

Cost-Effectiveness of Assertive Community Treatment Versus Standard Case Management for Persons with Co-Occurring Severe Mental Illness and Substance Use Disorders

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Objective. To determine the cost-effectiveness of Assertive Community Treatment (ACT) in comparison to Standard Case Management (SCM) for persons with severe mental illness and substance use disorders.

Data Sources and Study Setting. Original data on the effectiveness and social costs of ACT and SCM that were collected between 1989 and 1995. Seven community mental health centers in New Hampshire provided both types of treatment.

Study Design. Persons with schizophrenia, schizoaffective disorder, or bipolar disorder and a concurrent substance use disorder were randomly assigned to ACT or SCM and followed for three years. The primary variables assessed were substance use, psychiatric symptoms, functioning, quality of life, and social costs.

Data Collection Methods. Effectiveness data were obtained from interviews at six-month intervals with persons enrolled in treatment and with their service providers. Social cost and service utilization data came from client reports; interviews with informal caregivers; provider information systems and Medicaid claims; law enforcement agencies; courts; and community service providers.

Principal Findings. Participants in both groups showed significant reductions in substance use over time. Focusing on quality of life and substance use outcomes, ACT and SCM were not significantly different in cost-effectiveness over the entire three-year study period. Longitudinal analyses showed that SCM tended to be more efficient during the first two years but that ACT was significantly more efficient than SCM during the final year of the study.

Conclusions. In an adequately funded system, ACT is not more cost-effective than SCM. However, ACT efficiency appears to improve over time.

Key Words. Mental illness, substance use disorders, quality of life, Assertive Community Treatment (ACT), Standard Case Management (SCM), cost-effectiveness/cost benefit

Substance use disorders are common among persons with severe mental illness (SMI). According to the Epidemiologic Catchment Area study, approximately one-half of all persons with severe mental illness will have a substance use disorder during their lifetime, a rate three times that of the general population (Regier, Farmer, Rae, et al. 1990). Surveys of persons in treatment for SMI suggest even higher rates of lifetime substance abuse (Mueser, Bennett, and Kushner 1995). Associated with dual disorders are psychotic symptoms (Carey, Carey, and Meisler 1991); depression and suicidality (Bartels, Drake, and McHugo 1992); violence (Cuffel et al. 1994); and homelessness (Caton, Shrout, Eagle, et al. 1994). Treatment costs tend to be higher for persons with dual disorders (Bartels, Teague, Drake, et al. 1993; Dickey and Azeni 1996; Kivlahan, Heiman, Wright, et al. 1991). Studies also suggest that they require more assistance from their families (Clark 1994) and are more likely to be arrested and jailed than are others in the general population (Abram and Teplin 1991).

Effective treatment for persons with co-occurring disorders is vital. Improvements in symptoms and functioning would benefit them directly and might also reduce the societal costs associated with their high rates of

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hospitalization and frequent encounters with the legal system, and with the large time and money investments by their families. Despite these and other potential advantages, good treatment for dual disorders has been hampered by underdiagnosis of substance abuse problems among persons with SMI (Ananth, Vandewater, Kamal, et al. 1989; Drake, Osher, Noordsy, et al. 1990) and by fragmentation in the financing, organization, and delivery of substance abuse and mental health services (Ridgely, Goldman, and Willenbring 1990).

Mental health treatment providers have begun to address these problems through specialized training and integrated treatment programs. Training has focused on the unique problems associated with diagnosis and treatment of substance abuse in persons with SMI. Diagnostic and screening approaches have been developed specifically for persons with SMI and substance use disorders (Drake, Rosenberg, and Mueser 1996; Rosenberg, Drake, Wolford, et al. 1998); and the concept of treatment stages, with interventions targeted to each client's stage of recovery, has been applied to co-occurring disorders (McHugo et al. 1996).

Integrated treatment models unify services at the provider level rather than forcing clients to negotiate treatment in the mental health and substance abuse systems simultaneously (Minkoff 1989). Such approaches may provide separate but well-coordinated services, or they may have a single team of clinicians taking responsibility for both substance abuse and mental health treatment. The latter model is often patterned after Assertive Community Treatment (ACT), which was developed specifically for persons with SMI. Among other aims, ACT seeks to improve treatment engagement and compliance by focusing on clients' practical needs and by delivering services in community settings where learning may generalize more readily to daily living (Test 1992).

In spite of its promise, relatively little is known about the cost-effectiveness of integrated treatment compared to traditional interventions for dual disorders. ACT and similar models of intensive case management can be significantly more expensive than traditional treatment, yet they can also reduce hospitalization and may actually lower total costs over time (Bond et al. 1988; Bond, Witheridge, Dincin, et al. 1990; Borland, McRae, and Lycan 1989; Bush et al. 1990). Mental health treatment that addresses substance abuse directly may be more effective for persons with SMI than simply referring them to a separate substance abuse treatment provider. Evidence from a small naturalistic study showed that persons with SMI and a current substance use disorder had substantially higher institutional costs (hospitals and jails) and used emergency services more frequently than did similar

persons with a history of substance use but with no current disorder or persons with SMI who had never had a substance use disorder (Bartels, Teague, Drake, et al. 1993). Jerrell and colleagues (Jerrell 1996; Jerrell, Hu, and Ridgely 1994) showed that clients who were enrolled in a treatment program patterned after ACT and those who received behavioral skills training showed significantly greater improvements in psychiatric symptoms and had lower supportive treatment costs than did those referred to a 12-step program similar to Alcoholics Anonymous. Persons enrolled in behavioral skills training also showed significant reductions in substance abuse symptoms and in intensive treatment costs. Although this study is perhaps the strongest evidence to date for the cost-effectiveness of integrated treatments relative to others, interpretation of the findings is colored by nonrandom assignment to treatment and by a variation in program implementation across sites.

The well-documented impact of co-occurring SMI and substance use disorders on the legal system, on families, and on the use of other social programs suggests that treatment programs should be evaluated in a broad context. Focusing exclusively on treatment costs could make programs that shift costs to other systems appear to be more efficient than they really are. On the other hand, a program could also avert other social service costs, a positive effect that should be understood. The societal perspective, in principle including all costs and benefits, is perhaps the most relevant one from which to compare the cost-effectiveness of interventions or conditions that generate significant external costs. Several studies have used societal or modified societal perspectives to compare the cost-effectiveness of treatments for SMI (Dickey et al. 1986; Jerrell, Hu, and Ridgely 1994; Weisbrod 1983; Wolff, Helminiak, and Diamond 1995).

This article compares the cost-effectiveness of two integrated treatment models for persons with co-occurring SMI and substance use disorders. One model incorporates specialized treatment for dual disorders in an ACT team. The other is a standard case management (SCM) program with targeted substance abuse services. A detailed analysis of clinical and functional outcomes is presented elsewhere (Drake, McHugo, Clark, et al. 1998). Here, we present new data on treatment and social costs and combine cost data with two basic outcome measures to evaluate the cost-effectiveness of the two treatment alternatives.

TREATMENT MODELS

Assertive Community Treatment teams with special training in substance abuse treatment were developed in seven catchment areas in New Hamp-

shire. Each ACT team was located in a nonprofit community mental health center (CMHC) with an existing standard case management program. ACT teams followed established principles of assertive treatment but also provided the following: direct substance abuse treatment; nonconfrontational, behaviorally oriented treatment directed toward achieving abstinence; groups for the stages of persuasion and active treatment; and a clear team focus on dual disorders (Drake, Teague, and Warren 1990). ACT teams had substantially smaller caseloads than the SCM programs (12:1 versus 25:1).

Standard case management provided less individual treatment for substance abuse, did not have a team focus, and gave less intensive service. Both programs provided similar percentages of service in community settings, used assertive outreach to engage clients, followed a dual disorders model including group treatment, and combined practitioners from different disciplines (e.g., case managers, social workers, nurses, psychologists, and psychiatrists). For a more thorough description of how the two models were implemented, see Teague, Drake, and Ackerson (1995).

Hypothesis

Because of their greater intensity and more focused approach to substance abuse treatment, we hypothesized that ACT teams would be more cost-effective in reducing substance abuse than standard case management. Specifically, we hypothesized that ACT participants would achieve greater reductions in substance use and that lower substance use would result in less frequent and shorter hospitalizations, fewer arrests and other encounters with the legal system, less use of shelters and soup kitchens for the homeless, and a lowered demand on families for financial support and caregiving. When combined, these changes would result in significantly better substance abuse outcomes, a higher quality of life, and lower societal costs for persons treated by the ACT team.

METHODS

Sample

Study participants were selected from seven of New Hampshire's ten mental health catchment areas. Two of these areas were urban; the remaining five were predominantly rural with towns of 25,000 persons or less. People were eligible for the study if they met the following criteria: a DSM-III-R diagnosis of schizophrenia, schizoaffective disorder, or bipolar disorder; an active substance use disorder according to DSM-III-R criteria; between the ages of

18 and 60; no medical comorbidities that would prevent participation in the study; without a diagnosis of developmental learning disability; and with a willingness to provide written informed consent to participate in the study.

Of the 306 persons who were initially screened, 223 were enrolled in the study and were randomly assigned to either ACT or SCM. Participants were predominantly male (74 percent), nonminority white (96 percent), never married (61 percent), with at least a high school education (63 percent), and unemployed (82 percent). The average age of participants was 34 at study entry. Just over one-half of the participants were diagnosed with schizophrenia (53.6 percent), 22.7 percent had a diagnosis of schizoaffective disorder, and the remainder (23.6 percent) met criteria for bipolar disorder.

Over the three-year study period, 20 participants were lost to follow-up. Of these, 11 refused to continue the study, 7 died, and 2 moved to other states and could not be located for subsequent interviews. Those who enrolled in standard case management were more likely to be lost to attrition than were those assigned to ACT (14.0 percent versus 3.7 percent, $X^2(1,223) = 7.33$, $p = .007$). However, analysis of the remaining 203 participants showed that those enrolled in SCM and ACT did not differ significantly on any of the criteria for study entry. For a more detailed description of sample selection and comparisons for equivalence, see Drake, McHugo, Clark, et al. (1998).

We were unable to collect complete cost data on ten of the 203 participants who completed the study (five participants from each treatment group). The primary reason for incomplete cost data was that these participants received significant amounts of treatment from an out-of-state provider for one or more six-month measurement periods, preventing us from accurately assessing mental health treatment costs. The resulting final sample analyzed in this article was 193 persons: 100 in ACT and 93 in SCM.

Procedures

Study participants were interviewed at the time they enrolled in the study (between 1989 and 1991) and at six-month intervals thereafter, for a total of three years. Interviews covered substance use, psychiatric symptoms, quality of life, housing stability, and other areas related to participants' functioning and well-being. Additional data on substance abuse and services provided were collected from case managers.

Effectiveness Measures

Substance Abuse Treatment Ratings. Upon study entry and at six-month intervals over the study period, each participant's substance abuse treatment progress

was assessed using a consensus rating process based on the Substance Abuse Treatment Scale (SATS) (McHugo et al. 1996). Consensus ratings used data from a variety of sources including participant and clinician reports, and urine drug screens. The advantage of this approach is that it reduces distortion due to the underreporting of alcohol and other drug use by persons in treatment and that it views recovery from substance use disorders as a longitudinal process rather than as an acute event. See Drake, Mueser, and McHugo (1995) for a more detailed description of the SATS and the rating process. For the cost-effectiveness analysis we used both point measures (e.g., baseline score at study entry, six-month score, end-of-study score) and a cumulative score created by summing ratings from all six assessments after study entry. Baseline ratings were excluded from the latter measure. Although the point measures are useful for comparing ratings at a particular time or for assessing change from one point to another, the cumulative scores provide a measure of participants' substance use recovery over the entire three-year period. Compared to end-point measures, cumulative scores are more heavily influenced by the speed of recovery and are less affected by brief relapses and measurement error. Further, they do not assume that a person's recovery from substance abuse is linear or irreversible. Using cumulative scores, an individual's substance use may fluctuate substantially over time: at the end point, she or he may have improved or may actually have more extensive substance use than before. The goal was to characterize each client's substance use during the entire period, taking into account reductions in use, periods of abstinence, and periods of relapse.

Subjective Quality of Life. Quality of life ratings are based on the average of two subjective ratings by the study participant at each of the seven measurement periods (baseline and each six months for three years). The question, taken from the Quality of Life Interview (Lehman 1988), asked "How do you feel about your life overall?" Participants chose one of seven responses ranging from "terrible," which was assigned a value of 1, to "delighted," which rated a 7. Average ratings on this question, asked twice, at the beginning and at the end of the interview, were highly correlated with other subjective ratings from the Quality of Life Scale. In an effort to make these ratings easier to interpret for readers accustomed to utility-type ratings, we converted these values to range from 0 (terrible) to 1 (delighted). To produce cumulative scores, ratings from each of the six interviews after study entry were weighted by the length of time, in years, spent in each rating. For example, a rating of 6 ("pleased" on the terrible-to-delighted scale) during the first six months of the study would be converted to a value of .83 on the 0 to 1 scale and then multiplied by .5 to

indicate one-half year at that rating. These weighted ratings were summed for each participant over the six post-baseline measurement periods to produce the cumulative score.

The validity of quality of life (QOL) ratings by persons with SMI, particularly subjective ratings, is controversial. Atkinson, Zibin, and Chuang (1997), for example, reported that people with mood disorders tended to give lower QOL ratings than those with schizophrenia, even though objective indicators suggested that they had a higher quality of life. These authors also argued that self-reports may be unduly influenced by recent life events. Further, our reliance on only two ratings in each time period may yield less stable QOL measures than would more extensive scales.

The criticisms notwithstanding, we chose a QOL rating for one of our two outcome measures because it represents a global measure of how study participants evaluated their lives. As such, it offers a view complementary to that provided by the SATS, which is based on a more objective assessment of substance use and treatment involvement. While diagnostic differences and recent events may introduce some measurement error, random assignment and the use of multiple ratings at different time points should reduce the effects of such error on group comparisons.

Resource Consumption and Cost Measures

Through an exhaustive multi-method approach, we measured the consumption of mental health treatment; general healthcare; services provided through the legal system; community services, such as shelters for the homeless and soup kitchens; the administrative cost of transfer payments; and informal caregiving from family members or friends. All costs were adjusted for inflation using the consumer price index (CPI-U) and are reported in 1995 dollars. The general approach was to measure resource use carefully, from one or more primary sources whenever possible; then to determine the economic cost per unit of service or goods consumed; and finally to multiply units consumed by unit cost to produce total costs per person. A detailed description of methods and data sources is contained in several published sources (Clark and Drake 1994; Clark, Teague, Ricketts, et al. 1994; Clark, Ricketts, and McHugo 1996). Next is a brief overview of the cost data.

Mental health treatment costs were based on an analysis of service utilization data from CMHC management information systems for most outpatient services; a combination of self-reports, CMHC clinical reports, and hospital records for inpatient services; and Medicaid payments for outpatient services supplied by private providers. Because all CMHCs contracted with

the state, outpatient services were defined and tracked in the same way across all seven centers. Service units for all CMHC outpatient services were computed separately for each program operated by the center and were based on client contact hours rather than on staff hours. For purposes of analysis, ACT and SCM costs were combined with other outpatient services, including day treatment, medication management, emergency intervention, and residential services. Unit costs were determined for the 1991, 1992, and 1993 fiscal years from audited cost reports. Where necessary, reported values of capital costs were adjusted to reflect the true economic cost of resources. For example, the value of donated or fully depreciated space was estimated at fair market rental rates for similar space. Inpatient costs were based on bed-day rates determined from Medicare cost reports for the year in which the hospitalization took place. Hospital rates were also adjusted to reflect the economic value of capital assets. In general, adjustments to reported costs had a negligible effect on average unit costs. The services of private providers, which were a small percentage of all outpatient costs, were valued at Medicaid payment rates.

General healthcare costs were based primarily on Medicaid payment records. Uncompensated care and treatment paid by other insurers were estimated from self-reports and were valued at Medicaid payment rates. During the study period, 82.5 percent of study participants were enrolled in Medicaid.

Legal system costs were based on an extensive search of local and state police, court, jail, prison, CMHC, and hospital records. Unit costs for different types of services were determined from careful analysis of public expenditure records, adjusted when necessary to reflect the economic value of capital assets. In most cases, resource measures were based on the actual amount of time (hours or minutes) spent with a study participant on each occasion. Our calculations differ from other figures reported in the literature because they include the value of civil action and of informal time (i.e., time spent by law enforcement officers that did not result in an arrest), as well as costs associated with arrests. To attribute costs, we used an episode approach (Clark, Teague, Ricketts, et al. 1994) that includes all costs triggered by events (e.g., arrests) during the study period. Costs associated with events before the study period were excluded.

The *cost of other community services* was based on extensive searches of records from a complete list of local public and private social service agencies, including homeless shelters, public guardianship programs, local fire departments, and ambulance companies. Unit costs of such services were

based on an analysis of representative providers' financial records. The costs of ambulance transport were derived from municipal records for publicly operated services and from Medicaid payments for private companies.

Informal caregiving and support costs were based on interviews, at six-month intervals, with family members or friends nominated by the study participants. In the interviews, caregivers reported the amount of time they spent providing care of various sorts to the study participant during the previous two weeks; expenditures for a study participant were reported for the past month. Whenever possible, caregivers reported informal assistance provided by others as well as by themselves. The economic value of caregiving was based on average hourly wages during 1993 for persons in New England of the same sex and similar age as the caregiver. Interview information on the amount of assistance provided and on the opportunity costs of caregiving was combined to estimate the total value of informal care given over the previous six-month period. Although caregivers for a significant number of the study participants were interviewed ($n = 177$), a number of caregivers did not begin their initial interview until the study was already under way. To produce a more complete picture of caregiving costs across the entire study period, we used multiple regression to estimate caregiving costs for missing periods based on family characteristics and on study participants' reports of how often they had seen their family during the previous six months.

Finally, the *administrative cost of transfer* payments was based on participants' reports of public benefits received, such as Supplemental Security Income (SSI) or Social Security Disability Insurance (SSDI). Only the cost of administering these payments was included because, from a societal perspective, income transfers do not increase or decrease national wealth. Our measurement of administrative costs followed the approach used by Frisman and Rosenheck (1996). The actual amount of transfer payments was also calculated but was excluded from our cost-effectiveness analyses.

Analytic Approach

Our analysis began with a comparison of costs and outcomes between SCM and ACT over the entire study period. Next we constructed group and individual cost-effectiveness ratios for univariate comparisons of efficiency in producing substance use and quality of life outcomes. We then used least-squares regression to examine the effects of group assignment and other covariates on efficiency. Finally, we used a random-effects model to track nonlinear trends of efficiency over time.

We used both group-level and individual-level approaches to cost-effectiveness analysis. Traditional cost-effectiveness analysis compares group differences, or increments, in costs and in effectiveness. When costs are less and effectiveness is greater, a treatment is said to “dominate” others and is the preferred choice. When a treatment is more effective but more costly, or when it is less effective but less costly, a ratio of cost per unit of effectiveness gained is used to measure the amount of value that is gained or lost.

Another approach, developed more recently and less grounded in economic theory, compares cost-effectiveness ratios at an individual rather than a group level. For these univariate comparisons of individual ratios, we employed a likelihood ratio test developed by Siegel, Laska, and Meisner (1996). This test statistic has an underlying chi-square distribution with a null hypothesis that average ratios are equivalent for each group.

To examine the influence of various factors on these outcomes, we employed more advanced techniques. Using ordinary least squares (OLS) regression to predict the average cost-effectiveness ratios described earlier, we included the following variables in the model: gender; age at study entry; a variable coded 1 if the participant had a bipolar disorder and 0 if he or she had schizophrenia or a schizoaffective disorder; baseline stage of treatment or quality of life score; and a dummy variable indicating that the participant had baseline inpatient costs in the top one-third of all participants (1 = yes; 0 = no), a dummy variable indicating that the participant had total mental health costs in the top third of participants during the baseline period (1 = yes; 0 = no), and a dummy variable indicating the treatment program to which the participant was assigned (1 = ACT; 0 = SCM). Regressions used logged and raw versions of the average cost-effectiveness ratio scores.

To model nonlinear trends, we used a random-effects model (REM) (Gibbons et al. 1988; Laird and Ware 1982) implemented with the SAS Proc Mixed procedure. A major advantage of REM, compared to conventional repeated-measures approaches, is its ability to model correlated longitudinal or cluster data and incomplete (missing at random) data. In the case of repeated measures analysis, this model assumes that dependence among observations over time within the same subject is due to the natural heterogeneity of subjects caused by unmeasured factors. In other words, because it assumes that each individual subject may respond to treatment differently, the model accommodates this by allowing parameters to vary from subject to subject. Since it uses available data to estimate an individual regression line, not group means, subjects do not have to be assessed at all time points and at the same time.

In our analysis, we treated the intercept and slope as random effects to account for the possible individual heterogeneity in beginning level and in the rate of linear change. We included random components in our model, but for our purposes we were interested in the fixed-effect components of the model. The fixed-effect coefficients can be interpreted in the same way as standard least-squares regression.

RESULTS

Both the ACT and the SCM groups reduced their substance use significantly and achieved higher stages on the Substance Abuse Treatment Scale (SATS) over time. SATS scores for SCM improved from a baseline mean stage of 2.8 to 4.9 at the end of the three-year study period ($t = 11.11$, $df = 92$, $p < .001$). ACT participants improved from a mean of 2.8 at study entry to 5.1 in the last study period ($t = 12.48$, $df = 99$, $p < .001$). Ratings for the two treatments were not significantly different in the final measurement period ($t = .42$, $df = 191$, *n.s.*). Mean cumulative ratings over the study period were also slightly higher for ACT than for SCM, but differences were not significant (SCM = 26.00; ACT = 26.45; $t = .36$, $df = 191$, *n.s.*).

Subjective quality of life ratings also increased for both groups over the study period. From study entry to ending, ratings increased from .61 to .65 for SCM participants ($t = 1.77$, $df = 92$, $p = .08$) and from .56 to .66 for ACT participants ($t = 4.06$, $df = 99$, $p < .001$). Mean quality of life years over the three-year study period were slightly higher for ACT participants than for SCM enrollees, but not significantly so (SCM = 1.74, ACT = 1.77; $t = .27$, $df = 191$, *n.s.*). For a more detailed discussion of effectiveness outcomes see Drake, McHugo, Clark, et al. (1998).

Table 1 displays total social costs for each treatment group over the three-year study period. ACT participants showed a trend toward lower average social costs and lower costs in each of the major subcategories (e.g., mental health, general health, etc.) except for the administrative cost of transfers, which was slightly higher for ACT. Despite this general tendency toward lower costs for ACT, differences between ACT and SCM were not statistically significant for total costs or for any of the component costs using standard *t*-tests and analysis of variance. Using log transformations to reduce the effects of extreme scores did not change the finding of no difference in total social costs or in mental health treatment costs over the study period. However, ACT social costs were significantly lower than SCM in the final six-month period. SSI and SSDI payments over the study period, which were

excluded from the analysis along with other transfer payments, averaged \$14,930 per person for ACT and \$15,080 per person for SCM.

The analysis of specific types of services used indicated that ACT program services increased steadily during the first year of the study and remained relatively constant afterward. Six-month costs for ACT, beginning with the first period and continuing through the sixth period, were \$2,816, \$3,168, \$3,710, \$3,952, \$3,583, and \$3,750. Standard case management program costs demonstrated a similar pattern but were about one-half of ACT program costs; they averaged, respectively, \$2,325, \$1,414, \$1,621, \$1,720, \$1,806, and \$1,657. However, SCM participants used significantly larger amounts of other mental health center services, such as intensive and rehabilitative day treatment, housing support, and crisis/respite care. In contrast to some previous studies, ACT inpatient costs were not significantly lower than inpatient SCM costs.

In our comparison of differences in raw effectiveness and in cost scores to assess cost-effectiveness, ACT appeared to dominate SCM (i.e., it was more effective and less costly) in both substance abuse and quality of life comparisons. However, as previously noted, the differences were not statistically significant, either individually or using the Fieller method of computing confidence intervals for ratios (Fieller 1954).

As an alternative to incremental cost-effectiveness analysis, we compared ratios of cumulative quality of life years to total social costs and mental health treatment costs for ACT and SCM over the three-year study period. This analysis showed, again, that the two treatments were not significantly different. A similar comparison of cumulative substance abuse treatment scores also showed no difference between ACT and SCM. Average ratios for quality of life years per \$10,000 *in social costs* were .24 for ACT and .20 for SCM (likelihood ratio $X^2 = .011$, n.s.). Ratios for quality of life years per \$10,000 *in treatment costs* were .65 for ACT and .45 for SCM ($X^2 = .004$, n.s.). Ratio comparisons using stage of treatment yielded similar results with cumulative stages of treatment per \$10,000 in social costs for ACT = 1.65 and for SCM = 1.44 ($X^2 = .0739$, n.s.) and for mental health treatment costs 4.15 and 3.38, respectively ($X^2 = .00003$, n.s.).

Goodness-of-fit statistics and residual plots for the OLS regression analysis showed that models with logged versions of ratios had a better model fit. Results of the logged versions are shown in Table 2. For substance abuse treatment ratios, those who entered the study at higher stages of treatment cost less per unit of effectiveness to treat than those who entered with lower scores; participants with higher costs for inpatient treatment or for total mental health

Table 1: Average Costs for Persons Assigned to Standard Case Management (SCM) or to Assertive Community Treatment (ACT)

Cost Category	1st Year Study Costs		2nd Year Study Costs		3rd Year Study Costs		3-Year Total Study Costs	
	SCM Observed Costs (n = 93)	ACT Observed Costs (n = 100)	SCM Observed Costs (n = 93)	ACT Observed Costs (n = 100)	SCM Observed Costs (n = 93)	ACT Observed Costs (n = 100)	SCM Observed Costs (n = 93)	ACT Observed Costs (n = 100)
<i>Mental Health</i>								
MH outpatient	\$ 19,915	\$ 16,236	\$ 18,932	\$ 16,944	\$ 18,464	\$ 15,685	\$ 57,311	\$ 48,864
MH inpatient	\$ 7,471	\$ 10,993	\$ 10,467	\$ 11,555	\$ 9,665	\$ 11,457	\$ 27,604	\$ 34,006
<i>General Health</i>								
GH outpatient	\$ 1,125	\$ 776	\$ 1,720	\$ 1,309	\$ 2,368	\$ 1,913	\$ 5,212	\$ 3,999
GH inpatient	\$ 204	\$ 1,001	\$ 56	\$ 199	\$ 385	\$ 145	\$ 645	\$ 1,345
<i>Legal</i>								
Arrest episodes	\$ 856	\$ 1,133	\$ 677	\$ 532	\$ 858	\$ 297	\$ 2,390	\$ 1,963
Non-arrest episodes	\$ 105	\$ 181	\$ 145	\$ 89	\$ 102	\$ 112	\$ 361	\$ 382
<i>Other Community Services</i>								
Shelter	\$ 45	\$ 8	\$ 6	\$ 28	\$ 6	\$ 1	\$ 57	\$ 37
Public guardian	\$ 44	\$ 9	\$ 44	\$ 10	\$ 49	\$ 53	\$ 136	\$ 71
Fire and ambulance	\$ 37	\$ 20	\$ 25	\$ 29	\$ 25	\$ 16	\$ 87	\$ 64
<i>Family</i>								
Family expenditures	\$ 2,216	\$ 2,129	\$ 2,115	\$ 2,282	\$ 2,046	\$ 2,085	\$ 6,376	\$ 6,496
Family time costs	\$ 7,778	\$ 6,711	\$ 7,840	\$ 6,866	\$ 7,324	\$ 6,227	\$ 22,942	\$ 19,804
<i>Administrative Cost of Transfer Payments</i>								
	\$ 350	\$ 370	\$ 361	\$ 347	\$ 313	\$ 328	\$ 1,023	\$ 1,046
<i>Mean Total Study Costs</i>								
	\$ 40,145	\$ 39,568	\$ 42,396	\$ 40,191	\$ 41,604	\$ 38,319	\$ 124,145	\$ 118,078
(standard deviation)	(\$ 24,275)	(\$ 28,671)	(\$ 28,857)	(\$ 29,189)	(\$ 28,710)	(\$ 37,385)	(\$ 63,143)	(\$ 81,437)

Note: Means in some categories include persons with costs = 0. All costs are in 1995 dollars. No differences are statistically significant at < .05.

treatment during the year before study entry had lower (less efficient) ratios than those with pre-study costs in the lower two-thirds of all participants. Further, participants with bipolar disorders or who were older had higher (more efficient) ratios. Results for quality of life year ratios were quite similar to those of the treatment stage ratios, with no difference between the two treatment groups.

To explore changes in cost-effectiveness ratios over the study period, we used a nonlinear random effects model to analyze growth curves for each treatment group over the study period. The same independent variables used in the cumulative model were employed in the longitudinal model plus variables for time and group-by-time interactions. Table 3 displays results of this analysis for stage of treatment to total cost ratios and for quality of life years to total cost ratios. Functionally, this method combines a linear term, represented by the group-by-time interaction, with a quadratic term represented by the time-by-time-by-group interaction. In this analysis, the

Table 2: Cumulative Three-Year Efficiency

<i>Independent Variable</i>	<i>Dependent Variable</i>	
	<i>Stage of Treatment/\$10,000 Regression Coefficient</i>	<i>Quality of Life/\$10,000 Regression Coefficient</i>
<i>Sex</i> (Male = 0; Female = 1)	-.001	-.031
<i>Age</i>	.009**	.002
<i>Diagnosis</i> (Schizophrenia spectrum = 0; Bipolar = 1)	.232***	.047
<i>Baseline Stage of Treatment Rating</i>	.109*	
<i>Baseline Quality of Life Rating</i>		.152*
<i>High Inpatient Costs in Baseline Year</i>	-.159**	-.058**
<i>High Total Mental Health Treatment Costs in Baseline Year</i>	-.196***	-.073***
<i>Treatment Program</i> (SCM = 0; ACT = 1)	.014	.010
<i>Constant</i>	.600***	.219**
<i>Adjusted R²</i>	.256	.160

Note: Ordinary least-squares regression. * $p < .05$, ** $p < .01$, *** $p < .001$.

linear term essentially represents relationships during earlier time periods while the quadratic term describes the later portion of the study period.

For both the stage of treatment and quality of life ratios, the quadratic interaction terms were statistically significant. The linear interaction term was significant only in the quality of life ratio analysis. In both models the linear interaction term was negative while the quadratic term was positive. This indicates that during earlier periods SCM produced better outcomes per \$10,000 invested than did ACT. During the final year of the study the relationship was reversed, with ACT producing substantially better outcomes per \$10,000 than SCM. This curvilinear relationship is illustrated in Figures 1

Table 3: Changes in Efficiency Over Time

<i>Independent Variable</i>	<i>Dependent Variable</i>	
	<i>Stage of Treatment/\$10,000 Regression Coefficient</i>	<i>Quality of Life/\$10,000 Regression Coefficient</i>
<i>Sex</i> (Male = 0; Female = 1)	-.070	-.036*
<i>Age</i>	.001	.001
<i>Diagnosis</i> (Schizophrenia spectrum = 0; Bipolar = 1)	.228***	.090***
<i>Baseline Stage of Treatment Rating</i>	.551***	
<i>Baseline Quality of Life Rating</i>		.271***
<i>High Inpatient Costs in Baseline Year</i>	-.072	-.028
<i>High Total Mental Health Treatment Costs in Baseline Year</i>	-.076	-.064**
<i>Treatment Program</i> (SCM = 0; ACT = 1)	-.011	.022
<i>Time</i>	.078*	.031
<i>Time by Time Interaction</i>	-.010	-.005
<i>Treatment Group by Time Interaction</i>	-.089	-.066**
<i>Treatment Group by Time by Time Interaction</i>	.024**	.015***
<i>Constant</i>	.445***	.144*
<i>Mull Model LRT X² for Improvement over OLS Regression</i>	300.00***	213.94***

Note: Random-effects model with random intercept-slope. * $p < .05$, ** $p < .01$, *** $p < .001$.

and 2. In the final measurement period, the only period in which the groups differed in costs or in effectiveness outcomes, *t*-tests confirm that SCM and ACT were significantly different.

Taking into account time preferences for costs and benefits, the analyses just described were repeated after discounting costs and outcomes at 3 percent and at 5 percent rates. Discounting did not significantly alter the previously reported results. Sensitivity analysis showed that our use of imputed data for some informal caregiving costs and our episode approach to legal costs did not affect our results significantly.

DISCUSSION

For the combined three years encompassed by this study, assertive community treatment and standard case management were not significantly different in cost or in effectiveness. However, there was substantial variation in relative efficiency over the course of the study. During the first two years SCM was more efficient than ACT. The relationship reversed during the third year, with ACT becoming significantly more cost-effective than SCM. Efficiency

Figure 1: Predicted and Observed Ratios of Treatment Stage per \$10,000 for ACT and SCM

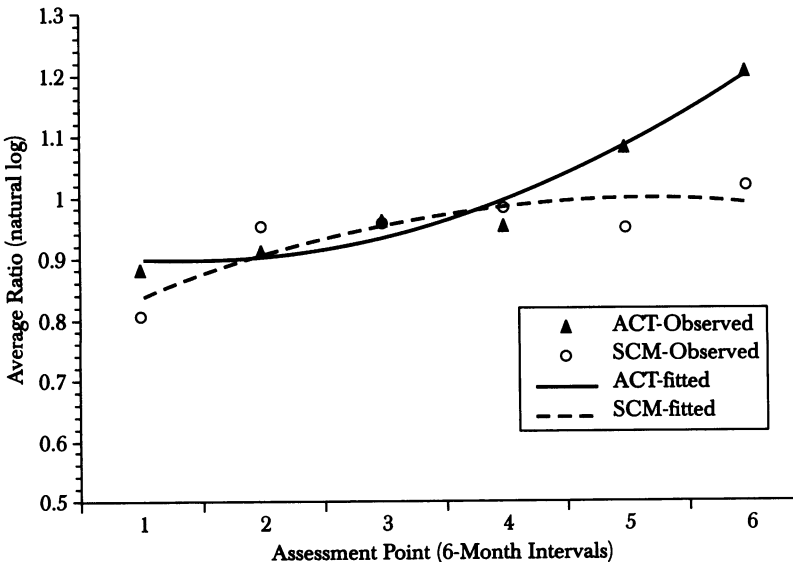
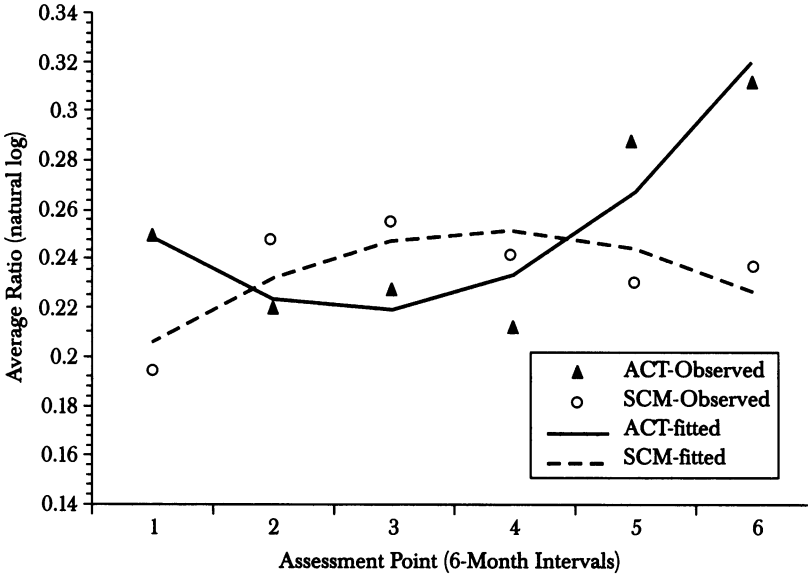


Figure 2: Predicted and Observed Ratios of Quality of Life Years per \$10,000 for ACT and SCM



differences were driven primarily by a decrease in total costs for ACT enrollees during the final year of the study. The two treatments did not have significantly different effects on cumulative substance use or on subjective quality of life ratings.

Cumulative three-year costs for ACT clients were nominally lower in most major categories, but the effects were small and our study did not have sufficient statistical power to detect such differences given the large cost variation among study participants. Gray et al. (1997) have noted the need for greater statistical power in cost-effectiveness studies based on randomized clinical trials. But adding the participants necessary to achieve sufficient power would have increased research costs significantly and might have hampered our ability to measure social costs accurately.

Because this study collected data on social costs for a longer period than had previous studies of ACT, it provides some useful insights into the long-term effects of assertive community treatment. The trajectory of costs over the study period is consistent with the belief that, although intensive treatment costs more than conventional treatment initially, it may be equally or less costly in the long run. Coefficients from the mixed-effects analysis suggest

that SCM was more efficient than ACT in the first two years but less efficient afterward than ACT. Of course, the trends shown in Figures 1 and 2 cannot be expected to continue the same divergency observed during the final year of study. Further research is needed to assess efficiency and effectiveness beyond three years.

The higher costs of the ACT teams in this study were balanced by lower costs for other outpatient services used by ACT participants. This suggests that standard case managers compensated for the lower amounts of direct service they provided by enrolling clients in other structured programs, such as housing programs and day treatment. This type of substitution might not have been possible in a more resource-poor system.

The observed differences in efficiency over time do not support the notion that ACT participation should be limited to a predetermined length of time. Although it might not be feasible to maintain ACT enrollment indefinitely, the data show that over three years assertive community treatment was no more costly than the alternative form of treatment. Given the relative efficiency of ACT during the final year, it is not clear that transferring ACT clients to standard treatment would result in savings; in fact, it could actually increase costs.

Recovery from substance abuse and treatment for severe mental illness are longitudinal processes that require varying intensities of service over time. Even those who reach abstinence need support to maintain that status as well as continuous treatment and support for their psychiatric illness. In the absence of strong evidence to suggest an ideal length of treatment, the most appropriate way to manage the length of ACT participation is probably on an individual basis, taking into account each person's specific needs and progress toward treatment goals.

Cost decreases for persons enrolled in ACT resulted from a general downward trend for most categories, but particularly for housing support, day treatment, and arrest-related costs. This general trend toward lower costs suggests a more pervasive treatment effect than that reported in previous ACT studies, where cost savings generally came from reduced hospitalization. The reason for these reductions is not entirely clear. If costs fell solely because of decreased client service needs—the conventional explanation for cost reductions—we would have expected costs for both SCM and ACT participants to have declined at about the same rate (client outcomes improved for both groups at similar rates). However, total costs for ACT clients declined more rapidly than those for SCM clients in the last year of the study. Another potential explanation might have been that ACT clients began a transition

to another program during the final year, but examination of client records does not support this hypothesis either. Participation in ACT remained high through the end of the third year, and many clients continued their ACT enrollment long after the study ended. A more likely explanation for the decline in total costs is that something about the way ACT services were organized or delivered helped to lower costs in the final year. Perhaps lower caseloads allowed team members to tailor services more appropriately to their clients' changing needs as their conditions improved. Case managers for the SCM cohort may have had less influence on day-to-day treatment decisions than their ACT counterparts, who saw their clients more often. A better understanding of the specific mechanisms that resulted in lower costs requires further study.

Results of this study do not present a strong case either for or against assertive community treatment for persons with dual disorders. Those who prefer the ACT approach may take comfort in the fact that it was no less efficient than SCM. Proponents of standard case management may also be encouraged by the finding of no difference in cumulative cost or effectiveness. Critical to the generalization of these findings to other locations is the understanding that ACT and SCM may be implemented very differently from place to place, and that total costs may be affected by the accessibility of additional services. It is likely that the quality and amount of care available in New Hampshire's publicly funded mental health system is higher than they are in most locations. Specifically, the SCM comparison group probably received better service than is available as standard care in many areas. Lack of ethnic diversity among study participants and the relatively rural setting of many mental health centers in New Hampshire should also be considered when attempting to generalize findings to other areas. Law enforcement costs, in particular, may have been higher in a more urban setting.

Although a definitive difference between the ACT and the SCM would have been easier to explain, we believe that our findings offer useful information for policy and point to areas for further research. Our study is the first to document carefully the social costs associated with treatment for dual disorders over a three-year period. The significant differences in cost and in efficiency occurring during the final year are findings that have not been noted in other studies, most of which follow participants for a maximum of 18 months. Longitudinal treatment and cost studies are appropriate for chronic, relapsing illnesses such as mental illness and substance use disorders, and they are likely to offer insights that could not be gained from shorter

studies. A great deal remains to be learned about the cost and effectiveness of long-term treatment for dual disorders.

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