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**Multisystemic Therapy versus management as usual in the treatment of adolescent antisocial behaviour (START): a randomised controlled pragmatic effectiveness superiority trial**

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## Summary

**Background:** Adolescent antisocial behaviour is a major health and social problem.

Multisystemic Therapy (MST) has reduced symptoms and offending rate in US trials, but non-US findings are equivocal.

**Methods:** We conducted an 18-month multisite pragmatic randomised controlled superiority trial in England. Adolescents (aged 11–17) with moderate to severe antisocial behaviour received either management as usual (MAU; n=342) or 3–5 months of MST followed by MAU (n=342). Primary outcome was proportion of out-of-home placements. Secondary outcomes included offending data, service and criminal justice sector costs, participant wellbeing, and substance misuse, measured at baseline, 6, 12, and 18 months. We used logistic regression for the primary outcome and mixed-effects regression models for secondary outcomes.

**Outcomes:** At 18 months the treatment effect for out-of-home placement was not significant (OR 1.25, 95% CI 0.77–2.05; p=0.37). Time to first offence was also comparable but the number of offences was higher for the MST group at 18 months. There were consistent short-term symptom reductions from MST in some secondary outcomes, but no evidence of sustained superiority on most secondary outcomes. Conduct disorder diagnoses were reduced by >40% in both groups. Mean total service costs were not significantly different.

**Interpretation:** The findings do not support MST over MAU as the intervention of choice for adolescents with moderate to severe antisocial behaviour. MST achieves some early symptomatic gains on parent-rated outcomes, but not those based on independent records, which after 12 months favour MAU.

**Funding:** Department for Children, Schools and Families; Department of Health.

## **Research in context**

### **Evidence before this study**

We undertook a systematic review to identify randomised studies of Multisystemic Therapy (MST) for conduct disorder. We searched Embase, MEDLINE, and PsycINFO from inception to December 2016 using the terms “Multisystemic Therapy” or “MST” in combination with 49 terms covering conduct problems, to identify relevant RCTs and systematic reviews of MST published in the English language. The search terms were based on systematic searches originally conducted in 2012 by the National Collaborating Centre for Mental Health for National Institute for Health and Care Excellence (NICE) guidelines. We identified 495 papers with relevant abstracts, and full text screening of these yielded 22 primary randomised studies of MST for CD for inclusion. Previous reviews (eg, those for NICE) identified MST as a promising intervention for delinquent adolescents in reducing recidivism and improving individual and family pathology, mitigating this major public health problem; these findings justified the national rollout of MST in England and elsewhere in Europe. Our review, like others with similar scope, found the replicability of findings in some non-USA studies to be mixed, with MST failing in some reports to reduce antisocial behaviour more than usual services but even then often demonstrating significant economic advantages.

### **Added value of this study**

To our knowledge, this is the only independently conducted, large-sample, community-based, superiority cost-effectiveness study assessing the medium-term effects and costs of MST. The study was conducted with the treatment developers’ full collaboration but with no involvement from them at any stage of data acquisition or data processing. Researchers were blinded to treatment condition and participants were representative of those likely to be referred to MST services in the UK. Treatment quality in all but one of the sites was well

above the carefully independently specified standard expected by the developers, and the majority (491, 75%) of the participants were retained; reliable data on out-of-home placement and offending were collected from official records even for untraced participants. No long-term benefit of MST was found, and no evidence of superior cost-effectiveness compared with management as usual (MAU). There was no indication of benefit in terms of reduction in custodial or other out-of-home arrangements, and there was a statistically significant beneficial effect associated with MAU versus MST in relation to offending behaviour at 18 months following recruitment. However, there was consistent evidence that MST brought about more rapid change in young people's behaviour as rated by their parents and, to a lesser extent, by themselves. Post-hoc analysis pointed to early-onset problems, and association with delinquent peers as contraindications for MST.

### **Implications of all the available evidence**

Previous evidence from the USA and some European countries had suggested that MST is a very promising treatment, but the question of whether MST would be similarly effective in the UK had not been fully investigated before this study. Our results do not provide strong evidence for the continued national rollout of MST in child and adolescent health and social services. We found no evidence that major savings would ensue from further implementation of the model. The substantial improvements observed in both groups reflect the effectiveness of routinely offered interventions for this group of young people, at least when observed via trial methodology. Further post-hoc analysis of differences in MAU outcomes may provide suggestions for rational investment and/or disinvestment in this expensive domain of service provision. .

## **Introduction**

Youth antisocial behaviour is a common and serious problem, with costly consequences for the young people, their families and wider society;<sup>1</sup> an elevated risk of health and social problems;<sup>2</sup> and a ten-fold increase in public sector costs by age 28.<sup>3</sup>

Multisystemic Therapy (MST) is an intensive family- and home-based intervention for young people with serious antisocial behaviour.<sup>4</sup> Recent high-quality, quantitative systematic reviews of 22 randomised controlled trials (RCTs)<sup>1,5</sup> identified MST as a promising intervention for improving the prognosis of adolescent antisocial and offending behaviour, mitigating public health impacts, and improving individual and family morbidity. However, outside the USA replicability of findings has been mixed, with MST failing to reduce antisocial behaviour more than usual services in some studies.<sup>6-9</sup>

A small UK-based RCT provided preliminary support for MST versus comprehensive targeted services delivered by Youth Offending Teams (YOTs) in reducing non-violent offending in the 18 months following randomisation.<sup>10</sup> The Systemic Therapy for At Risk Teens (START) study was a pragmatic multicentre superiority trial in which a large nationally representative sample of young people with moderate to severe antisocial behaviour were individually randomised to MST followed by management as usual (MAU) or MAU alone in order to determine the value added by MST in reducing the risk of out-of-home placements and criminal behaviour over the 18-month period following referral. The trial also assessed MST's impact on family relationships, wellbeing, educational performance, and cost-effectiveness, and the impact of previously identified moderating factors (callous–unemotional (CU) traits,<sup>11</sup> pre-adolescent onset,<sup>12</sup> delinquent peers<sup>13</sup>) and hypothesized mediators (parental attitudes and discipline practices<sup>14</sup>) in the context of a full economic evaluation.

## **Methods**

### **Study design and participants**

The study design and procedures are fully described in the published trial protocol.<sup>15</sup> (For the study protocol see

[http://www.ucl.ac.uk/start/START\\_research\\_protocol\\_v3\\_\(Final\)\\_05.11.2013.pdf](http://www.ucl.ac.uk/start/START_research_protocol_v3_(Final)_05.11.2013.pdf)) There were nine MST pilot sites in the UK with at least 12 months' experience of running the programme. Young people were recruited from social services, Youth Offending Teams (YOTs), schools, Child and Adolescent Mental Health Services (CAMHS), and voluntary services; all were referred to local multi-agency panels to standardise the referral process. These panels identified participants' suitability for MST (see below) and invited them for formal assessment.

All participants met one of five general antisocial behaviour inclusion criteria: (1) persistent (weekly) and enduring ( $\geq 6$  months) violent and aggressive interpersonal behaviour; (2) at least one conviction plus three additional warnings, reprimands, or convictions; (3) a current DSM-IV diagnosis of CD that had not responded to treatment; (4) a permanent school exclusion for antisocial behaviour; (5) a significant risk of harm to others or self; and, additionally, at least three severity criteria indicating past difficulties across several settings (appendix). Exclusion criteria were kept to a minimum (appendix).

The MST supervisor and researcher visited proposed participants and their families to assess inclusion and exclusion criteria and discuss the trial, including the identification of an acceptable and credible MAU path. Written informed consent for randomisation was sought at the second visit, 3–7 days after the first, when a research assistant (RA) performed the baseline assessment. The study protocol was approved by the London South-East Research Ethics Committee (09/H1102/55).

## **Randomisation and masking**

The RA initiated a secure randomisation by telephone from the trial centre (UCL), which in turn communicated to the referrer and family within 24 hours. Families were randomised to MST or MAU by an equal allocation ratio using stochastic minimisation, balancing for treatment centre, sex, current age (<15 or ≥15 because of differences in CAMHS service provision based on Gillick competence), and age at onset of antisocial behaviour (≤11 or >11, representing transition to secondary school with increased exposure to psychosocial risks and lower controls in the school environment). RAs remained blind to treatment allocation and were located separately to avoid leakage of trial information. Treatment fidelity assessments were carried out by a geographically separate research group without access to outcomes information. All coding, data entry, and data cleaning were done blind to allocation. Data were housed by a Mental Health Research Network data warehouse separate from the research teams. A sample (25%) of data was double-entered to reduce the chance of entry errors.

## **Interventions**

Multisystemic Therapy (MST) is an intensive family- and home-based intervention for young people with serious antisocial behaviour.<sup>4</sup> The MST therapist works primarily with the young person's caregiver to improve parenting skills, enhance family relationships, increase support from social networks, develop skills and resources, address communication problems, encourage school attendance and achievement, and reduce the young person's association with delinquent peers. The intervention is tailored to each family's specific needs, using techniques from cognitive-behavioural, behavioural, and strategic and structural family therapies. Therapists meet the family three times a week for 3–5 months, and over this period are available 24 hours a day, 7 days a week.

Programme fidelity is maintained by (1) manualised weekly group supervision with an MST expert designated by MST Services;<sup>16</sup> (2) a well-developed quality assurance system<sup>17</sup> with twice-yearly implementation reviews; and (3) the Therapist Adherence Measure-Revised (TAM-R) based on independently administered interviews with parents.<sup>18</sup> All but one site averaged above criterion adherence (appendix).

Following MST, families received MAU from YOTs, CAMHS, and social and education services.

MAU was based on the best available local service(s) for the young person identified by the multi-agency referral panel and simply designed to be in line with current community practice informed by treatment guidelines offered on an as-needed basis.<sup>1,19</sup> MAU interventions were multicomponent, no less resource-intensive than MST, and consistent with the young people's complex mental health needs and behavioural difficulties.<sup>20</sup> Unlike MST, they were not coordinated in the context of a single overarching formulation, and were delivered without weekly expert supervision. No attempt was made to standardise MAU. See appendix for details of MAU interventions and services.

## **Outcomes**

Outcome assessment measures were administered at baseline and 6, 12, and 18 months (primary endpoint chosen as at least 1 year after end of treatment to determine whether treatment gains were maintained). The primary outcome, chosen by the commissioners of the MST service because of high costs and poor long-term outcomes,<sup>21</sup> was the proportion of participants assigned to long-term ( $\geq 3$  months) placement in specialist residential provision. We report a wide range of secondary outcomes, which reflect the diverse interests of Government policymakers who commissioned the investigation. To ensure comparability with other MST trials, antisocial behaviour was examined as time to first criminal offence

and the total number of offences, based on official records from the Police National Computer and Young Offender Information System. Further secondary outcomes were obtained from questionnaire measures concerning antisocial behaviour and attitudes, completed by parents and young people (Strengths and Difficulties Questionnaire [SDQ],<sup>22</sup> Inventory of Callous and Unemotional Traits<sup>23</sup>), by young people alone (Self-Report Delinquency Measure [SRDM], which includes a substance misuse scale,<sup>24</sup> Antisocial Beliefs and Attitudes Scale,<sup>25</sup> and Youth Materialism Scale)<sup>26</sup>, and by teachers and parents (the ADHD scales from the Conners Comprehensive Behaviour Rating Scales [CBRS]<sup>27</sup>). Intermediate outcome measures of parenting skills (Alabama Parenting Questionnaire [APQ]<sup>28</sup>) and family functioning (Loeber Caregiver Questionnaire,<sup>29</sup> Family Adaptability and Cohesion Evaluation Scale [FACES-IV]<sup>30</sup>, Level of Expressed Emotion Questionnaire,<sup>31</sup> and Conflict Tactics Scale)<sup>32</sup> were completed by parents and/or young people, as appropriate. Only the Monitoring and Supervision subscale of the APQ is reported here, as it is central to adolescent antisocial behaviour.<sup>33</sup> Questionnaire measures concerning young people's and parental wellbeing and adjustment were completed by young people (Mood and Feelings Questionnaire [MFQ]<sup>34</sup> and SDQ) and parents (SDQ, CBRS,<sup>27</sup> and General Health Questionnaire [GHQ])<sup>35</sup>.

Data on educational participation (attendance and exclusions) were obtained from the National Pupil Database. Psychiatric disorders were identified at baseline and at 12 months by the Development and Well-Being Assessment (DAWBA).<sup>36</sup> Child IQ estimates were obtained using two subtests from the Wechsler Abbreviated Scale of Intelligence (WASI).<sup>37</sup> Two qualitative studies, to be reported separately, were also conducted with a subsample of families and professionals, exploring service characteristics and experiences of MST. We intended to use three additional questionnaires to characterise the nature and delivery of interventions in both the MST and MAU arms (the Expectancies Questionnaire,<sup>38</sup> the

California Psychotherapy Alliance Scale,<sup>39</sup> and the Reasons for Termination checklist)<sup>40</sup>.

However, these measures were dropped following feedback from parents and young people about the burden of assessments and in consultation with the Trial Steering Committee. We intended to use the Child Attachment Interview to measure the quality of attachment relationships in a subsample of families.<sup>41</sup> However, the young people approached expressed concerns about completing the interview on camera (necessary for scoring) and no data were collected. All measures and schedules for data collection, together with observed reliability of the instruments, are described in the appendix.

### **Statistical analysis**

On the basis of a previous UK trial<sup>10</sup> and official records, we anticipated that 30% of the MAU arm would have an out-of-home placement. We considered a reduction to 20% to be significant clinically and in terms of policy, and calculated that 700 participants would give 86% power to detect this difference (two-sided significance level of 5%). To take account of within-therapist correlation of outcomes in the MST arm, assuming based on a previous study<sup>10</sup> an intraclass correlation of 0.02 giving design effects of 1.22 in the MST arm and 1 in the MAU arm, power would be reduced to 83%. For the primary outcome, no loss to follow-up was expected, so this sample size was not increased.

Analysis was by intention to treat. The primary analyses entailed a logistic regression of out-of-home placement status at 18 months and a Cox regression for time-to-event outcomes for first criminal offence. Clustering by therapist was accounted for by including a random therapist effect. The logistic regression model included site, number of past convictions, sex, and age at onset of criminal behaviour as fixed effects, and was fitted using `glmer()` in the R package `lme4` with a Wald test of the effect of intervention. Secondary outcomes were modelled using linear mixed-effects models (for continuous outcomes) adjusting for baseline values, and Poisson mixed models for count variables. For longitudinal outcomes, separate

treatment effects for 6-, 12-, and 18-month outcomes were used, together with two parameters representing the linear and quadratic time-trend in the outcome. Tests of interaction were planned to explore whether the intervention effects differed according to (1) sex, (2) age, (3) referral path, and (4) severity as indicated by the presence of a criminal record. Further non-prespecified moderator analyses were performed. These are exploratory and should be interpreted with caution.

As the primary outcome data were obtained independently of the subjects, negligible missing data were expected. For secondary outcomes, the analysis models used yield valid inferences under a missing-at-random assumption. As suggested by the Data Monitoring Committee, we performed a sensitivity analysis using post-baseline offending data (ie, total number of offences committed at each 6-month interval) as auxiliary variables in a multiple imputation analysis (appendix). As these made only minor differences to the results, the report is based on non-imputed outcomes; imputed outcomes are provided in the figures and the appendix. Statistical tests were deemed significant if their two-sided p value was  $<0.05$ . All analyses were performed in R version 3.3.0.

For the economic analysis, the costs and cost-effectiveness of treatment arms were compared at 18 months in terms of the proportion of participants requiring out-of-home placements. The economic evaluation took a broad societal perspective, including all health, social, education, and non-statutory sector services, as well as costs to the criminal justice sector resulting from crimes committed. Data on MST contacts to enable costing of the MST intervention were collected directly from pilot schemes to maintain the RAs' blindness to group allocation. RAs collected data on use of other services (number and duration of contacts) in interviews with families at baseline and at each follow-up using the Child and Adolescent Service Use Schedule (CA-SUS). The CA-SUS was based on previous economic studies in similar populations<sup>42</sup> and was adapted for use in the present study through a review

of the literature and pilot testing, to ensure comprehensive coverage and face validity. Data were collected in the following domains: delivery of MST intervention, accommodation services, education services, NHS secondary care services, community-based services, use of prescribed medication, out-of-pocket expenses, criminal justice system contacts, and criminal activity. The economic analysis uses all occurrences of criminal behaviour as reported in the CA-SUS rather than only convictions recorded in the Police National Computer or the Young Offender Information System database to capture all costs associated with criminal activity.

Unit costs for the financial year 2012–13 were applied to all resources used. The cost of MST was calculated using a standard micro-costing approach.<sup>43</sup> This involved estimation of indirect time spent on individual cases, including preparation, meetings, telephone calls and supervision, as well as detailed recording of face-to-face contacts. Unit costs were calculated using data on salaries, employer on-costs (National Insurance and superannuation), conditions of service, and appropriate administrative, managerial, and capital overheads, plus the cost of contributions from MST Services, which included MST training, MST supervision, and the MST licence. Nationally applicable unit costs were applied to all other services, including MAU. These are outlined in detail in the appendix, along with a costing schema for the MST intervention. Costs in the second year were discounted by 3.5%, as recommended by the National Institute for Health and Care Excellence.<sup>44</sup> Detailed information on the economic data and unit costs applied are provided in the appendix. For the cost-effectiveness analysis, we calculated incremental cost-effectiveness ratios (the difference in mean cost divided by the difference in mean effect) and explored uncertainty with cost-effectiveness acceptability curves, which show the probability that MST is the optimum choice, for a range of possible values of willingness to pay for improvements in outcome.<sup>45</sup> All economic analyses were adjusted for the prespecified covariates and for baseline cost and outcomes, as appropriate. Complete case analysis was used, with the effect of missing data

explored in sensitivity analyses. A prespecified secondary economic analysis using quality-adjusted life years measured by the three-level version of the EQ-5D<sup>46,47</sup> was planned but an administrative error at the start of the trial meant that the EQ-5D was not included in the outcome pack, resulting in extensive missing data, and this analysis had to be abandoned. In addition, out-of-pocket expenses had to be excluded from the cost-effectiveness analysis because of poor quality of reporting (less than one-quarter of the sample provided adequate data to enable these expenses to be costed).

This trial is registered with ISRCTN, number ISRCTN77132214.

### **Role of the funding source**

Beyond the tender brief, funders had no role in the study design, data collection and analysis, or interpretation of the findings. Representatives of the funders and MST-UK were present at the Trial Steering Committee meetings and had the opportunity to comment on drafts of this paper. The corresponding author had full access to all the study data and had final responsibility for the decision to submit the findings for publication.

### **Results**

Between February 4, 2010 and September 1, 2012, 1076 young people were referred to the nine multi-agency panels, the largest group from Children's Services and then YOTs (figure 1). Of these, 16% were inappropriate referrals for MST and a further 10% did not complete the referral process (4% refused to take part in the study and 6% turned down the clinical interventions on offer). The 684 who consented to baseline assessment and randomisation were clinically and demographically representative of appropriate referrals (for inclusion and exclusion criteria, see appendix). Of this sample, 85% was retained for 6-month assessment and 80% at 12 months. At the final time point more than three-quarters of those (491, 75%) who had not withdrawn from the study were available for assessment, with slightly fewer

from the MAU (234, 70%) than the MST (257, 77%) group; 91% of assessments were completed within 30 days of the assessment due date.

Three direct observational points were available for nearly 85% of the families. Official records were available for almost the complete sample (98%) for out-of-home placements, criminal convictions, and educational outcomes. Client and family baseline characteristics and moderators are displayed in table 1. The two groups were similar except there were slightly more young people with ADHD diagnoses in the MST arm. Over 80% of the sample met ICD-10 criteria for CD.

For the overall sample of 684 at baseline, 443 participants were identified to have persistent and enduring violent and aggressive interpersonal behaviour; 63 participants had at least one conviction plus three additional warnings, reprimands, or convictions; 531 currently met DSM-IV diagnosis of CD that had not responded to treatment; 179 participants had been permanently excluded from school for antisocial behaviour; and 67 were at significant risk of harm to themselves (appendix). All 684 young people at baseline scored >65 on the WASI, with similar scores in the MST (mean 84.2, SD 13.2) and MAU (84.0, SD 13.2) groups.

### **Primary and key forensic outcomes**

MST had no significant effect on the probability of out-of-home placement (12.6% vs 10.7%; OR 1.25, 95% CI 0.77 to 2.05;  $p=0.37$ ) (table 2A), determined from a combination of parent-report and Local Authority computerised records. The key forensic analyses examined the time to first offence using a Cox proportional hazards model (table 2B). MST did not significantly delay the time to first offence (HR 1.06, 95% CI 0.84 to 1.33;  $p=0.64$ ). The number of offences committed in 6-month periods after the end of the intervention, based on police records, are displayed in table 3. Overall, the numbers were low, with the mean

number of offences never exceeding 1. The Poisson mixed-effects model showed that a significantly higher mean number of offences were committed in the MST versus the MAU condition by 18 months (difference in mean number 0.65, 95% CI 0.28 to 1.02;  $p=0.00067$ ). When violent and non-violent crimes were analysed separately, the difference was in the same direction, but not statistically significant. Reconviction rates cannot be reported because these were not reliably recorded on the databases available to the research team.

### **Secondary outcomes: Antisocial behaviour and attitudes**

Further analyses of parent- and youth-reported secondary outcomes are reported in tables 4 to 6. Graphical illustrations are displayed in the appendix for summary results and individual variables alongside non-prespecified subscales and analyses based on multiple imputations.

Self-report and parent report of antisocial behaviour and attitudes (tables 4A and B) showed significant benefits from MST at 6 months, but mostly these were no longer significant by 12 months. Analysis of young people's self-ratings revealed smaller differences between the groups even at 6 months and no differences in self-reported behaviour on the SDQ at any time point. Self-reported attitudinal measures of antisociality yielded no group differences at any time, although CU traits were rated lower by young people in MST at 18 months. MST showed some benefit at 6 months on self-reported delinquency (SRDM) in terms of reduced volume and variety of substance misuse. Materialistic attitudes characteristic of conduct problems did not change significantly during the study period (table 4B).

Information obtained from the National Pupil Database indicated that MST had no significant effects on exclusion from school. The odds ratios (95% CI) for 6, 12, and 18 months were 1.00 (0.70 to 1.43), 0.93 (0.64 to 1.37), and 0.71 (0.45 to 1.13), respectively.

### **Secondary outcomes: Parenting skills and family functioning**

Parents' reports of their own parenting behaviour (Loeber Caregiver Questionnaire and APQ Monitoring and Supervision subscale; table 5A) indicated increased parental support and involvement and reduced problems with monitoring and supervision in the MST group at 6 months. Young people's report on parenting behaviour on the APQ Monitoring and Supervision subscale or Level of Expressed Emotion (table 5A) indicated no significant effect of MST at any point. Parent-rated family functioning (FACES-IV) favoured the MST participants at 6 months, but differences were no longer significant at 18 months (table 5B). Parent reports of partner conflict on the CTS showed no significant group differences at any time point (table 5B).

### **Secondary outcomes: Young people's and parental wellbeing and adjustment**

Young people's self-report of their emotional wellbeing on the SDQ and MFQ indicated statistically significant benefits from MST at 6 and 12 months but no differences at 18 months (table 6A). Parental reports of young people's wellbeing on the SDQ revealed some between-group differences but none were maintained at 18-month follow-up. On the parent-rated Conners ADHD scale, scores were significantly higher in the MAU condition at 6 months but not thereafter, but teachers were unable to detect this change (table 6B). Parental reports suggested larger effects at 6 and 12 months but these dissipated at 18 months (table 6B). Teachers' ratings using the other Conners behaviour rating scales (appendix) did not detect an impact of the MST intervention, although teachers reported less disruptive behaviour in the MST group at 12 months (estimate:  $-2.56$ , 95% CI  $-4.77$  to  $-0.35$ ;  $p=0.025$ ). Parental wellbeing benefited from MST and differences on the GHQ continued to favour MST at 18 months post-baseline (table 6B). Clinician ratings on the DAWBA identified no significant between-group differences in psychiatric disorders at either baseline or 12 months (table 6C).

## **Moderator analyses**

We considered several potential moderators (table 2). Onset of antisocial behaviour before 11 years powerfully moderated the effect of MST on out-of-home placements (interaction: OR 4.95, 95% CI 1.74 to 14.0;  $p=0.0026$ ). There was a significant detrimental effect of MST (OR 3.11, 95% CI 1.40 to 6.93;  $p=0.0014$ ) in the early-onset group when directly compared with the late-onset group, and a non-significant beneficial effect of MST in the late-onset group (OR 0.63, 95% CI 0.32 to 1.23;  $p=0.17$ ).

CU traits at baseline also moderated the impact of MST on out-of-home placement (interaction: OR 0.95, 95% CI 0.90 to 1.00;  $p=0.048$ ). MST was significantly detrimental relative to MAU in participants low on CU traits at baseline (those scoring below the median in CU traits) (OR 2.77, 95% CI 1.20 to 6.40;  $p=0.017$ ). There was no significant moderating effect of high baseline CU traits on the MST group (OR 0.70, 95% CI 0.36 to 1.35;  $p=0.29$ ).

In participants with few delinquent peers ( $\leq$ the median peer delinquency score of 3), MST significantly decreased the time to first offence (HR 1.47, 95% CI 1.04 to 2.09;  $p=0.029$ ), while in the group where delinquency was more socialised, MST significantly increased the time to first offence (HR 0.68, 95% CI 0.50 to 0.94;  $p=0.020$ ).

Figure 2 shows Kaplan–Meier curves for each subgroup. Finally, there were no interaction effects with psychiatric comorbidities on these treatment outcomes.

The high level of provision (appendix) underscores (1) the participants' high service need and (2) the groups' comparability in terms of hours of face-to-face treatment, with almost no differences between the conditions, notwithstanding that the MST therapist contacts were not included in computing MAU.

## **Economic analyses**

Total service costs and outcomes over the 18-month follow-up period are summarised in table 7, including a breakdown of costs by service-providing sector. The mean total costs over 18-month follow-up were £30,928 in the MAU group and £28,678 in the MST group; this difference was not statistically significant (adjusted difference –£1623, 95% CI –£7684 to £4438;  $p=0.60$ ). The cost-effectiveness acceptability curve (appendix) indicates that the probability that MST is cost-effective compared with MAU is low and does not rise above 18% for a range of willingness-to-pay thresholds.

## **Discussion**

We identified no long-term behavioural, mental health, social care, forensic, or educational benefit, nor any economic advantage, for this therapy compared with MAU by local services. MST may actually have worsened some of these outcomes for some young people. There was no evidence that MST reduces the likelihood of out-of-home placement; if anything, it was slightly increased, perhaps because of MST's greater attention to young people at risk triggering safeguarding arrangements for these young people. It should be noted that both arms achieved the reduction of 20% (from the actuarial estimate of 30% to the observed 10%) that we a priori identified as clinically significant.

In terms of the key secondary outcome of criminal behaviours, the reduction in convictions achieved by MST was no better than that achieved with MAU, and some advantage for MAU was noted by 18 months.

MST brought about change more rapidly than MAU, especially as noted by parents, although this change was no more likely to be sustained in the longer term. Parents valued MST even though its impact on participants dissipated by the end of the study. This may account for the improvements in parents' own overall mental health and reporting of improved family

functioning. Overall, and compared with the young people, parents may have somewhat benefitted from the MST programme, and sustained change in self-reported parenting in combination with improved mood may turn out to bring long-term behavioural benefit; this will be examined by an ongoing extended follow-up of this sample. In contrast, young people reported little change in parenting behaviour, including failing to confirm the lasting reduction in inconsistent parenting reported by parents in the MST group.

It is unclear why the young people themselves appeared less sensitive to the programme's benefits. Self-rated conduct problems and delinquent behaviour decreased across both groups with time. There were few between-group differences in antisocial attitudes, apart from an unpredicted difference in CU traits at 18 months favouring MST. Measures of emotional wellbeing (anxiety and depression) also indicated benefit from MST for the year following the interventions; the group differences were small in absolute terms and fell short of mean differences on the MFQ usually associated with clinical significance (5 points or more) but the pattern was statistically robust across two measures.

There was little indication of MST's educational benefit from either teachers or records of school attendance, although there were considerable missing data. Despite earlier pilot study evidence suggesting that MST led to cost savings,<sup>48</sup> in this larger economic evaluation there is no evidence that MST is more cost-effective than MAU. Although total costs were slightly lower, differences were not significant, and poorer outcomes in terms of out-of-home placement resulted in a low probability of MST being cost-effective compared with MAU.

Analysis of the severity moderators yielded findings worthy of further exploration. With early-onset antisocial behaviour, MST appeared to increase the likelihood of costly out-of-home placement, although it is possible that this was because close observation of family dynamics in MST revealed more instances where such placements were appropriate. MST

appeared to delay reoffending when delinquent peer influences were marked, while increasing risk of offending in young people without antisocial peers. MST appeared to be similarly detrimental relative to MAU for a low-risk group, namely low-CU individuals, whose time to first offence decreased following MST. The authors speculate that in relatively low-risk groups the focus of MST on criminal activity (eg, police involvement with acts of violence to family members as part of MST safety planning) may have the effect of enhancing adverse outcomes in individuals not previously sensitised to offending possibilities.

This trial is the most comprehensive study of MST reported so far and has a number of strengths. It was independently conducted, with the developers' collaboration but without their involvement at any stage of data acquisition or data processing. The participants were representative of individuals likely to be referred to MST services in the UK. We were able to independently assure treatment quality, all but one of the sites performed well above the standards expected by the developers, and no information on treatment assignment was available to anyone on the research team. The study retained the vast majority of participants, and reliable data on offending and out-of-home placement were collected for almost all participants. Multiple imputations using available data ensured representativeness of estimates where the young people, parents, or educators were unable to provide information. Outcomes covered the principal domains of interest, including offending; out-of-home placements; parent, educator, and self-rated behaviour; emotional wellbeing; family functioning; and societal and service costs. A putative mediator variable (parenting) was also incorporated.

However, significant limitations remain. The MAU group was not a homogenous comparison condition, with considerable between-site variation of what was offered. Future analysis will reveal whether differences between services significantly influenced outcomes. MAU may

have offered more flexibility in addressing the young people's specific needs, as opposed to MST, which focuses more on helping the family bring about behavioural change. While MST allows flexibility in the way specific problems are targeted, it also requires a high level of adherence to the interventions used, which may carry disadvantages. While the implementation of MST met formal fidelity criteria, the current average fidelity ratings for UK services significantly exceed levels achieved by these first-generation services. However, failures to replicate USA RCTs of interventions for youth antisocial behaviour are more likely due to the greater effectiveness of usual treatment rather than limitations of the UK implementation. A recent UK trial of Functional Family Therapy likewise found no improvement compared with controls, despite adequate implementation.<sup>49</sup> We tested a large number of secondary outcomes, so some significant results may be attributable to multiple testing and, along with our moderator analyses, are best considered exploratory and requiring replication. While the Cronbach's alpha (interclass reliability) coefficients were high or acceptable, some of the mean inter-item correlations (appendix) were outside the 0.15–0.20 range recommended as an indication of reasonable scale internal consistency.<sup>50</sup>

In conclusion, this rigorous and comprehensive evaluation found that MST did not significantly reduce dependence on MAU and brought no long-term advantages in terms of outcome. Although parents saw MST as bringing about more rapid and effective change, this was not reflected in objective indicators of delinquency. The medium-term gain from MST relative to MAU is limited in the behavioural domain, with some suggestion of adverse effect of MST in increased risk of criminal activity for individuals who are relatively low in risk in terms of the factors assessed in this study.

The findings also reflect the effectiveness of UK mental health, youth offending, and social care services, which were active in both arms of the trial, in reducing the risk of crime and

protecting young people and society, at least when under the scrutiny of a randomised controlled trial.

### **Contributors**

PF, SBu, DC, SS, SP, IE, PFu, SBy, and IMG were responsible for the original proposal, for securing funding for the trial, and for drafting the original protocol with assistance from EA. PF as chief investigator had overall responsibility for the management of the study, with support from SBu as clinical research lead. IMG had responsibility for the East Anglia site; DC and AK for the Northern site; and IE, SS, and PFu for the South-East sites. SP, PFu and SBu were responsible for the development of the measure of MAU interventions. RE was project manager throughout the trial and developed and coordinated the randomisation and minimisation protocol. ES was the Senior Research Assistant and supported RE with the trial coordination. RE (with PF and SBu) set up and coordinated the database, with all data held in a single repository managed by the MHRN at the East Anglia site. RE and ES coordinated and supervised the treatment fidelity project managed by MST Inc. JW and SBy wrote the statistical analysis plan. JW, PG, and SBy did the statistical analyses. RE and ES were responsible for data cleaning. PF wrote the initial draft of the manuscript with support from EA. All authors contributed to and approved the final manuscript.

### **Declaration of interests**

We declare no competing interests.

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(CLAHRC) North Thames at Barts Health NHS Trust. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health. Nicole Hickey (Imperial College London) entered, coded, analysed and prepared tables for the youth offending data from official records from the Police National Computer and Youth Offender Information System for all nine MST sites. The authors acknowledge the excellent work of the team of RAs involved in acquiring the data across the nine MST sites; the wise counsel of Professor Eric Taylor and members of the Trial Steering Committee he chaired, and of Professor Philip Graham and members of the Data Management and Ethics Committee he chaired; and the consistent and thoughtful support and oversight of Cathy James, National Multisystemic Therapy Programme Lead, National Implementation Service supported by Kathryn Harney, Associate Director of Research, Greater Manchester West Mental Health NHS Foundation Trust, without whom this trial could not have been completed.

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## **Figure captions**

**Figure 1: Trial profile**

**Figure 2: Time to first offence of young people with high or low levels of peer delinquency**

Del=peer delinquency. MAU=management as usual. MST=Multisystemic Therapy.