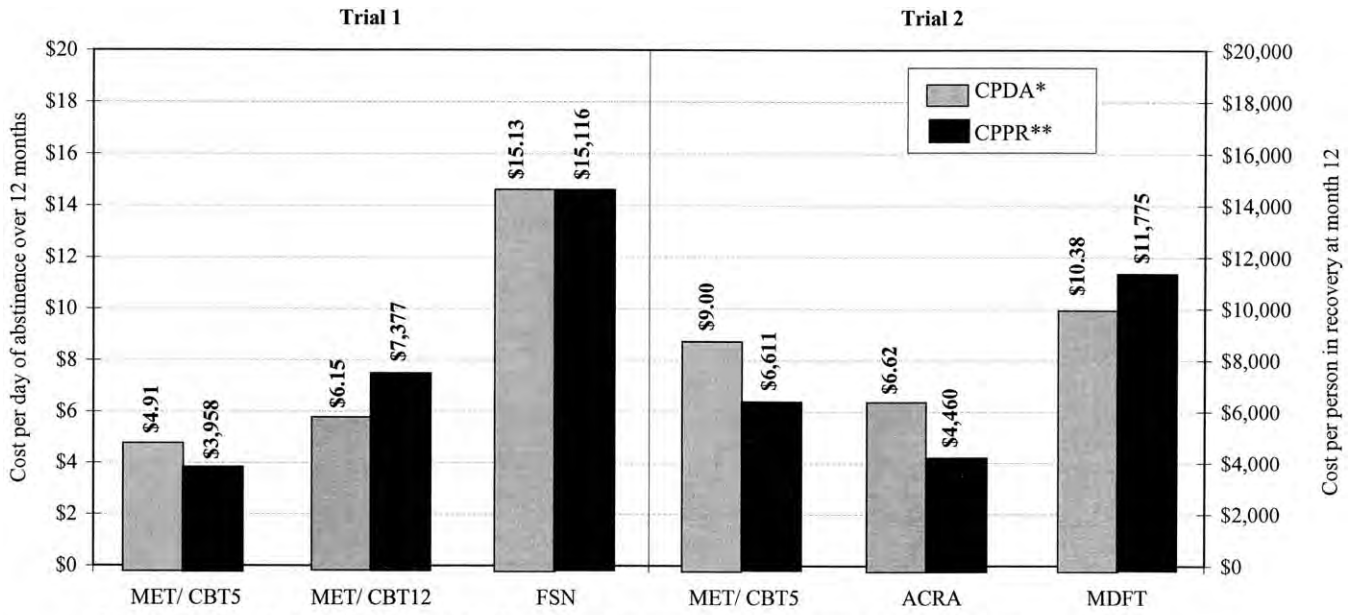
Fig. 1. Illustration of treatment and stability effects across trials, sites and conditions (n = 597).



* Total Days Abstinent not statistically significant by condition after controlling for site & baseline days of abstinence; Effect size f=0.06 in Trial 1 and f=0.06 in Trial 2.

** Percent in Recovery not statistically significant by condition after controlling for site and recovery status in the month before intake; Effect size f=0.12 in Trial 1 and f=0.16 in Trial 2.

Fig. 2. Clinical outcomes by condition.



* Cost Per Day Abstinent (CPDA) statistically significant by condition ($p<.05$) after capping at 99% and controlling for site & baseline days of abstinence; CPDA Effect size f=0.48 in Trial 1 and f=0.22 in Trial 2.

** Cost Per Person in Recovery (CPPR) at month 12 statistically significant by condition ($p<.05$) after controlling for site and recovery status in the month before intake; CPPR Effect size f=0.72 in Trial 1 and f=0.78 in Trial 2.

Fig. 3. Economic efficiency of CYT Therapies across site.

with ACRA (40%) having a higher percent in recovery than MDFT (22%) and MET/CBT5 (18%). However, the pair-wise differences were not large enough to reach significance using a Tukey multiple range test.

3.2. Cost-effectiveness analysis

Given the differences by condition in cost presented earlier (see Table 3) and the similarity of clinical outcomes (Fig. 2), the next logical step was to consider the economic efficiency with which the conditions achieve their clinical outcomes. Across trials and conditions, the average cost of CYT interventions per day of abstinence achieved over the next 12 months was $8.72 per day and the average cost per person in recovery at the end of the study was $8,231. Fig. 3 shows the difference by condition for each trial in these measures and is summarized below. (Site level data and detailed calculations are available from JSAT in an on-line appendix at http://www.chestnut.org/LI/downloads/Dennis_et_al_CYT_MF_Appendix.pdf).

In Trial 1, the average cost per day of abstinence over the 12 months post intake was $8.79 and varied significantly by condition (Cohen's $f = 0.48$, $p < .05$). Based on Tukey range tests, the primary difference was that MET/CBT5 ($4.91) and MET/CBT12 ($6.15) had significantly lower cost per day of abstinence than FSN ($15.13). This pattern held at both Site 1 ($5.75 and $7.67 vs. $17.04; $f = 0.40$, $p < .05$) and Site 2 ($4.17 and $5.00 vs. $13.80; $f = 0.63$, $p < .05$). The average cost per person in recovery at the end of the study was $8,846 and varied significantly by condition (Cohen's $f = 0.72$, $p < .05$), with MET/CBT5 ($3,958) costing significantly less per person in recovery than MET/CBT12 ($7,377) and both of the MET/CBT models costing significantly less per person in recovery than FSN ($15,116). This pattern held at Site 1 ($3,495 vs. $9,257 vs. $18,284; $f = 0.67$, $p < .05$) and Site 2 ($4,369 vs. $5,914 vs. $12,899; $f = 0.81$, $p < .05$). Given that MET/CBT5 economically dominated the other conditions (i.e., it was both the most effective and least expensive), cost-effectiveness ratios were neither necessary nor appropriate.

In Trial 2, the average cost per day of abstinence was $8.65 and varied significantly by condition overall (Cohen's $f = 0.22$, $p < .05$); while there was a trend for ACRA ($6.62) to have a lower cost per day of abstinence than MET/CBT5 ($9.00) or MDFT ($10.38), the pair-wise comparisons were not significant using the more conservative criterion in Tukey range tests. Part of the problem was that across conditions there were large site differences (Site 3 = $5.15 vs. Site 4 = $12.23) and differences in the pattern by site. The Site 4 (CHOP) results parallel the cross-site findings, with ACRA having a lower average cost per day of abstinence than MET/CBT5 or MDFT ($8.09 vs. $15.83 vs. $12.79; $f = 0.23$, $p < .05$). The differences between the ACRA and MDFT were significant in pair-wise Tukey range testing, but MET/CBT5 was between them in terms of cost effectiveness and was not significantly different than either. In Site 3, MET/CBT5 was less expensive than ACRA or MDFT in pair-wise comparisons ($839 vs. $1,237 vs. $1,428), but also had a (non-significant) trend to be less effective (257 vs. 281 vs. 271 days abstinent). While it had a lower average cost per day of abstinence ($3.86 vs. $5.36 vs. $5.94; $f = 0.21$, $p < .05$), when we controlled for the average performance for the site, MET/CBT5 was actually less cost-effective (i.e., [condition cost-average cost] / [condition effect-average effect]) than ACRA ($26.34 vs. $4.10 per additional day of abstinence over average). The average cost per person in recovery at the end of the study was $7,615 and varied significantly by condition (Cohen's $f = 0.78$, $p < .06$), with ACRA ($4,460) being lower than MET/CBT5 ($6,611) and both being lower than MDFT ($11,775) in Tukey range tests. While there were still major site differences in magnitude, the above order and significance findings were replicated at Site 3 ($3,123 vs. $4,673 vs. $6,490; $f = 0.61$) and Site 4 ($6,029 vs. $8,016 vs. $17,979; $f = 0.83$, $p < .05$). Both across and within sites, ACRA economically dominated MET/CBT5 and MDFT and MET/CBT5 economically dominated MDFT.

4. Discussion

4.1. Summary

This study examined the relative clinical effectiveness and cost-effectiveness of five short-term (90 days or less) outpatient treatments for adolescents with cannabis use disorders in two randomized trials with 600 adolescents from four sites. All five CYT interventions demonstrated significant pre-post treatment effects that were stable in terms of increasing days of abstinence during the 12 months after they were randomized to a treatment intervention and the percent of adolescents in recovery at the end of the study. Overall, the clinical outcomes were very similar across sites and conditions. The effect sizes were generally small (Cohen's $f = .1$) and varied by measure and site. Such findings are also consistent with earlier studies with adults that compared multiple approaches to substance abuse treatment (sharing many common components/approaches; e.g., Babor & Del Boca, 2003; Crits-Christoph et al., 2001; Cooney, Babor, DiClemente, & Del Boca, 2003). Alternative analyses using mixed models, repeated measures, and scales (instead of individual items) to reduce measurement error and increase statistical power were consistent with these findings. Though the findings from these analyses were similar in direction and magnitude of effect sizes, the increased statistical power of these analyses did identify some additional statistically significant differences. (See appendix noted above for more detail.)

Given the similarity in clinical outcomes and large differences in the costs of the interventions, cost-effectiveness was also examined. There were significant cost differences by condition in each of the 4 sites. When treatment costs

were combined with clinical outcomes to estimate the cost per day of abstinence over the 12-month followup period and cost per person in recovery at the last followup interval, moderate (Cohen's $f = .2$) to large ($f \geq .4$) significant differences by condition were revealed. In Trial 1, MET/CBT5 and to a lesser extent MET/CBT12, were more cost-effective than FSN. In Trial 2, ACRA and to a lesser extent MET/CBT5, were more cost-effective than MDFT.

4.2. Strengths and limitations

This study has both strengths and limitations. It offers initial evidence that: (a) the five treatments can be delivered in the manner intended and can be differentiated quantitatively and qualitatively; (b) the costs of these treatments differ in predictable ways associated with their intensity but all are roughly within the bounds now commonly spent on adolescent outpatient treatment (see French et al., 2002); (c) the treatments are reasonably acceptable to the adolescents and their families as evidenced by participation and retention rates reported above; (d) many (though certainly not all) of these adolescent cannabis users show significant improvement in substance use and in other measures "during" treatment (months 0–3) and these improvements are sustained for significant periods following treatment completion; (e) the amount and duration of the clinical improvements were very similar between sites and across treatments; and (f) the cost-effectiveness differences are moderate to large.

The primary methodological limitations of this study are its reliance on participant self-report, the generalizability of the cost estimates to non-experimental settings, and the lack of a no-treatment control group. While self-reports are generally valid and typically more sensitive to change than biometric measures, collateral reports, or records (Del Boca & Noll, 2000; Dennis, Titus, et al., 2002; Rouse, Kozel, & Richards, 1985), the study would have been strengthened by having multiple types of measures available at all followup waves. While the economists tried to control for research and start up costs, there were large differences by site and ideally these cost estimates need to be replicated as part of more natural/on-going efforts to implement these interventions. CYT was also one of the first economic evaluations of adolescent treatment. Further work is need to better understand the differences in cost-effectiveness (based on direct costs and clinical outcomes) as reported here and benefit-cost effectiveness (based on a range of other tertiary outcomes—but *not* the core clinical outcomes). Both clinical and economic outcomes might vary with other populations and settings. From a methodological perspective, it would have been preferable to have a no-treatment control group; however, this was considered unethical at the time of CYT and it is unlikely that any Institutional Review Board or Principal Investigator would go back to compare the CYT interventions to a no-treatment control. However, comparisons with other interventions based on research and/or practice are clearly warranted. Replications are already under way to evaluate each of the CYT interventions. These include a 22-site study of MET/CBT5 in multiple populations and settings, MET/CBT5 and MDFT in early intervention programs, MET/CBT12, FSN, ACRA, and MDFT in several day and juvenile drug court programs, and ACRA in several continuing care studies.

4.3. Implications and suggestions for future study

Contrary to expectations based on reviews of studies that had minimal treatment comparison groups (Kaminer, 2001; Kaminer & Burleson, 1999; Kaminer et al., 1998), we found only limited evidence that simply increasing the dosage of treatment had a differential effect on substance use and associated problems.

Despite concerns in the literature that group therapy might produce iatrogenic effects (e.g., Dishion, McCord, & Poulin, 1999), all three group therapy conditions were associated with reduced substance use and problems during the three month treatment phase and these changes were stable during the 12 month followup. No evidence was found that there were iatrogenic effects from the group therapy relative to individual and family therapy.

Although it was expected that the longer and resource intensive family treatment approaches would be more effective, family treatments did *not* prove to be consistently superior to the other interventions. In Trial 1, MET/CBT5 was as effective as FSN and in Trial 2; ACRA was as effective as the more family systems focused MDFT. We believe these findings can be explained, at least in part, because all the interventions were designed to be developmentally appropriate and implemented with a high level of quality assurance as was common in the early family therapy studies.

Each treatment team expected that their respective intervention would be significantly more effective than the others, but the clinical outcomes over time were relatively similar. It is possible that these similarities occurred because treatment outcomes are driven more by general factors (e.g., Frank & Frank, 1991) rather than the kinds of differences found in the treatment approaches tested in this study. Alternatively, the similar findings may be due to shared "other factors" (e.g., days in subsequent treatment, incarceration, juvenile justice monitoring, systematic and structured ways of helping teens to attend to and decrease their connection to cannabis and alcohol).

When relapse patterns were further examined over the followup period, it was found that half of the adolescents went in and out of periods of recovery and relapse one or more times after discharge. Two thirds were still reporting substance use or related problems at the 12-month followup interview. Thus, while the CYT interventions were relatively effective as initial interventions, they were not enough to interrupt all future substance use and problems for many adolescents. For significant subgroups of clinically referred teens, the conceptualization of their

drug problems as a chronic condition (Kazdin, 1987) suggests the need to focus more on monitoring and re-intervention or continuing care.

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This appendix provides site and cross site level data to document the results reported in the main findings paper, a discussion of several concerns and alternative analyses that have been conducted to address common questions about the findings, and the results of more complicated analyses that differ somewhat from what is reported in the main paper.

A.1 Documentation of Site Level Analysis of Clinical Outcomes and Cost Effectiveness

Table A1 at the end of this appendix displays the results of the cost, clinical outcome, and cost effectiveness analyses for each condition across sites (the focus of the main paper) and within each site. As shown in Table 3 in the main findings paper, the treatment costs are in 1999 dollars and have been previously reported (French et al., 2002). The next two columns show the results of the two clinical outcomes: the average days abstinent over the 12 month follow-up period and percent of participants in recovery at the end of the study with the across site data matching what was summarized in Figure 2 in the main paper. In the last two columns are the two economic measures: the cost per day of abstinence over the 12 month follow-up and the cost per person in recovery at the end of the study. For each column, the table shows the mean, Cohen's f, and the probability of this degree of group differences occurring by chance at alpha <.05 overall, as well as for site effects.

Notice the large site difference in the cost per day abstinent in Trial 2 (Site 3=$5.15 vs. Site 4=$12.23) and differences in the pattern by site. The Site 4 (CHOP) results parallel the cross-site findings, with ACRA having a lower average cost per day of abstinence than MET/CBT5 or MDFT ($8.09 vs. $15.83 vs. $12.79; f=0.23, p<.05). The differences between the ACRA and MDFT were significant in pair-wise Tukey range testing, but MET/CBT5 was between them in terms of cost effectiveness and was not significantly different than either. In Site 3, MET/CBT5 was less expensive than ACRA or MDFT in pair-wise comparisons ($839 vs. $1,237 vs. $1,428), but also had a (non-significant) trend to be less effective (257 vs. 281 vs. 271 days abstinent). While it had a lower average cost per day of abstinence ($3.86 vs. $5.36 vs. $5.94; f=0.21, p<.05), when we controlled for the average performance for the site, MET/CBT5 was actually less cost-effective (i.e., [condition cost-average cost] / [condition effect-average effect]) than ACRA ($26.34 vs. $4.10 per additional day of abstinence over average).

A.2 Alternative Analyses

Several additional analyses were conducted to examine alternative explanations that have been raised as possible alternative explanations for the findings. One possible explanation was that there might have been inadequate power to detect greater differences among the

interventions. All of the main analyses conducted for the main findings paper had over 90% power, though several of the within site and pair-wise comparison analyses as part of Tukey range testing dropped down to 80%.

A second explanation that has been raised regarding the finding that overall participants reported an increase in days of abstinence and after treatment a higher percent of adolescents were in recovery is that drug substitution may have occurred. Both the days of abstinence and percent in recovery variables considered use of alcohol, cannabis and other drugs. We also evaluated cannabis, alcohol and cocaine individually, with no change in the findings. We did find some small differences (2-3 days per quarter) in the days in a controlled environment, but these differences varied by site and condition and we believe this is better considered in terms of changes in the total cost to society of multiple high cost services simultaneously as reported in the cost-benefit paper (see French et al., 2003).

A third explanation that has often been suggested is that examining other outcome variables would reveal differences among treatment models. Across interventions, there were significant reductions from intake to 12 months in days of behavioral problems (-58%), family problems (-56 %), arguing/ violence (-66%), illegal activity (-70%), and missing school (-40%). These changes were not significantly different by condition in 9 of 10 comparisons. While there was a significant difference by condition in Trial 1, it was primarily due to MET/CBT5(-54%) having a quicker impact in the first three months of treatment and holding its gains, FSN (-63%) having a slower impact initially, but eventually doing better and MET/CBT12 (-43%) having the least impact initially, but eventually showing an impact. Even in this one case, however, the effect was still small (Cohen's f = .1).

A fourth explanation suggested is that certain interventions might be more effective for certain adolescents due to treatment by subject matching effects. No treatment matching effects were found on common classification schemes (gender, onset age, family history, externalizing disorders, internalizing disorders and temperament) in terms of substance use frequency, substance abuse problems, social support for substance use, family conflict, school problems and negative peer associations (see Babor et al., 2002).

A fifth explanation suggested that differential outcomes were obscured because the analyses did not adequately control for individual differences in characteristics, trajectory, and treatment dosage received. To address this concern, we conducted a more complicated analysis and did find some differences that are summarized below. JSAT's reviewers considered these analyses to be more complicated than warranted and revealing little additional information that was of clinical significance, but they are included here for those who are interested.

A.3 Results of Alternative Mixed Model Analysis

To better model individual differences we used a SPSS (2001) mixed-effects model allowing the a-intercept to be a random factor. To control for differences in the quantity of different treatment services received, a term for the number of days of therapy sessions -- nested within site and condition -- was included. To address the statistical "hinge" in the trend line of Figure 1, we modeled time effects with two orthogonal contrasts: a) a "treatment outcome" effect calculated by contrasting the intake value with the average value of a measure across all 4 follow-up waves (i.e., a contrast of -4 +1 +1 +1 +1 by observation wave); and, b) an "outcome stability" effect calculated by comparing the average values from early (3-months and 6-months) with later (9-months and 12-months) follow-up interviews (i.e., a contrast of 0 –1 –1 +1 +1 by

observation wave). This approach increases the observed eta square and effect size by 25-50% (depending on the variable) instead of attempting to fit the data to a single linear trend that ignores this hinge. Within each trial, site differences were modeled with a dummy variable. Reflecting the randomized block design, conditions were modeled as nested within site. To model dosage effects, we used the days attending therapy sessions, nested within condition and site (i.e., does more dosage in any model predict better outcomes?). Missing data were estimated in the mixed effects analyses using the restricted maximum likelihood (REML) method recommended by Little and Rubin (1989) for randomized trials. To reduce measurement error in the dependent variables, we switched from days abstinent to the GAIN's Substance Frequency Scale (SFS) and Substance Problem Scale (SPS). The SFS is based on the average percent of days during a 90 day period that an adolescent reports each of the following: days of "any" substance use, days of heavy substance use, days of problems from substance use, days of alcohol, cannabis, crack/cocaine, and heroin/opioid use. It has good internal consistency (alpha=.76 to .85), test-retest reliability (rho=.94) and is sensitive to change (Dennis et al., 2003; Dennis, Titus et al., 2002; Shane et al., 2003). The SPS is based on recency ratings (e.g., past month, 2-12 months ago, more than 12 months ago, never) of 16 symptoms: 7 corresponding to DSM-IV criteria for dependence, 4 for abuse, 2 for substance-induced health and psychological problems, and 3 that correspond to lower severity symptoms of use (hiding use, people complaining about use, weekly use). The past month SPS symptom count has good internal consistency (Cronbach alpha=.85 to .92), test-retest reliability (rho=.70 to .81), and has also been demonstrated to be sensitive to change (Dennis et al., 2003; Dennis, Titus et al., 2002; Shane et al., 2003). While this analysis produced similar effect sizes between conditions to those reported in the paper, the increased power of the above approach led to more "statistical significant" (i.e., reliably measured) differences being found. Tables A2 (SFS) and A3 (SPS), at the end of this document, summarizes the results over time by trial, site and condition, as well as the outcome and stability effects in terms of raw change, relative change, Cohen's effect size d for pre to post change and Cohen's effect size f for comparing change by therapy condition and is summarized below.

Across sites and conditions in Trial 1 (see top section of Tables), there was a significant, moderate-sized effect of treatment on reducing substance use (-34%, d= -0.39, $p<.05$) that was stable over the follow-up period (-1%, d= -0.01, n.s.d.). UCHC adolescents had higher rates of substance use across waves, but also had a larger treatment effect than PAR adolescents (-38% vs. –28%; d= -0.51 vs. –0.30, $p<.05$) and had further reductions (vs. increases in Site 2) over the follow-up period (-15% vs. +15%; d= -0.13 vs. +0.11, $p<.05$). There were no significant differences by conditions in substance use frequency for either the treatment effect or stability effect analyses across the PAR sites. Across sites and conditions in Trial 1, there was a significant, moderate-sized effect of treatment on reducing substance problems (-46%, d= -0.50, $p<.05$) that showed further improvement over the course of the follow-up period (-25%, d= -0.17, $p<.05$). There were no significant "site differences" in the overall level of problems, treatment effects or the stability of the effects. There were significant differences by condition in the treatment effects for substance related problems in the treatment effects analysis. FSN and MET/CBT5 participants reported greater decreases in problems than MET/CBT12 participants (-51% vs. –50% vs. –33%; d= -0.62 vs. -0.53 vs. -0.35; f=0.15, $p<.05$). Though the pattern of these differences and effect sizes (f=0.15, $p<.05$; f=0.14, $p<.05$) was consistent within each site, the condition differences were not significant due to the smaller sample size/power for the within-site analyses.

Across sites and conditions in Trial 2 (see bottom section of Tables), there was a significant, moderate-sized effect of treatment on reducing substance use (-35%, d= -0.47, p<.05) that was stable over the follow-up period (-6%, d= -0.05, n.s.d). CHS participants had higher rates of substance use across waves, but had similar treatment effects to CHOP participants in terms of relative change (-34% vs. -36%, p<.05), better treatment outcomes in terms of effect sizes (d = -0.52 vs. -0.42, p<.05) and continued gains (vs. deterioration in CHS) over the follow-up period (-17% vs. +11%; d= -0.18 vs. +0.07, p<.05). While there were no significant differences in overall treatment outcomes by condition, there were moderately sized and statistically significant differences by conditions in terms of stability (f=0.19, p<.05). Over the course of follow-up waves, substance use was further reduced for both ACRA (-10%; d=-0.10, p<.05) and MDFT participants (-11%; d=-0.07, p<.05), but remained unchanged for MET/CBT5 participants (+4%; d= +0.02, n.s.d.). Increased treatment dosage (within condition and site) was also significantly related to better outcomes. Though varying in magnitude, these patterns were replicated in each of the sites. Across sites and conditions in Trial 2, there was a significant, moderate-sized effect of treatment on substance related problems (-43%, d= -0.49, p<.05) that was stable over the follow-up period (-8%, d= -0.05, n.s.d.). CHOP adolescents had higher rates of substance related problems across waves, but similar treatment effects and outcome stability to those in the CHS site. While there were no significant differences by condition in treatment effects or outcome stability across sites, there were differences within site. At the CHS site, the treatment effect analysis revealed that ACRA participants reported the largest reductions in substance related problems compared to MDFT or MET/CBT5 (-54% vs. –38% vs. –28%; d=-0.67 vs. –0.38 vs. – 0.28; f=0.18, p<.05). At the CHOP site, the stability analysis revealed that MDFT participants reported further reductions in substance related problems during follow-up compared to ACRA or MET/CBT5 (-36% vs. +5% vs. +10%; d= -0.29 vs. +0.04 vs. +0.06; f=0.24, p<.05). Within the site and intervention conditions, adolescents receiving more than the average number of sessions generally reduced their substance problems more than those receiving less than the average number of sessions. This generic dosage effect was significant across sites, at the CHS site, and had a trend toward significance in the CHOP site.

Table A1. Cost, Effectiveness, and Efficiency Analysis by Trial, Site and Condition\a

		Episode Cost			Outcome Measures						Efficiency Measures					
		Cost (1999 Dollars) Per Treatment Episode\b			Days Abstinent (of 365)\c			% in Recovery at Month 12\d			Cost Per Days Abstinent (CPDA)\e			Cost Per Person in Recovery (CPPR)\f		
Site	Condition (n in analysis)	Mean	f	p	Mean	f	p	Mean	f	p	Mean	f	p	Mean	f	p
Trial 1																
Across Sites 1 & 2 (n=299)		**$ 1,861**	**0.78 \i**		**262**	**0.06**		**0.23**	**0.12 \i**		**$ 8.79**	**0.48 \i**		**$ 8,846**	**0.72**	**\h,i**
	MET/ CBT5 (n=102)	$ 1,113			269			0.28			$ 4.91			$ 3,958		
	MET/ CBT12 (n=95)	$ 1,185			256			0.17			$ 6.15			$ 7,377		
	FSNM (n=102)	$ 3,246			260			0.22			$ 15.13			$ 15,116		
Site 1 - UCHC (n=131)		**$ 1,800**	**0.72 \g**		**245**	**0.03**		**0.21**	**0.18 \g**		**$ 9.97**	**0.40 \g**		**$ 10,034**	**0.67**	**\g**
	MET/CBT5 (n=48)	$ 1,112			249			0.32			$ 5.75			$ 3,495		
	MET/CBT12 (n=41)	$ 1,187			242			0.13			$ 7.67			$ 9,257		
	FSNM (n=42)	$ 3,200			244			0.18			$ 17.04			$ 18,284		
Site 2 - PAR (n=168)		**$ 1,909**	**0.84 \g**		**275**	**0.11**		**0.24**	**0.06**		**$ 7.88**	**0.63 \g**		**$ 7,912**	**0.81**	**\g**
	MET/CBT5 (n=54)	$ 1,114			287			0.25			$ 4.17			$ 4,369		
	MET/CBT12 (n=54)	$ 1,183			266			0.20			$ 5.00			$ 5,914		
	FSNM (n=60)	$ 3,279			271			0.25			$ 13.80			$ 12,899		
Trial 2																
Across Sites 3 & 4 (n=298)		**$ 1,655**	**0.54 \h**		**258**	**0.06**		**0.25**	**0.16**		**$ 8.65**	**0.22 \h,i**		**$ 7,615**	**0.78**	**\h,i**
	MET/ CBT5 (n=99)	$ 1,558			251			0.23			$ 9.00			$ 6,611		
	ACRA (n=100)	$ 1,408			265			0.34			$ 6.62			$ 4,460		
	MDFT (n=99)	$ 2,002			257			0.19			$ 10.38			$ 11,775		
Site 3 - CHS (n=150)		**$ 1,194**	**0.57 \g**		**271**	**0.10**		**0.27**	**0.20 \g**		**$ 5.15**	**0.21 \g**		**$ 4,769**	**0.61**	**\g**
	MET/CBT5 (n=42)	$ 839			257			0.18			$ 3.86			$ 4,673		
	ACRA (n=54)	$ 1,237			281			0.40			$ 5.36			$ 3,123		
	MDFT (n=54)	$ 1,428			271			0.22			$ 5.94			$ 6,490		
Site 4 - CHOP (n=148)		**$ 2,118**	**0.52 \g**		**244**	**0.03**		**0.23**	**0.11**		**$ 12.23**	**0.23 \g**		**$ 10,462**	**0.83**	**\g**
	MET/CBT5 (n=57)	$ 2,078			247			0.26			$ 12.79			$ 8,016		
	ACRA (n=46)	$ 1,608			245			0.27			$ 8.09			$ 6,029		
	MDFT (n=45)	$ 2,691			240			0.15			$ 15.83			$ 17,979		
Average Across Trials (n=597)		**$ 1,758**	**0.66**		**260**	**0.06**		**0.24**	**0.14**		**$ 8.72**			**$ 8,231**		

\a Predicted as dependent variable at follow-up or $DV_{(post)} = DV_{(pre) + SITE} + COND(SITE)$

\b Cost in 1999 dollars estimates from French et al 2002; prorated based on % of mean days of formal treatment for site and condition.

\c Summed across follow-up waves 3 to 12 (with mean replacement within individual for missing waves).

\d Recovery is a dichotomous variable, so significance tested by logistic regression.

having zero cost; people with 0 days of abstinence being dropped; low correlation (r = -.03, n.s.d.) between cost and days abstinent; and rounding.

\f Individual cost divided by % in recovery for site & condition (a constant within cell); Estimates vary from simple division of means due to the low correlation between cost and recovery (r = -.02, n.s.d.) and rounding.

\g Significant difference (p<.05) between conditions within site

\h Significant difference (p<.05) between sites (Trial 1: UCHC=0, PAR=1; Trial 2: CHOP=0, CHS=1)

\i Significant differences (p</05) by condition (nested within site) across sites.

Table A2. Effects on Substance Frequency Scale (SFS) over Time by Site and Condition\a

			Follow-up Wave				Averages			Treatment (Tx) Effects				Stability (St) Effects			
Site	Condition (n in analysis)	Intake	3	6	9	12	3 to 12	3 & 6 9 & 12		Chng	R.C.	d_{Tx}	f_{Tx}	Chng	R.C.	d_{St}	f_{St}
Trial 1																	
Across Sites 1 & 2 (n=299) \b,d,e,f		**0.15**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**-0.05**	**-34%**	**-0.39**	**0.09**	**0.00**	**-1%**	**-0.01**	**0.10**
	MET/CBT5 (n=102)	0.15	0.09	0.11	0.09	0.09	0.09	0.10	0.09	-0.05	-35%	-0.40		-0.01	-10%	-0.06	
	MET/CBT12 (n=95)	0.15	0.11	0.12	0.10	0.11	0.11	0.11	0.10	-0.04	-26%	-0.30		-0.01	-7%	-0.07	
	FSNM (n=102)	0.16	0.10	0.09	0.10	0.11	0.10	0.09	0.11	-0.06	-38%	-0.47		0.01	14%	0.10	
Site 1 - UCHC (n=131) \b,g		**0.20**	**0.13**	**0.12**	**0.11**	**0.11**	**0.12**	**0.13**	**0.11**	**-0.07**	**-38%**	**-0.51**	**0.10**	**-0.02**	**-15%**	**-0.13**	**0.13**
	MET/CBT5 (n=48)	0.20	0.12	0.13	0.11	0.09	0.11	0.13	0.10	-0.08	-41%	-0.57		-0.03	-22%	-0.17	
	MET/CBT12 (n=41)	0.19	0.15	0.14	0.10	0.12	0.13	0.15	0.11	-0.05	-28%	-0.37		-0.03	-22%	-0.23	
	FSNM (n=42)	0.20	0.13	0.08	0.12	0.11	0.11	0.11	0.11	-0.09	-44%	-0.60		0.00	3%	0.05	
Site 2 - PAR (n=168) \b,g		**0.12**	**0.07**	**0.09**	**0.09**	**0.10**	**0.09**	**0.08**	**0.09**	**-0.03**	**-28%**	**-0.30**	**0.07**	**0.01**	**15%**	**0.11**	**0.06**
	MET/CBT5 (n=54)	0.10	0.05	0.09	0.07	0.09	0.08	0.07	0.08	-0.03	-26%	-0.26		0.01	8%	0.08	
	MET/CBT12 (n=54)	0.12	0.08	0.10	0.10	0.10	0.10	0.09	0.10	-0.03	-24%	-0.24		0.01	11%	0.09	
	FSNM (n=60)	0.14	0.08	0.09	0.10	0.11	0.09	0.08	0.10	-0.05	-33%	-0.38		0.02	24%	0.15	
Trial 2																	
Across Sites 3 & 4 (n=298) \b,d,e,f,i,k		**0.17**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**-0.06**	**-35%**	**-0.47**	**0.12**	**-0.01**	**-6%**	**-0.05**	**0.19**
	MET/CBT5 (n=99)	0.18	0.12	0.10	0.12	0.10	0.11	0.11	0.11	-0.06	-36%	-0.49		0.00	4%	0.02	
	ACRA (n=100)	0.16	0.11	0.11	0.10	0.10	0.10	0.11	0.10	-0.06	-36%	-0.46		-0.01	-10%	-0.10	
	MDFT (n=99)	0.18	0.14	0.10	0.11	0.11	0.12	0.12	0.11	-0.06	-32%	-0.45		-0.01	-11%	-0.07	
Site 3 CHS (n=150)\b,g,k		**0.15**	**0.09**	**0.09**	**0.10**	**0.09**	**0.09**	**0.09**	**0.10**	**-0.05**	**-36%**	**-0.42**	**0.11**	**0.01**	**11%**	**0.07**	**0.15**
	MET/CBT5 (n=42)	0.14	0.10	0.10	0.12	0.10	0.10	0.10	0.11	-0.03	-23%	-0.28		0.01	14%	0.09	
	ACRA (n=54)	0.14	0.09	0.10	0.08	0.08	0.09	0.09	0.08	-0.05	-36%	-0.38		-0.01	-11%	-0.09	
	MDFT (n=54)	0.17	0.08	0.08	0.11	0.10	0.09	0.08	0.11	-0.07	-45%	-0.56		0.03	35%	0.22	
Site 4 CHOP (n=148) \b,g,i		**0.20**	**0.16**	**0.12**	**0.12**	**0.12**	**0.13**	**0.14**	**0.12**	**-0.07**	**-34%**	**-0.52**	**0.12**	**-0.02**	**-17%**	**-0.18**	**0.23**
	MET/CBT5 (n=57)	0.20	0.14	0.11	0.13	0.11	0.12	0.12	0.12	-0.09	-43%	-0.67		0.00	-1%	-0.03	
	ACRA (n=46)	0.19	0.13	0.13	0.11	0.12	0.12	0.13	0.12	-0.07	-35%	-0.56		-0.01	-10%	-0.12	
	MDFT (n=45)	0.19	0.21	0.14	0.10	0.13	0.15	0.18	0.11	-0.04	-19%	-0.31		-0.07	-40%	-0.42	
Average Across Trials (n=597)		**0.16**	**0.11**	**0.11**	**0.10**	**0.10**	**0.11**	**0.11**	**0.10**	**-0.06**	**-34%**	**-0.43**		**0.00**	**-4%**	**-0.03**	

\a **Chng**. is Change=post-pre; **R.C**.is Relative Change calculated as (post-pre)/pre; $\mathbf{d}_{tx\ is}$ Cohen's effect size d for within condition/site "treatment effect"; $\mathbf{f}_{tx}$ is Cohen's effect size f for differences in treatment effects by condition(within site); $\mathbf{d}_{st\ is}$ Cohen's effect size d for within condition/site outcome "stability effect"; $\mathbf{f}_{St}$ is Cohen's effect size f for differences in stability effects by condition(within site).

\b Treatment effect (intake vs. average follow up) significant (p<.05)

\c Outcomes changing significantly (p<.05) over time (3 & 6 vs.9& 12)

\d Significant difference (p<.05) between site (Trial 1: UCHC=0, PAR=1; Trial 2: CHOP=0, CHS=1).

\e Treatment effects vary significantly (p<.05) by site.

\f Stability of outcomes vary significantly (p<.05) by site.

\g Significant baseline differences (p<.05) by condition (within site)

\h Treatment effects vary significantly (p<.05) by condition (within site)

\i Stability of outcomes vary significantly (p<.05) by condition (within site).

\j Days of formal treatment (within condition and site) significantly (p<.05) related to baseline rates of use.

\k Treatment effect varies significant (p<.05) by days of formal treatment (within condition and site).

\l Stability of outcomes varies significant (p<.05) by days of formal treatment (within condition and site).

Table A3. Effects on Substance Problem Scale (SPS) over Time by Site and Condition\a

			Follow-up Wave				Averages			Treatment (Tx) Effects				Stability (St) Effects			
Site	Condition (n in analysis)	Intake	3	6	9	12	3 to 12	3 & 6	9 & 12	Chng	R.C.	d_{Tx}	f_{Tx}	Chng	R.C.	d_{St}	f_{St}
Trial 1																	
Across Sites 1 & 2 (n=299) \b,c,h		**3.7**	**2.4**	**2.2**	**1.7**	**1.7**	**2.0**	**2.3**	**1.7**	**-1.7**	**-46%**	**-0.50**	**0.15**	**-0.6**	**-25%**	**-0.17**	**0.12**
	MET/CBT5 (n=102)	3.7	2.3	2.0	1.4	1.5	1.8	2.2	1.4	-1.8	-50%	-0.53		-0.8	-36%	-0.21	
	MET/CBT12 (n=95)	3.5	2.8	2.7	2.0	1.9	2.3	2.7	1.9	-1.2	-33%	-0.35		-0.7	-26%	-0.23	
	FSNM (n=102)	4.0	2.2	1.9	1.8	1.8	1.9	2.0	1.8	-2.1	-51%	-0.62		-0.2	-11%	-0.07	
Site 1 - UCHC (n=131) \b,c,g		**4.7**	**3.3**	**2.9**	**2.3**	**2.5**	**2.8**	**3.1**	**2.4**	**-1.9**	**-41%**	**-0.50**	**0.15**	**-0.7**	**-22%**	**-0.19**	**0.14**
	MET/CBT5 (n=48)	5.0	3.0	2.8	2.0	2.0	2.5	2.9	2.0	-2.5	-49%	-0.62		-0.9	-32%	-0.21	
	MET/CBT12 (n=41)	4.4	4.1	3.7	2.6	2.4	3.2	3.9	2.5	-1.2	-27%	-0.30		-1.2	-30%	-0.35	
	FSNM (n=42)	4.8	3.1	2.4	2.3	3.1	2.7	2.7	2.7	-2.1	-42%	-0.57		0.0	2%	0.00	
Site 2 - PAR (n=168) \b,c,g		**3.0**	**1.7**	**1.6**	**1.3**	**1.2**	**1.4**	**1.7**	**1.2**	**-1.5**	**-52%**	**-0.55**	**0.14**	**-0.5**	**-29%**	**-0.17**	**0.06**
	MET/CBT5 (n=54)	2.5	1.8	1.3	0.8	1.1	1.2	1.6	0.9	-1.3	-51%	-0.52		-0.7	-43%	-0.26	
	MET/CBT12 (n=54)	2.9	1.8	1.9	1.6	1.5	1.7	1.9	1.5	-1.2	-41%	-0.43		-0.4	-19%	-0.12	
	FSNM (n=60)	3.5	1.6	1.6	1.4	0.9	1.4	1.6	1.2	-2.1	-60%	-0.68		-0.4	-26%	-0.13	
Trial 2																	
Across Sites 3 & 4 (n=298) \b,d,k		**3.9**	**2.4**	**2.2**	**2.2**	**2.0**	**2.2**	**2.3**	**2.1**	**-1.7**	**-43%**	**-0.49**	**0.10**	**-0.18**	**-8%**	**-0.05**	**0.15**
	MET/CBT5 (n=99)	3.7	2.0	2.4	2.5	2.3	2.3	2.2	2.4	-1.4	-39%	-0.41		0.18	8%	0.06	
	ACRA (n=100)	4.4	2.4	2.1	2.2	2.0	2.2	2.3	2.1	-2.2	-50%	-0.64		-0.15	-6%	-0.06	
	MDFT (n=99)	3.5	2.8	2.0	2.0	1.8	2.2	2.4	1.9	-1.4	-40%	-0.43		-0.59	-24%	-0.16	
Site 3 - CHS (n=150) \b,g,h,k		**3.9**	**2.4**	**2.3**	**2.3**	**2.1**	**2.3**	**2.4**	**2.2**	**-1.7**	**-42%**	**-0.46**	**0.18**	**-0.19**	**-8%**	**-0.05**	**0.08**
	MET/CBT5 (n=42)	3.8	2.4	3.0	3.1	2.6	2.8	2.7	2.9	-1.1	-28%	-0.28		0.18	7%	0.05	
	ACRA (n=54)	4.7	2.6	2.1	1.8	2.0	2.1	2.4	1.9	-2.5	-54%	-0.67		-0.37	-16%	-0.12	
	MDFT (n=54)	3.2	2.3	2.0	2.2	1.6	2.0	2.1	1.9	-1.2	-38%	-0.38		-0.28	-13%	-0.07	
Site 4 - CHOP (n=148) \b,g,i		**3.8**	**2.4**	**2.1**	**2.2**	**2.0**	**2.2**	**2.2**	**2.1**	**-1.7**	**-44%**	**-0.54**	**0.01**	**-0.17**	**-8%**	**-0.05**	**0.24**
	MET/CBT5 (n=57)	3.7	1.8	2.0	2.2	2.0	2.0	1.9	2.1	-1.7	-47%	-0.52		0.18	10%	0.06	
	ACRA (n=46)	4.0	2.3	2.1	2.6	2.0	2.2	2.2	2.3	-1.8	-44%	-0.60		0.11	5%	0.04	
	MDFT (n=45)	3.9	3.6	2.0	1.7	2.0	2.3	2.8	1.9	-1.7	-42%	-0.48		-1.00	-36%	-0.29	
Average Across Trials (n=597)		**3.81**	**2.44**	**2.19**	**1.98**	**1.88**	**2.12**	**2.31**	**1.93**	**-1.69**	**-44%**	**-0.50**		**-0.37**	**-16%**	**-0.11**	

\a **Chng**. is Change=post-pre; **R.C**.is Relative Change calculated as (post-pre)/pre; $\mathbf{d}_{tx\ is}$ Cohen's effect size d for within condition/site "treatment effect"; $\mathbf{f}_{tx}$ is Cohen's effect size f for differences in treatment effects by condition(within site); $\mathbf{d}_{st\ is}$ Cohen's effect size d for within condition/site outcome "stability effect"; $\mathbf{f}_{St}$ is Cohen's effect size f for differences in stability effects by condition(within site).

\b Treatment effect (intake vs. average follow up) significant (p<.05)

\c Outcomes changing significantly (p<.05) over time (3 & 6 vs.9& 12)

\d Significant difference (p<.05) between site (Trial 1: UCHC=0, PAR=1; Trial 2: CHOP=0, CHS=1).

\e Treatment effects vary significantly (p<.05) by site.

\f Stability of outcomes vary significantly (p<.05) by site.

\g Significant baseline differences (p<.05) by condition (within site)

\h Treatment effects vary significantly (p<.05) by condition (within site)

\i Stability of outcomes vary significantly (p<.05) by condition (within site).

\j Days of formal treatment (within condition and site) significantly (p<.05) related to baseline rates of use.

\k Treatment effect varies significant (p<.05) by days of formal treatment (within condition and site).

\l Stability of outcomes varies significant (p<.05) by days of formal treatment (within condition and site).