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Multisystemic Therapy for Social, Emotional, and Behavioral Problems in Youth Aged 10-17

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Campbell Systematic Reviews

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Cover sheet

Title

Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)

Reviewers

Littell JH, Popa M, Forsythe B

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JL (lead author) conducted the meta-analysis and wrote the review. BF helped devise and implement the search strategy and participated in study inclusion/exclusion decisions. MP helped develop and implement data abstraction procedures, coded studies, and participated in the analysis of data.

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None known.

What's new

We report results of new analyses conducted to boost statistical power (i.e., the ability to detect effects). Results of fixed effect models are reported, even though these models do not fit the data well. We expanded the discussion of results.

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Synopsis

Results of eight randomised controlled trials of Multisystemic Therapy (MST) conducted in the USA, Canada, and Norway indicate that it is premature to draw conclusions about the effectiveness of MST compared with other services. Results are inconsistent across studies that vary in quality and context. There is no information about the effects of MST compared with no treatment. There is no evidence that MST has harmful effects.

Abstract

Background

Multisystemic Therapy (MST) is an intensive, home-based intervention for families of youth with social, emotional, and behavioral problems. Masters-level therapists engage family members in identifying and changing individual, family, and environmental factors thought to contribute to problem behavior. Intervention may include efforts to improve communication, parenting skills, peer relations, school performance, and social networks. Most MST trials were conducted by program developers in the USA; results of one independent trial are available and others are in progress.

Objectives

To provide unbiased estimates of the impacts of MST on restrictive out-of-home living arrangements, crime and delinquency, and other behavioral and psychosocial outcomes for youth and families.

Search strategy

Electronic searches were made of bibliographic databases (including the Cochrane Library, C2-SPECTR, PsycINFO, Science Direct and Sociological Abstracts) as well as government and professional websites, from 1985 to January 2003. Reference lists of articles were examined, and experts were contacted.

Selection criteria

Studies where youth (age 10-17) with social, emotional, and/or behavioral problems were randomised to licensed MST programs or other conditions (usual services or alternative treatments).

Data collection & analysis

Two reviewers independently reviewed 266 titles and abstracts; 95 full-text reports were retrieved, and 35 unique studies were identified. Two reviewers independently read all study reports for inclusion. Eight studies were eligible for inclusion. Two reviewers independently assessed study quality and extracted data from these studies.

Significant heterogeneity among studies was identified (assessed using Chi-square and I^2), hence random effects models were used to pool data across studies. Odds ratios were used in analyses of dichotomous outcomes; standardised mean differences were used with continuous outcomes. Adjustments were made for small sample sizes (using Hedges g). Pooled estimates were weighted with inverse variance methods, and 95% confidence intervals were used.

Main results

The most rigorous (intent-to-treat) analysis found no significant differences between MST and usual services in restrictive out-of-home placements and arrests or convictions. Pooled results that include studies with data of varying quality tend to favor MST, but these relative effects are not significantly different from zero. The study sample size is small and effects are not consistent across studies; hence, it is not clear whether MST has clinically significant advantages over other services.

Reviewers' conclusions

There is inconclusive evidence of the effectiveness of MST compared with other interventions for youth. There is no evidence that MST has harmful effects.

Background

Multisystemic Therapy (MST) is a multi-faceted, short-term, home- and community-based intervention for families of youth with severe psychosocial and behavioral problems. Based on social ecological and family systems theories, and on research on the causes and correlates of serious antisocial behavior in youth (Henggeler 1998, Henggeler 2002a), MST is designed to address complex psychosocial problems and provide alternatives to out-of-home placement of children and youth.

The conceptual framework for MST is derived from reviews of research on juvenile delinquency and other psychosocial problems in childhood and adolescence that point to the influences of a variety of individual, family, school, peer, neighborhood, and community characteristics (Fraser 1997a, Henggeler 1998). MST program developers argue that, if these problems are multidetermined, 'it follows that effective interventions should be relatively complex, considering adolescent characteristics as well as aspects of the key systems in which adolescents are embedded' (Henggeler 1995, p. 116). They note that this is consistent with social ecological theories of human development (e.g., Bronfenbrenner 1979), in which behavior is viewed as a product of reciprocal interactions between individuals and their social environments, and with family systems theories, in which children's behaviors are thought to reflect more complex family interactions (Haley 1976, Minuchin 1974).

As described by its developers (Henggeler 1998), MST uses a 'family preservation service delivery model' that provides time-limited services (4 to 6 months) to the entire family. Treatment teams consist of professional therapists and crisis caseworkers, who are supervised by clinical psychologists or psychiatrists. Therapists are mental health professionals with masters or doctoral degrees; they have small caseloads and are available to program participants 24 hours a day, seven days a week. Treatment is individualized to address specific needs of youth and families, and includes work with other social systems including schools and peer groups (hence, the name multisystemic). Treatment may focus on cognitive and/or behavioral change, communication skills, parenting skills, family relations, peer relations, school performance, and/or social networks.

Clinical features of MST include a comprehensive assessment of child development, family interactions, and family members' interactions in other social systems. Interviews with family members usually take place in the family's home. In consultation with family members, the therapist identifies a well-defined set of treatment goals. Tasks required to accomplish these goals are identified, assigned to family members, and monitored in regular family sessions that occur at least once a week, sometimes daily, in the family's home.

MST does not have a unique set of intervention techniques; instead, 'intervention strategies are integrated from other pragmatic, problem-focused treatment models' including strategic family therapy, structural family therapy, and cognitive behavior therapy (Henggeler 1995, p. 121). According to its developers, 'Multisystemic therapy is distinguished from other intervention approaches by its comprehensive conceptualisation of clinical problems and the multi-faceted nature of its interventions' (Henggeler 1995, p. 121).

MST programs are licensed by MST Services, Inc. (see www.mstservices.com).

Replication

There are more than 250 licensed MST teams in North America and Europe, treating approximately 10,000 serious juvenile offenders and other youth with serious social, emotional,

and behavioral problems each year (Henggeler 2003a). Considerable attention has been paid to the transportability and dissemination of MST, and to the fidelity of MST replications (e.g., Henggeler 2002b, Schoenwald 2000b, Schoenwald 2001). 'Treatment adherence is optimized by quality assurance mechanisms that . . . include task-oriented on-site supervision, measurement of adherence to the treatment model using research-validated instruments, and intensive training for all MST staff including a five day orientation training, weekly case consultation with an MST expert, and quarterly booster training' (MST Services 2003).

Research

Funding for research on MST rose from $5 million (US dollars) in 1995 to approximately $18 million in 2000 to $35 million in 2003 (Henggeler 2003a). In January 2004, MST developers announced receipt of $20 million in new research grants (Henggeler 2004b). According to MST Services Inc., at least 15 randomised controlled trials (RCTs) have been conducted to assess the impacts of MST, of which the results of eight are published, and many additional studies are underway (MST Services 2003). Most of these studies have been or are being conducted by the developers of MST, based at the Family Services Research Center (FSRC) at the Medical University of South Carolina (MUSC), USA. Below, we describe MST studies in detail, and document reasons for the inclusion and exclusion of studies in this review.

Previous reviews

MST trials have been included in meta-analytic reviews of effects of a wider array of interventions with juvenile offenders (Lipsey 1998), family treatment of youth delinquency (Latimer 2001), and family and parenting interventions for conduct disorder and delinquency (Woolfenden 2002, Woolfenden 2004). These reviews do not speak to the effectiveness of MST per se.

Curtis and colleagues (Curtis 2004) reported results of a meta-analysis of published studies of effects of MST conducted by MST program developers. Unpublished studies and those conducted by independent research teams were not included. The meta-analysis included studies of abusing or neglectful parents, juvenile sexual offenders, violent and chronic juvenile offenders, substance abusing juvenile offenders, and psychiatrically disturbed adolescents. Three studies used an alternative treatment as the control condition, four used a usual services control group. Effect sizes (*d* indexes) were estimated incorrectly (treating Fs from multivariate analysis of variance as if they came from one-way analysis of variance) and only for statistically significant effects for at least one study (Brunk 1987). Corrections for small sample bias were applied to only one study. D indexes were averaged across domains within studies and then pooled across studies without using inverse variance methods to adjust for differences in the precision of the estimates. Curtis et al. reported an overall, unweighted effect size of $d = .55$. However, this estimate may be affected by publication bias (cf. Rothstein in press), allegiance effects (cf. Luborsky 1999), and estimation errors.

Results of MST outcome studies have been summarized in non-systematic reviews of the effects of family preservation services (Fraser 1997b), interventions for child physical and sexual abuse (Swenson 2003), treatment for substance abuse (NIDA 1999), treatment for delinquency and disruptive behavior in youth (Smith 1997), children's mental health services (Burns 2004, Burns 2000, Kazdin 1998), and programs to reduce crime (Aos 2001, US DHHS 2001) and prevent violence (Mihalic 2004). Several reviewers suggested that MST is one of the most promising empirically-based treatments for children and youth (Hoagwood 2001, Kazdin 1998). One reviewer concluded that MST has positive effects that been replicated 'across problems, therapists, and settings. This shows that the treatment and methods of decision making can be extended and that treatment effects are reliable' (Kazdin 1998, pp. 27-28). Chorpita and colleagues classified MST as a 'probably efficacious treatment' for conduct and oppositional disorders, but noted that 'no studies

to date support MST other than those conducted by its developers' (Chorpita 2002, p. 177).

Using data from three studies of effects of MST on criminal outcomes, Aos and colleagues (Aos 2001) reported that, compared to alternative interventions (usual services, community services, or individual therapy), MST reduced the proportion of youth who commited criminal offenses (SMD= -.31, sd=.10). They estimated that the net direct cost of the program per participant was $4,743 (US dollars). When they compared this cost with estimated economic benefits of anticipated reductions in crime, the estimated net benefits of MST range from $31,661 (for taxpayers only) to $131,918 (for taxpayers and crime victims) per MST program participant. Thus, a program that served ten participant families would be expected to produce a net savings of $316,610 in public funds plus over $1 million in savings to potential crime victims.

Objectives

To assess the impacts of MST on out-of-home living arrangements, crime and delinquency, and other behavioral and psychosocial outcomes for youth and families.

Criteria for considering studies for this review

Types of studies

The review was limited to experimental studies in which participants were randomly assigned to groups. Studies using other group designs were identified, but not included. There were no publication or language restrictions.

Types of participants

Children and youth (ages 10-17) with social, emotional, and behavioral problems, and their family members. These youth may be at risk of out-of-home placement. Participants include:

- abused, neglected, and dependent children and youth who may be at risk of foster care or other out-of-home placements in child welfare settings;
- children and youth with mental health problems who may be at risk of psychiatric hospitalization; and
- delinquent youth at risk of incarceration or placement in residential treatment settings.

Types of interventions

Multisystemic Therapy (as defined above) was compared with any counterfactual condition, including 'usual services' (in juvenile justice or child welfare), other treatment conditions (e.g., individual therapy), and no treatment. To be included in this review MST programs had to be licensed; other multisystemic treatments were not included.

Types of outcome measures

Measures of behavioral, psychosocial, and family outcomes were examined.

- Behavioral outcomes included antisocial behavior (as measured by arrest or conviction of a criminal offense), drug use (self-reports and drug tests), and school attendance.

- Psychosocial outcomes included measures of psychiatric symptoms (on standardized scales), school performance (teacher reports), peer relations (self-reports and parent or teacher reports), and self esteem.

- Family outcomes include living arrangements for children and youth (primarily in-home versus out-of-home care) and qualities of family functioning (e.g., adaptability, cohesion).

To be included in this review, outcome data had to be provided for the full sample with response rate of at least 60%.

Search strategy for identification of studies

Search strategy for identification of studies

The decision to limit searches to 1985 - most current was taken because it was known that the first published work on MST appeared in 1986. Relevant studies were identified through electronic searches of the Cochrane Central Register of Controlled Trials (CENTRAL) (Issue 1, 2003) and of other bibliographic databases, government policy databanks and internet search engines including:

Biomedical Sciences Databases
MEDLINE (1985 - January 2003)
EMBASE (1985 - January 2003)
CINAHL (1985 - January 2003)
PsycINFO (1985 - January 2003)

Social Sciences and general references databases:
ASSIA (1985 - January 2003)
C2-SPECTR (1985 - January 2003)
Cambridge Journals (1985 - January 2003)
Dissertation Abstracts International (DAI) (1985 - January 2003)
ERIC (1985 - January 2003)

Family Services Research Center of the Medical University of South Carolina (www.musc.edu/fsrc) (January 2003)
Info Trac (1985 - January 2003)
Science Direct (1985 - January 2003)
Sociological Abstracts (1985 - January 2003)
Social Work Abstracts (1985 - January 2003)
Web of Knowledge / Web of Science (January 2003)

Government policy sources:
U.S. Department of Health and Human Services (January 2003)
U.S. National Institutes of Health, CRISP database (January 2003)
U.S. Centers for Disease Control (January 2003)
U.S. Government Printing Office (January 2003)
UK Home Office (January 2003)

Search engines
Biblioline (January 2003)
Google (January 2003)

Search terms for MEDLINE (modified as necessary for other databases) were as follows:

(multisystemic therap$) AND (research or evaluation or outcom$)
(multi-systemic therap$) AND (research or evaluation or outcome$)
(multisystemic treatment) AND (research or evaluation or outcome$)
(multi-systemic treatment) AND (research or evaluation or outcome$)

Personal contacts
Personal contacts with MST developers and independent investigators were made to identify unpublished reports and ongoing studies. (These contacts included Steve Aos, Robert Barnowski, Charles Borduin, Alison Cunningham, Scott Henggeler, Alan Leschied, Mark Lipsey, Terge Ogden, Sonja Schoenwald, Jane Timmons-Mitchell, and Bahr Weiss).

Cross-referencing of bibliographies
The references in reviews and primary studies were scanned to identify new leads.

Methods of the review

Selection of trials
Two reviewers (JL and BF/MP) independently screened 266 titles and abstracts identified in the search and indicated which reports should be retrieved. If there was not enough information in the title and abstract to make this decision, the full text was retrieved. Two reviewers independently read 95 full-text reports and determined which studies met the inclusion criteria. Selection decisions were reviewed and any disagreements were resolved by the review team. Specific reasons for exclusion were documented for each study that did not meet inclusion criteria (see Table of Excluded Studies).

Assessment of methodological quality
Random allocation is an inclusion criterion for this review, given its importance in minimising bias (Schulz 1995). The quality of allocation concealment was rated by (JL and MP) using categories described in the Cochrane Handbook (Alderson 2004) where:

(A) indicates adequate concealment of the allocation (for example, by centralised randomisation);
(B) indicates uncertainty about whether the allocation was adequately concealed (for example, coin toss or unknown method of concealment);
(C) indicates that the allocation was definitely not adequately concealed (for example, open random number lists or quasi-randomisation such as alternate days, odd/even date of birth, or hospital number).

For the purposes of this review, only trials meeting categories (A) and (B) were included because earlier reviews indicated that most MST trials attempted to conceal allocation using random assignment. Included studies were also assessed on: adequate implementation of random assignment, standardization and blinding of assessments, attrition, and intent-to-treat analysis. As explained below, studies were rank-ordered in terms of their ability to support intent-to-treat analysis and use of standardized outcome measures.

Data management
Information on study design and implementation, sample characteristics, intervention characteristics, and outcomes was extracted from studies and coded on a data extraction form. Two reviewers (JL and MP) independently coded all studies. Differences between raters were

discussed in order to refine coding schemes and resolve any discrepancies. Citations and data were entered and organized in RevMan 4.2.3. Authors of studies with missing data were contacted and some additional data were obtained as a result; no attempts were made to impute missing data.

Data synthesis and analysis
Data synthesis was conducted with RevMan 4.2, the latest version of the Cochrane Collaboration's meta-analysis software.

Continuous data were analysed if means and standard deviations were available or there was some other way to calculate effect size (e.g., from t-tests, F-tests, or exact p-values). When reports contained insufficient data, we sought additional information from the authors. Where scales measured the same clinical outcomes (e.g., psychiatric symptoms) in different ways, standardized mean differences (SMD) were compared across studies. The RevMan formula for SMD is Hedge's *g*, which is like Cohen's *d* but includes an adjustment for small sample bias. Inverse variance methods were used to pool SMDs, so that each effect size was weighted by the inverse of its variance in an overall estimate of effect size. Confidence intervals of 95% were used for individual study data and pooled estimates.

Binary outcomes were analyzed by calculating odds ratios with 95% confidence intervals. Although the odds ratio provides an effect for use in meta-analysis (Lipsey 2001), attempts were made to preserve information about base rates (actual proportions) and differences in proportions, since this information is of interest to policy makers. RevMan 4.2 uses Mantel-Haenszel methods for combining binary outcome data across studies.

When some primary studies reported an outcome (e.g., incarceration) as a dichotomous measure and others used a continuous measure of the same construct, two separate meta-analyses were generated (one for odds ratios and another for SMDs). Next, in order to increase the statistical power of these analyses, odds ratios were converted to *d* indices using the Cox formula (log odds ratio divided by 1.65; Sanchez-Meca 2003), study average effect sizes (ES) were calculated with Hedges' *g*, and meta-analysis was performed on study average ES using Comprehensive Meta Analysis software.

When a primary outcome study provided multiple measures of the same construct (e.g., parent and youth reports on family cohesion) at the same point in time, an average effect size was used to avoid dependence problems. When a primary outcome study reported multiple measures of the same construct at different points in time, we used the measure that was closest in time to a one-year follow-up.

Both fixed effect and random effects models were examined. Heterogeneity was evaluated with I^2, the Chi-square test of heterogeneity, and by comparing results of fixed and random effects models (Higgins 2002). We expected and found evidence of heterogeneity, hence we rely on results of random effects models.

Subgroups were examined in analyses of out-of-home placements, which were defined differently for different populations (incarceration of juvenile offenders versus hospitalization of youth with psychiatric disorders). However, results were relevant and similarly defined across populations (peer relations, family functioning). The decision to pool results was driven by claims that positive effects of MST are reliable 'acoss problems, therapists, and settings' (Kazdin 1998) and the practice of combining outcomes across populations and comparison conditions in previous reviews of MST (e.g., Curtis 2004).

There were too few studies in the analysis to conduct moderator analyses to investigate possible sources of heterogeneity which (as explained below) are confounded.

Description of studies

A total of 35 distinct MST outcome studies were identified. There were multiple reports for many of these studies and some reports presented data on multiple studies (non-overlapping samples).

Fourteen studies were excluded (see Table on Characteristics of Excluded Studies). Ten studies were excluded because they did not involve random allocation to treatment; of these studies, eight had comparison groups (Henggeler 1986; TimmonsMitchell 2003; Rosenblatt 2001a, Cunningham 2001; Barnoski & Aos 2004; Randall 1999; Schoenwald 2003; Satin 2000) and two did not (Sutphen 1993;Thomas 2002). Two studies were excluded because they were not focused on youth with social, emotional, or behavioral problems (both involved families of youth with Type 1 diabetes; Ellis 2003, Pendley 2002). One study (Brunk 1987) was excluded because it only reported results for subgroups of program completers, had no follow-up data, and did not provide sufficient data (sample means and standard deviations) for meta-analysis. One study was excluded because it did not evaluate a licensed MST program (Little 2004).

Thirteen randomized or possibly-randomized studies were classified as "ongoing" (see Table on Characteristics of Ongoing Studies). Preliminary data are available on a few of these studies (e.g., TimmonsMitchell2003b); but none had sufficient data on participants, interventions, study design, and outcomes for use in this review. There were reports that some of these studies have ended (e.g., Miller 1998, Rosenblatt 2001b), but we do not yet have enough information on these studies to include (or exclude) them. It is hoped that some or all of the ongoing studies will be included in a future version of this review.

Eight studies met inclusion criteria for this review (see Table of Characteristics of Included Studies).

Study methods
As indicated above, all studies used random allocation to MST treatment and comparison conditions. In some studies (Henggeler 1992; Henggeler 1997; Henggeler 1999a; Henggeler 1999b), cases that were randomly assigned to MST were paired (yoked) with cases randomly assigned to usual services, based on timing of entry into the study. In one study, "eligible youths were referred...in yoked pairs, with one youth randomly selected...to receive MST and the other to receive the usual services" (Henggeler 1992a, p. 954). Since there was no treatment completion date for usual services cases, "post-treatment" assessments for both cases were conducted after MST services ended in the MST case.

Setting of studies
The eight studies included within this review were undertaken between 1990 and 2004 in three countries. Six studies were conducted in the USA (Borduin 1990; Borduin 1995; Henggeler 1992; Henggeler 1997; Henggeler 1999a; Henggeler 1999b), one in Canada (Leschied 2002), and one in Norway (Ogden 2004). Several studies included multiple sites; one study was conducted in two sites in South Carolina (Henggeler 1997); the Canadian study took place in four sites in Ontario; and the Norwegian study was conducted in four sites in that country. Site-specific results were not reported in the USA and Norway studies. To our knowledge, none of the multi-site studies took

nesting into account when data were pooled across sites (this can increase Type I error, leading to more false positives than would be the case in a multi-level analysis).

Sample characteristics
Six studies focused on effects of MST for juvenile offenders, including sex offenders (Borduin 1990), juvenile offenders with substance abuse problems (Henggeler 1999a), and juvenile offenders in general (Borduin 1995; Henggeler 1992; Henggeler 1997; Leschied 2002). The Norwegian study included youth with problem behaviours such as aggression, rule breaking, other antisocial behaviour, serious academic difficulty, or dysfunctional relationships (Ogden 2004). One study focused on effects of MST for youth with psychiatric emergencies (Henggeler 1999b).

Intervention characteristics
All studies included licensed MST programs. The average number of hours of direct contact between family members and MST therapists was 23 (in Borduin 1995) to 33 (Henggeler 1992) in studies of juvenile offenders, 40 in a study of juvenile offenders with substance abuse problems (Henggeler 1999a), and 92 in the study of youth with psychiatric emergencies (Henggeler 1999b). Interventions varied within studies (e.g., Borduin 1995; see Table of Characteristics of Included Studies)

Comparison conditions
Studies of juvenile offenders compared MST with individual therapy (Borduin 1990; Borduin 1995), usual services in juvenile justice (Henggeler 1992; Henggeler 1997; Leschied 2002), and outpatient substance abuse services (Henggeler 1999a). The Norwegian study compared MST to usual services in the child welfare system (placement, in-home supervision, etc., Ogden 2004) It is important to note that usual services are different across studies, given their different geographic locations. The study of youth with psychiatric emergencies compared MST with psychiatric hospitalization (Henggeler 1999b).

Outcome measures
Outcome measures included archival data (police and court records) on arrests and/or convictions for criminal offenses and incarceration in studies of juvenile offenders in the USA and Canada. These outcomes were not assessed in Norway, where youth under 15 are not arrested and those under 18 are rarely prosecuted (Ogden 2004). In some studies, data on the types and duration of out-of-home placements were obtained via caregiver reports (Henggeler 1999b; Ogden 2004). Caregiver reports of youth hospitalization and school attendance were confirmed with hospital and school records in one study (Henggeler 1999b). Self-reports on substance use and drug tests (urinalysis) were available in another study (Henggeler 1999a). Self-reported frequency of drug use was assessed with the Personal Experience Inventory (PEI; Winters 1989).

Psychiatric symptoms, delinquency, peer relations, self-esteem, and family functioning were assessed via self-reports and parent reports on standardised measures or standardised measures that were sometimes adapted to fit the sample (e.g., translated into Norwegian in Ogden 2004). Psychiatric symptoms were assessed with the Global Severity Index (GSI) of the Brief Symptom Inventory (BSI; Derogatis 1993) or the full SCL-90-R (Derogatis 1983) and the Child Behavior Checklist (CBCL; Achenbach 1991). The Revised Problem Behavior Checklist (RPBC, Quay 1987) and the Self Report Delinquency (SRD) Scale (Elliott 1983) were used in several studies. Peer relations were assessed with the Missouri Peer Relations Inventory (MPRI; Borduin 1989). Self-esteem was measured with the Self-Esteem subscale of the Family, Friends, and Self Scale (Simpson 1992) in one study (Henggeler 1999b). Family functioning was assessed with the Family Adaptability and Cohesion Evaluation Scales (FACES-II, Olson 1982; or FACES-III,Olson 1985)

and the Family Assessment Measure (FAM-III; Skinner 1983). In one study, parental supervision was assessed with the parent version of the Monitoring Index (Patterson 1985), another study used original indices of parental supervision (Leschied 2002)

Duration of follow-up observations
Follow-up observations of approximately one year or more were available for all studies except the Norwegian study (Ogden 2004). Immediate post-intervention data are available for the Norwegian study and investigators plan to produce follow-up data on treated cases. As explained below, several studies did not use standardised observation periods in their data analysis.

Independence
Six studies were conducted by MST program developers, one study was "semi-independent" (conducted by an independent investigator, with a co-author at the FSRC of the MUSC who performed the data analysis; Ogden 2004), and one study was conducted by independent investigators (Leschied 2002).

Methodological quality of included studies

Allocation concealment
The methods of allocation concealment used in these studies were not fool-proof. For example, coin tosses were used in one study (Borduin 1995), sealed envelopes in others (Henggeler 1999b; Ogden 2004). Most studies noted when and where randomisation occurred (e.g., in family home with MST therapist present, Leschied 2002), but did not describe the method of randomisation.

Although all studies utilised randomisation, it was not clear whether all cases in each study were randomised. For example, in the Diffusion study (Henggeler 1997), 146 cases were assigned to MST or usual services in 73 yoked pairs and 9 cases were assigned to MST. The Norwegian study assigned 62 families to MST and 38 to usual services, but replaced 4 of the cases that were originally assigned to MST (Ogden 2003). An early report indicated that the odds of assignment to MST were 5/9 in Norway (Ogden 2003), but a published report stated that the odds were 6/10 (Ogden 2004). It is possible that all cases in these studies were randomised, but the authors do not indicate what, if any, mechanisms were used to determine whether randomisation was used and followed in all cases.

All studies were rated B on allocation concealment (as described above).

Blinding of allocation
Study participants and therapists could not have been blind to allocation. Collection of archival data (e.g., from juvenile justice records) might be considered blind; however, law enforcement officials could not be blind to group assignment and their knowledge that a youth was receiving or had received MST could have affected key decisions about youth (e.g., arrests, convictions, and incarceration; Leschied 2002a). Pre-test, post-test, and follow-up measures were collected by MST therapists (Leschied 2002) or researchers who were usually not blind to participants' group allocation.

Standardization of outcome assessments
Archival data on arrests (in the USA) and convictions (Leschied 2002) were routinely collected in studies of juvenile offenders. Follow-up periods were described in terms of the mean time (days or weeks) elapsed since random assignment or (more commonly) treatment completion. The duration

of these observation periods varies across cases within studies (as is often the situation when cases are enrolled in a study over an extended period of time) and in some studies, the range in observations is quite substantial: 21 to 49 months in the sex offenders study (Borduin 1990); 2-5 years for the first follow-up and 10-15 years for the long-term follow-up in the MDP study (Borduin 1995); and 16-97 weeks in the FANS study (Henggeler 1992). Investigators used survival analysis to take variable observation periods into account in the MDP and FANS studies. Several studies (Borduin 1990; Borduin 1995; Henggeler 1992) reported the percentage of successes/failures on several measures, but these include all observations, regardless of variations in the length of observations. For example, the percentage of recidivists among sex offenders includes one case observed for 21 months and one observed for 49 months; we do not know whether the 21-month case recidivated within the next 28 months, hence its outcome is not comparable to the outcome for a case observed over a longer period of time. Moreover, it is not clear whether the distribution of follow-up intervals differs between conditions. This problem (analysis of unstandardised observations) is not recognized in most study reports, which use mean observation periods (e.g., the FANS study is usually described as having a 59-week observation period, rather than an observation period that ranged from 16 to 97 weeks). In the Diffusion study (Henggeler 1997), archival data were collected at a fixed point in time (1.7 years after the end of the project) and then annualized to account for variations in the follow-up observation period (e.g., by computing number of rearrests per year observed). Since arrest rates tend to decline over time, cases with longer follow-up observation periods are likely to have a lower annualized rate than those with short observation periods. We requested fixed-interval data (one-year follow-ups) from authors, but received this for only one study (Leschied 2002).

Most self-report measures were based on standardised instruments and measures used in previous studies. Questions can be raised about the suitability of some instruments in certain samples (e.g., the self-esteem scale used in the Henggeler 1999b study was developed for use with Mexican-American youth (see Simpson 1992), although that study's sample was 1% Hispanic). Authors rarely reported information on the performance (e.g., internal consistency) of standardised instruments in the study samples. Some standardised instruments were adapted for the purposes of a particular study, thus there are cross-study variations in measures. For example, in the Norwegian study, back-translation methods were used for some measures (e.g., the CBCL) and not others; however, authors' reports on the internal consistency of these modified scales indicate that this was a reasonable approach.

When multiple reports (e.g., from youth and parents) were available on a single measure, average scores were used with pooled standard deviations (calculated using macros developed by David Wilson, see http://mason.gmu.edu/~dwilsonb/ma.html).

Intent-to-treat analysis

Assessment of the studies' ability to support intent-to-treat analysis was complicated by conflicting reports on the number of cases randomly assigned in several studies. For example, according to an early report on the Missouri Delinquency Project (MDP; Borduin 1995) "a total of 210 families of juvenile offenders agreed to participate in the assessment and treatment components of the study. Following the initial assessment session, each family was randomly assigned to either multisystemic therapy or the alternative treatment group. Approximately 84% (n=88) of the families in multisystemic therapy and 65% (n=68) of the families assigned to alternative therapy completed treatment" (Borduin 1990a, p. 76). From this, we deduced that 105 cases were randomly assigned to each group (84% of 105 = 88, 65% of 105 = 68). However, one report indicates that 200 cases were randomly assigned (Henggeler 1991). The most widely cited report on this study (Borduin 1995a) indicates that 200 cases were assessed, but only 176 were randomly assigned. We noted

this discrepancy in a preliminary report that we submitted to the authors, but received no explanation for conflicting reports on sample size. Although prior reviews have been based on the assumption that 176 cases were randomly assigned in this study (e.g., Aos 2001; Cormack 2000; Farrington 2003; Woolfenden 2004), we use the original figure of 210.

Similarly, an early report indicated that 96 cases were randomly assigned in the FANS study (Henggeler 1992). Twelve cases were excluded for various reasons (2 cases were considered ineligible, 6 MST cases did not receive treatment or could not be located, 2 control cases were court-ordered to MST, and archival data were not available on 2 cases; see Henggeler 1992a, p. 954). Subsequent reports are based on the remaining 84 cases, with no mention of excluded cases (Henggeler 1993; Henggeler 1996a). Prior reviews assumed that only 84 cases were randomly assigned in the FANS study (Aos 2001; Brosnan 2000; Farrington 2003; Woolfenden 2004).

Similar discrepancies emerged in the CDA project (Henggeler 1999a), although these are minor compared to the inconsistencies in MDP reports. Most reports on the CDA project (e.g., Henggeler 1996b; Henggeler 1999b) suggest that 118 cases were randomly assigned, but Brown and colleagues (Brown 1999) put this number at 120. We use Brown's figure because she also indicated that cases were "temporarily yoked" in pairs (and all reports indicate that there were 60 usual services cases).

As indicated above, four studies used yoked pairs of MST and comparison cases (to link the timing of the second assessment for comparison cases to the post-intervention assessment for MST cases; Henggeler 1992; Henggeler 1997; Henggeler 1999a; Henggeler 1999b). However, if one of the cases dropped out of the study, its mate was retained in the analysis. Some readers thought this undermined the yoked design and the unyoked cases should have been dropped to retain the benefits of random assignment; others disagreed. In any case, one could use sensitivity analysis to determine whether inclusion of unyoked cases affected results; to our knowledge, this was not done.

The exclusion of MST drop-outs is problematic, because these cases tend to have more negative outcomes (e.g., higher rates of arrest or conviction) than MST completers (Borduin 1995, Leschied 2002).

The Diffusion study (Henggeler 1997) provided data on incarceration for all cases assigned to MST (N=82), but it is not clear whether the comparison is all cases assigned to usual services (US, n=73) or, as in the remainder of the report, cases that completed US. Similarly, it is not clear whether arrest data pertain to the full sample or program completers (in part, because these data are presented within a table that is largely comprised of post-treatment data on program completers (Henggeler 1997a, p. 828). Below we assume that all MST and US cases are included in analyses derived from archival records on incarceration and arrest, and we treat these two outcomes as intent-to-treat analyses (with an unstandardised follow-up observation period). The remainder of the outcome data on this study are restricted to program completers (75 MST cases and 65 US cases).

Full intent-to-treat analysis was possible in only one study (Leschied 2002), and only for outcome measures derived from archival data in that study (interim response rates on psychosocial measures were below 60% and, thus, are not included here).

Assumptions

When were not able to resolve questions about study methodology, we made assumptions that

favored the study. We assumed that all cases in the Diffusion and Norwegian studies were randomly assigned, although that was not clear from written reports (and some readers thought we should drop these studies). We assumed that unyoked designs are not a fundamental departure from randomisation, although some readers disagreed. We assumed that all MST and US cases are included in analysis of archival data in the Diffusion study, although that was not clear.

Methodological quality rankings
We ranked studies in terms of their overall methodological quality on two aspects: intent-to-treat and follow-up. Rankings were as follows:

1) Full intent-to-treat analysis with standardised follow-up period (highest quality). One study met these criteria for some outcome measures (Leschied 2002, N=409).
2) Intent-to-treat analysis with unstandardised follow-up period. One study met these criteria (Borduin 1990, N=16).
3) Attempted intent-to-treat analysis with unyoked designs. Two studies met these criteria (Henggeler 1999a, valid n=118 of 120 cases; Henggeler 1999b, n=156 of 160 cases).
4) Follow-up observations that systematically excluded cases that refused treatment or dropped out of treatment (Borduin 1995, n=176 of 210 cases; Henggeler 1992, n=84 of 96 cases).
5) Post-treatment observations on program completers (Henggeler 1997, n=140 of 155 cases; Ogden 2004, N=96 of 104 cases).

These rankings reflect important differences among the studies in this review in terms of their ability to support causal inferences. However, the rankings are not intended to be used as a generic study-quality scale, and they were not used to weight results of this meta-analysis.

Results
See also: Table of comparisons and data and Figures 1 through 21. Please note that we have not altered the direction of effects. In some analyses, a positive effect favors MST; however, most analyses concern negative outcomes (e.g., incarceration) and negative effects on these outcomes (e.g., reduced likelihood of incarceration) favor MST. The captions below the figures show whether results favor MST or the control group, and we attend to the direction of effects in the text below.

Out-of-home placements
Four studies reported data on the proportion of juvenile offenders (N=766) who were incarcerated within approximately one year after intervention. There was virtually no difference between MST and usual services in intent-to-treat analysis in Ontario, where 33% of MST cases were incarcerated, compared with 32% of usual services cases (Leschied 2002). Effect sizes from two other studies were not statistically significant (one favored the MST group (Henggeler 1997) and the other favored the control group (Henggeler 1999a)). The fourth study found statistically significant differences that favored MST (Henggeler 1992). Pooled results show that MST cases were less likely to be incarcerated than other services cases (OR .61), but the study-level effect sizes are hetergeneous and the confidence interval is so large (95%CI .27 to 1.39) that the effect is not statistically significant. This means that we cannot rule out the possibility that there is no difference between MST and other services in effects on incarceration. (Similar results are obtained in the fixed effect model, where OR .77, 95%CI .57 to 1.03; given substantial heterogeneity between studies, the fixed effect model is not tenable.)

The same studies reported information on the average length of incarceration, but one study

(Henggeler 1999a) did not provide information that could be used to calculated an effect size (in Henggeler 1999a, the mean length of incarceration was 9.8 days for 58 MST cases and 17.5 days for 60 comparison cases at 11 months). Results for the remaining studies show no differences between MST and usual services cases in Ontario (intent-to-treat analysis) and significant differences favoring MST in two studies. Pooled results indicate that MST tended to reduce the length of incarceration (SMD = -.31), but this effect is not statistically different from zero (95%CI -.72 to .10) and there is substantial heterogeneity between studies. (In the fixed effect model, SMD -.17, 95%CI -.32 to -.01; but this does not take substantial between-study heterogeneity into account.)

In order to use all follow-up data on incarceration in one meta-analysis, we converted odds ratios to *d* indices using the Cox formula, generated study-level mean ES for incarceration (using Hedges' *g*), and performed meta-analysis on study mean ES as described above. Study means ES for incarceration were .94 (Henggeler 1992), .38 (Henggeler 1997), -.18 (Henggeler 1999a), and -.03 (Leschied 2002). With 766 cases and four studies in the analysis, the pooled estimate for the effect of MST on incarceration is g = .25 (random effects, .13 fixed effect); however, there is significant heterogeneity of effects among studies (Q=19.93, df=3, p<.001) and the point estimate is not statistically different from zero (random effects 95%CI -.16 to .66, p=.23)

MST was compared with hospitalization in the study of youth with psychiatric emergencies (Henggeler 1999b); hence, we treat initial hospitalizations as part of the comparison condition (49% of MST youth and 100% of hospitalized youth were hospitalized during the intervention period). Initial results showed that MST youth had relatively fewer hospitalizations after intervention. However, during the one-year follow-up period, 48% of MST youths had experienced out-of-home placements (of any type) compared with 47% of hospitalized youth, a nonsignificant difference (OR 1.06, 95%CI .56 to 1.98). Mean lengths of stay were 57 days for the MST group and 67 days for the comparison group (no other information was provided on length of stay; Henggeler 2003b).

The Norwegian study only reported data on out-of-home placements (combining all types of placements) for a subsample of cases at the post-intervention assessment (Ogden 2004).

Arrest or conviction of a criminal offense

Five studies provided follow-up data on the number or proportion of youth who were arrested or convicted of a criminal offense at approximately one year. Studies conducted in the USA used arrest data (Borduin 1990; Borduin 1995; Henggeler 1992; Henggeler 1999a), the Ontario study used conviction data (arrest data were not available). Further, the follow-up periods for these data are not strictly comparable. Follow-up periods average 3 years in the sex offenders study (mean 37 months, range 21 to 49 months; Borduin 1990), 4 years in the Missouri Delinquency Project (mean 3.95 years, range 2.04 to 5.41 years; Borduin 1995), and 1 year in the FANS (mean 59 weeks, range 16 to 97 weeks; Henggeler 1992), CDA (11 months; Henggeler 1999a), and Ontario studies (1 year; Leschied 2002).

In Ontario, the between-group difference in convictions favored the control group (47% of MST and 42% of control cases were convicted within one year), but the difference was not statistically significant. In the USA, four studies reported arrest rates that favored MST; these differences were statistically significant in two of these studies. Pooled results show that MST cases were less likely to be arrested or convicted (OR .39) but, again with substantial heterogeneity between studies, the confidence interval is large (95%CI .14 to 1.05) and the estimate is not statistically different from zero. (Ignoring heterogeneity, the fixed effect model produces OR .62, 95%CI .47 to .81.)

Five studies provided data on the average number of arrests or convictions for youth in the MST and comparison groups within various follow-up periods. As before, a nonsignificant difference favors the control group in Ontario, while four studies in the USA reported results that favor MST; only one of the study-level effects is statistically significant. Pooled results show no significant difference between groups in the average number of arrests or convictions (SMD -.16, 95%CI -.40 to .08). There is less evidence of heterogeneity in this analysis than in previous analyses, but the fixed effect model produces similar results (SMD -.07, 95%CI -.21 to .07).

After converting odds ratios to *d* indices we calculated study mean ES for arrest data (*g*=1.27 for Borduin 1990; 1.18 for Borduin 1995; .46 for Henggeler 1992; .13 for Henggeler 1997; .25 for Henggeler 1999a; and -.11 for Leschied 2002). With six studies and 958 cases in the analysis, *g* = .46 (random effects, .25 fixed effects); with significant heterogeneity of effects (Q=50.44, df=5, p<.001), the estimate is almost statistically significant (for random effects, 95%CI <0 to .92, p=.0504)

Drug use

One study reported results of urinalysis for substance use at a six-month follow-up. Results show no significant difference between MST and comparison cases on urine screens for marijuana or cocaine and there were no signficant differences on self-reported alcohol/marijuana use or other drug use. Four-year follow-up data are available on a subsample of cases in this study (Henggeler 1999a). Two studies provided data on self-reported substance use for subsamples (Borduin 1995; Henggeler 1992).

School attendance

In the study of youth with psychiatric emergencies (Henggeler 1999b), youth in the MST group spent more days in regular school settings at the beginning of the one-year follow-up period than their counterparts (who had been hospitalized). These differences dissipated by the end of one year; data were not reported, but investigators noted that between-group differences in school attendance were not significant (Henggeler 2003b). Another study provided data on within-group changes in school attendance, but did not provide data on between-group comparisons (Brown 1999, pp. 88-89).

Self-esteem

In the Henggeler 1999b study, investigators noted that short-term differences between MST and hospitalized youth on the Self Esteem subscale were not evident at the one-year follow-up.

Post-intervention Analyses

The remaining analyses are generally limited to post-intervention (not follow up) data on program completers (not the full samples). These analyses examine immediate effects of Treatment on the Treated (TOT; see Shadish 2002) and may be used to estimate effects of MST with willing participants. Since drop-outs are systematically omitted, these analyses do not make full use of the experimental design.

Self-reported delinquency

Three studies conducted by FSRC investigators (MST program developers) provided self-report data on delinquency from program completers at the post-treatment assessment, using the Self-Report Delinquency Scale. Results favor MST in two studies and the control group in one study. Pooled results show that differences between groups are not statistically significant (SMD -.21, 95%CI -.50 to .08).

Peer relations (self-reports and parent or teacher reports).
Three studies provided post-treatment data on the Missouri Peer Relations Inventory (MPRI) for program completers. The MPRI has three subscales. Pooled results indicate no significant differences between groups on the bonding scale (SMD -.06, 95%CI -.28 to .16), aggression scale (SMD -.18, 95%CI -.40 to .04), or maturity scale (SMD -.05, 95%CI -.27 to .17). (Total scores are not computed because the subscales measure different constructs.)

Social competence
Three studies reported post-treatment results of multiple reports on the CBCL social competence subscale. Composite scores were used. Pooled results show that MST did not have significant effects on this measure (SMD -.07, 95%CI -.32 to .17).

Caregiver-reported youth behavior problems
Three studies provided post-treatment caregiver reports of youth behavior problems on the Revised Problem Behavior Checklist (RBPC) for program completers only. Pooled results show no significant differences between groups (SMD -.50, 95%CI -1.42 to .42).

Psychiatric symptoms
Three studies provided post-treatment, youth self-report data on psychiatric symptoms, using the SCL-90-R or GSI-BSI with program completers. Pooled results show no significant differences between groups (SMD -.21, 95%CI -.51 to .02).

Three studies provided post-treatment data on youth internalising and externalising symptoms using the Child Behaviour Checklist (CBCL), but standard deviations were missing in one study (Leschied 2002). CBCL reports from caregivers and teachers were available on initial cases in the hospitalization study (Henggeler 1999b) and the Norwegian study provided composite z-scores from caregiver, youth, and teacher reports (Ogden 2004). Pooled results are not significant (for internalising behaviours, SMD -.09, 95%CI -.39 to .21; for externalising behaviours, SMD -.18, 95%CI -.46 to .09).

Four studies provided post-treatment, parent self-report data on psychiatric symptoms for parents of youth who completed programs, using the SCL-90-R or GSI-BSI. Pooled results show no significant differences between groups (SMD -.05, 95%CI -.30 to .20).

Qualities of family functioning
Several studies used the Family Adaptability and Cohesion Evaluation Scales (FACES) version II or III in post-treatment assessments. Some studies combined reports from several family members on this measure, using mean scores or mean z-scores (e.g., Borduin 1995, Henggeler 1992; Ogden 2004). We calculated mean FACES scores for studies that presented caregiver and youth data separately (Henggeler 1997; Henggeler 1999b). Pooled results from 5 studies show no significant differences on the Cohesion scale (SMD .08, 95%CI -.12 to .28) or Adaptability scale (SMD -.01, 95%CI -.27 to .24).

Discussion

The most credible evidence of intervention effects comes from randomised controlled trials (RCTs) that provide outcome data for the full sample (intent-to-treat analysis) at a well-defined follow-up point (i.e., a fixed interval of time that is at least several months after the intervention ended). MST has more RCTs than most social interventions, and hence the evidence base for MST is relatively

robust. Eight randomized controlled trials of MST met the inclusion criteria for this review. However, only one of these trials was able to support full intent-to-treat (ITT) analysis with a well-defined follow-up observation period for at least some outcome measures. The other studies had variable observation periods that could not be accounted for in the meta-analysis and/or they excluded program drop-outs and refusers. Archival data on outcomes were used in most MST studies; hence, it is not clear why full ITT analysis was not conducted in some studies (except in Norway, where investigators do not have access to archival data on drop-outs).

Psychosocial outcomes measures were usually assessed immediately after treatment, via self-reports from program completers or by program staff or interviewers who were not blind to group assignments. It is not possible to determine whether these data were affected by demand characteristics of the experiment (i.e., expectancy or allegiance effects). In some studies, these assessments would have been strengthened by blinding interviewers to participants' group assignments.

The largest study conducted to date (and the only fully independent study with full ITT analysis) found no significant differences in outcomes of MST and usual juvenile justice services. When results of studies of varying quality are pooled, there is evidence of substantial heterogeneity among them, indicating that different studies point to somewhat different conclusions. In pooled analyses, the average effects of MST are not significantly different from effects of other services. This pattern obtains in analyses of follow-up measures of incarceration and arrest or conviction, and in analyses of immediate post-intervention measures of psychosocial functioning. The overall direction of effects usually favors MST and, given the low statistical power of the analysis, it is possible that MST has some effects that cannot be detected in this small set of heterogeneous studies. However, we cannot rule out the possibility that MST is no more effective than other services.

Thus, available evidence does *not* support the hypothesis that MST is consistently more effective than usual services or other interventions for youth with social, emotional, or behavioral problems. However, it is not appropriate to conclude that MST has no effects. In sum, evidence about the effectiveness of MST is inconclusive.

These conclusions are not consistent with those of previous reviews which suggested that the effectiveness of MST is well-established. Below, we examine some possible explanations for differences between MST studies and for discrepancies between this review and prior reviews.

Heterogeneity and statistical power

Studies in this review differed in terms of their geo-political context, sample characteristics, comparison conditions, and methodology. With only eight studies in the analysis, the statistical power to detect heterogeneity of effects was quite low; nevertheless, we expected heterogeneity and found statistical evidence of it. We used random effects models to take this heterogeneity among studies in the review into account. The power of these models (ability to detect significant differences between MST and other services) is not great, hence confidence intervals for pooled effects are fairly large. We also examined fixed effect models (which are, arguably, not appropriate for such heterogeneous data); point estimates were similar to those found in random effects models and confidence were smaller. However, reliance on such inappropriate statistical models amounts to "fishing" for significant differences. Since statistical power is low, we cannot conclude that MST is not more effective than other services.

Possible sources of heterogeneity

As described above, the included studies differ on several variables, including methodological quality, sample characteristics, intensity and duration of MST, comparison conditions, observation periods, and independence (i.e., associations between investigators and program developers). As is often the case in meta-analysis, these differences are confounded. For example, the null findings in Ontario could be explained by its independence from MST developers (this is the only fully independent study that has been completed to date), by its relatively robust comparison conditions (usual services in Ontario are more extensive than those in the US), or by the fact that it was the only study to support full ITT analysis with a well-defined follow-up period. Since these factors are confounded, it is not possible to know which factors or combinations of factors account for the differences between the Ontario study and early studies of MST conducted by program developers in the US. Early MST trials that are sometimes referred to as efficacy studies have somewhat weaker methodological quality than later trails that focus on effectiveness (however, Shoenwald and others have noted that early MST trials could be considered "hybrids" of efficacy and effectiveness research; Schoenwald 2003). Until more studies are available for moderator analysis, it is not possible to assess the relative influence of potential sources of heterogeneity. In other words, there is no systematic way to determine *why* results vary across studies. Nevertheless, there has been some speculation about this, as discussed below.

Fidelity

It has been suggested that between-study differences in effect sizes may be accounted for by variations in fidelity to MST (Henggeler 2004a). In some studies, fidelity to MST has been measured with a Treatment Adherence Measure (TAM, available at http://www.mstinstitute.org). However, the TAM taps some constructs (such as engagement, treatment participation, and therapeutic alliance) that are not unique to MST (sample items are: 'the sessions were lively and energetic,' 'my family and the therapist worked together effectively,' 'the therapist recommended that family members do specific things to solve our problems'). The TAM has not been shown to discriminate between MST and other interventions. Although the TAM has some predictive validity, it is not clear whether that is due to fidelity to MST, engagement, treatment participation, alliance, or other constructs. Thus, the hypothesis that fidelity to MST accounts for some of the differences in effects cannot be tested with available data.

Site effects

Data do not support the hypothesis that MST is more effective in some sites than others. As indicated above, cross-study comparisons are confounded by differences in study qualities, samples, and contexts. The only multi-site study that reported site-level data (Leschied 2002) did not find significant differences between MST and usual services groups on *any* outcome measure in *any* site. Some sites had higher conviction rates than others, but these differences were evident in both MST and comparison groups; pre-post differences were found within groups on some outcome measures, but there were no significant between-group differences on those measures. To our knowledge, none of the multi-site studies have used multi-level models to account for nesting effects.

Why are these results different from those of prior reviews?

Different review methods can produce different results. Previous reviews of MST outcome studies have not been fully systematic. Some MST reviews excluded unpublished studies; others did not assess studies' allocation methods, ability to support intent-to-treat analysis, or blinding of assessment; others relied on narrative analysis or used meta-analytic methods that were not transparent. Most prior reviews of research on effects of MST rely on narrative summaries of convenience samples of published studies (Littell 2005).

The exclusion of unpublished studies tends to introduce a confirmatory bias in reviews, because studies with null or negative findings are less likely to published than those with positive results (this is known as the 'file drawer' problem; cf. Rothstein in press). In MST reviews, the inclusion or exclusion of the Ontario study may account for some of the differences in reviewers' conclusions.

However, this does not explain different conclusions about effects of MST on immediate post-intervention outcomes based on analyses of data from program completers. In our review, the Ontario study is not included in these analyses, yet we find no significant overall differences between MST and other services on these measures. Most previous reviews conclude that MST has more positive effects than other services on measured outcomes. Indeed seven of the eight the MST studies in our review found significant differences on one or more outcome measures. However, these effects were not consistent across studies, thus average effects on any single outcome measure were not statistically different from zero. This overall pattern is likely to be missed in narrative reviews that highlight the statistically significant effects found in individual studies.

Previous MST reviews have not made the distinction between intent-to-treat (ITT) analysis and analysis of outcomes for program completers (TOT analysis). The latter exclude program drop-outs and refusers, who tend to have more negative outcomes than program completers (Borduin 1995; Leschied 2002). As explained above, it appears that some reviewers were not aware of the systematic exclusion of drop-outs and refusers in some MST studies. Hence, they erroneously assumed that some studies supported full ITT analysis. The assumption that published studies supported full ITT analysis may have led reviewers to overestimate the confidence that can be placed in results.

The limitations of narrative reviews of multiple studies have been considered at length, as has the importance of transparency in meta-analysis (cf. Alderson 2004; Cooper 1994; Lipsey 2001). The purpose of a systematic review (as that term is used by the Cochrane Collaboration and the Campbell Collaboration) is to minimize biases that are common in narrative reviews, while conducting research synthesis in a manner that is clear and open to critical assessment.

Reviewers' conclusions

Implications for practice

Evidence suggests that MST is not consistently more effective than other alternatives for youth with social, emotional, or behavioral problems. There is no evidence that MST has harmful effects compared with these alternatives (which include individual therapy and usual services). This review calls into question often-repeated conclusion that the effectiveness of MST is well established. Additional, independent studies are needed to confirm or refute the hypothesis that MST has significant effects over other services. Until then, the decision to adopt MST must be made on other grounds.

MST has several advantages over other services for troubled youth and families. It is a comprehensive intervention, based on current knowledge and theory about the problems and prospects of youth and families. MST has been documented and studied more than many services for youth and families. There is no evidence that any known interventions are more effective than MST. However, there are still gaps in knowledge about the widespread implementation of MST, its long-term effects, and important mechanisms of change. Further, MST is costly (about $5,000 USD per case, Aos 2001); if MST does not reduce the long-term costs of incarceration, hospitalization, recidivism, and costly problem behaviors in the long-run, it may not be cost-effective compared with less expensive alternatives.

It is important to recognize that there may be real limits to the kinds of outcomes that can be achieved with short-term, individual- and family-focused interventions, no matter how well-designed and well-intentioned these interventions are. Perhaps more robust, longer-lasting interventions and/or more consistent economic, educational, medical, and therapeutic supports for youth and families are needed to achieve lasting improvements in youth and family functioning.

Implications for research

The use of RCTs to test intervention effects is one of the great strengths of the MST research base. Most social interventions have not been as carefully tested. Even so, this review points to improvements that can be made in future RCTs (of MST and other interventions) in the areas of allocation concealment, blinding of assessment, and intent-to-treat analysis.

Future studies should use more advanced methods of allocation concealment that create centralised and permanent electronic records of group assignments.

Blind assessments should be used whenever possible. Of course, participants and therapists cannot be blind to group assignments in studies of complex psychosocial interventions, nor can group assignments be concealled from law enforcement officials and others who make key decisions about youth and families. However, psychosocial data can be collected by interviewers who are blind to participants' group assignments, and this is preferrable to data collection by program staff or interviewers who are aware of group assignments.

RCTs should be designed to support intent-to-treat analysis on at least some outcomes. Since archival data are used in many MST studies, this can be used to support full intent-to-treat analysis in MST studies in most countries.

When results of additional MST outcome studies are available, subgroup analysis and moderator analysis can be used to better understand overall effects of MST and sources of heterogeneity.

Characteristics of included studies

Study ID	Methods	Participants	Interventions	Outcomes	Notes	Allocation concealment
Borduin 1990	Random assignment to treatment conditions	16 male adolescents who had been arrested for sexual offenses. Mean age 14, 62% Caucasian, 38% African American	MST (average 37 hours, range 21 to 49) vs individual therapy (average 45 hours)	Re-arrest for sexual offense, arrest for non-sexual offense	Variable observation period (21 to 49 months; mean = 37 months)	B
Borduin 1995	Random assignment to treatment conditions and to therapist within conditions.	210 families of youth age 12-17 who had 2+ prior arrests and no evidence of psychosis or dementia. Youth were living with at least one parent or parent figure in 2 rural counties in Missouri. Average age 15; 79% male; 68% Caucasian, 32% African American.	MST provided by 2nd and 3rd year doctoral students in clinical psychology. Average 23 hours of service (range 5 to 54). Interventions varied (83% received family therapy, 60% school intervention, 57% peer intervention, 28% individual therapy, 26% marital therapy). Individual therapy provided by Master's level therapists at local social service agencies, mean of 28 hours (range 15 to 72). Brief contact with parents in 66% of cases.	Subsequent arrest, arrest for substance-related offense, arrest for violent crime. Data from subsample (n=126) on psychiatric symptoms, behavior problems, family functioning, peer relationships.	Outcomes measured after the end of probation. Variable observation periods. Conflicting reports on number of cases randomly assigned.	B
Henggeler 1992	Random assignment to treatment conditions in yoked pairs	96 juvenile offenders at imminent risk of out-of-home placement for recent, serious offense in Simpsonville, SC. Mean age 15, 77% male, 56% African American, 42% Caucasian, 26% lived with neither biological parent.	MST delivered by 3 Master's level therapists. Average duration 13.4 weeks (range 5 to 23), average 33 hours direct contact (sd 29). Usual services in juvenile justice including court	Subsequent arrest, incarceration data on 84 cases. Data from smaller subsample (n=56) on self-reported delinquency, family functioning, peer relations, psychiatric symptoms	Yoked design was not retained. Variable observation period (16 to 97 weeks, mean = 59.6, sd=25.4) after referral.	B

			orders, monitoring by probation officers, passive referrals for other services.			
Henggeler 1997	Random assignment to treatment conditions, using yoked pairs.	155 cases (73 yoked pairs plus 9 MST cases). Youth ages 11 to 18 who committed a violent criminal offense or had 3 prior arrests, cases that were not yet adjudicated, youth at imminent risk of out-of-home placement. Two sites in South Carolina: one rural and urban, predominantly (78%) Causian; the other rural and predominantly (58%) African American.	MST provided by Master's level mental health professionals (with backgrounds in social work or pastoral counseling) over an average of 122.6 days (sd 32.6) in one site, and 116.6 days (sd 39.8) in the other site. Usual services in juvenile justice, including a minimum of six months on probation.	Emotional and behavioral functioning, criminal activity, incarceration, family relations, peer relations.	Yoked design was not retained. Outcome data were pooled across sites. Some correlations between adherence measures and outcomes.	B
Henggeler 1999a	Random assignment to treatment conditions. Data collection at baseline, post treatment, 6 months post treatment, 12 months post treatment.	120 juvenile offenders (average 2.9 prior arrests) age 12-17 (mean 15.7) with substance abuse or dependence in Charleston County, South Carolina. 79% male; 50% African American, 47% Caucasian.	MST delivered by Master's and Bachelor's level mental health counselors. Average of 130 days (sd 32), 40 hours of contact (sd 28, range 12 to 187). Usual services including referral by probation officer to outpatient substance abuse services. 78% received no substance abuse or mental health services	Substance use, arrests, aggressive crimes, property crimes, incarceration, psychiatric hospitalization, residential placement, school attendance, internalizing and externalizing behavior problems. empowerment.	4-year follow-up on 80 cases (67%)	B
Henggeler 1999b	Random allocation to MST or hospitalization following referral for emergency psychiatric hospitalization	160 youth ages 10-17 with psychiatric illness severe enough to warrant hospitalization. Residents of	MST with additional clinical staff (psychiatrist, crisis caseworker) and pharmacological	Adolescent psychiatric symptoms (GSI of BSI), internalizing and externalizing behavior	Yoked design was not retained. Data collected but not analyzed/reported: urine screens for drug use (low	B

	and consent. Allocation decisions in sealed envelopes opened by crisis caseworkers in hospital. Psychosocial assessments of yoked pairs at baseline (T1), after hospitalized youth was released (T2), at completion of MST (T3), 6 months post-intervention (T4), 1-year post-intervention (T5).	Charleson County, SC in non-institutional placements. 65% male, 65% African American, 70% of families receiving public assistance. (Early reports include the first 116 youth in this study.)	interventions. Average duration 127 days (sd 32); average 92 hours of clinical service. Psychiatric hospitalization in the Youth Division Psychiatric Inpatient Unit at the Medical University of South Carolina. Similar psychotropic medication use (type and frequency) in the two groups.	problems (CBCL), substance use (urine screens for drug use), self-esteem (self reports), social functioning, family functioning (FACES III), consumer satisfaction, school attendance and placement settings (monthly, phone administered Service Utilization Survey). Research staff administered instruments in home or hospital or by phone.	base-rate), caregiver symptoms (in normal range at T1). Program costs: MST US$5,954 per youth, hospitalization US$6,174 per youth; including incremental costs (other placements), total costs: US$8,017 MST, US$7,878 hospitalization.	
Leschied 2002	Random assignment to treatment conditions.	409 juvenile offenders, age 10 to 18 (average 14.6), in 4 sites in Ontario. 2 sites received referrals only from probations. Overall 74% male, 13% Aboriginal. 27% of MST cases dropped out.	MST average of 34 sessions over 4.9 months Usual services in juvenile justice, including case management plan developed by probation officer and interventions with therapeutic components.	Prosecutions, convictions, incarceration, social skills, parental supervision, family functioning.	Unpublished data. Estimated cost of MST: $6,000 to $7,000 (CDN) per case under non-research conditions. Actual MST costs: $25,000 (CDN) per case.	B
Ogden 2004	Random assignment to treatment conditions.	104 families of youth age 12-17 (average 15 years) with antisocial behavior problems in 4 sites in Norway. 4 families refused to participate in MST. Of 100 remaining, 63% were male.	MST vs usual services (placement, in-home supervision, or other)	Internalizing and externalizing behavior problems, social competence, family functioning, out-of-home placement, treatment satisfaction.	4 MST cases were replaced. Proportion of cases in MST is higher than expected, given original 5/9 odds of assignment to MST. Collection and analysis of follow-up data are underway; intent-to-treat analysis will not be possible, since investigators can not follow drop-outs.	B

Characteristics of excluded studies

Study ID	Reason for exclusion
01	
Barnoski & Aos 2004	Non-random allocation to treatment. (Wait-list comparison study of MST in progress in Washington state.)
Brunk 1987	No data on drop-outs, no follow-up data, main effects are not reported, posttreatment data (means) on subgroups only (abuse vs. neglect), insufficient data for ES calculations (no sds) especially for nonsignificant results (no Fs).
Cunningham 2001	Non-random allocation to treatment. (Quasi-experimental study of MST with middle school students at risk of expulsion and court referral.)
Ellis 2003	Not focused on youth with social, emotional, or behavioral problems. (Includes youth with Type 1 diabetes.)
Henggeler 1986	Non-random allocation to treatment. (Quasi-experimental comparison of inner-city delinquent youth in MST, delinquent youth in alternative treatment, and non-delinquent youth.)
Little 2004	Not a licensed MST program
Pendley 2002	Not focused on youth with social, emotional, or behavioral problems. (Includes youth with Type 1 diabetes.)
Randall 1999	Non-random allocation to treatment. (Quasi-experimental comparison of residents in two neighborhoods.)
Rosenblatt 2001a	Non-random allocation to treatment. Nonexperimental study of youth with behavioral disorders and other problems in Hawaii.)
Satin 2000	Non-random allocation to treatment. (Quasi-experimental study of MST as aftercare following residential placement for serious juvenile offenders in New York).
Schoenwald 2003	Non-random allocation to treatment. (Quasi-experimental study of therapist adherence to MST and family outcomes.)
Sutphen 1993	Non-random allocation to treatment. (Non-experimental study of MST for 8 first-time offenders.)
Thomas 2002	Non-random allocation to treatment. (Non-experimental study of programs for serious juvenile offenders in Galveston, TX.)
TimmonsMitchell 2003	Non-random allocation to treatment. (Quasi-experimental study in progress with domestically violent youth referred to court in Stark

County, OH.)

Characteristics of ongoing studies

Study ID	Trial name	Participants	Interventions	Outcomes	Starting date	Contact info	Notes
11							
Borduin 2001	Juvenile sex offender replication	sex offenders	MST vs usual juvenile justice services	Recidivism, out-of-home placements, behavior problems, peer relations, family relations, school grades, caregiver psychiatric symptoms		Charles Borduin, U of MO	RCT
Dawe 2001	Australia	Families with one or more parents enrolled in a methadone-maintenance program	Up to 12 sessions of MST vs brief, family -focused intervention vs standard care (monthly contact with caseworker)	Child behavior, parental functioning, parental substance abuse		Susan Dawe, Griffith University	RCT
Glisson 2003	Rural Appalachia	Youth referred to courts for antisocial behavior in 8 impoverished counties	MST vs usual services; community-organizational intervention vs none	Implementation of MST	2003	Charles Glisson, U of TN, Knoxville	Quasi?
Henggeler 1999e	Drug Court, Charleston, SC	Substance-abusing and dependent juvenile offenders and their families	US vs. drug court vs drug court + MST vs drug court + MST + enhanced community reinforcement (CRA model)	Drug use, criminal behavior, psychiatric functioning, family functioning, peer and school relations, service utilization, cost effectiveness.	1999	Scott Henggeler, Jeff Randall	RCT
Henggeler 1999f	MST with alcohol abusing delinquents	Juvenile delinquents with alcohol abuse or dependence	MST + CRA vs usual community services	Alcohol and drug use, criminal activity, mental health, family	1999	Scott Henggeler	RCT

				relations, peer relations, school attendance, service utilization and costs			
Henggeler 2003c	Effectiveness of MST w/ sex offenders	Juvenile sex offenders	MST vs usual services	Criminal activity, mental health, substance use, family relations, peer relations, school attendance, service utilization, placements, costs.	2003	Scott Henggeler	RCT
Miller 1998	Delaware Alternative to Secure Care Project	Serious juvenile offenders	MST vs out-of-state residential treatment	Recidivism, service and placement costs.	1995	Marsha Miller	RCT. Minimal treatment fidelity and 100% clinical staff turnover in first 2 years.
Rosenblatt 2001b	Hawaii continuum of care	Youth with severe psychiatric disorders	MST vs usual services			Rosenblatt, Rowland	RCT. Project terminated early.
Schoenwald 2000	MST Continua of Care (Philadelphia)	Serious juvenile offenders w/ serious emotional disturbance, at risk of out-of-home placement	MST-based continuum of care vs. usual community services	Mental health, drug use, criminal activity, family functioning, school functioning, service utilization, costs.		Sonja Schoenwald	RCT
Sundell 2003	Sweden		MST			Knut Sundell	RCT is planned
Swenson 2000	NIMH-funded effectiveness trial	Families with an indicated case of physical child abuse	MST vs group behavioral parent training	Child, parent, family, and service system outcomes; recidivism, costs	2000	Cynthia Swenson, U of MD Baltimore	RCT
TimmonsMitchell200	Stark County, OH	163 juvenile offenders	MST vs usual services	Clinical and educational outcomes, recidivism,		Jane Timmons-Mitchell	RCT

				out-of-home placements			
Weiss 2003	Vanderbilt University	160 preadjudicated junior high school and high school students with behavioral disorders.	MST + public school Moderate Intervention Program (MIP) vs MIP alone	Individual functioning of parent and child, family relations, peer relations, involvement in the legal system, cost-effectiveness	1999	Bahr Weiss, Vanderbilt	RCT

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- 03 Internalising behaviour
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08 Parent behavior and symptoms
- 01 Parent psychiatric symptoms
  - 01 TOT

09 Family functioning
- 01 FACES Cohesion
  - 03 unyoked studies
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- 02 FACES Adaptability
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  - 05 TOT

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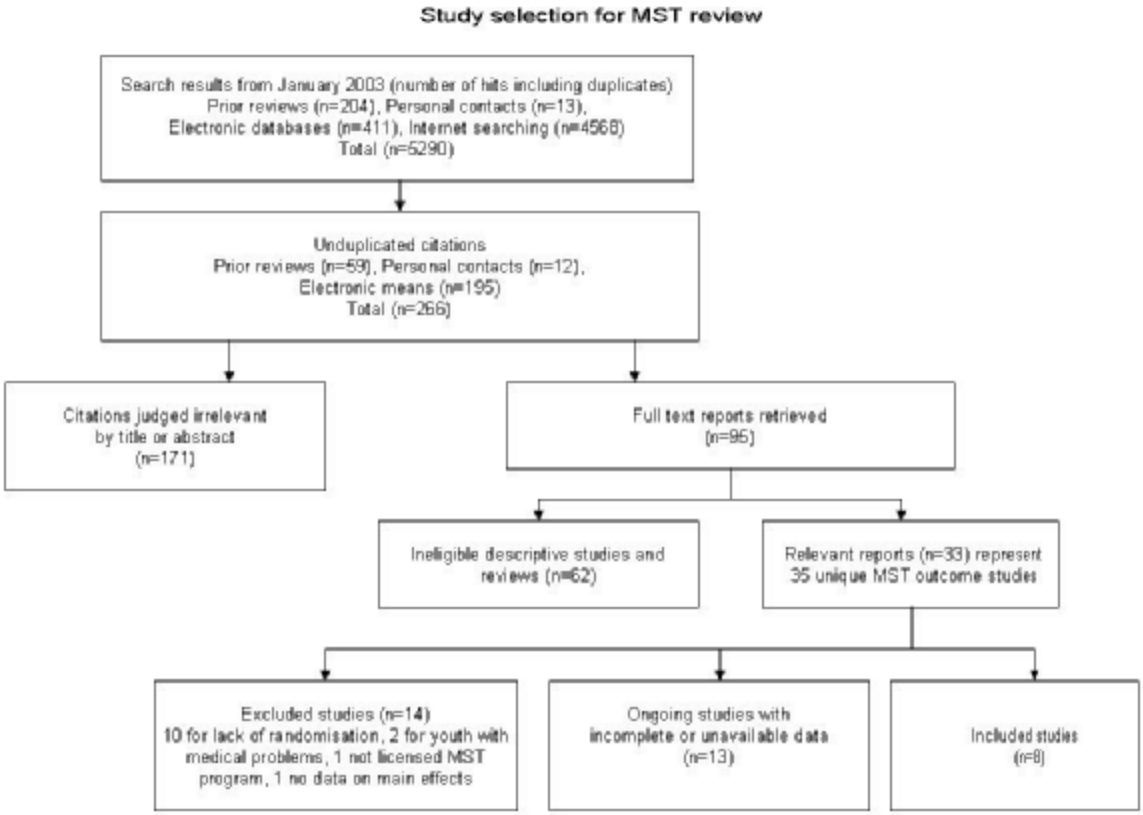

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Unpublished CRG notes

Exported from Review Manager 4.2.3
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Published notes

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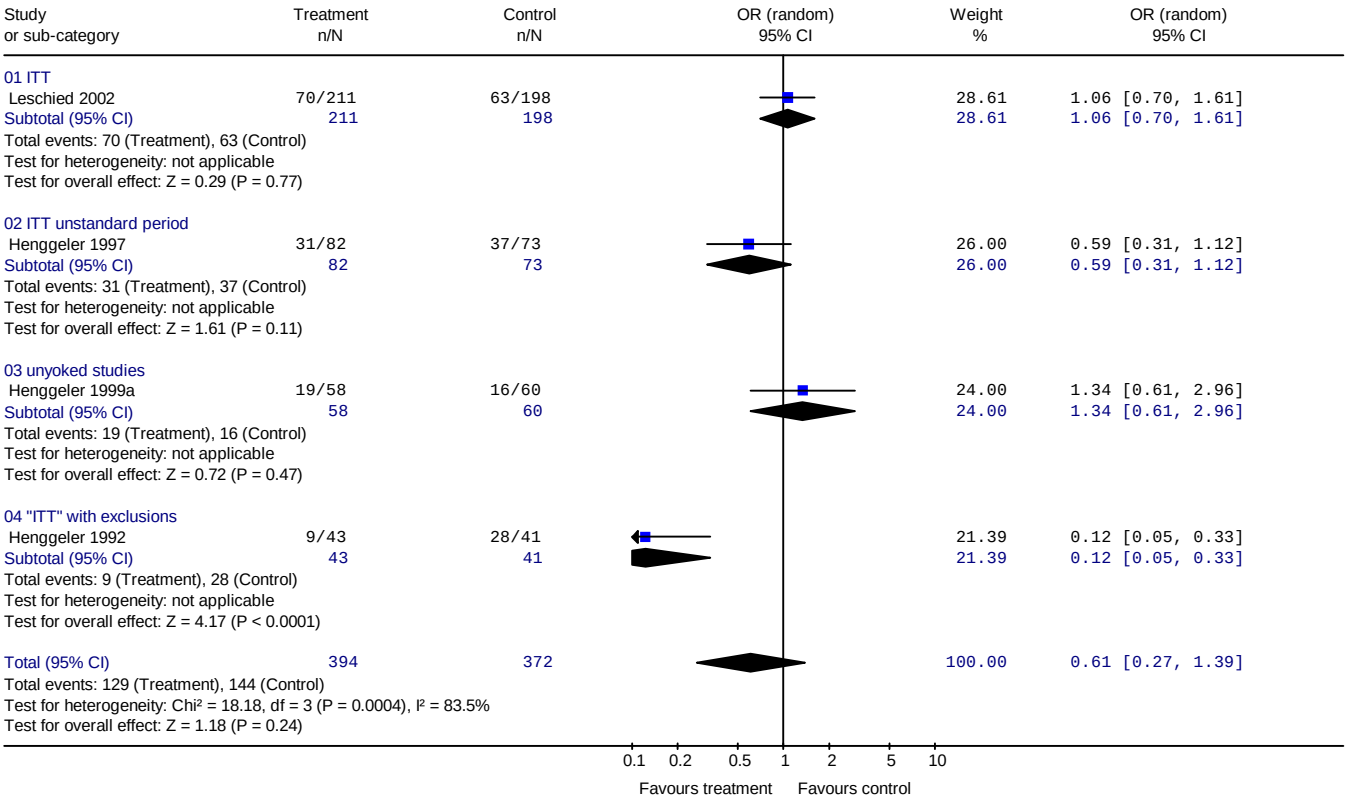
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)

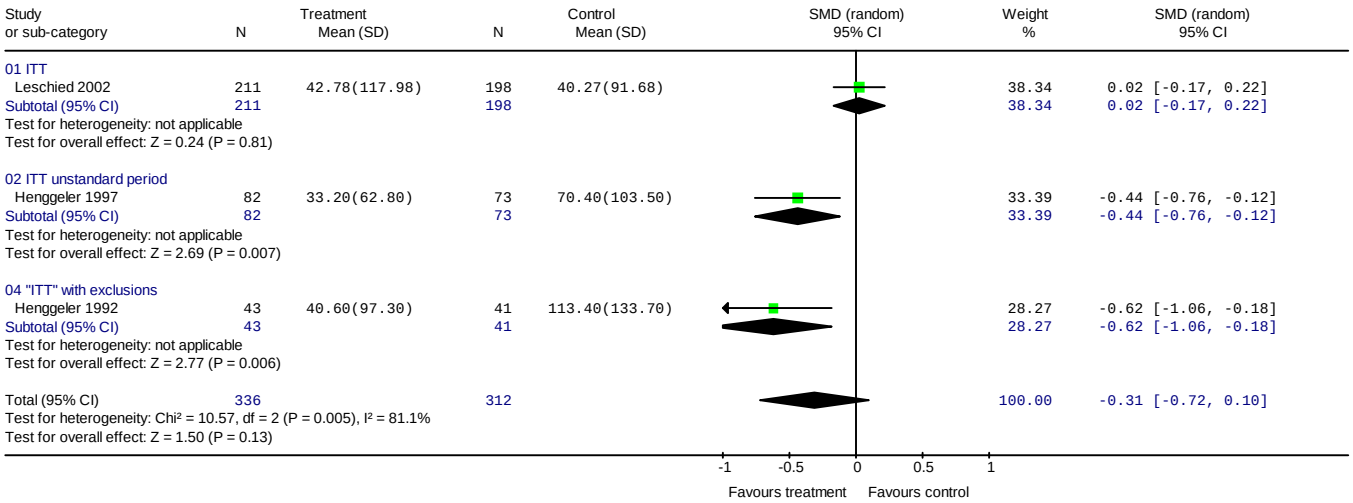
Total number of included studies: 8

Comparison or outcome	Studies	Participants	Statistical method	Effect size
01 Out-of-home placement				
01 Incarceration	4	766	OR (random), 95% CI	0.61 [0.27, 1.39]
02 Days incarcerated	3	648	SMD (random), 95% CI	-0.31 [-0.72, 0.10]
03 Hospitalization			OR (fixed), 95% CI	No total
02 Arrest or conviction				
01 Arrest or conviction	5	803	OR (random), 95% CI	0.39 [0.14, 1.05]
02 Number of arrests or convictions	5	782	SMD (random), 95% CI	-0.16 [-0.40, 0.08]
03 Substance use				
01 Positive screen for marijuana at 6 month follow-up			OR (fixed), 95% CI	No total
02 Positive screen for cocaine at 6 month follow-up			OR (fixed), 95% CI	No total
03 Self-reported alcohol/marijuana use at 6 month follow-up			SMD (fixed), 95% CI	No total
04 Self-reported drug use other than alcohol/marijuana at 6 month follow-up			OR (fixed), 95% CI	No total
04 Self-reported delinquency				
01 Self-reported delinquency	3	304	SMD (random), 95% CI	-0.21 [-0.50, 0.08]
05 Peer relations				
01 Peer relations: MPRI bonding	3	322	SMD (random), 95% CI	-0.06 [-0.28, 0.16]
02 Peer relations: MPRI aggression	3	322	SMD (random), 95% CI	-0.18 [-0.40, 0.04]
03 Peer relations: MPRI maturity	3	322	SMD (random), 95% CI	-0.05 [-0.27, 0.17]
04 Social competence	3	265	SMD (random), 95% CI	-0.07 [-0.32, 0.17]
07 Youth behaviour and symptoms				
01 Behaviour problems (RBPC scores)	3	322	SMD (random), 95% CI	-0.50 [-1.42, 0.42]
02 Youth psychiatric symptoms	3	379	SMD (random), 95% CI	-0.24 [-0.51, 0.02]
03 Internalising behaviour	2	209	SMD (random), 95% CI	-0.09 [-0.39, 0.21]
04 Externalising behaviour	2	209	SMD (random), 95% CI	-0.18 [-0.46, 0.09]
08 Parent behavior and symptoms				
01 Parent psychiatric symptoms	4	435	SMD (random), 95% CI	-0.05 [-0.30, 0.20]
09 Family functioning				
01 FACES Cohesion	5	531	SMD (random), 95% CI	0.08 [-0.12, 0.28]
02 FACES Adaptability	5	531	SMD (random), 95% CI	-0.01 [-0.27, 0.24]

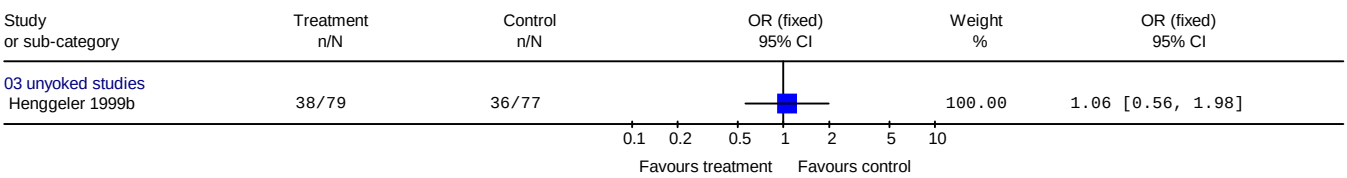
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 01 Out-of-home placement
Outcome: 01 Incarceration



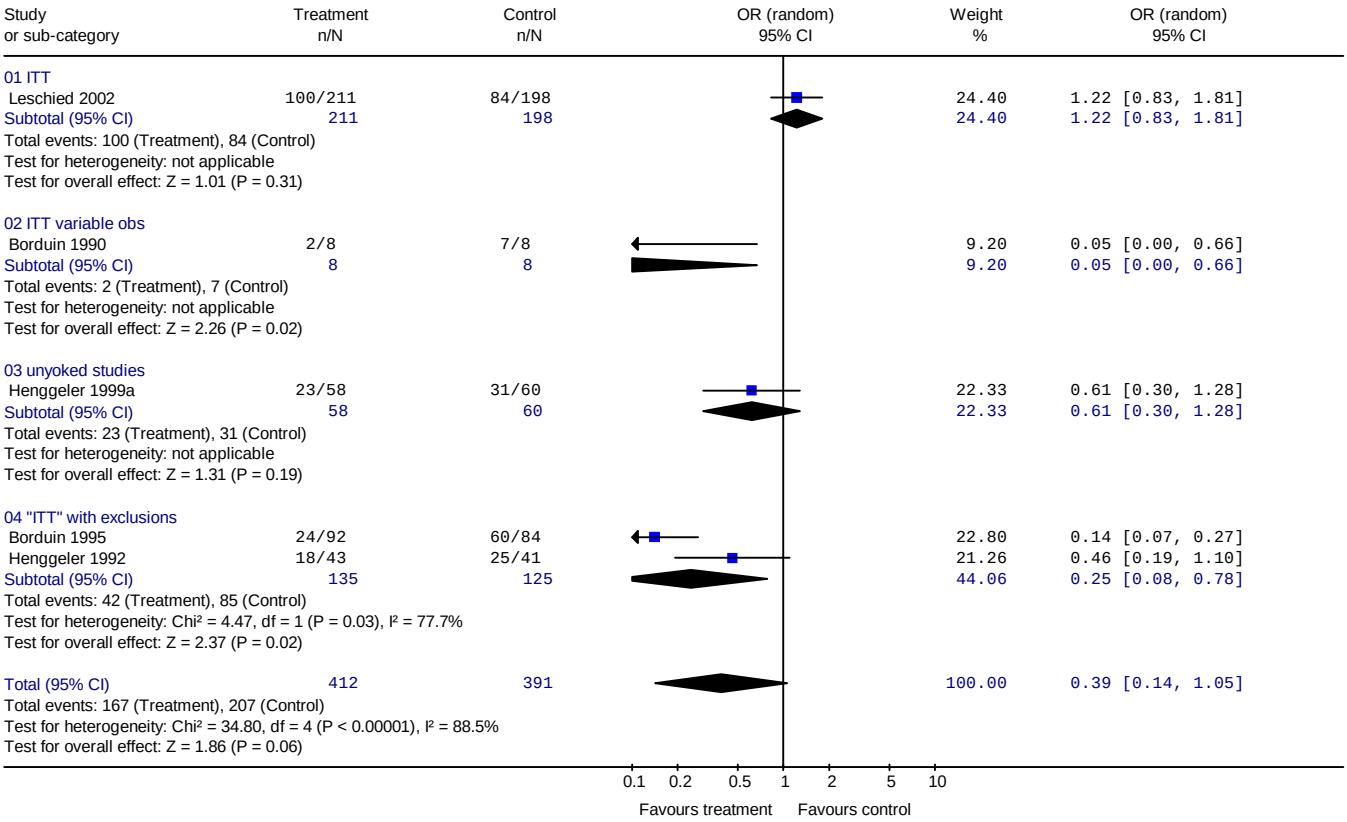
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 01 Out-of-home placement
Outcome: 02 Days incarcerated



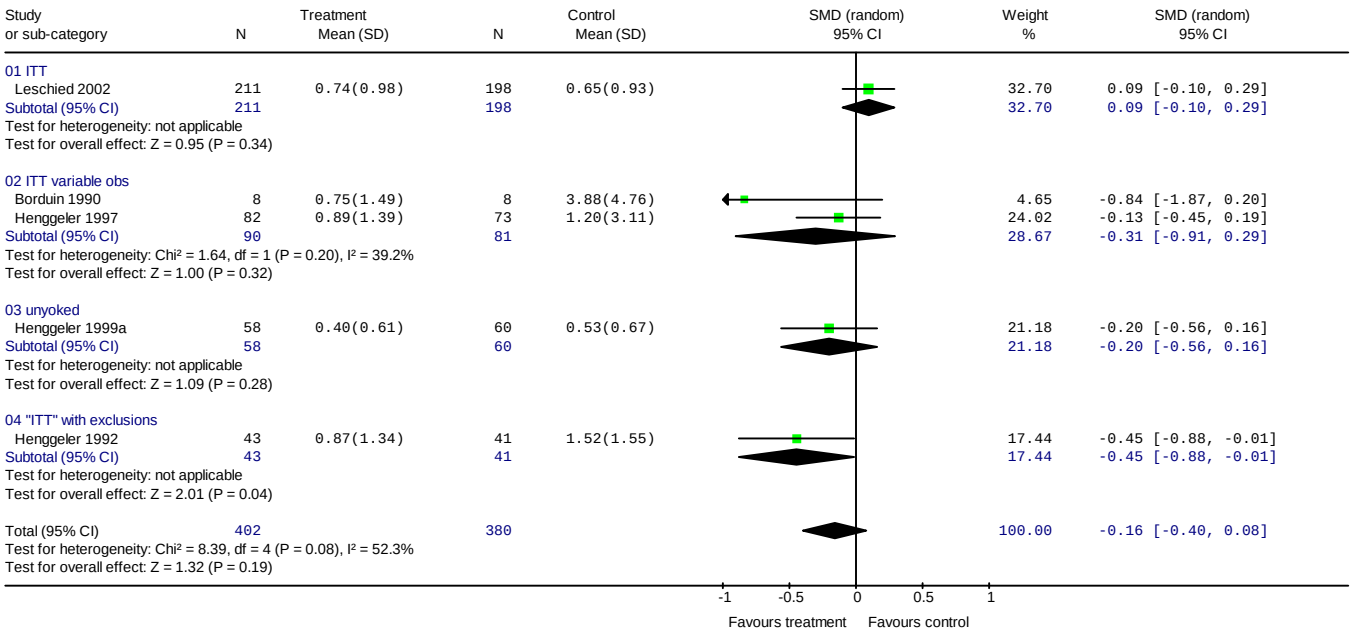
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 01 Out-of-home placement
Outcome: 03 Hospitalization



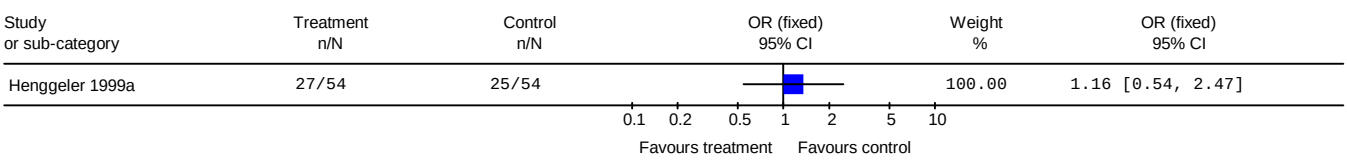
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 02 Arrest or conviction
Outcome: 01 Arrest or conviction



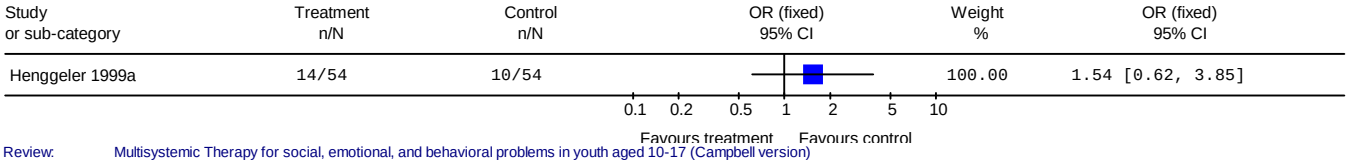
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 02 Arrest or conviction
Outcome: 02 Number of arrests or convictions



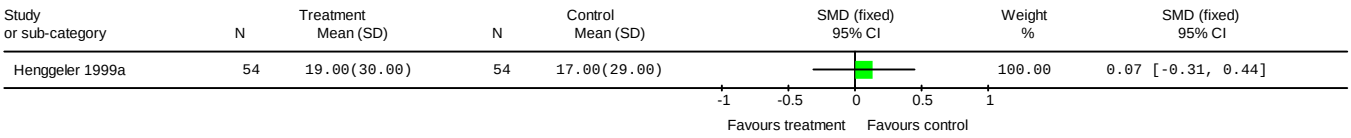
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 03 Substance use
Outcome: 01 Positive screen for marijuana at 6 month follow-up



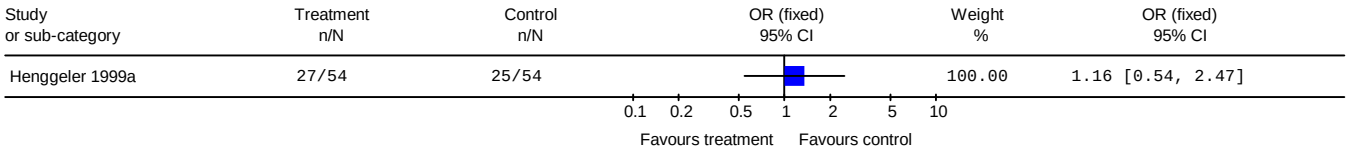
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 03 Substance use
Outcome: 02 Positive screen for cocaine at 6 month follow-up



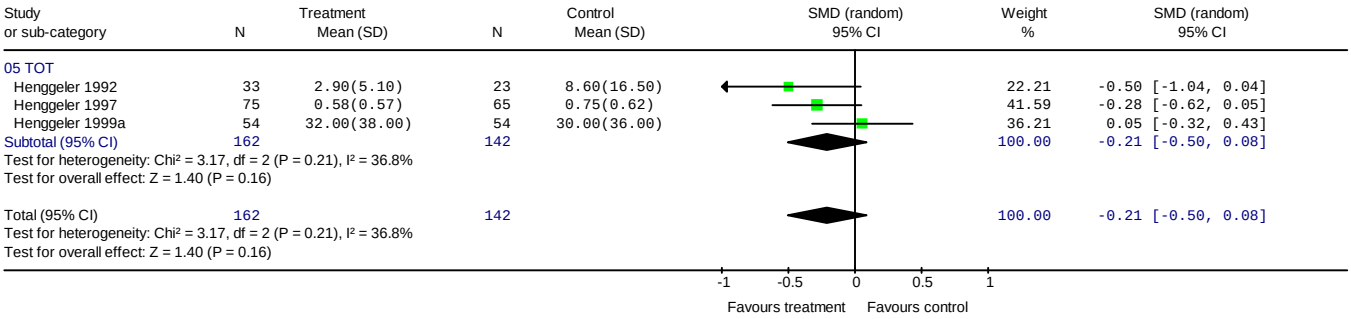
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 03 Substance use
Outcome: 03 Self-reported alcohol/marijuana use at 6 month follow-up



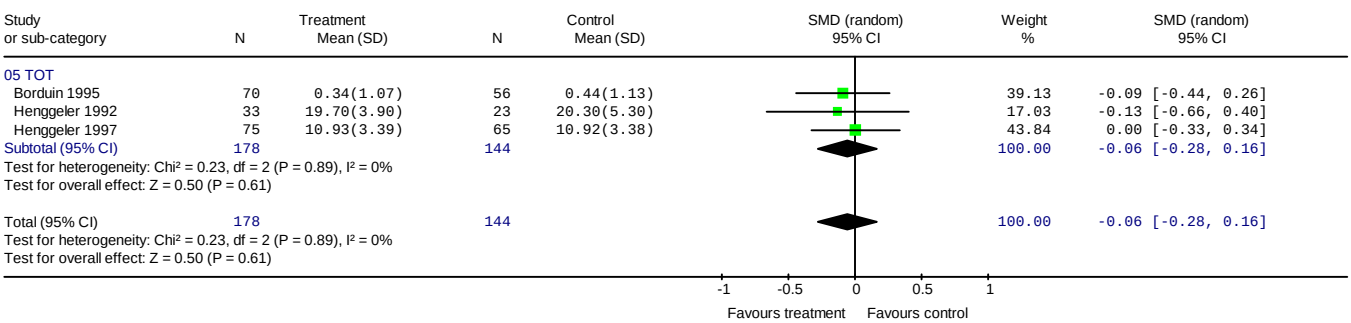
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 03 Substance use
Outcome: 04 Self-reported drug use other than alcohol/marijuana at 6 month follow-up



Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 04 Self-reported delinquency
Outcome: 01 Self-reported delinquency

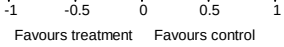


Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 05 Peer relations
Outcome: 01 Peer relations: MPRI bonding



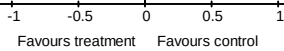
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 05 Peer relations
Outcome: 02 Peer relations: MPRI aggression

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
05 TOT							
Borduin 1995	70	-0.11(1.88)	56	0.32(1.65)		39.07	-0.24 [-0.59, 0.11]
Henggeler 1992	33	2.70(5.50)	23	4.60(5.70)		16.90	-0.34 [-0.87, 0.20]
Henggeler 1997	75	-0.48(3.75)	65	-0.21(3.70)		44.03	-0.07 [-0.40, 0.26]
Subtotal (95% CI)	178		144			100.00	-0.18 [-0.40, 0.04]
Test for heterogeneity: Chi² = 0.84, df = 2 (P = 0.66), I² = 0%							
Test for overall effect: Z = 1.62 (P = 0.11)							
Total (95% CI)	178		144			100.00	-0.18 [-0.40, 0.04]
Test for heterogeneity: Chi² = 0.84, df = 2 (P = 0.66), I² = 0%							
Test for overall effect: Z = 1.62 (P = 0.11)							



Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 05 Peer relations
Outcome: 03 Peer relations: MPRI maturity

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
05 TOT							
Borduin 1995	70	0.17(1.81)	56	0.24(1.88)		39.15	-0.04 [-0.39, 0.31]
Henggeler 1992	33	8.20(4.30)	23	8.60(4.80)		17.04	-0.09 [-0.62, 0.45]
Henggeler 1997	75	3.86(2.46)	65	3.97(2.51)		43.81	-0.04 [-0.38, 0.29]
Subtotal (95% CI)	178		144			100.00	-0.05 [-0.27, 0.17]
Test for heterogeneity: Chi² = 0.02, df = 2 (P = 0.99), I² = 0%							
Test for overall effect: Z = 0.44 (P = 0.66)							
Total (95% CI)	178		144			100.00	-0.05 [-0.27, 0.17]
Test for heterogeneity: Chi² = 0.02, df = 2 (P = 0.99), I² = 0%							
Test for overall effect: Z = 0.44 (P = 0.66)							

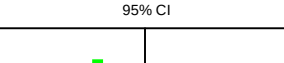


Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 05 Peer relations
Outcome: 04 Social competence

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
03 unyoked studies							
Henggeler 1999b	57	34.90(7.37)	56	35.25(7.80)		44.16	-0.05 [-0.41, 0.32]
Subtotal (95% CI)	57		56			44.16	-0.05 [-0.41, 0.32]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.24 (P = 0.81)							
05 TOT							
Henggeler 1992	33	30.20(9.00)	23	32.20(9.50)		21.07	-0.21 [-0.75, 0.32]
Ogden 2004	61	-0.04(0.61)	35	-0.03(0.64)		34.77	-0.02 [-0.43, 0.40]
Subtotal (95% CI)	94		58			55.84	-0.09 [-0.42, 0.24]
Test for heterogeneity: Chi² = 0.33, df = 1 (P = 0.57), I² = 0%							
Test for overall effect: Z = 0.54 (P = 0.59)							
Total (95% CI)	151		114			100.00	-0.07 [-0.32, 0.17]
Test for heterogeneity: Chi² = 0.36, df = 2 (P = 0.83), I² = 0%							
Test for overall effect: Z = 0.57 (P = 0.57)							

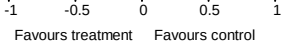
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 07 Youth behaviour and symptoms
Outcome: 01 Behaviour problems (RBPC scores)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
05 TOT							
Borduin 1995	70	-0.54(0.81)	56	0.64(0.85)		33.68	-1.42 [-1.81, -1.02]
Henggeler 1992	33	40.80(30.80)	23	38.20(33.90)		32.03	0.08 [-0.45, 0.61]
Henggeler 1997	75	31.00(30.20)	65	35.20(30.30)		34.29	-0.14 [-0.47, 0.19]
Subtotal (95% CI)	178		144			100.00	-0.50 [-1.42, 0.42]
Test for heterogeneity: Chi² = 29.84, df = 2 (P < 0.00001), I² = 93.3%							
Test for overall effect: Z = 1.07 (P = 0.29)							
Total (95% CI)	178		144			100.00	-0.50 [-1.42, 0.42]
Test for heterogeneity: Chi² = 29.84, df = 2 (P < 0.00001), I² = 93.3%							
Test for overall effect: Z = 1.07 (P = 0.29)							



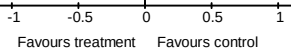
Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 07 Youth behaviour and symptoms
Outcome: 02 Youth psychiatric symptoms

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
05 TOT							
Borduin 1995	70	-0.15(0.79)	56	-0.07(1.03)		33.43	-0.09 [-0.44, 0.26]
Henggeler 1997	75	0.27(0.34)	65	0.53(0.66)		35.02	-0.50 [-0.84, -0.17]
Henggeler 1999b	57	0.74(0.90)	56	0.84(0.70)		31.55	-0.12 [-0.49, 0.25]
Subtotal (95% CI)	202		177			100.00	-0.24 [-0.51, 0.02]
Test for heterogeneity: Chi² = 3.43, df = 2 (P = 0.18), I² = 41.8%							
Test for overall effect: Z = 1.80 (P = 0.07)							
Total (95% CI)	202		177			100.00	-0.24 [-0.51, 0.02]
Test for heterogeneity: Chi² = 3.43, df = 2 (P = 0.18), I² = 41.8%							
Test for overall effect: Z = 1.80 (P = 0.07)							



Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 07 Youth behaviour and symptoms
Outcome: 03 Internalising behaviour

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
03 unyoked studies							
Henggeler 1999b	57	60.35(12.80)	56	59.75(11.97)		55.32	0.05 [-0.32, 0.42]
Subtotal (95% CI)	57		56			55.32	0.05 [-0.32, 0.42]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.26 (P = 0.80)							
05 TOT							
Ogden 2004	61	-0.06(0.85)	35	0.14(0.61)		44.68	-0.26 [-0.67, 0.16]
Subtotal (95% CI)	61		35			44.68	-0.26 [-0.67, 0.16]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.21 (P = 0.23)							
Total (95% CI)	118		91			100.00	-0.09 [-0.39, 0.21]
Test for heterogeneity: Chi² = 1.15, df = 1 (P = 0.28), I² = 13.3%							
Test for overall effect: Z = 0.58 (P = 0.56)							



Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 07 Youth behaviour and symptoms
Outcome: 04 Externalising behaviour

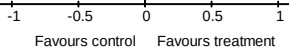
Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
03 unyoked studies							
Henggeler 1999b	57	64.25(12.10)	56	66.15(13.61)		56.04	-0.15 [-0.52, 0.22]
Subtotal (95% CI)	57		56			56.04	-0.15 [-0.52, 0.22]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.78 (P = 0.44)							
05 TOT							
Ogden 2004	61	-0.03(0.71)	35	0.14(0.78)		43.96	-0.23 [-0.65, 0.19]
Subtotal (95% CI)	61		35			43.96	-0.23 [-0.65, 0.19]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.08 (P = 0.28)							
Total (95% CI)	118		91			100.00	-0.18 [-0.46, 0.09]
Test for heterogeneity: Chi² = 0.08, df = 1 (P = 0.77), I² = 0%							
Test for overall effect: Z = 1.30 (P = 0.19)							

Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 08 Parent behavior and symptoms
Outcome: 01 Parent psychiatric symptoms

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 TOT							
Borduin 1995	70	-0.15(0.97)	56	0.20(1.26)		27.76	-0.31 [-0.67, 0.04]
Henggeler 1992	33	0.54(0.11)	23	0.51(0.10)		16.16	0.28 [-0.26, 0.81]
Henggeler 1997	75	0.49(0.53)	65	0.43(0.48)		29.67	0.12 [-0.21, 0.45]
Henggeler 1999b	57	0.46(0.50)	56	0.57(0.70)		26.40	-0.18 [-0.55, 0.19]
Subtotal (95% CI)	235		200			100.00	-0.05 [-0.30, 0.20]
Test for heterogeneity: Chi² = 5.02, df = 3 (P = 0.17), I² = 40.3%							
Test for overall effect: Z = 0.43 (P = 0.67)							
Total (95% CI)	235		200			100.00	-0.05 [-0.30, 0.20]
Test for heterogeneity: Chi² = 5.02, df = 3 (P = 0.17), I² = 40.3%							
Test for overall effect: Z = 0.43 (P = 0.67)							

Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 09 Family functioning
Outcome: 01 FACES Cohesion

Study or sub-category	Treatment N	Treatment Mean (SD)	Control N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
03 unyoked studies							
Henggeler 1999b	57	32.05(8.06)	56	33.15(7.98)		21.71	-0.14 [-0.51, 0.23]
Subtotal (95% CI)	57		56			21.71	-0.14 [-0.51, 0.23]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.72 (P = 0.47)							
05 TOT							
Borduin 1995	70	0.14(0.88)	56	-0.08(0.74)		23.22	0.27 [-0.09, 0.62]
Henggeler 1992	33	0.30(1.86)	23	-0.58(1.70)		11.66	0.48 [-0.06, 1.02]
Henggeler 1997	75	32.55(5.74)	65	32.40(4.16)		25.36	0.03 [-0.30, 0.36]
Ogden 2004	61	31.66(7.10)	35	32.16(4.72)		18.06	-0.08 [-0.49, 0.34]
Subtotal (95% CI)	239		179			78.29	0.14 [-0.07, 0.35]
Test for heterogeneity: Chi² = 3.52, df = 3 (P = 0.32), I² = 14.8%							
Test for overall effect: Z = 1.29 (P = 0.20)							
Total (95% CI)	296		235			100.00	0.08 [-0.12, 0.28]
Test for heterogeneity: Chi² = 5.17, df = 4 (P = 0.27), I² = 22.6%							
Test for overall effect: Z = 0.81 (P = 0.42)							



Review: Multisystemic Therapy for social, emotional, and behavioral problems in youth aged 10-17 (Campbell version)
Comparison: 09 Family functioning
Outcome: 02 FACES Adaptability

Study or sub-category	Treatment N	Treatment Mean (SD)	Control N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
03 unyoked studies							
Henggeler 1999b	57	22.40(6.85)	56	23.10(6.20)		21.35	-0.11 [-0.48, 0.26]
Subtotal (95% CI)	57		56			21.35	-0.11 [-0.48, 0.26]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.56 (P = 0.57)							
05 TOT							
Borduin 1995	70	0.13(0.86)	56	-0.16(0.71)		22.13	0.36 [0.01, 0.72]
Henggeler 1992	33	-0.32(1.79)	23	-0.67(1.27)		14.29	0.22 [-0.32, 0.75]
Henggeler 1997	75	29.00(5.02)	65	29.75(4.21)		23.32	-0.16 [-0.49, 0.17]
Ogden 2004	61	25.96(3.95)	35	27.43(4.80)		18.91	-0.34 [-0.76, 0.08]
Subtotal (95% CI)	239		179			78.65	0.01 [-0.32, 0.34]
Test for heterogeneity: Chi² = 8.06, df = 3 (P = 0.04), I² = 62.8%							
Test for overall effect: Z = 0.08 (P = 0.94)							
Total (95% CI)	296		235			100.00	-0.01 [-0.27, 0.24]
Test for heterogeneity: Chi² = 8.36, df = 4 (P = 0.08), I² = 52.1%							
Test for overall effect: Z = 0.10 (P = 0.92)