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Do Improvements in Substance Use and Mental Health Symptoms During Treatment Translate to Long-Term Outcomes In The Opposite Domain?

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Abstract

Providers who treat adolescents with co-occurring substance use and mental health issues may prioritize treatment of one set of symptoms believing that improvements in one domain will results in improvements of the other. However, limited empirical data for adolescents provides evidence of such “spillover effects.” Using data from 2900 youth in outpatient treatment, we examined whether during-treatment changes in substance use or mental health symptoms predicted 12-month outcomes in the analogous and opposite domains. There was very little evidence of spillover effects, only that youth with no internal distress at 0 and 3 months reported lower levels of substance use problems at 12-months relative to youth with internal distress that stayed the same from 0 to 3 months. These findings suggest that providers treat both sets of substance use and mental health symptoms in an integrated manner given that these symptoms commonly co-occur among youth with either set.

Keywords

Adolescent treatment; mental health; causal effects; response to treatment

1. Introduction

Between one-quarter to one-half of the 150,000 adolescent treatment admissions to substance abuse treatment facilities in the United States each year are for youth with co-occurring substance use and mental health issues (Chan, Dennis, & Funk, 2008; Diamond et

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al., 2006; C. E. Grella, Hser, Joshi, & Rounds-Bryant, 2001; Jaycox, Morral, & Juvonen, 2003; Robbins et al., 2002; Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality, 2012). However, there is a dearth of evidence-based interventions that simultaneously treat both young peoples' substance use behaviors and mental health symptoms (Hawkins, 2009). Absent of such treatments, those charged with treating adolescents with comorbid conditions are thus encouraged to offer "integrated care" (Brannigan, Schackman, Falco, & Millman, 2004; Hawkins, 2009; National Institute on Drug Abuse, 2009). The dominant strategy for offering integrated care is based on a quadrant model of severity of both mental health and substance use symptoms (i.e., patients' care is determined by whether they have high or low severity on both mental health and substance use symptoms). (National Association of State Mental Health Program Directors & National Association of State Alcohol and Drug Abuse Directors, 1998); however, this model may have limited clinical utility broadly (Pincus, Watkins, Vilamovska, & Keyser, 2006) and there is debate as to whether the model is developmentally appropriate for adolescents (Hawkins, 2009; Stewart et al., 2011).

Although intuitively appealing, there are noted challenges associated with delivering integrated care. Barriers result from an "organizationally fragmented health care system" in which substance use, mental health, and general health services are "de-linked" from each other and even further siloed by confidentiality policies that limit communication between systems (Sterling, Weisner, Hinman, & Parthasarathy, 2010). This suggests that concurrent treatment of both substance use and mental health symptoms must be directed and managed by the client (or in the case of adolescent clients, families or guardians). Treatment takes place in different settings by different professionals who may have different treatment philosophies and who may face organizational barriers that prohibit collaboration (Burnam & Watkins, 2006; Kavanagh et al., 2000).

Another barrier to offering integrated care, and the focus of the current study, is that some providers may opt to treat only one set of symptoms assuming that the improvements in one domain will yield either concurrent or consequent improvements in the other. For the purposes of the current analysis, we term such effects – whether hypothesized or realized – as "spillover effects." In fact, such notions may not necessarily be a 'barrier' because there is some evidence of spillover effects, though these have been observed primarily in adult samples. For example, one prospective study of adults admitted to residential and methadone treatment revealed that exposure to substance use treatment alone led to rapid and sustained reductions in psychiatric symptoms (Gossop, Marsden, & Stewart, 2006). Similar evidence suggests also that the converse is true, namely that treating psychiatric symptoms alone in adults leads to improvements in substance use symptoms (Baker et al., 2007; C. E. Grella et al., 2001; C.E. Grella, Joshi, & Hser, 2004; Magura, Rosenblum, & Betzler, 2009).

Although evidence of spillover effects has been observed in adult samples, to our knowledge there is limited empirical evidence of spillover effects among adolescents. For example, there is some evidence that effective mental health treatments may prevent the development of subsequent substance use disorders (Curry et al., 2012; Kendall, Safford, Flannery-Schroeder, & Webb, 2004); however, only limited empirical evidence supports the

beneficial effects of effective substance use treatment on long-term psychological well-being (Edelen, Slaughter, McCaffrey, Becker, & Morral, 2010). More generally, mental health symptoms have been hypothesized to modify the effect of substance use treatment, though a recent meta-analysis of outpatient adolescent treatment finds no empirical evidence of such effect modification (Tanner-Smith, Wilson, & Lipsey, 2013); similarly, findings are mixed whether substance use severity at intake modifies the effect of mental health treatment (e.g., Goldstein et al., 2009; Hirschtitt et al., 2012; McKowen, Tompson, Brown, & Asarnow, 2013).

This does not suggest, however, that researchers and treatment providers alike do not presume such effects exist. Evaluations of substance abuse treatments for adolescents are often conducted with an implicit assumption that improvements in substance using behaviors among adolescents in treatment will result in reduced psychiatric symptoms (Kelly, Urbanoski, Hoepfner, & Slaymaker, 2012). This is demonstrated in part by the number of substance use treatment evaluations that examine mental health outcomes in addition to substance use outcomes without specifying why psychiatric symptoms are hypothesized to improve (e.g., M. Dennis et al., 2004; Godley et al., 2010; Ramchand, Griffin, Suttrop, Harris, & Morral, 2011). In light of such practices, research is needed to better understand how treatments that effect symptoms in one domain may effect symptoms in the other.

One way to study spillover effects is to test whether changes that occur during treatment in one domain (e.g., substance use) predict long-term, post-treatment outcomes in the other (e.g., mental health). Kelly and colleagues (2012) term this strategy ‘response to treatment’ and advocate more generally for evaluating adolescent substance abuse treatment programs by examining the relationships between during treatment changes with post-treatment outcomes. In that study, described as the first attempt to study ‘response to treatment’ in adolescents, the researchers examined whether changes in adolescent residential clients’ psychological distress, motivation to abstain and abstinence self-efficacy, coping skills, and commitment to NA/AA between intake and discharge predicted 3-month abstinence. They found only evidence that changes in abstinence self-efficacy during treatment predicted abstinence 3-months post-discharge (Kelly et al., 2012).

In the present study, we adopt a similar strategy to test for spillover effects among adolescents. Specifically, we test the hypothesis that changes in one domain of outcomes will result in improvement in the other by examining (i) whether short-term reductions in substance use behaviors and problems that occur in the first three-months of treatment translate to improved 12-month substance use and emotional well-being outcomes and (ii) whether improvements in emotional well-being in the first three-months of treatment translate to improved 12-month emotional well-being and substance use outcomes. We do so with a large sample of youth receiving a brief intervention delivered in community-based settings; however, we are not evaluating the treatment, *per se*. Rather, we are evaluating whether symptom changes that occur during the period in which youth are receiving treatment predict long-term outcomes. We define changes that occur during the period in which youth are receiving treatment as “response to treatment,” though note that such changes may not necessarily be a causal response. Findings from the current study will

provide further evidence on whether there are potential associations between initial responses to treatment on both substance use and emotional well-being outcomes, informing both how to improve the care afforded to youth with comorbid conditions as well as how to evaluate this care.

2. Materials and Methods

2. 1. Sample/Data

In 2003, the Center for Substance Abuse Treatment (CSAT) launched the Effective Adolescent Treatment (EAT) initiative that provided support for 37 community-based programs across the U.S. to adopt a brief, evidence-supported therapy (Motivational Enhancement Treatment/Cognitive Behavioral Therapy-5 or MET/CBT-5) to treat adolescent cannabis use. MET/CBT-5 is a 5-session treatment offered over the course of 6–7 weeks, consisting of two individual motivational enhancement therapy sessions and three group cognitive behavioral therapy sessions (Diamond et al., 2002; Sampl, Kadden, & Center for Substance Abuse Treatment (U.S.), 2001). The selected community-based programs were provided three years of support, including training and supervision in the MET/CBT-5 protocol, and were required to collect client data at baseline and at 3, 6 and 12-months using a standardized instrument (Hunter et al., 2012).

In aggregate, 3609 youth were interviewed at both baseline and at the 3-month follow-up. Of these, 2900 were eligible to have a 12-month interview (i.e., they were enrolled during a time for which the treatment facility still had funding to conduct a 12-month interview with the client). Approximately three-quarters of those eligible ($N=2130$, 73.4%) were interviewed at 12-months. Analyses showed that those who responded to the assessment at 12-months looked representative of the 3,609 youth with both baseline and 3-month data on age, race, gender and baseline values of the outcomes considered here.

2. 2. Measures

All client-level data were collected via self-report using the Global Appraisal of Individual Needs (GAIN) (M. L. Dennis, 1999). The GAIN has eight sections assessing background and demographic characteristics (asked at baseline only), substance use, physical health, risk behaviors, mental health, environment, legal, and educational/vocational problem areas. We employed the same two measures of substance use used in the original trial of MET/CBT-5, (M. Dennis et al., 2004) and two measures of mental health symptoms.

The *Substance Problem Scale (SPS)* is a 16-item scale comprised of seven items which are criteria for substance dependence, four items which are criteria for substance abuse, two items related to substance-associated health and psychological problems, and three items related to lower severity symptoms (e.g., hiding use, people complaining about use, and weekly use), with higher scores indicating more problems (range: 0 to 16). Internal reliability is excellent ($\alpha = 0.92$) (M. L. Dennis, Chan, & Funk, 2006) and evidence suggests a unidimensional construct, which primarily reflects addiction severity and its impact on daily life (Stucky, Edelen, & Ramchand, 2014).

The *Substance Frequency Scale (SFS)* is an 8-item scale that assesses the average proportion of days where alcohol and other drugs were used in the past 90, with higher scores indicating increased frequency of use in terms of days of use, days being high most of the day, and days actually causing problems (scale is standardized and ranges from 0 to 1). Internal reliability was good ($\alpha = 0.80$) for the substance use frequency scale (Ramchand et al., 2011).

The *Internal Mental Distress Scale (IMDS)* is a 43-item scale that comprises a count of past-year symptoms at baseline and past 90-day symptoms at each follow-up related to internalizing disorders (somatic, anxiety, depression, traumatic stress and suicidal and homicidal thoughts) with excellent reliability ($\alpha = 0.94$) (M. L. Dennis et al., 2006). Here too, evidence suggest a unidimensional construct that reflects severe levels of mental distress, such as traumatic stress and homicidal and suicidal thoughts (Stucky et al., 2014). Scores of 9 or above indicate moderate or severe internal distress.

The *Behavior Complexity Scale (BCS)* is a 33-item scale that comprises a count of past-year symptoms at baseline and past 90-days at follow-up relating to externalizing disorders (attention deficit, hyperactivity/impulsivity, and conduct disorder), also with excellent reliability ($\alpha = 0.94$) (M. L. Dennis et al., 2006). Evidence suggests a unidimensional construct that most strongly reflects inattention and less so symptoms of conduct disorder (Stucky et al., 2014). Scores of 6 or above indicate a possible diagnosis of Attention Deficit Hyperactivity Disorder (ADHD; inattentive or hyperactive types) and/or conduct disorder.

2.2.1. Defining “Response to Treatment”—We examined response to treatment across the four domains listed in the measures section: substance use frequency, substance use problems, internalizing symptoms, and behavioral problems. For each, we created an indicator of response to treatment and assigned individuals to one of four categories. Those classified as having “No Problems” were youth who reported 0 on the given scale both at baseline and at 3-months; those who “Got Better” showed between baseline and 3 months a reduction in scale values greater than 0.5 standard deviations from baseline; those who “Got Worse” showed between baseline and 3 months an increase in scale values greater than 0.5 standard deviations from baseline; those who “Stayed the Same” showed no change (or were within 0.5 standard deviations from baseline) between 0 and 3 months. Because the treatment prescribed to each adolescent was MET/CBT-5, it is presumed to have been completed during this three month interval (Hunter et al., 2012).

Since each of the four domains were not assessed uniformly across study sites, the total sample sizes of youth with “response to treatment” information varied for each domain. Specifically, 2,125 have baseline and 3-month values of substance problems and at least one 12-month outcome of interest (substance problem, substance frequency, internal mental distress, behavior complexity); 2,130 have baseline and 3-month values of substance frequency and at least one 12-month outcome; 1,360 have baseline and 3-month values of internal mental distress and at least one 12-month outcome and 1,016 have baseline and 3-month values of behavior complexity and at least one 12-month outcome. Fewer youth have mental health measures because certain CSAT sites opted not to administer the mental health section of the GAIN at the 3-month follow-up. Bowker’s tests were run to test

whether there was variability in the groupings across domains (e.g. that the same youth weren't being represented repeatedly in the response to treatment groups for each of our analyses).

2. 3. Analysis

As might be expected for all four measures (SPS, SFS, IMDS, and BCS), youth within each of the response to treatment categories varied on a number of important baseline characteristics that might be associated with outcomes in this study. In order to account for these differences, we estimated 4 different sets of propensity score weights that aimed to balance the "response to treatment" groups. Propensity score weights provide a robust and principled method to control for pre-treatment/pre-exposure imbalances on observed variables in observational studies like ours and are generally preferred over multivariate regression adjustment when interest lies in understanding the effect changing groups might have on an outcome as in this study (D.F. McCaffrey, Griffin, Almirall, Slaughter, & Ramchand, 2013).

Propensity score weights were estimated across youth in each response to treatment category to match the characteristics of the overall baseline sample with respect to distributions of 6 baseline variables: sex, age, race, and the number of days that the client had been institutionalized in the 90 days prior to entering treatment. In addition, for the models estimating substance use outcomes (substance frequency and substance problems), the propensity score weights adjusted for baseline mental health status (internal distress and behavior complexity); for models estimating mental health outcomes, the propensity score weights adjusted for baseline levels of substance use.

Generalized Boosted Models (GBM) were used to estimate the propensity score weights for each group using a recently developed procedure to create propensity score weights for more than two groups (i.e., no problems, got better, got worse, and stayed the same) (D.F. McCaffrey et al., 2013). GBM is a flexible, nonparametric, machine-learning estimation method that estimates the propensity score using an iterative process with multiple regression trees to capture complex and nonlinear relationships between treatment assignment (here response to treatment categories) and the baseline pretreatment covariates without over-fitting the data. (D. F. McCaffrey, Ridgeway, & Morral, 2004). This was implemented using the *twang* package in R (Ridgeway, McCaffrey, Morral, Burgette, & Griffin, 2012). After propensity score weighting, we calculated pairwise pre- and post-weighting absolute standardized mean difference (ASMD) for each group on each of the pretreatment variables to ensure that the groups were balanced with respect to these pretreatment covariates. We deemed groups to be balanced if the standardized differences were less than 0.20 (Cohen, 1992).

We next used weighted linear regression models to estimate the association between the response to treatment categories for each measure and the four outcome measures at 12-months. The models regressed the outcome on indicators of response to treatment as well as mean-centered covariates which, after weighting, had $ASMD > 0.20$ (Kang & Schafer, 2007). All models controlled for clustering of clients within facilities.

In our regression models, we first computed a joint F-test to assess whether any of the response to treatments group means was significantly different from zero. For those models whose F-test statistic had a p-value less than 0.05, we present the standardized effect size (Mean=0, SD=1) and associated p-value for the three group indicators (no problems, got better, and got worse) versus the group who stayed the same. As a sensitivity test, we assessed whether findings were qualitatively different when adding a covariate to indicate the number of days the youth received inpatient, outpatient, or residential mental health treatment in the 90 days that they were also receiving substance abuse treatment (as measured by self-report at the 3-month assessment). Receipt of subsequent treatment after the first three months of observation and before the 12-month assessment may be in the causal path and thus were not included as potential confounders.

3. Results

3.1. Sample Characteristics

Table 1 shows the basic demographic characteristics of all youth used in our analytic models. The sample looks generally representative of adolescent outpatient admissions to substance abuse treatment facilities nationally: almost three quarters are between ages 15 and 18, just over half are White and a quarter is Hispanic, and just over two thirds are male (Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality, 2012). With respect to clinical characteristics, the mean baseline score on the substance frequency scale was 0.11 (standard deviation, SD=0.12); classical interpretation of this scale suggests that scores above 0.14 indicate possible difficulty in stopping use without assistance. The mean substance problem scale score was close to 3; 1 or more on this scale typically suggests abuse, while a score of 4 or more may suggest dependence. The mean behavioral complexity score was nearly 10; a score of 6 generally warrants investigation of ADHD (inattentive or hyperactive types) or conduct disorder. Finally, the mean internal mental distress score was close to 8 in both waves, which generally reflects low levels of distress (GAIN Coordinating Center, 2011). We note that there were no significant differences between the overall sample characteristics shown in Table 1 and the four subgroups of youth who had response to treatment information for each of the 4 domains.

3.2 Response to treatment

In Figure 1 we present the proportion of respondents who, for each model, reported no problems at baseline and 3-months follow-up, got worse, stayed the same, or got better. For each measure of response to treatment, getting worse occurred least frequently, ranging from 3% for internal mental distress to 13% for substance problems. For substance use frequency and internal mental distress, the most prevalent response to treatment was to stay the same (49% and 40%, respectively); for substance use problems and behavioral problems, the most prevalent response to treatment was to get better (33% and 53%, respectively). When looking at the cross-tabulation of response to treatment designations among the reduced sample of adolescents who have data on all four domains, there is significant evidence (Bowker's test p-value<0.05) that there is sufficient variability across domains such that youth in a single type of response to treatment are different across the four domains.

3.3. Casemix Adjustment

Figure 2 shows the maximum ASMD before and after propensity score weighting for each of our four sets of propensity score weights (one for each response to treatment domain). As shown, prior to weighting, the four response to treatment groups had a number of covariates for which the maximum ASMD across the four groups were greater than 0.20 (6 for SFS response to treatment groups; 4 for SPS-based groups; 6 for IMDS-based groups and 6 for BCS-based groups). After weighting, these differences were greatly attenuated with only five ASMD's remaining above the 0.20 threshold. Specially, after applying propensity score weights, youth whose internal distress symptoms “got better” still had higher levels of baseline levels of substance use problems than the “no problem” and “got worse” groups a and lower levels of substance use frequency than the got worse group (ASMD's ≈ 0.22); youth with no behavioral complexity problems at both baseline and 3-months had 10 percentage points fewer females than those categorized as “got worse” while those who reported no substance use at both baseline and 3-months had 10 percentage points more females than youth whose substance use increased (i.e., “got worse”; ASMD ≈ 0.22); and youth who reported no substance use at baseline and 3 months were also slightly younger than youth whose substance use increased (ASMD = 0.21). These variables were included in our linear regression models as covariates (Kang & Schafer, 2007).

3.4. Outcome Analyses

Table 2 shows the estimated regression results for each of the four response to treatment domains and the four outcomes; we begin by discussing response to treatment with respect to substance use frequency (the first four rows of results in Table 2). As shown from the F-test statistics, there was no evidence of significantly different group means for the two mental health outcomes across the response to treatment groups. However, there was evidence that youth who reported no substance use at both baseline and 3-months had significantly lower levels substance use frequency (effect size difference = -0.444 , $p < 0.001$) and substance use problems (effect size difference = -0.404 , $p < 0.001$) at 12-months compared to youth whose use stayed the same during the first three months of follow-up. In addition, youth whose use increased between 0 and 3 months (i.e., “got worse”) had significantly worse substance use frequency (effect size difference = 0.967 , $p < 0.001$) and substance use problems (effect size difference = 0.640 , $p < 0.001$) at 12-month than youth whose use stayed the same. We find a strikingly similar pattern of results with respect to substance use problems: those who reported no problems at both 0 and 3 months had lower substance use frequency and substance use problems at 12 months than youth whose problems stayed the same. In addition, youth whose substance use problems increased (i.e., “got worse”) had worse 12-month outcomes.

For internal distress, youth who reported no problems at both baseline and 3-months had significantly lower levels of 12-month internal distress and behavior complexity while youth whose problems increased (i.e., “got worse”) had significantly worse 12-month internal distress and behavior complexity, both relative to youth whose internal distress stayed the same. There was evidence of spillover effects: youth who had no internal distress symptoms at both baseline and 3-months had lower levels of substance use problems at 12-months (effect size difference = -0.209 , $p < 0.006$). However, the effect of worsening internal distress

on behavioral outcomes was no longer significant after controlling for concurrent mental health treatment; similarly, the spillover effect of no internal distress at both baseline and 3-months was no longer significant when controlling for concurrent mental health treatment.

Finally, youth without behavior problems at 0 and 3 months had better 12-month internal distress and behavior problems relative to youth whose behavioral problems stayed the same. In models that controlled for concurrent mental health treatment, those whose internal distress symptoms got worse had elevated behavior problems at 12-months (effect size difference=0.743, $p=0.008$). There was also evidence that youth whose behavior problems got better had better 12-month behavior outcomes than those whose problems stayed the same (effect size difference = -0.334, $p=0.016$) and that those whose problems got worse had higher mean 12-month behavioral problems (effect size difference = 0.553, $p=0.026$). There was no evidence that response to treatment groups in the behavioral domain were significantly different from each other with respect to either substance use outcome.

4. Discussion

This study sought to examine empirically whether spillover effects are seen among adolescents entering substance abuse treatment. We did so by examining whether adolescents who “respond to treatment” by exhibiting improved substance use behaviors between intake and 3-months exhibit had better 12-month mental health outcomes, and conversely whether those who respond to treatment with fewer mental health symptoms exhibit better substance use behaviors at 12-months. We found little evidence in support of such spillover effects: only that youth with no internal distress at 0 and 3 months reported lower levels of substance use problems at 12-months relative to youth whose internal distress stayed the same. In fact, youth who reported getting better on substance use frequency and substance use problems continued to have relatively high levels of both internalizing and behavioral problems (estimated means from regression models approximately 1.69 and 1.85 (substance use frequency) and 1.72 and 1.90 (substance use problems), respectively which represents moderate severity on these scales). Similarly, youth who got better on internalizing and behavior problems had mean rates of substance use that still suggest room for improvement (0.08 and 0.04) and substance problems (1.30, 0.31) at 12-months.

Our findings stress the importance of needing to treat *both* mental health and substance use symptoms among youth in substance abuse treatment and do not support an approach that rests on the assumption that treating only one set of symptoms will result in improvements in both clinical domains. By showing no evidence of an association between improvements in one set of symptoms and long-term outcomes in the opposite domain, this study joins a chorus of research that stresses the importance of integrated care for adolescents (e.g., C. E. Grella et al., 2001; Hawkins, 2009; Sterling et al., 2010) but stands in contrast to what may be observed more frequently in practice where one set of symptoms is prioritized over the other. Confidence in this conclusion is supported by our findings of analogous relationships; that is, we were able to predict 12-month substance use outcomes among those whose substance use behaviors “responded” to treatment and were able to predict 12-month mental health outcomes among those whose mental health behaviors “responded” to treatment.

Unfortunately, these findings were strongest for the youth who ‘responded’ by ‘getting worse,’ but our sensitivity analysis did indicate that controlling for concurrent mental health treatment attenuated the effect of worsening internalizing symptoms on internal distress at 12-months, and actually made significant the effect of behavioral health problems. We also found that reductions in behavioral problems were associated with better 12-month behavioral outcomes.

Our findings do not provide evidence about how such integrated care should be delivered. Sterling et al. (2010) describe how the delivery of integrated care for adolescents is impeded by financial and legal barriers, as well as limitations among providers in both mental health and substance abuse treatment systems. Hawkins (2009) raises similar concerns and recommends integrated behavioral health assessments in both settings as well as developing and expanding resources for providers; one study found that outpatient substance abuse treatment staff benefit from training on delivery of quality mental health care (Hunter et al., 2005). However, it is also important that future generations of treatment providers learn how to treat youth with co-occurring disorders in their clinical training programs (Hawkins, 2009).

The strongest set of associations in this study show that those youth whose symptoms “get worse” consistently have worse 12-month outcomes in each of the four domains. It is worth noting that the group that gets worse is also the smallest category of youth, representing between 3 (for internalizing problems) and 13 (for substance use problems) percent of youth in the study. Researchers like McClellan et al. (McClellan, McKay, Forman, Cacciola, & Kemp, 2005) have called for adaptive treatment strategies in which symptoms are monitored in real time and treatment plans changed during the course of treatment. At the very least, the results from this study suggest that those whose symptoms are getting worse are a relatively small group to identify, and are good candidates for treatment augmentation. The emergence of experimental tools to build such adaptive treatment strategies (i.e., SMART trials) has enhanced researchers’ ability to examine treatment strategies such as treatment augmentations or treatment switches (Murphy, 2005). The results from this study provide some information that can guide clinicians in identifying adolescents in need of additional or augmented treatment and may be used to guide optimal decision points in these SMART trials (Murphy, Lynch, Oslin, McKay, & TenHave, 2007).

These study results are important but should be considered along with certain study limitations. First, our study sample was not drawn from a population designed to be nationally representative, which may limit the generalizability of our findings. Nonetheless, the demographic profile of the sample does appear to be similar to the profile of adolescent admissions to outpatient treatment programs nationally. Generalizability is also limited by our focus on youth exposed to one brief intervention developed specifically for treating substance use; other studies examining other substance use treatments may yield different effects, and studies of mental health interventions specifically have already produced findings suggesting some spillover in the prevention of subsequent substance use disorders (Curry et al., 2012; Kendall et al., 2004). To isolate the causal effect of response to treatment on 12-month outcomes, we performed casemix adjustment using a powerful, nonparametric approach to account for baseline differences that may produce selection bias. To the extent

that certain characteristics are associated with both clients' responses to treatment and treatment outcomes and are not controlled for in the casemix adjustment approach (either directly or because these characteristics are not correlated with those variables included in the adjustment strategy) such bias may still be present. Our cutoff of 0.50 SD to define response to treatment designations is somewhat arbitrary, but additional analyses using different thresholds (0.25 SD, 0.75 SD) produced qualitatively similar results. Finally, we rely on client self-report for all of our measures, including our outcome substance use measures. These are less ideal than objective measures, such as what could be available were the youth to have been given biological drug screenings.

Using the concept of "response to treatment" (Kelly et al., 2012) we found scant evidence that changes in substance use behaviors during treatment with a brief, 5-session intervention predicted 12-month mental health outcomes, nor that changes in mental health symptoms during treatment predicted 12-month substance use outcomes. These results suggest that providers not opt for one treatment over the other, but that they treat both sets of symptoms in an integrated manner given that these symptoms commonly co-occur among youth with either set. Given the current lack of evidence-based approaches for simultaneously treating both substance use and mental health symptoms, integrated care that involves creating systems of care to meet patients' needs via treatment planning and care coordination may be the optimal way in which this can occur (Hawkins, 2009). Future research should both examine, and empirically evaluate, how such integrated care can be optimally delivered, and also how the notion of during-treatment symptom response can be used to guide clinical decisions for the delivery of care.

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Highlights

We looked for spillover effects among adolescents in substance use treatment.

No evidence that changes in substance use during treatment impact mental health.

Little evidence that changes in mental health during treatment impact substance use.

Providers should treating both substance use and mental health symptoms.

Figure 1.
Response to treatment (intake-3 months) among adolescent clients, unweighted

Figure 2.
Maximum ASMB Before and After Propensity Score Weighting

Table 1

Baseline characteristics of adolescents in the study

Demographic Characteristics	
TOTAL	2130 (100%)
Age in years (%)	
10–12	52 (2%)
13–14	483 (23%)
15–16	1031 (48%)
17–18	510 (24%)
19–21	54 (3%)
Race/Ethnicity (%)	
White	1101 (52%)
Black	162 (8%)
Hispanic	514 (24%)
Other	353 (17%)
Missing	0 (<1%)
Gender (%)	
Male	1442 (68%)
Female	688 (32%)
Current living situation (%)	
House/Apt	1875 (88%)
Jail/Correctional Facility	115 (5%)
Other	139 (7%)
Missing	1 (<1%)
Clinical Characteristics	Mean (SD)
Substance Frequency Scale (Possible Range: 0–1)	0.11 (0.12)
Substance Problems Scale (Possible Range: 0–16)	2.77 (3.39)
Days Institutionalized (Possible Range: 0–90)	4.58 (15.90)
Behavioral Complexity Scale (Possible Range: 0–33)	9.99 (7.76)
Internal Mental Distress Scale (Possible Range: 0–43)	7.95 (8.57)

Table 2

Regression results for each of the four response to treatment domains and the four outcomes.

	12-Month Outcomes							
	Substance Use Frequency		Substance Use Problems		Internalizing Problems		Behavior Problems	
	Est.	p-value	Est.	p-value	Est.	p-value	Est.	p-value
Response to Treatment								
Substance Use Frequency								
Model F-test		<0.001		<0.001		0.677		0.990
Stayed Same (Intercept)	0.514	(Ref)	0.482	(Ref)	0.327	N/A	0.366	N/A
No Problems	-0.444	0.000	-0.404	0.000	-0.083	N/A	-0.024	N/A
Got Better	0.089	0.157	0.066	0.262	0.049	N/A	-0.009	N/A
Got Worse	0.967	0.000	0.640	0.000	0.019	N/A	-0.028	N/A
Substance Use								
Model F-test		<0.001		<0.001		0.284		0.284
Stayed Same (Intercept)	0.667	(Ref)	0.564	(Ref)	0.344	N/A	0.375	N/A
No Problems	-0.475	0.000	-0.380	0.000	-0.099	N/A	-0.022	N/A
Got Better	-0.124	0.062	-0.046	0.508	-0.049	N/A	-0.084	N/A
Got Worse	0.611	0.000	0.567	0.000	0.072	N/A	0.102	N/A
Internalizing Problems								
Model F-test		0.245		0.041		0.001		0.002
Stayed Same (Intercept)	0.630	N/A	0.586	(Ref)	0.328	(Ref)	0.450	(Ref)
No Problems	-0.162	N/A	-0.209 ^a	0.006	-0.292	0.010	-0.319	0.005
Got Better	-0.043	N/A	-0.070	0.231	0.129	0.208	-0.022	0.843
Got Worse	-0.091	N/A	0.026	0.883	0.820	0.002	0.788 ^b	0.003
Behavior Problems								
Model F-test		0.432		0.211		0.001		<0.001
Stayed Same (Intercept)	0.522	N/A	0.496	N/A	0.579	(Ref)	0.723	(Ref)
No Problems	-0.141	N/A	-0.188	N/A	-0.423	0.002	-0.655	0.001
Got Better	0.011	N/A	-0.004	N/A	-0.164	0.096	-0.334	0.016

Response to Treatment	12-Month Outcomes							
	Substance Use Frequency		Substance Use Problems		Internalizing Problems		Behavior Problems	
	Est.	p-value	Est.	p-value	Est.	p-value	Est.	p-value
Got Worse	-0.046	N/A	0.074	N/A	0.268 ^c	0.169	0.553	0.026

Note: All significant findings remained in models controlling for mental health treatment between baseline and 3-month follow-up except

- (a) Est.=0.075, p-value=0.289;
- (b) Est.=0.191, p-value=0.325;
- (c) Est.=0.743, p-value=0.008.