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Placement and Delinquency Outcomes Among System-Involved Youth Referred to Multisystemic Therapy: A Propensity Score Matching Analysis

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Abstract

Multisystemic therapy (MST) was developed to help youth with serious social, emotional, and behavioral problems. Research on the efficacy and effectiveness of MST has shown positive outcomes in different domains of development and functioning among various populations of youth. Nonetheless, even with a large body of literature investigating the treatment effects of MST, few studies have focused on the effectiveness of MST through large-scale dissemination efforts. Utilizing a large sample of youth involved in a statewide dissemination of MST ($n = 740$; 43% females; 14% Black; 29% Hispanic; 49% White; $M_{age} = 14.9$ years), propensity score matching was employed to account for baseline differences between the treatment ($n = 577$) and comparison ($n = 163$) groups. Treatment effects were examined based on three outcomes: out-of-home placement, adjudication, and placement in a juvenile training school over a 6-year period. Significant group differences remained after adjusting for baseline differences, with youth who received MST experiencing better outcomes in offending rates than youth who did not have an opportunity to complete MST due to non-clinical or administrative reasons. Survival analyses revealed rates of all three outcomes were approximately 40% lower among the treatment group. Overall, this study adds to the body of literature supporting the long-term effectiveness of MST in

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Compliance with Ethical Standards

Conflict of Interest Dr. Sarah Vidal declares that he/she has no conflict of interest. Dr. Christine Steeger declares that he/she has no conflict of interest. Dr. Colleen Caron declares that he/she has no conflict of interest. Ms. Leanne Lasher declares that he/she has no conflict of interest. Dr. Christian Connell declares that he/she has no conflict of interest.

Informed Consent This study involved secondary data analysis with deidentified administrative data.

Research Involving Human and Animal Rights This article does not contain any studies with animals performed by any of the authors. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with human participants performed by any of the authors.

reducing offending among high-risk youth. The findings underscore the potential benefits of taking evidence-based programs such as MST to scale to improve the well-being and functioning of high-risk youth. However, strategies to effectively deliver the program in mental health service settings, and to address the specific needs of high-risk youth are necessary.

Keywords

Multisystemic therapy; Delinquency; Out-of-home placement; Adjudication; Incarceration

Introduction

Persistent and serious problem behaviors, such as conduct problems, antisocial behavior, and delinquency, are among the most common reasons for child and youth contact with different service systems (e.g., child welfare, behavioral health, juvenile justice systems). The confluence of risk factors these youth experience, if not adequately addressed, increases their likelihood for poor outcomes, including mental health and substance use problems (Goodkind et al. 2013; Murray and Farrington 2010; Thornberry et al. 2014), multiple out-of-home placements (Connell et al. 2006), and further involvement in delinquent behaviors such as violent and property crimes (Puzzanchera and Kang 2014). Thus, there is a critical need for programs and services to help mitigate and prevent negative outcomes among high-risk populations of youth.

Several evidence-based programs exist for treating high-risk youth, including the well-researched treatment model, multisystemic therapy (MST; Henggeler et al. 1992, 1997, 2009; Borduin et al. 1995). The MST treatment framework posits that problem behaviors are associated with the interplay of individual, family, and community characteristics; thus, intervention must occur between multiple systems in order to create optimal behavioral and health outcomes for youth (for a review, see Henggeler 2011). Over a period of 4–6 months, youth and families work with a team of therapists and case workers to identify problem areas, build on strengths and natural support systems, remove barriers to successful outcomes, and empower youth and families to improve relationships and functioning (Henggeler et al. 2009).

Over the last 35 years, several studies conducted by MST program developers and independent, smaller-scale studies, have examined the efficacy and effectiveness of MST for reducing problem behaviors (e.g., Timmons-Mitchell et al. 2006; Henggeler et al. 1992, 1997; Borduin et al. 1995). However, few studies have examined the effectiveness of MST when disseminated in large-scale, statewide systems (e.g., Lofholm et al. 2014; Dekovic et al. 2012; Glisson et al. 2010), or across long-term follow-up periods. In this study, we aimed to advance the MST literature by testing the effects of a large-scale dissemination effort of MST among system-involved youth in the state of Rhode Island. Investigating the transportability of MST program effects to statewide systems and community settings is critical to developing better programs and adequately allocating resources for high-risk and system-involved youth (Schoenwald and Hoagwood 2001).

From Efficacy to Effectiveness Trials: Treatment Effects of MST

Research on the efficacy and effectiveness of MST has shown positive outcomes in various domains of development and functioning among different populations of high-risk youth. Randomized controlled trials (RCTs) and quasi-experiments involving serious offending youth demonstrate substantial reductions in reoffending rates (Glisson et al. 2010; Henggeler et al. 1997). For example, in a 22-year follow-up RCT with 176 serious offending youth in the Missouri Delinquency Project, Sawyer and Bourdin (2011) found that youth who received MST compared to youth who received individual therapy had 35% fewer felony arrests, 75% fewer violent felony arrests, and 33% fewer days incarcerated. The treatment effects of MST have also been linked to improved behavioral health symptoms 18 months after treatment among youth with antisocial and behavioral problems compared to youth who received wraparound services (Stambaugh et al. 2007) or treatment-as-usual (Glisson et al. 2010). The positive effects of MST in addressing problem behaviors among high-risk populations of offending youth have led to program adaptations for other at-risk populations of youth and families, including those with substance abuse problems (Henggeler et al. 1999, 2006), serious conduct problems (Asscher et al. 2013; Weiss et al. 2013), serious emotional disturbance (Stambaugh et al. 2007; Rowland et al. 2005), and youth and families involved in the child protective services (MST-Child Abuse and Neglect or MST-CAN; Swenson et al. 2010). The benefits of MST to reduce problem behaviors among high-risk youth and families have been corroborated by two meta-analytic studies, which suggest small to moderate treatment effect sizes on internalizing and externalizing symptoms among youth who participated in MST (van der Stouwe et al. 2014; Curtis et al. 2004; for a rebuttal, see; Littell et al. 2005). In sum, there is a strong empirical evidence supporting MST as an effective intervention to improve functioning across a range of behavioral outcomes for youth in high-risk populations.

Statewide Dissemination: Taking MST to Scale

Efficacy and effectiveness studies are critical to program development, improvement, and expansion. For instance, efficacy and effectiveness trials have the potential to inform scale-up efforts (i.e., statewide dissemination) in order to maximize program effects through a population-wide implementation of treatment. Indeed, the advent of evidence-based practices spurred renewed interests and efforts among service agencies to adopt, implement, and sustain practices that would promote effective intervention programs such as MST (Green 2012; McHugh and Barlow 2010). Yet, even with a growing body of literature investigating the treatment effects of MST, few independent studies have focused on the effectiveness of MST through large-scale dissemination efforts (e.g., Lofholm et al. 2014; Dekovic et al. 2012; Glisson et al. 2010).

Literature on translating knowledge into effective practice has identified several barriers to bridging the gap between taking effective practice into community-wide usual care settings. For example, statewide program dissemination involves expansion to a wider population of clients, often with varying levels of risks and needs (Schoenwald and Hoagwood 2001). In such context, agencies are often faced with the challenge of adapting services that would cater to a diverse population of clients. Funding and resource limitations may preclude agencies to successfully implement and sustain dissemination plans statewide (Milat et al.

2015; Hanson et al. 2010). Readiness of the organization to adopt and engage in active implementation of the program is also a key factor in successful program dissemination (Williams 2015; Proctor et al. 2009). To address these challenges, agencies often work with program developers who provide technical assistance and support during program implementation and dissemination. In 1996, MST Services, LLC was formed to assist with implementation and dissemination of MST to usual-care settings. Currently, MST Services, LLC works with 34 states and 15 countries, conducts training with administrators and clinicians, and provides state and local agencies with assistance related to budgeting, business planning, and quality assurance (MST Services, Inc. 2015). In Rhode Island, MST Services, LLC collects and monitors data related to implementation and dissemination of MST statewide, which provides a valuable opportunity to examine the program effects of MST in a larger, statewide context.

The complexities of large-scale dissemination of MST, however, limit rigorous evaluation of treatment effects of MST on a large-scale effort. Indeed, some MST dissemination studies are limited in scope and methodology. Although RCTs are considered the gold standard in measuring the efficacy and effectiveness of a program on a given outcome (Austin 2011), certain conditions including financial and ethical limitations proscribe randomized trials, particularly in large-scale and statewide dissemination efforts. For example, in a recent independent study, Fain et al.(2014) examined recidivism outcomes over a 6-month period among a large sample of youth (n = 1137) in Los Angeles County. The study included 757 offending youth who received MST, and a comparison group of 380 youth who met eligibility criteria for MST but did not participate in the treatment. Their findings showed that youth who participated in MST had significantly lower rates of incarceration and higher rates of completing community services 6 months later compared to the comparison group. However, it is important to note that the authors did not statistically adjust for baseline differences between the treatment and comparison groups, and the follow-up period was relatively short. Thus, the implications of these findings on the effects of MST in a large-scale effort are limited.

The Current Study

The current study builds on and extends existing literature in three ways. First, we utilized a large sample of youth involved in a statewide dissemination of MST. This sample consisted of youth who received MST treatment and a comparison group who was referred to MST but did not complete treatment due to reasons that were unrelated to case progress (described more fully below). Large-scale dissemination studies are greatly needed in the MST literature; such studies are critical for development, implementation, and dissemination of treatment programs and allocation of resources for at-risk and high-risk youth.

Second, we examined treatment effects on three outcomes: out-of-home placement, adjudication, and placement in a secure correctional facility. Out-of-home placement, a commonly examined child welfare outcome, serves as a critical juncture of a child's contact with the child welfare system. Out-of-home placements have been linked to disruption of care and poor child outcomes such as an increase in problem behaviors (Newton et al. 1999), and thus, are important measures of stability and child's well-being. We also included

adjudication and juvenile training school placement as measures of post-treatment reoffending. Although adjudication and placement in secure correctional facilities are the two most common reoffending measures used by state juvenile justice agencies (The Pew Charitable Trusts 2014), MST studies have primarily focused on arrests as measures of reoffending (Sawyer and Borduin 2011; Rowland et al. 2005; Schaeffer and Borduin 2005). To our knowledge, these three outcomes have not been investigated concurrently in any published MST studies.

Finally, we used propensity score matching (PSM) as a statistical analysis technique to account for baseline differences between the treatment and comparison groups. Only one published study has employed PSM in examining the effectiveness of MST (see Baglivio et al. 2014). When random assignment to treatment and control groups are not feasible, such as in statewide or large community settings, PSM can serve as a helpful tool to estimate treatment effects by statistically adjusting for baseline differences in the treatment and the comparison groups, thereby reducing the effects of selection bias or confounding in an observational study (Hodges and Grunwald 2005).

Method

Data Sources and Participants

There were two primary data sources for this study. First, data were obtained from the five MST providers active in Rhode Island during the study period. These data included program dates (dates of initial program contact¹ and discharge) and an indicator of MST case progress at discharge (e.g., completed treatment, lack of engagement, placed in a residential facility, etc.). Next, data from MST providers were matched with data extracted from the Rhode Island Department of Children, Youth, and Families (DCYF) management information system (Rhode Island Children's Information System, RICHIST). The RICHIST dataset includes variables such as child demographics and case characteristics (e.g., age at first removal, removal count, maltreatment history, juvenile justice dispositions)². In 2008–2011, 772 youth were referred to MST by either the Child Welfare Services or the Juvenile Correctional Services agencies in Rhode Island, primarily for reasons including behavioral problems, disobedience, truancy, and delinquency. Twenty-nine youth were unable to receive MST services because they began an out-of-home placement after being referred for services but prior to initial program contact. These youth were excluded from the final sample ($n = 740$) because they experienced a study outcome prior to the opportunity to receive services.

The majority (57%) of youth were males, and the average age of participants was 14.9 years ($SD = 1.4$, range = 11–17) when they were referred to MST treatment. Forty-nine percent of youth reported their racial/ethnic background as White, 14% as Black, 29% as Hispanic, and 8% as other or multiracial. At the time of MST referral, a majority (71%) of youth was assigned to a Family Service Unit or Intake worker and 25% were assigned to a Juvenile

¹This date was generally relatively soon after program referral—a median time of 6 days for the treatment group and 4 days for the comparison group

²Age at first removal and removal count refer to out-of-home placements. Out-of-home placement included placement in residential treatment, inpatient treatment, emergency shelter, or foster care; it does not include placement in juvenile correctional facilities

Probation Officer. In terms of case history, 36% of youth had a history of maltreatment and more than half (57%) had a history of out-of-home placement. The average number of placement episodes was 1.0 (SD = 1.0, range = 0–5); youth had experienced an average of 1.6 placement settings (SD = 2.2, range = 0–37) during the first out-of-home placement episode. Finally, more than one-quarter of youth had previously been adjudicated (26%) and placed in a juvenile training school (27%).

Treatment Condition: Participation in MST—Condition assignment was determined based on discharge indicators of case progress included in the provider extract for all youth referred to treatment. Providers were asked to indicate the status of the case at discharge using criteria developed by MST Institute (MST Institute 2015). Case progress indicators include treatment completion, reasons for lack of treatment completion, or reasons for exclusion from MST treatment if the youth was unable to receive services following referral.

Guided by an intent-to-treat approach, the treatment condition included all youth referred to MST who either completed treatment or had the opportunity to do so. The latter group included youth who were unable to complete treatment due to either lack of engagement or a placement occurring while involved in treatment. Of the total referred final sample (n = 740), 78% of youth (n = 577) met criteria for inclusion in the treatment condition, with 90% (n = 522) completing treatment, 8% (n = 46) discharged due to placement, and 2% (n = 9) discharged due to lack of engagement. The median length of stay in the program for this treatment group was 4.4 months.

The comparison group included the remaining 163 youth (22%) who were referred to MST but did not have the opportunity to complete treatment as a result of reasons unrelated to case progress. Of these, 94% (n = 154) were removed from treatment due to administrative or funding/referral reasons³ and 6% (n = 9) moved out of the program's service area. The median time for the comparison group from initial program contact to program discharge due to reasons unrelated to case program was 1.45 months.

Measures

Dependent Variables—The dependent variables for this study included rates of youth *out-of-home placement* (i.e., removal from parental custody due to reasons such as child behavior or disability, parental inability to cope, abuse or neglect, etc.), *adjudication* (i.e., court determination the youth committed a crime or delinquent offense), and *placement in a juvenile training school* following referral to MST treatment. Each of these dependent variables was operationalized as a “time-to-event” outcome; event occurrence was coded as 0 = no or 1 = yes, indicating whether or not a particular outcome happened, and time was calculated in months by subtracting the first date of occurrence for each outcome of interest from the date of initial program contact. Forty-eight youth experienced a subsequent MST referral or treatment prior to the end of the study observation period. For these youth, outcomes were censored at the beginning of the second MST referral for treatment. In

³These youth were removed from the program by MST program administration or by the funding or referral source due to administrative issues or decisions unrelated to the progress of the case

addition, youth who turned 18 prior to event occurrence or the end of study period were censored on their 18th birthday.

Propensity Score Covariates—To create matched groups of youth who received MST and those who did not receive MST for purposes of outcome analyses using PSM methods, we identified potential individual-level covariates available from the administrative data. These covariates were hypothesized to be related to either selection into treatment condition or to our outcome variables, based on previous research (West et al. 2014; van der Stouwe et al. 2014). Variables included youth *demographic characteristics* such as a youth's age at referral to MST treatment, gender (0 = male, 1 = female), and race (0 = white, 1 = non-white), and several *case characteristics* including number of prior episodes of out-of-home care, number of placements settings, history of maltreatment (0 = no, 1 = yes), history of adjudication (0 = no, 1 = yes), history of juvenile training school placement (0 = no, 1 = yes), and case assignment prior to or during MST treatment (0 = child welfare, 1 = juvenile probation).

Analysis Plan

Propensity Score Methods—Propensity score matching (PSM) was used to balance pre-treatment characteristics of youth across treatment conditions (i.e., youth who received MST treatment, and youth referred to MST but unable to receive treatment due to reasons unrelated to case progress) to facilitate comparisons of treatment effects. PSM statistically adjusts for baseline differences that may influence selection biases in treatment receipt to achieve a balanced distribution of covariates across treatment and comparison groups (Stuart 2010). First, covariates (e.g., demographic and case characteristics) that may be associated with selection into the treatment condition and the outcome variable are selected (Wong and Schonlau 2013). The treatment and comparison groups are then compared based on these covariates. Unbalanced covariates may produce biased estimates of treatment effects when they are also associated with the outcome variable (Austin 2011; Wong and Schonlau 2013). Propensity scores, or the probability of assignment to treatment based on the values of observed covariates (Rosenbaum and Rubin 1983), are estimated to achieve balance among covariates. Propensity scores are then used to match individuals in the treatment and comparison groups that share approximately similar probability of being selected into the treatment condition.

We compared multiple matching algorithms and considered the following criteria in choosing the most appropriate PSM method (see Guo et al. 2006)—*common support*, *covariate balancing*, and *median bias*. Of the matching methods we considered (i.e., nearest 1–1 with replacement; nearest 3–1 with replacement; nearest 1–1 with replacement and caliper; nearest 3–1 with replacement and caliper; and Kernel-based matching with different bandwidths; see Table 1 for a summary), the Kernel-based matching approach with bandwidth of 0.08 produced the fewest number of cases dropped within the common support guideline, successfully removed significant differences between the treatment and comparison groups, and produced the lowest median bias after matching. Given these results, we employed Kernel-based matching with this bandwidth and imposed a common support restriction in our final set of analyses.

The Kernel-based matching approach is a nonparametric estimator that uses the weighted average of the outcome for the comparison group, which is then used to compare to the outcome of the treatment group (Caliendo and Kopeinig 2008; Guo et al. 2006). Kernel-based matching can result in biased estimates of treatment effect if individual participants with propensity scores outside the area of common support are included; so it is typically recommended that the condition of common support be imposed on Kernel-based matching procedures (Caliendo and Kopeinig 2008). This condition restricts analyses to those cases in the treatment and comparison groups with substantial overlap in distribution of propensity scores and is used in the matching analysis (Wong and Schonlau 2013; Caliendo and Kopeinig 2008). Finally, treatment effects are estimated based on the matched sample.

Survival Analysis—The Cox regression model is a widely used survival analysis technique for analysis of timing of event occurrence (e.g., out-of-home placement, adjudication, and juvenile training school placement) and models event rates in the presence of censored data, or cases for whom the outcome is not observed by the conclusion of the study observation period (Connell 2012; Allison 1995). After the treatment and comparison groups are matched on key demographic and case characteristics, Cox proportional hazards regression was used to examine the risk of removal and delinquency outcomes following initial contact with the program. This model follows a regression framework and employs a log-linear model to determine the extent to which a set of covariates influences the dependent variable, survival time. Youth who did not experience the outcome of interest (i.e., out-of-home placement, adjudication or juvenile training school placement, respectively) were censored at the end of the study observation period.

All analyses were conducted in Stata 14.1 using `psmatch2` (Leuven and Sianesi 2003) to create and evaluate propensity scores via logistic regression and complete kernel-based matching procedures prior to implementation of Cox regression analyses. Outcome models were conducted using Stata clustering procedures to account for the nested nature of the data (i.e., youth served by one of five treatment provider settings) across the state.

Results

Descriptive Characteristics of Treatment and Comparison Groups

The average age of youth in the treatment group was 14.9 years ($SD = 1.4$), and the average age of youth in the comparison group was 15.0 years ($SD = 1.5$). A majority of the treatment group were males (58%) and white (50%); for the comparison group, a comparable percentage of youth were males (59%), though a greater percentage was non-white (60%). Both the treatment and comparison groups comprised a comparable proportion of youth on probation, with 25 and 24%, respectively. The treatment and comparison groups also showed comparable proportions of youth with previous system involvement, including histories of substantiated maltreatment (35% in treatment and 39% in comparison groups), adjudication (24 and 26%, respectively), and juvenile training school placement (26 and 28%, respectively). The average number of out-of-home care episodes for youth in the treatment group was 0.90 ($SD = 0.95$) and 1.4 ($SD = 1.2$) for the comparison group. Finally, among youth who had out-of-home-care episodes and were in the treatment group, the average

number of placement settings was 1.5 (SD = 1.8), and the average number of placement settings was 1.9 (SD = 3.3) for youth in the comparison group.

Covariate Balance before and after Propensity Score Matching

Kernel-based matching with common support restrictions was used to balance covariates across treatment and comparison conditions. This restriction resulted in 20 cases outside the common support region being excluded from analyses prior to outcome analyses. Table 2 shows the results from pre- and post-matching *t*-tests examining differences between the treatment and comparison groups on baseline covariates. Prior to matching, significant differences were found between the treatment and comparison groups on race/ethnicity, number of removals from parental custody, and number of out-of-home placement settings in the first removal episode. Compared to the comparison group, the treatment group had fewer racial and ethnic minority youth, experienced fewer out-of-home care episodes, and fewer placement transitions in their first episode of care. After matching, no significant differences were found between the treatment and comparison groups on these covariates, indicating that PSM was successful in achieving covariate balance across conditions.

Estimating Treatment Effects Through Survival Models

Cox Regression survival analyses were conducted with the matched sample to estimate for treatment effects of MST on out-of-home placement, adjudication, and juvenile training school placement. Separate survival analyses were conducted for each of the three outcomes on the matched sample (Table 3). The propensity score matched model accounted for the weighted average of the outcome for the comparison group resulting from the Kernel-based matching approach. We also included demographic and case covariates in the final outcome models. Though these covariates were balanced across condition, inclusion of regression-based covariates in conjunction with matched samples may enhance robustness (Stuart 2010) and permits analysis of treatment effects in conjunction with other predictors associated with our dependent variables.

Model 1 examined the effect of MST on risk of out-of-home placement. As indicated in Table 3, the overall model was significant ($X^2 = 50.2$ (10), $p < 0.001$). Receipt of MST was associated with a statistically significant reduction in out-of-home placement ($HR = 0.61$, 95% CI: 0.45–0.81); approximately 41% of the treatment group experienced out-of-home placement compared to 59% of the comparison group within the study period. Figure 1 (panel a1–a2) depicts the cumulative survival function and kernel-smoothed hazard function for risk of out-of-home placement. The survival function describes the number of youth who have not experienced the outcome over time, and the hazard curves depict changes in probability of risk of event occurrence over time. Smoothing estimates of the hazard function is generally recommended for continuous-time Cox regression models to emphasize the overall form of the hazard function, reduce noise, and provide more readily interpretable estimates of the pattern of risk for event occurrence over time (Singer and Willett 2003). As demonstrated by these figures, risk of out-of-home placement was only significantly lower, over-time, for youth in the MST treatment group. For both groups, risk of out-of-home placement increased during the initial 6 months following referral to MST, after which the risk of out-of-home placement began to decline sharply and then level off

around 18 months. A history of previous out-of-home placements ($HR = 1.32$, 95% CI 1.14–1.53) and a history of placement instability ($HR = 1.08$, 95% CI 1.03–1.13) were also associated with greater risk of subsequent out-of-home placement for youth.

Model 2 examined the effect of MST on risk of an adjudicated offense. The overall model was significant ($X^2 = 163.2$ (10), $p < 0.001$). Receipt of MST was associated with a significant reduction in likelihood of adjudication compared to the matched comparison group ($HR = 0.57$, CI: 0.41–0.80). Approximately 42% of the treatment group experienced adjudication compared to 62% of the comparison group within the study period. Figure 1 (panel b1–b2) depicts the cumulative survival function and kernel-smoothed hazard function for adjudication. Risk of adjudication escalated through about 8–9 months, but declined at a slower rate than out-of-home placement through the subsequent 3-year period. The slight spike in risk of adjudication depicted at 33 months may be attributable, in part, to the relatively small sample remaining in the risk set after that point (Singer and Willett 2003). A number of child-related factors were also associated with risk of adjudication including being male ($HR = 1.79$, CI: 1.22–2.63), being on probation ($HR = 14.11$, CI: 6.29–31.71), and prior history of adjudication ($HR = 0.25$, CI: 0.11–0.59) and incarceration ($HR = 1.86$, CI: 1.16–2.98). The adjudication finding, indicating greater risk among those with no history of previous court adjudication, was unanticipated.

Finally, Model 3 examined the effect of MST on risk of placement in a juvenile training school. The model was significant ($X^2 = 109.5$ (10), $p < 0.001$). As with adjudication, receipt of MST was associated with a significant reduction in likelihood of juvenile training school placement compared to the matched comparison group ($HR = 0.61$, CI: 0.44–0.85). Approximately 41% of the treatment group experienced juvenile training school placement compared to 60% of the comparison group during the follow-up period. Figure 1 (panels c1–c2) depicts the cumulative survival function and kernel-smoothed hazard function of juvenile training school placement for treatment and comparison groups. Risk of juvenile placement followed a pattern similar to that of adjudication, though with a less steep increase and risk and a more steady rate over time; again a spike was observed at approximately 28–36 months, which may be attributable to relatively fewer cases with that level of follow-up.

Discussion

MST is a widely disseminated evidence-based program for youth with significant emotional and behavioral problems. It is critical to examine the program effects of MST, particularly in large-scale dissemination efforts in order to develop better programs and adequately allocate resources for at-risk youth. This study contributes to existing literature on MST in three important ways. First, we examined the long-term effects of a statewide program dissemination of MST over a 6-year time period, using a large sample of system-involved youth. Second, we examined treatment effects on three outcomes relevant to high-risk youth: out-of-home placement, adjudication, and placement in a juvenile training school. Finally, we employed a PSM approach to account for baseline differences between the treatment and comparison groups, thereby reducing the effects of selection bias or confounding in an observational study. Two important findings emerged with implications for research and practice.

First, after adjusting for baseline differences, the MST treatment group had better outcomes than the comparison group reflected in lower risks for out-of-home placement, adjudication, and juvenile training school placement. These findings are consistent with existing literature demonstrating that MST has significant effects in reducing negative outcomes, including out-of-home placement and delinquency, compared to individual therapy or usual treatment among high-risk and high-need youth (van der Stouwe et al. 2014). For example, our finding that out-of-home placement decreased by 39% among youth who completed MST was consistent with Butler and colleagues' (2011) finding that MST was associated with a 41% reduction in out-of-home placement among offending youth randomly assigned to MST. Others have found similar effects with a 49–78% reduction in out-of-home placements among offending youth and youth with serious emotional and behavioral problems randomly assigned to MST (e.g., Ogden and Halliday-Boykins 2004; Schoenwald et al. 2000). This finding is notable particularly because removal from home is associated with multiple living transitions and poor health outcomes, including poor emotional and behavioral functioning (Stambaugh et al. 2007), recurrence of maltreatment, and delinquency (Graves et al. 2007; Connell et al. 2006; Ryan and Testa 2005).

Our findings also showed that receipt of MST was associated with a significant risk reduction for adjudication and juvenile placement in a training school. These findings also are consistent with previous studies reporting that participation in MST was associated with a 53–54% reduction in recidivism 2–14 years following treatment among serious and violent offending youth (Schaeffer and Borduin 2005; Henggeler et al. 1997). Our findings add to current literature by indicating that receipt of MST treatment was associated with decreased likelihood of negative outcomes, such as offending, resulting in significant reductions in risk of occurrence over the duration of the follow-up period. Altogether, these findings support the long-term effects of MST in reducing negative outcomes involving legal or child welfare system involvement among a high-risk population of youth.

Consistent with findings from efficacy and effectiveness studies, our findings support the promise of taking MST to scale. However, we also note that future research needs to explore the mechanisms that underlie successful large-scale program implementation and contribute to program effectiveness. Although we were not able to examine the mechanisms that may contribute to effectiveness of statewide implementation of MST, research suggests that fidelity to treatment is a critical factor in fostering successful program implementation and positive program effects (Brunk et al. 2014; Lofholm et al. 2014; Schoenwald et al. 2008; Henggeler et al. 2002). In Rhode Island, preliminary caregiver reports of clinicians' treatment fidelity suggest high (above the national MST target) adherence to treatment for the five Rhode Island MST providers (Rhode Island 2013). The extent to which treatment fidelity contributes to program effectiveness in a statewide implementation is critical to understanding and advancing program transportability efforts.

A secondary set of findings relates to observed pre-match differences in characteristics of youth across the two study treatment conditions. Both conditions included youth who were referred to MST for treatment and who met eligibility criteria for referral. The treatment group consisted of youth who either successfully completed treatment or who failed to complete treatment as a result of case-related factors (e.g., lack of engagement, treatment

dropout, a new charge or placement resulting in case closure). The comparison group, in contrast, was removed from the program relatively soon after initial program contact due to a factor unrelated to case progress (e.g., primarily due to administrative or funding decisions). This comparison group has been used in prior studies (e.g., Fain et al. 2014), but analyses did not control for group differences across these conditions. Our pre-match analyses revealed that youth in the comparison group were more likely to represent racial or ethnic minority backgrounds and had a history of more pre-MST out-of-home placements and placement instability while in care. These differences have important implications for implementation and dissemination of MST, particularly in terms of the ability to reach high-risk populations of youth and families.

For example, the most common reason for why youth in the comparison group did not receive treatment was a result of administrative or funding mechanisms unrelated to case progress (94% or 154 out of 163 youth). This is consistent with Fain and colleagues' (2014) observations within their comparison group (e.g., inability to receive MST due to lack of Medicaid coverage). One of the challenges of a large-scale dissemination effort for an evidence-based program is designing a funding mechanism that aligns with the organization's objectives for a successful implementation of a program (Timmons et al. 2006; Goldman et al. 2001). Many jurisdictions have primarily relied on Medicaid funding for implementation of MST programs (Strother and Duncan 2009). Indeed, Medicaid funding has played a critical role in facilitating and sustaining the growth of MST. However, there are several limitations and challenges of using Medicaid as the primary payer of MST services, including ineligibility for some families in need of MST and constraints in reimbursement policies (e.g., in some jurisdictions, Medicaid only reimburses face-to-face contacts, and at times, only for contacts when the youth is present; Strother and Duncan 2009). Due to these limitations, decisions of participation in treatment are often based on funding considerations rather than clinical risks. This can be problematic given that youth and families typically referred to MST are high risk and high need cases who may require immediate help and services (Henggeler 2011). Recognizing these challenges, MST Services, Inc. recommends adoption of blended funding mechanisms, which allows for service agencies to pool and combine multiple sources of funding in order to address the limitations of a single payer system such as Medicaid (Strother and Duncan 2009). These considerations are important in developing implementation and dissemination program protocols that can better cater to diverse needs of youth and their families.

The other key set of differences among comparison youth (higher percentage of racial and ethnic minority youth, greater frequency of prior placements and unstable placement trajectories) suggest potential barriers in program involvement for youth who are in particular need of the supports provided by MST. Such barriers are problematic, since MST provides a comprehensive yet individualized and flexible treatment approach that targets key problem areas and utilizes the strengths of youth and families (Henggeler et al. 1996). Our findings suggest the need to revisit and strengthen the ways in which evidence-based programs such as MST can be structured to meet the specific needs of underserved populations of youth, including minority youth. Although we can extrapolate from our findings that a greater proportion of minority youth did not complete MST treatment due to administrative or funding reasons (26 vs. 18% of white youth) and that 62% of youth

excluded for these reasons were minority youth, the extent of how this problem truly affects underserved populations is unclear. In addition, others (e.g., van der Stouwe et al. 2014) have observed that MST is more effective for younger, non-ethnic minority, and higher-risk youth—so even if services are able to be delivered they may not fully meet the needs of some of these youth. Whether their findings are attributable to funding mechanisms that may disparately affect underserved populations of youth is subject to empirical investigation. However, identifying both *psychosocial* and *clinical* risks unique to underserved populations of youth may help promote better implementation of MST program and adequately and effectively address the needs of these youth (Stambaugh et al. 2007).

There are several limitations to keep in mind when interpreting these findings. First, due to limitations of using administrative datasets, we were not able to adjust for other relevant youth and family characteristics that could influence selection into treatment and the outcomes. These characteristics include specific reasons for MST referral, parent-related data (e.g., parenting practices and skills), dosage or intensity of treatment, and fidelity to treatment measures. For example, studies have shown that factors such as parenting practices (Asscher et al. 2013; Tighe et al. 2012) and fidelity to treatment (Brunk et al. 2014; Henggeler et al. 2002) are important mechanisms of change in MST. In addition, we did not have information on whether supplementary or other types of treatment were received by our treatment group and whether our comparison group received some type of treatment (e.g., usual services) during the observation period. Future studies must take these factors into account in order to better understand the mechanisms by which MST promote positive outcomes, particularly in large-scale dissemination efforts.

Second, this study focused on dissemination of MST in one state, Rhode Island. Implementation of MST is typically tailored and adapted specific to the needs and capacities of a state or an agency, which may affect the generalizability of findings to other state contexts or service populations. This limitation, nonetheless, is tempered by the consistency between our findings and those observed in other published studies (e.g., Butler et al. 2011; Glisson et al. 2010; Letourneau et al. 2009; Ogden and Hagen 2006; Ogden and Halliday-Boykins 2004).

Finally, although PSM offers a promising approach to assess treatment effects in observational data, this method is not without limitations. Propensity score matching's capacity to reduce selection bias and adjust for bias in baseline differences between the treatment and comparison groups is highly dependent on selection of variables for matching (West et al. 2014; Wong and Schonlau 2013; Guo et al. 2006). Although nine relevant variables were incorporated into our estimation of propensity scores, we cannot adjust for unobserved predictors of treatment participation and study outcomes (i.e., out-of-home placement, adjudication, juvenile training school placement) that were not available in RICHIST and MST provider data systems. To the extent that these unobserved variables may be related to selection into treatment and outcomes measures, PSM methods cannot account such influences on unbiased estimates of treatment effects. Future studies should expand on the types of pre-treatment covariates included in outcome comparisons using PSM.

In a related vein, future research on treatment effectiveness and dissemination efforts also would benefit from broader operationalization of appropriate comparison groups. A strength of the current study was the use of a naturalistic design within a statewide system that included a statistically matched comparison group who had been referred to the treatment condition but unable to complete treatment for reasons unrelated to case progress. However, as was observed by Fain et al. (2014), MST is frequently disseminated in a system for which capacity mirrors demand and there are often limits on the ability to withhold treatment for youth in need or randomize to alternative treatments in a broad-based dissemination effort. Though our approach strengthens the rigor of the comparison design beyond that of Fain et al. it is still possible that there are inherent differences that led to exclusion of our comparison group from receipt of treatment that are not captured by the PSM approach. Identification of alternative comparison groups who also met criteria for MST referral but were given other treatment services would provide another meaningful way to test for treatment effects relative to other service models.

Despite these limitations, we believe the current analyses demonstrate the benefits of using PSM to assess treatment effects resulting from large-scale or system-wide dissemination efforts—providing a framework to examine program effects in a naturalistic observational design. Although RCTs represent the gold standard with respect to rigor in estimating treatment effects, such designs limit external generalizability that may pose problems for large-scale dissemination trials (Sanson-Fisher et al. 2007; Davidson et al. 2004).

Overall, this study adds to the literature supporting the long-term effectiveness of MST in reducing negative outcomes among a high-risk population of youth. It is important to note that programs such as MST are not a universal remedy; youth who received MST are still at significant risk of negative outcomes such as removal from home or system involvement related to delinquent or criminal activity, though generally at lower rates than youth who did not complete the treatment. Taken together, our findings underscore the potential benefits of taking evidence-based programs such as MST to scale to improve the well-being and functioning of high-risk and high-need youth.

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Fig. 1. Kernel-smoothed hazard function for **a** out-of-home placement, **b** adjudication, and **c** placement in juvenile training school; **1** cumulative survival curve, **2** smoothed hazard function

Table 1

Comparison of matching algorithm

Matching algorithm	Number off-support (treatment)	Median bias ^a	Number significant covariates
Nearest neighbor (1), with replacement	20	3.1	2
Nearest neighbor (3), with replacement	20	7.1	1
Nearest neighbor (1), with caliper and replacement	20	3.1	2
Nearest neighbor (3), with caliper and replacement	20	7.1	1
Kernel Match (epanechnikov, bandwidth 0.08)	20	2.8	0
Kernel Match (epanechnikov, bandwidth 0.06)	20	2.9	0
Kernel Match (epanechnikov, bandwidth 0.04)	20	3.6	0

Optimal matching algorithm indicated in bold typeface

^aMedian bias estimate (unmatched sample) = 6.9

Matching results comparing treatment and comparison groups on selection variables pre- and post-adjustment

Table 2

Covariate	Treatment group (n = 554, on support)	Comparison group (n = 162)			
		Unadjusted means		PS adjusted means	
		Mean	t value	Mean	t value
Age	14.87	15.03	-1.64	14.87	0.08
Gender (male)	0.58	0.59	-0.40	0.56	0.47
Race/ethnicity (minority)	0.50	0.60	-2.68**	0.54	-1.26
Probation status (yes)	0.25	0.24	0.57	0.23	0.75
Out-of-home placement episodes count	0.90	1.35	-5.25***	0.90	0.02
Out-of-home placement settings count	1.53	1.93	-2.21*	1.43	0.91
Substantiated maltreatment history (yes)	0.35	0.39	-0.78	0.35	0.08
Adjudication history (yes)	0.24	0.26	-0.31	0.21	1.09
Juvenile placement history (yes)	0.26	0.28	-0.53	0.25	0.38

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Table 3

Propensity score adjusted Cox Regression Models of treatment effects on dependent variables, Kernel-Matched result

	Model 1: out-of-home placement	Model 2: adjudication	Model 3: placement in juvenile training school
	<i>HR</i> [95% CI]	<i>HR</i> [95% CI]	<i>HR</i> [95% CI]
MST treatment condition	0.61 *** [0.45–0.81]	0.57 *** [0.41–0.80]	0.61 ** [0.44–0.85]
Age	0.92 [0.82–1.02]	1.00 [0.88–1.15]	1.10 [0.96–1.26]
Gender (female)	0.95 [0.69–1.31]	1.79 ** [1.22–2.63]	1.33 [0.92–1.90]
Race (non-minority)	1.14 [0.82–1.57]	1.33' [0.95–1.88]	1.39' [0.99–1.97]
Probation status (no)	0.95 [0.52–1.72]	14.11 *** [6.29–31.71]	2.20 ** [1.28–3.76]
Out-of-home placement episodes count	1.32 *** [1.14–1.53]	0.87 [0.73–1.04]	0.99 [0.84–1.17]
Out-of-home placement settings count	1.08 *** [1.03–1.13]	0.98 [0.92–1.05]	1.01 [0.96–1.06]
Substantiated maltreatment history (no)	0.78 [0.55–1.11]	1.11 [0.78–1.57]	1.03 [0.71–1.48]
Adjudication history (no)	0.81 [0.45–1.49]	0.25 *** [0.11–0.59]	1.07 [0.59–1.97]
Juvenile placement history (no)	1.06 [0.62–1.82]	1.86 ** [1.16–2.98]	1.97 ** [1.19–3.25]
Model fit	$\chi^2 = 50.2$ (10), $p < 0.001$	$\chi^2 = 163.2$ (10), $p < 0.001$	$\chi^2 = 109.5$ (10), $p < 0.001$

$t_p < 0.10$,

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Reference categories are shown in the parentheses