APPENDIX

Appendix A: Study design and methods

Eligibility criteria

The aim of the trial was to increase generalisability by using the minimum number of entry criteria· Young people were considered to be eligible for the trial if they met the following inclusion criteria:

1· Aged 11 to 17 years

2· Sufficient family involvement for MST to be applied, excluding adolescents already in local authority care or foster accommodation

3· No existing agency involvement (e·g·, the family is already engaged with a therapist) which would interfere with MST

4· Meets ONE of the following set of criteria indicating suitability for MST:

a. Persistent (weekly) and enduring (6 months or longer) violent and aggressive interpersonal behaviour OR
b. A significant risk of harm to self or to others OR
c. At least one conviction and three warnings, reprimands or convictions in the last 18 months OR
d. Current diagnosis of externalising disorder and a record of unsuccessful outpatient treatment OR
e. Permanent school exclusion

Additional referral criteria were developed to reflect the different referral routes into the trial, including Youth Offending Services, Social Services, CAMHS, and education services· As a result, eligible candidates could be referred if they met 3 of the following features indicative of "risk status":

1· Excluded or at significant risk of school exclusion

2· High levels of non-attendance at school

3· An offending history or at significant risk of offending

4· Previous episodes on the Child Protection Register

5· Previous episodes of being looked after

6· Previous referral to Family Group Conference to prevent young person from becoming looked after

7· History of siblings being looked after

Exclusion criteria included:

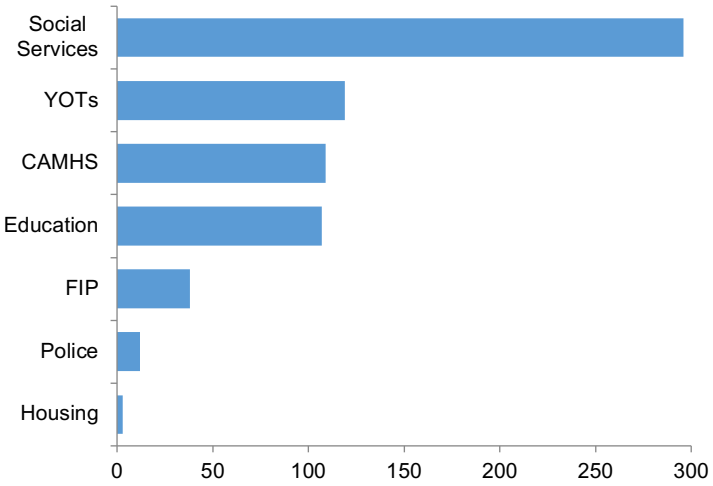
1· History or current diagnosis of psychosis

2· Generalised learning problems (clinical diagnosis) as indicated by IQ below 65

3· Risk of injury or harm to a worker

4· Presenting issues for which MST has not been empirically validated, in particular substance abuse in the absence of criminal conduct or sex offending as the sole presenting issue·

Figure A1: Referral sources for the START trial, including only randomised cases



Source	n	%
Social Services	296	43·3%
YOTs	119	17·4%
CAMHS	109	15·9%
Education	107	15·6%
Police	12	1·8%
FIP	38	5·6%
Housing	3	0·4%
Total	**684**	**100%**

CAMHS=Child and Adolescent Mental Health Services· FIP=Family Intervention Project· YOTs=Youth Offending Teams·

Table A1: Recruitment and therapist adherence scores at the nine trial sites

Site	Became active	Date first family recruited	Recruitment (n)	MST (%):MAU (%)	TAM-R score	
					Mean	SE
Barnsley	June 2010	June 28, 2010	80	38 (49):41 (51)	0·698	0·035
Greenwich	February 2010	February 4, 2010	80	38 (48):42 (52)	0·790	0·035
Hackney	February 2010	March 16, 2010	70	35 (50):35 (50)	0·640	0·035
Leeds	February 2010	March 8, 2010	83	44 (53):39 (47)	0·733	0·033
Merton & Kingston	July 2010	July 29, 2010	80	41 (51):39 (49)	0·610	0·033
Peterborough	February 2010	March 4, 2010	81	41 (51):40 (49)	0·615	0·034
Reading	September 2010	October 11, 2010	70	36 (51):34 (49)	0·704	0·036
Sheffield	December 2010	January 20, 2011	70	35 (50):35 (50)	0·705	0·039
Trafford	December 2010	January 13, 2011	70	33 (47):37 (53)	0·806	0·038
Total			684	342 (50):342 (50)	0·698	0·012

MAU=management as usual· MST=Multisystemic Therapy· TAM-R=Therapist Adherence Measure-Revised·

Table A2: Comorbid diagnosis at baseline

	MST		MAU	
	n or mean	SD or %	n	SD or %
Conduct disorder	262	77·7	270	79·4
Oppositional defiant disorder	14	4·2	14	4·1
Any conduct disorder	274	81·3	280	82·4
Social phobia	12	3·6	9	2·6
Obsessive-compulsive disorder	1	0·3	2	0·6
Posttraumatic stress disorder	25	7·4	26	7·6
Separation anxiety disorder	7	2·1	15	4·4
Specific phobia	6	1·8	13	3·8
Generalised anxiety disorder	6	1·8	9	2·6
Panic disorder	5	1·5	3	0·9
ADHD Combined	113	33·5	91	26·8
ADHD Hyperactive–Impulsive	8	2·4	3	0·9
ADHD Inattentive	13	3·9	12	3·5
PDD/autism	3	0·9	4	1·2
Eating disorders	2	0·6	2	0·6
Tic disorder	7	2·1	4	1·2
Major depression	30	8·9	42	12·4
Any emotional disorder	73	21·7	90	26·5
Mixed anxiety/conduct disorder	46	13·6	56	16·5
Number without diagnosis	50	14·8	50	14·7
Average number of Axis I diagnoses	1·5	1	1·5	1·1
Onset of conduct disorder	148	43·3	149	43·7
ICUT score	33·5	9·7	32·7	9·6
Peer delinquency score (SRDM)	5·0	4·7	4·9	4·7

Table A3a: Demographic characteristics of families who were seen vs· not seen at 24-month follow-up

	24 months	
	Collected (n=478)	Not collected (n=205)
Arm	49% MST	54% MST
Sex	62% male	66% male
Age at randomisation (years)	13·78 (1·42)	13·89 (1·40)
Onset of conduct problems	56% late	57% late
Ethnicity	78% White, 10% Black, 3% Asian, 7% Mixed/Other	78% White, 10% Black, 2% Asian, 8% Mixed/Other
SES	63% low, 26% medium, 10% high	61% low, 27% medium, 10% high
Parents' marital status at baseline	39% single, 40% married, 20% separated	42% single, 39% married, 20% separated
Total violent offences (prior to baseline)	0·14 (0·46)	0·18 (0·70)
Total non-violent offences (prior to baseline)	0·17 (0·59)	0·29 (1·14)
Total ALL offences (prior to baseline)	0·39 (1·07)	0·60 (2·12)

Table A3b: Demographic characteristics of families who were seen vs· not seen at 36-month follow-up

	36 months	
	Collected (n=433)	**Not collected (n=250)**
Arm	48% MST	53% MST
Sex	63% male	65% male
Age at randomisation (years)	13·75 (1·42)	13·92 (1·39)
Onset of conduct problems	55% late	60% late
Ethnicity	78% White, 10% Black, 3% Asian, 8% Mixed/Other	79% White, 10% Black, 2% Asian, 7% Mixed/Other
SES	62% low, 26% medium, 10% high	63% low, 26% medium, 10% high
Parents' marital status at baseline	40% single, 40% married, 19% separated	40% single, 40% married, 21% separated
Total violent offences (prior to baseline)	0·12 (0·42)	0·20 (0·71)
Total non-violent offences (prior to baseline)	0·20 0(·67)	0·22 (0·99)
Total ALL offences (prior to baseline)	0·4 (1·12)	0·53 (1·94)

Table A3c: Demographic characteristics of families who were seen vs· not seen at 48-month follow-up

	48 months	
	Collected (n=349)	**Not collected (n=334)**
Arm	48% MST	52% MST
Sex	64% male	63% male
Age at randomisation (years)	13·72 (1·43)	13·91 (1·38)
Onset of conduct problems	54% late	59% late
Ethnicity	79% White, 10% Black, 3% Asian, 7% Mixed/Other	78% White, 10% Black, 2% Asian, 8% Mixed/Other
SES	65% low, 23% medium, 11% high	60% low, 29% medium, 9% high
Parents' marital status at baseline	42% single, 40% married, 18% separated	38% single, 39% married, 22% separated
Total violent offences (prior to baseline)	0·10 (0·35)*	0·20 (0·69)*
Total non-violent offences (prior to baseline)	0·17 (0·60)	0·24 (0·96)
Total ALL offences (prior to baseline)	0·33 (0·84)**	0·58 (1·91)**

* $F(1,677)=5·633$, p=0·018; ** $F(1,677)=5·051$, p=0·025·

Note: no other significant differences were found at any other follow-up point, all p-values >0·5·Data are n (%) or mean (SD)· ADHD=attention deficit hyperactivity disorder· ICUT=Inventory of Callous-Unemotional Traits· SRDM=Self-Report Delinquency Measure·

Table A4: Summary of service use from baseline to 18-month follow-up

	MAU			MST		
	Number of contacts	**Duration of contacts (minutes)**	**n (%) used**	**Number of contacts**	**Duration of contacts (minutes**	**n (%) used**
Baseline						
CAMHS	1·42 (3·9)	75·61 (222·9)	72 (25·3%)	2·47 (9·7)	128·79 (495·1)	72 (24·7%)
Social care	4·74 (10·7)	252·33 (815·5)	122 (42·9%)	5·45 (12·4)	344·77 (949·7)	123 (42·2%)
YOT	6·12 (14·2)	290·6 (715·9)	87 (30·6%)	5·17 (11·8)	321·96 (1644·6)	82 (28·1%)
6 mfu						
CAMHS	1·5 (6·0)	94·41 (417·3)	53 (19·9%)	2·13 (8·4)	267·95 (2443·8)	56 (22·3%)
Social care	5·82 (16·2)	286·28 (711·2)	102 (38·3%)	4·42 (11·5)	250·05 (821·4)	91 (36·2%)
YOT	4·47 (10·8)	222·07 (613·2)	67 (25·1%)	4·93 (11·3)	240·7 (600·3)	70 (27·8%)
12 mfu						
CAMHS	4·02 (19·1)	547·04 (4050·1)	50 (20·4%)	1·66 (7·3)	77·03 (270·6)	57 (23·8%)
Social care	5·44 (15·4)	318·85 (1179)	92 (37·5%)	4·52 (9·8)	256·24 (679·3)	91 (38%)
YOT	5·07 (13·7)	228 (587)	57 (23·2%)	4·59 (14·7)	194·18 (554·9)	55 (23%)
18 mfu						
CAMHS	6·84 (21·3)	729·19 (4250)	89 (40%)	6·27 (19·9)	486·35 (3066·3)	89 (42·5%)
Social care	13·93 (27)	716·67 (1553·1)	138 (62·1%)	12·43 (22·4)	722·71 (1576·8)	122 (58·3%)
YOT	14·21 (29·9)	640·53 (1415·9)	87 (39·1%)	12·92 (24)	584·38 (1175·1)	92 (44%)

Standard deviations are shown in parentheses· CAMHS=Child and Adolescent Mental Health Services· MAU=management as usual· mfu=Months follow-up· MST=Multisystemic Therapy· YOT=Youth Offending Team·

Table A5a: Summary of secondary measures

Measure name	Measure construct(s)	Collected at (time points)							Completed by		
		Baseline	6m	12m	18m	24m	36m	48m	Parent	Young Person	Teacher
Demographic and background information											
Family Information Form	Demographic information	X			(if necessary)				X	X	
Wechsler Abbreviated Scale of Intelligence (WASI II)	Child IQ for inclusion/exclusion	X								X	
Coddington Life Events Questionnaire - Adult (CLES-A)	Significant life events					X	X	X		X	
Measures of antisocial problems and attitudes											
Strengths and Difficulties Questionnaire (SDQ)	Antisocial behavioural problems and beliefs, and young people's and parental wellbeing	X	X	X	X	X	X	X	X	X	
Inventory of Callous-Unemotional Traits (ICUT)	Callous-unemotional traits	X	X	X	X	X	X	X	X	X	
Adult Behaviour Check list (ABCL)	Behavioural and emotional problems					X	X	X	X		
Self-Report Delinquency measure (SRD)	Conduct problems	X	X	X	X	X	X	X		X	
Antisocial Beliefs and Attitudes Scales (ABAS)	Antisocial behaviour and attitudes	X	X	X	X	X	X	X		X	
Youth Materialism Scale	Materialistic values	X	X	X	X	X	X	X		X	
Adult Materialism Scale	Materialistic values					X	X	X		X[a]	
Young person mental health and wellbeing											
Development and Well-Being Assessment (DAWBA)	Psychiatric disorders			X					X	X	
Conners Rating Scale (ADHD and Learning & Language subscales)	ADHD symptoms	X	X	X	X	X	X	X	X		X
Adult Self-Report questionnaire (ASR)	Behavioural and emotional problems					X	X	X		X	
Short Mood and Feelings Questionnaire (SMF)	Well-being and depression	X	X	X	X	X	X	X		X	
Adolescence resilience questionnaire (ARQ)	Psychological resilience					X	X	X		X	
SF-36 Health Survey	Quality of life					X	X	X		X	

Measure name	Measure construct(s)	Collected at (time points)							Completed by		
		Baseline	6m	12m	18m	24m	36m	48m	Parent	Young Person	Teacher
Parenting assessment											
Alabama Parenting Questionnaire (APQ)	Parenting controls, and skills for monitoring and supervision	X	X	X	X	X	X	X	X	X	
Loeber Caregiver Questionnaire	Family functioning (parental supervision and involvement)	X	X	X	X	X	X	X	X		
Family functioning											
Family Adaptability and Cohesion Evaluation Scales (FACES-IV)	Family functioning (family adaptability and cohesion)	X	X	X	X	X	X	X	X		
Couple Conflicts Tactics Scale (CTS2)	The degree of conflict in the parental relationship	X	X	X	X	X	X	X	X		
Levels of Expressed Emotions (LEE)	Family functioning (levels of expressed emotions)	X	X	X	X	X	X	X		X	
Parental mental health											
General Health Questionnaire (GHQ)	Screen for minor psychiatric disorders	X	X	X	X	X	X	X	X		
Health economic measures											
Child and Adolescent Service Use Schedule (CA-SUS)	Data on use of all services and other resource use	X	X	X	X	X	X	X	X	X	
EQ-5D-3L measure of health-related quality of life	Quality-adjusted life years	X	X	X	X	X	X	X	X	X	
National Pupil Database	Educational participation (attendance and exclusions)		X	X	X						

[a] If the young person is 18 or over

Note: The measures as they appear here have been pre-specified in the trial protocol, which can be found at https://www.isrctn.com/ISRCTN77132214

Table A5b: Brief description of secondary measures

Demographic and background information

Family Information Form: a demographic questionnaire pertaining to gender, ethnicity, and socioeconomic status·

Wechsler Abbreviated Scale of Intelligence (WASI II): an IQ test suitable for administration from ages 6 and up, including an evaluation of general intelligence as well as verbal and performance intelligence·

Coddington Life Events Questionnaire - Adult (CLES-A): a questionnaire assessing whether the person completing has recently experienced any of 50 significant life events which have the potential to impact physical and mental health·

Measures of antisocial problems and attitudes

Strengths and Difficulties Questionnaire (SDQ): a brief screening instrument for assessing emotional and behavioural problems in children and adolescents· It is used to assess and test for between-group differences regarding the severity of behavioural problems endorsed by the informant·

Inventory of Callous-Unemotional Traits (ICUT): a 24-item questionnaire designed to provide a comprehensive assessment of callous- unemotional traits· These traits have proven to be important for designating a distinct subgroup group of antisocial and aggressive youth· This measure allowed us to test for the unique contribution of callous-unemotional traits on our offending outcomes·

Adult Behaviour Check List (ABCL): See Adult Self-Report Questionnaire (ASR)·

Self-Report Delinquency measure (SRD): this scale allows for the assessment of the type and frequency of delinquent or law-breaking engaged in by each of the two groups across the follow-up period· SRD have consistently been measured in the majority of youth offending RCTs as a complement to objective offending measures·

Antisocial Beliefs and Attitudes Scales (ABAS): the ABAS is a developmentally sensitive, broad-based instrument that assesses antisocial cognitions in older children and adolescents· Antisocial beliefs and attitudes are a major risk factor for persistent antisocial behaviour and would theoretically be expected to change with improvements in offending behaviour following intervention·

Youth and Adult Materialism Scales: these scales measure materialism as an emerging value and cultural factor that empirically has been shown to contribute to lower well-being in young people and specifically to antisocial behaviour problems·

Young person mental health and wellbeing

Conners Rating Scale (ADHD and Learning & Language subscales): this rating scale allows for a well-validated assessment of ADHD and learning vulnerabilities in young people up to 18 years of age· Given that MST focuses on improving young people's adjustment at school and advocates for better plans to address educational needs, we hypothesized the young people would show improvements in these areas· Again, there is very little evaluation of the school context in the MST literature, despite its status as an intervention designed to address multiple systems in young people's lives·

Adult Self-Report questionnaire (ASR) and the Adult Behaviour Check list (ABCL): these two screening instruments, completing by the parent and young people emerging into young adulthood in our sample at successive longer-term follow-ups, assess for emotional and behavioural problems in the older age ranges· They allow for continuity of these basic mental health outcomes completed by these two key informants·

Short Mood and Feelings Questionnaire (SMFQ): The SMFQ is a brief self-report measure of childhood and adolescent depression focused on core depressive symptomatology·

Adolescence Resilience questionnaire (ARQ): The ARQ measures adolescents' resilience and their capacity to achieve positive outcomes despite stressors· Consistent with the MST ecological focus, it includes measures of resilience within self and in family, school, peer and community domains· While indisputably a key construct in child mental health, to our knowledge there have been no previous assessments of this construct in MST trials· We hypothesized that young people receiving MST would not just show decreases in measures of antisocial behaviour and emotional well-being, but, over time, would show increases in their resilience and capacities to deal with adversity·

SF-36 Health Survey: a measure of physical health and day-to-day functioning·

Parenting assessment

Alabama Parenting Questionnaire (APQ): This 42-item questionnaire measures five dimensions of parenting· We employed the APQ to assess parental monitoring and supervision of the young person's behaviour, the most empirically supported parenting domains associated with adolescent antisocial behaviour· This measure was completed by both the mother and young person and allows a rigorous assessment of between-group changes in this parenting domain across the extended follow-up period·

Loeber Caregiver Questionnaire: we used 15 items from the parent-completed questionnaire that yields a total parenting score (parental support) that includes the major components of parenting with items particularly applicable to antisocial adolescents· The total score therefore includes subscales examining parental involvement, parental discipline, and parental monitoring and supervision·

Family functioning

Family Adaptability and Cohesion Evaluation Scales (FACES-IV): this measure was developed to evaluate the adaptability and cohesion dimensions in family interactions· This is the degree to which families have clear roles, responsibilities and boundaries within the family, as well as the degree to which family members feel close to and involved in each other's lives· MST is a family intervention and the quality of emotional relationships and boundaries between parents and their children are key targets of the intervention· Furthermore, this family scale is the most frequently used measure in MST trials and crucially allows thee key components of family functioning to be assessed outside the context of parenting·

Couple Conflicts Tactics Scale (CTS-2): is a measure that explores intra-family conflict and violence focusing particularly on intimate partner violence· Despite the well-documented and pernicious effects of family violence on youth offending and emotional well-being, this is an area that is seldom assessed in MST trials·

Level of Expressed Emotion (LEE): The LEE is designed to measure to what degree the adolescent perceives lack of emotional support, intrusiveness and criticism in their major relationships within the family· The level of criticism and emotional conflict is related to both delinquent functioning and has been found to moderate treatment effect in relation to young people's emotional well-being·

Parent Mental Health

General Health Questionnaire (GHQ): The GHQ is a well-established screening device for identifying significant mental health problems in community samples· In youth antisocial behaviour, parental mental health would interact with key mediating mechanisms such as parenting and youth antisocial behaviour· Moreover, youth antisocial behaviour itself places parents at risk for mental health difficulties, so the effects are bidirectional· Consequently, we hypothesized that a targeted, evidence-based intervention for antisocial behaviour would lead to decreases in parent report mental health difficulties as a result of their involvement in MST·

Health Economic Measures

Child and Adolescent Service Use Schedule (CA-SUS): a questionnaire developed specifically for the trial, designed to record all contact with health, social care, and criminal justice services· The rationale was to account for the multi-component, resource-intensive support provided to young people in this complex population and its effects on the associated costs·

EQ-5D-3L: a measure of health-related quality of life, used to calculate Quality-Adjusted Life Years (QALYs)·

National Pupil Database: we collected information on young people's absences and expulsion from the UK National Pupil Database· MST works extensively with parents to advocate for their children's educational needs, yet this area is seldom evaluated in MST trials, principally due the attrition regarding teacher completion rates of school-related adjustment· We anticipated that these objective markers of school adjustment would allow us to determine whether MST was having significant effects on school adjustment compared to MAU·

Table A6a: Internal consistency of secondary outcome measures based on START I (to 18 months)

Assessment	Baseline (T1)	6 months (T2)	12 months (T3)	18 months (T4)	Cronbach's α (reliability coefficient)	Mean inter-item correlation*
Parent Questionnaires						
General Health Questionnaire (GHQ)	X	X	X	X	0·95	0·41
Conners Comprehensive Behaviour Rating Scale – Parent form (CBRS)	X	X	X	X	0·89	0·26
Inventory of Callous-Unemotional Traits (ICUT)	X	X	X	X	0·85	0·20
Strengths and Difficulties Questionnaire (SDQ)	X	X	X	X	0·72	0·06
Conflict Tactics Scale (CTS2S)	X	X	X	X	0·83	0·20
Alabama Parenting Questionnaire (APQ)	X	X	X	X	0·62	0·07
Family Adaptability and Cohesion Evaluation Scale (FACES-IV)	X	X	X	X	0·73	0·08
Loeber Caregiver Questionnaire	X	X	X	X	0·76	0·15
Young Person Questionnaires						
Short Mood and Feelings Questionnaire (MFQ)	X	X	X	X	0·89	0·58
Inventory of Callous-Unemotional Traits (ICUT)	X	X	X	X	0·78	0·13
Self-Report Delinquency Measure (SRDM)	X	X	X	X	0·92	0·19
Levels of Expressed Emotion (LEE)	X	X	X	X	0·98	0·08
Antisocial Beliefs and Attitude Scale (ABAS)	X	X	X	X	0·93	0·17
Strength and Difficulties Questionnaire (SDQ)	X	X	X	X	0·70	0·08
Alabama Parenting Questionnaire (APQ)	X	X	X	X	0·61	0·10
Youth Materialism Scale	X	X	X	X	0·84	0·27
Education data						
Conners Comprehensive Behaviour Rating Scale – Teacher form (CBRS)	X	X	X	X	0·89	0·26

*Clark and Watson (1995) have recommended a mean inter-item correlation between 0·15 and 0·20 for broad constructs and between 0·40 and 0·50 for more narrow constructs·

Clark, L· A· & Watson, D· (1995)· Constructing validity: Basic issues in objective scale development· *Psychological Assessment*, *7*, 309-319

Table A6b: Internal consistency of secondary outcome measures for START II (from 18 to 48 months)

	24 month follow-up		36 month follow-up		48 month follow-up	
	Cronbach's α (reliability coefficient)	Mean inter-item correlation	Cronbach's α (reliability coefficient)	Mean inter-item correlation	Cronbach's α (reliability coefficient)	Mean inter-item correlation
Assessment						
Parent Questionnaires						
General Health Questionnaire (GHQ)	0·96	0·48	0·97	0·52	0·96	0·49
Conners Comprehensive Behaviour Rating Scale – Parent form (CBRS)	0·94	0·38	0·94	0·40	0·95	0·42
Inventory of Callous- Unemotional Traits (ICUT)	0·89	0·25	0·89	0·26	0·89	0·25
Strengths and Difficulties Questionnaire (SDQ)	0·86	0·20	0·86	0·19	0·84	0·17
Conflict Tactics Scale (CTS2S)	0·77	0·21	0·81	0·34	0·81	0·32
Alabama Parenting Questionnaire (APQ)	0·72	0·15	0·71	0·16	0·70	0·15
Family Adaptability and Cohesion Evaluation Scale (FACES-IV)	0·86	0·10	0·84	0·09	0·88	0·11
Loeber Caregiver Questionnaire	0·64	0·95	0·67	0·10	0·74	0·15
Adult Behaviour checklist (ABC)	0·95	0·43	0·95	0·43	0·94	0·41
Strengths and Difficulties Questionnaire (SDQ) Sibling	0·89	0·25	0·89	0·24	0·91	0·28
Young Person Questionnaires						
Short Mood and Feelings Questionnaire (MFQ)	0·91	0·45	0·92	0·48	0·94	0·53
Inventory of Callous- Unemotional Traits (ICUT)	0·84	0·18	0·87	0·22	0·85	0·19
Self-Report Delinquency Measure	0·90	0·15	0·90	0·18	0·89	0·16

(SRDM)						
Levels of Expressed Emotion (LEE)	0·94	0·25	0·94	0·27	0·94	0·27
Antisocial Beliefs and Attitude Scale (ABAS)	0·94	0·17	0·94	0·17	0·95	0·20
Strength and Difficulties Questionnaire (SDQ)	0·78	0·13	0·76	0·11	0·79	0·13
Alabama Parenting Questionnaire (APQ)	0·75	0·18	0·71	0·13	0·77	0·19
Youth Materialism Scale	0·74	0·14	0·64	0·09	0·75	0·14
EQ-5D-3L	0·51	0·21	0·58	0·25	0·67	0·35
ARQ	0·96	0·23	0·94	0·16	0·94	0·16

Appendix B: Outcomes

Table B1: Routine care received by the two intervention groups at baseline

	MAU (n=284)			MST (n=291)		
	Mean (SD) number of contacts	**Mean (SD) duration (hours)**	**Number (%) used**	**Mean (SD) number of contacts**	**Mean (SD) duration (hours)**	**Number (%) used**
Care Coordinator	0·15 (1·8)	6·89 (77·9)	4 (1·4%)	1·1 (8·1)	46·63 (372·4)	9 (3%)
Psychiatrist	0·21 (0·9)	10·49 (50·6)	18 (6·3%)	0·13 (0·8)	7·15 (44·1)	12 (4·1%)
Clinical Psychologist	0·34 (2·1)	19·26 (127·5)	16 (5·6%)	0·48 (4)	30·73 (248·6)	13 (4·4%)
CAMHS worker	0·67 (2·5)	36·53 (145·8)	45 (15·8%)	0·68 (3·4)	39·84 (208·1)	43 (14·7%)
Community Psychiatric Nurse	0·04 (0·3)	2·43 (21·6)	4 (1·4%)	0·07 (1·2)	4·43 (73·8)	2 (0·6%)
Total routine CAMHS	**1·42 (3·9)**	**75·61 (222·9)**	**72 (25·3%)**	**2·47 (9·7)**	**128·79 (495·1)**	**72 (24·7%)**
Social worker	3·07 (7·7)	159·62 (633·1)	100 (35·2%)	3·37 (7·5)	221·74 (687·7)	100 (34·3%)
Family support worker	1·18 (5·8)	58·25 (293·6)	23 (8%)	1·91 (9·2)	113·24 (598·3)	29 (9·9%)
Social services youth worker	0·49 (3·8)	34·46 (382·4)	12 (4·2%)	0·17 (1·1)	9·83 (58·9)	11 (3·7%)
Total routine social care	**4·74 (10·7)**	**252·33 (815·5)**	**122 (42·9%)**	**5·45 (12·4)**	**344·77 (949·7)**	**123 (42·2%)**
Total routine YOT	**6·12 (14·2)**	**290·6 (715·9)**	**87 (30·6%)**	**5·17 (11·8)**	**321·96 (1644·6)**	**82 (28·1%)**
Total	**12·28 (18)**	**618·55 (1136)**	**199 (70%)**	**13·09 (19·9)**	**795·53 (2032·2)**	**190 (65·2%)**

CAMHS=Child and Adolescent Mental Health Services· MAU=management as usual· MST=Multisystemic Therapy· YOT=Youth Offending Team· *Indicates significant differences between the trial conditions on *t*-test or χ^2 test·

Table B2a: Summary of effect of MST on mean number of violent offences in year periods

Time	MST	MAU	Difference	p
1–12 months	0·4	0·38	0·06 (–0·33, 0·44)	0·78
13–24 months	0·22	0·12	0·15 (–0·26, 0·57)	0·46
25–36 months	0·12	0·11	–0·01 (–0·49, 0·47)	0·96
37–48 months	0·11	0·14	0·11 (–0·37, 0·58)	0·66
49–60 months	0·08	0·08	–0·29 (–0·85, 0·28)	0·32
Overall			**0·02 (–1·75, 1·78)**	**0·98**

MAU=management as usual・MST=Multisystemic Therapy・

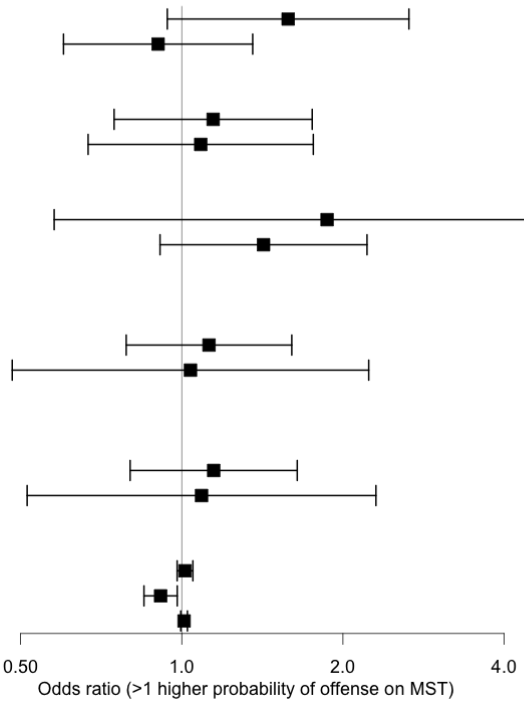
Table B2b: Summary of effect of MST on mean number of non-violent offences in year periods

Time	MST	MAU	Difference	p
1–12 months	0·44	0·5	–0·03 (–0·39,0·33)	0·880
13–24 months	0·32	0·18	0·34 (–0·03,0·71)	0·075
25–36 months	0·2	0·17	0·34 (–0·08,0·75)	0·110
37–48 months	0·17	0·15	0·38 (–0·04,0·8)	0·078
49–60 months	0·1	0·11	–0·15 (–0·67,0·37)	0·560
Overall			**0·87 (–0·76,2·51)**	**0·300**

MAU=management as usual・MST=Multisystemic Therapy・

Table B3: Pre-specified moderators and outcomes

Variables	OR	Confidence interval	P-value
Sex			
Male	1.58	(0.94,2.66)	0.085
Female	0.9	(0.6,1.36)	0.62
Onset			
Early	1.14	(0.75,1.75)	0.53
Late	1.08	(0.67,1.76)	0.74
Previous offender			
Yes	1.87	(0.58,6.04)	0.3
No	1.42	(0.91,2.22)	0.12
Conduct Disorder or ADHD at baseline			
Yes	1.12	(0.79,1.6)	0.52
No	1.04	(0.48,2.23)	0.92
Conduct Disorder, anxiety or depression at baseline			
Yes	1.15	(0.8,1.64)	0.45
No	1.09	(0.51,2.31)	0.82
Continuous variables			
ICU score	1.01	(0.98,1.05)	0.42
Peer delinquency score	0.91	(0.85,0.98)	0.012
ABAS score	1.01	(1,1.02)	0.18



Demographic and background information

Table B4: Young person-rated secondary endpoints, CLES-A (imputed)

Variable	CLES-A 0 to 3 months	CLES-A 0 to 6 months	CLES-A 0 to 9 months	CLES-A 0 to 12 months
MST 24 months	173·91	254·77	290·19	314·63
MAU 24 months	188·12	274·06	307·12	327·84
Difference 24 months	–5·71 (–34·27, 22·85), p=0·7	–15·75 (–56·08, 24·57), p=0·44	–15·42 (–62·30, 31·47), p=0·52	–16·43 (–65·82, 32·97), p=0·52
MST 36 months	164·94	244·81	283·86	303·40
MAU 36 months	178·49	255·25	287·94	307·94
Difference 36 months	–7·39 (–37·95, 23·16), p=0·64	–8·80 (–51·87, 34·28), p=0·69	–3·79 (–53·95, 46·37), p=0·88	–3·75 (–54·79, 47·28), p=0·89
MST 48 months	173·25	254·35	295·30	316·21
MAU 48 months	177·12	251·91	291·39	316·00
Difference 48 months	5·46 (–25·67, 36·58), p=0·73	14·01 (–32·62, 60·64), p=0·56	12·88 (–39·48, 65·24), p=0·63	13·70 (–42·62, 70·02), p=0·63

Measures of antisocial problems and attitudes

Table B5: Parent-rated secondary endpoints, SDQ (imputed)

Variable	SDQ Conduct problems	SDQ Emotional problems	SDQ Hyperactivity	SDQ Impact	SDQ Prosocial	SDQ Total Difficulties Score
MST 24 months	4·08	3·43	5·11	2·76	6·11	15·67
MAU 24 months	4·38	3·29	5·33	2·74	6·26	15·79
Difference 24 months	–0·19 (–0·60, 0·21), p=0·35	–0·23 (–0·59, 0·14), p=0·22	–0·39 (–0·81, 0·04), p=0·079	–0·15 (–0·60, 0·29), p=0·5	–0·06 (–0·47, 0·35), p=0·77	–0·78 (–1·83, 0·28), p=0·15
MST 36 months	4·49	3·42	5·81	2·80	6·08	16·62
MAU 36 months	3·92	3·58	5·70	2·76	6·20	15·99
Difference 36 months	0·10 (–0·37, 0·57), p=0·69	–0·20 (–0·70, 0·30), p=0·44	0·06 (–0·36, 0·49), p=0·78	0·04 (–0·53, 0·61), p=0·89	–0·02 (–0·40, 0·35), p=0·9	–0·05 (–1·20, 1·11), p=0·93
MST 48 months	3·98	3·52	5·48	2·78	6·37	15·86
MAU 48 months	3·75	3·94	5·77	2·87	6·42	16·24
Difference 48 months	–0·10 (–0·64, 0·44), p=0·71	–0·20 (–0·85, 0·45), p=0·54	0·07 (–0·51, 0·65), p=0·82	–0·08 (–0·94, 0·79), p=0·86	0·06 (–0·50, 0·62), p=0·85	–0·62 (–2·05, 0·82), p=0·4

Table B6: Young person-rated secondary endpoints, SDQ (imputed)

Variable	SDQ Conduct problems	SDQ Emotional problems	SDQ Hyperactivity	SDQ Impact	SDQ Prosocial	SDQ Total Difficulties Score
MST 24 months	3·54	3·61	5·42	1·66	7·02	15·67
MAU 24 months	3·62	3·75	5·39	1·72	7·11	15·94
Difference 24 months	0·09 (–0·21, 0·38), p=0·57	–0·18 (–0·53, 0·16), p=0·29	0·11 (–0·22, 0·44), p=0·52	0·02 (–0·38, 0·41), p=0·94	–0·07 (–0·39, 0·26), p=0·69	–0·09 (–0·92, 0·74), p=0·83
MST 36 months	3·22	3·57	5·38	2·16	6·96	15·16
MAU 36 months	3·20	3·86	5·18	1·78	7·16	15·32
Difference 36 months	–0·07 (–0·43, 0·28), p=0·69	–0·38 (–0·80, 0·05), p=0·085	0·03 (–0·36, 0·41), p=0·9	0·16 (–0·44, 0·76), p=0·6	–0·21 (–0·58, 0·16), p=0·27	–0·61 (–1·46, 0·23), p=0·16
MST 48 months	3·58	3·40	5·63	2·37	6·95	16·30
MAU 48 months	3·10	4·15	5·54	1·71	7·32	16·27
Difference 48 months	0·36 (–0·14, 0·87), p=0·16	–0·53 (–1·06, –0·01), p=0·053	0·32 (–0·39, 1·02), p=0·39	0·91 (0·39, 1·42), p=0·0013	–0·10 (–0·63, 0·44), p=0·72	0·15 (–1·24, 1·53), p=0·84

Table B7: Parent-rated secondary endpoints, ICUT (imputed)

Variable	ICUT
MST 24 months	33·30
MAU 24 months	33·84
Difference 24 months	–0·37 (–2·04, 1·29), p=0·66
MST 36 months	33·45
MAU 36 months	32·77
Difference 36 months	–0·84 (–2·85, 1·17), p=0·41
MST 48 months	32·90
MAU 48 months	31·75
Difference 48 months	–0·61 (–2·82, 1·61), p=0·59

Table B8: Young person-rated secondary endpoints, ICUT (imputed)

Variable	ICUT
MST 24 months	27·43
MAU 24 months	28·08
Difference 24 months	–0·92 (–2·19, 0·35), p=0·15
MST 36 months	27·30
MAU 36 months	26·98
Difference 36 months	–0·66 (–2·11, 0·79), p=0·37
MST 48 months	26·07
MAU 48 months	26·00
Difference 48 months	–0·32 (–2·04, 1·41), p=0·72

Table B9a: Parent-rated secondary endpoints, ABC (imputed)

Variable	ABC Friends	ABC Spouse/ Partner	ABC Personal Strengths	ABC Anxious/ Depressed	ABC Withdrawn	ABC Somatic Complaints
MST 24 months	1·53	1·31	46·27	58·65	59·00	54·89
MAU 24 months	1·70	1·43	44·58	59·84	60·61	54·85
Difference 24 months	–0·16 (–0·87, 0·55), p=0·65	–0·12 (–0·80, 0·57), p=0·74	–1·32 (–7·72, 5·08), p=0·69	1·65 (–2·64, 5·94), p=0·46	–0·20 (–3·48, 3·08), p=0·9	–0·04 (–2·02, 1·93), p=0·97
MST 36 months	3·01	2·32	42·37	56·65	61·80	54·78
MAU 36 months	3·23	2·43	43·17	57·95	60·91	54·27
Difference 36 months	–0·21 (–0·92, 0·50), p=0·57	–0·10 (–0·79, 0·59), p=0·78	–0·69 (–3·97, 2·58), p=0·68	0·60 (–2·80, 4·00), p=0·73	0·56 (–1·61, 2·74), p=0·62	0·47 (–1·39, 2·33), p=0·63
MST 48 months	3·37	4·27	41·03	59·51	60·34	54·04
MAU 48 months	4·02	4·66	41·45	56·51	61·12	54·08
Difference 48 months	–0·64 (–1·35, 0·07), p=0·078	–0·38 (–1·07, 0·30), p=0·28	0·46 (–2·41, 3·32), p=0·76	2·26 (–0·96, 5·49), p=0·17	0·37 (–1·27, 2·02), p=0·66	0·38 (–1·00, 1·76), p=0·59

Table B9b: Parent-rated secondary endpoints, ABC (imputed) (continued)

Variable	ABC Thought Problems	ABC Attention Problems	ABC Aggressive Behaviour	ABC Intrusive	ABC Internalising Problems	ABC Thought Problems
MST 24 months	57·59	55·07	60·05	60·37	55·87	54·89
MAU 24 months	55·07	55·50	61·84	57·21	51·48	54·85
Difference 24 months	1·60 (–2·23, 5·43), p=0·42	–0·72 (–4·36, 2·93), p=0·7	–0·43 (–3·17, 2·31), p=0·76	2·65 (–0·40, 5·70), p=0·1	0·62 (–5·63, 6·87), p=0·85	–0·04 (–2·02, 1·93), p=0·97
MST 36 months	55·02	56·64	61·85	59·13	51·62	54·78
MAU 36 months	54·61	55·00	63·39	59·16	52·38	54·27
Difference 36 months	0·48 (–1·44, 2·39), p=0·63	0·18 (–1·91, 2·27), p=0·87	–0·78 (–2·90, 1·35), p=0·48	0·39 (–1·73, 2·52), p=0·72	–1·19 (–6·55, 4·16), p=0·67	0·47 (–1·39, 2·33), p=0·63
MST 48 months	53·98	54·18	63·74	60·28	56·33	54·04
MAU 48 months	54·51	54·03	64·03	60·79	53·38	54·08
Difference 48 months	–0·71 (–2·66, 1·24), p=0·48	0·11 (–1·71, 1·93), p=0·91	–0·35 (–2·30, 1·59), p=0·72	0·36 (–1·94, 2·66), p=0·76	3·74 (–1·45, 8·93), p=0·17	0·38 (–1·00, 1·76), p=0·59

Table B9c: Parent-rated secondary endpoints, ABC (imputed) (continued)

Variable	ABC Externalising Problems	ABC Total Problems	ABC Critical Items	ABC Tobacco Times Per Day	ABC Alcohol Days Drunk
MST 24 months	57·03	58·66	58·92	1·48	1·25
MAU 24 months	57·33	58·40	58·53	1·53	1·40
Difference 24 months	–0·11 (–3·60, 3·37), p=0·95	–0·84 (–5·36, 3·67), p=0·72	1·06 (–2·80, 4·92), p=0·6	–0·05 (–0·58, 0·48), p=0·85	–0·15 (–0·58, 0·29), p=0·5
MST 36 months	57·37	58·37	58·61	2·25	1·83
MAU 36 months	58·50	58·82	58·34	2·43	1·92
Difference 36 months	–0·68 (–3·35, 2·00), p=0·62	–0·26 (–3·15, 2·63), p=0·86	0·65 (–1·48, 2·77), p=0·56	–0·17 (–0·70, 0·35), p=0·52	–0·09 (–0·53, 0·34), p=0·68
MST 48 months	58·22	56·47	56·95	2·34	1·87
MAU 48 months	58·87	57·89	58·09	3·07	2·52
Difference 48 months	–0·55 (–3·38, 2·29), p=0·71	–0·35 (–2·83, 2·14), p=0·79	0·01 (–1·75, 1·77), p=0·99	–0·73 (–1·25, –0·20), p=0·0068	–0·65 (–1·08, –0·22), p=0·0034

Table B9d: Parent-rated secondary endpoints, ABC (imputed) (continued)

Variable	ABC Drugs Days Used	ABC Mean Substance Use	ABC Depressive Problems	ABC Anxiety Problems	ABC Somatic Problems
MST 24 months	1·34	1·67	56·64	53·73	54·84
MAU 24 months	1·34	1·69	59·96	52·79	54·01
Difference 24 months	0·00 (–0·40, 0·40), p=1	–0·02 (–0·97, 0·93), p=0·97	–1·64 (–6·43, 3·16), p=0·51	0·54 (–1·46, 2·53), p=0·6	0·42 (–1·75, 2·58), p=0·71
MST 36 months	1·65	3·42	60·53	54·08	54·99
MAU 36 months	1·82	3·59	60·31	53·47	53·60
Difference 36 months	–0·17 (–0·57, 0·23), p=0·41	–0·16 (–1·12, 0·79), p=0·74	–0·23 (–2·58, 2·12), p=0·85	–0·02 (–1·52, 1·48), p=0·98	0·89 (–0·83, 2·61), p=0·32
MST 48 months	1·88	3·39	60·72	53·07	53·87
MAU 48 months	2·44	4·91	60·38	53·57	53·77
Difference 48 months	–0·56 (–0·96, –0·16), p=0·0062	–1·52 (–2·47 ,–0·57), p=0·0018	0·32 (–1·90, 2·54), p=0·78	–0·04 (–1·62, 1·54), p=0·96	0·16 (–1·10, 1·42), p=0·8

Table B9e: Parent-rated secondary endpoints, ABC (imputed) (continued)

Variable	ABC Avoidant Personality	ABC ADH Problems	ABC Antisocial Personality	ABC Sluggish Cognitive Tempo	ABC Obsessive Compulsive Problems
MST 24 months	60·34	58·24	56·97	57·32	53·38
MAU 24 months	60·61	58·81	58·01	58·29	52·89
Difference 24 months	0·56 (–2·31, 3·44), p=0·7	–0·52 (–4·97, 3·92), p=0·82	0·00 (–3·68, 3·67), p=1	–2·07 (–5·12, 0·99), p=0·2	0·10 (–2·37, 2·57), p=0·94
MST 36 months	63·83	61·50	59·77	60·07	52·58
MAU 36 months	62·40	60·28	59·13	59·18	52·21
Difference 36 months	1·09 (–1·22, 3·39), p=0·36	0·57 (–1·71, 2·85), p=0·63	0·03 (–1·82, 1·88), p=0·98	0·54 (–1·73, 2·80), p=0·65	–0·27 (–1·67, 1·13), p=0·71
MST 48 months	63·39	59·73	59·85	57·43	51·73
MAU 48 months	63·34	61·27	60·07	59·08	51·88
Difference 48 months	0·34 (–1·50, 2·17), p=0·72	–0·34 (–3·18, 2·51), p=0·82	–0·27 (–2·45, 1·90), p=0·81	–0·25 (–2·18, 1·68), p=0·8	0·14 (–1·35, 1·62), p=0·86

Table B10: Young person-rated secondary endpoints, SRD (imputed)

Variable	Delinquency Variety	Delinquency Volume	Variety of Substance Misuse	Volume of Substance Misuse	Peer Delinquency Score	Peer Substance Misuse
MST 24 months	1·93	1·49	0·67	1·49	2·73	3·37
MAU 24 months	2·06	1·53	0·65	1·53	2·92	3·49
Difference 24 months	0·03 (–0·39, 0·45), p=0·9	–0·04 (–0·27, 0·18), p=0·7	–0·09 (–0·32, 0·14), p=0·44	–0·04 (–0·27, 0·18), p=0·7	–0·67 (–1·36, 0·02), p=0·061	–0·09 (–0·39, 0·21), p=0·54
MST 36 months	1·60	1·58	0·71	1·58	2·44	3·58
MAU 36 months	1·60	1·37	0·59	1·37	2·42	3·64
Difference 36 months	–0·05 (–0·48, 0·39), p=0·84	0·07 (–0·15, 0·30), p=0·54	0·06 (–0·17, 0·29), p=0·61	0·07 (–0·15, 0·30), p=0·54	–0·39 (–1·05, 0·27), p=0·25	0·06 (–0·27, 0·40), p=0·71
MST 48 months	2·15	1·79	0·81	1·79	2·96	4·01
MAU 48 months	1·14	1·35	0·56	1·35	2·20	3·65
Difference 48 months	0·67 (0·08, 1·26), p=0·03	0·10 (–0·18, 0·39), p=0·48	0·09 (–0·21, 0·39), p=0·57	0·10 (–0·18, 0·39), p=0·48	0·89 (–0·08, 1·86), p=0·077	0·42 (–0·06, 0·90), p=0·098

Table B11: Young person-rated secondary endpoints, ABAS (imputed)

Variable	ABAS total score
MST 24 months	49·93
MAU 24 months	50·68
Difference 24 months	–0·06 (–3·01, 2·89), p=0·97
MST 36 months	48·93
MAU 36 months	48·93
Difference 36 months	–0·46 (–3·28, 2·36), p=0·75
MST 48 months	48·87
MAU 48 months	49·11
Difference 48 months	–0·07 (–4·47, 4·34), p=0·98

Table B12: Young person-rated secondary endpoints, Youth Materialism Scale (imputed)

Variable	Youth Materialism
MST 24 months	35·74
MAU 24 months	37·16
Difference 24 months	–0·81 (–2·07, 0·45), p=0·21
MST 36 months	36·25
MAU 36 months	36·88
Difference 36 months	–0·45 (–2·15, 1·24), p=0·6
MST 48 months	35·29
MAU 48 months	37·19
Difference 48 months	–0·59 (–3·11, 1·94), p=0·65

Table B13: Young person-rated secondary endpoints, Adult Materialism Scale (imputed)

Variable	Adult Materialism total
MST 24 months	71·97
MAU 24 months	77·46
Difference 24 months	–0·57 (–11·19, 10·05), p=0·92
MST 36 months	72·82
MAU 36 months	73·17
Difference 36 months	–0·60 (–5·23, 4·03), p=0·8
MST 48 months	68·84
MAU 48 months	73·10
Difference 48 months	–0·96 (–6·59, 4·67), p=0·74

Young person mental health and wellbeing

Table B14: Parent-rated secondary endpoints, Conners (imputed)

Variable	Conners ADHD T score	Conners Learning and Language T score
MST 24 months	66·87	62·19
MAU 24 months	67·08	63·47
Difference 24 months	–0·59 (–3·54, 2·36), p=0·7	–1·49 (–3·85, 0·88), p=0·22
MST 36 months	64·77	61·62
MAU 36 months	65·23	62·58
Difference 36 months	–0·30 (–3·58, 2·99), p=0·86	–2·55 (–5·08, –0·02), p=0·053
MST 48 months	62·16	59·73
MAU 48 months	63·46	62·78
Difference 48 months	–1·36 (–5·63, 2·92), p=0·54	–3·04 (–6·23, 0·16), p=0·069

Table B15a: Young person-rated secondary endpoints, ASR (imputed)

Variable	ASR Friends	ASR Spouse/ Partner	ASR Family	ASR Job	ASR Education	ASR Mean Adaptive
MST 24 months	43·39	45·58	45·00	49·14	46·62	42·96
MAU 24 months	46·87	44·17	48·88	50·03	44·59	47·07
Difference 24 months	–0·54 (–5·01, 3·92), p=0·81	0·21 (–7·34, 7·75), p=0·96	–2·49 (–6·27, 1·29), p=0·21	–0·85 (–5·42, 3·72), p=0·72	0·43 (–5·51, 6·37), p=0·89	–1·26 (–4·63, 2·12), p=0·47
MST 36 months	47·29	44·02	47·01	48·61	48·33	46·71
MAU 36 months	47·58	44·95	48·84	49·09	45·20	46·84
Difference 36 months	0·79 (–1·67, 3·25), p=0·53	–0·05 (–6·22, 6·11), p=0·99	–1·77 (–3·95, 0·41), p=0·12	–0·58 (–2·82, 1·65), p=0·61	0·85 (–2·79, 4·50), p=0·65	–0·01 (–1·84, 1·82), p=0·99
MST 48 months	46·62	48·33	48·80	49·29	43·82	46·21
MAU 48 months	47·96	45·22	48·54	48·41	45·68	47·09
Difference 48 months	0·04 (–2·47, 2·55), p=0·97	0·69 (–4·66, 6·04), p=0·8	–0·73 (–2·97, 1·50), p=0·52	–0·58 (–3·82, 2·66), p=0·73	–0·95 (–5·73, 3·84), p=0·7	–0·23 (–2·34, 1·87), p=0·83

Table B15b: Young person-rated secondary endpoints, ASR (imputed) (continued)

Variable	ASR Personal Strengths	ASR Anxious/ Depressed	ASR Withdrawn	ASR Somatic complaints	ASR Thought Problems
MST 24 months	39·67	54·22	56·92	54·87	57·58
MAU 24 months	46·35	53·91	58·05	55·15	57·69
Difference 24 months	–2·95 (–8·44, 2·53), p=0·3	–0·40 (–2·56, 1·75), p=0·72	–0·32 (–2·56, 1·93), p=0·78	–0·25 (–2·20, 1·70), p=0·8	1·02 (–1·21, 3·26), p=0·38
MST 36 months	42·31	53·58	56·30	55·98	57·11
MAU 36 months	43·28	53·98	57·62	55·71	57·94
Difference 36 months	–0·08 (–3·19, 3·03), p=0·96	–0·87 (–2·65, 0·92), p=0·35	–0·82 (–2·84, 1·20), p=0·43	–0·13 (–1·68, 1·42), p=0·87	–0·14 (–2·42, 2·14), p=0·91
MST 48 months	41·76	54·77	57·00	56·82	57·60
MAU 48 months	42·11	54·23	56·94	56·21	57·85
Difference 48 months	0·19 (–3·11, 3·49), p=0·91	0·07 (–1·32, 1·46), p=0·92	–0·04 (–1·74, 1·66), p=0·97	–0·19 (–1·60, 1·23), p=0·8	–1·05 (–2·88, 0·77), p=0·26

Table B15c: Young person-rated secondary endpoints, ASR (imputed) (continued)

Variable	ASR Attention Problems	ASR Agreessive Behaviour	ASR Rule Breaking Behaviour	ASR Intrusive	ASR Internalising Problems
MST 24 months	54·88	58·35	56·47	53·77	51·83
MAU 24 months	55·08	57·52	58·23	53·55	52·36
Difference 24 months	–1·00 (–3·39, 1·38), p=0·42	–0·04 (–2·95, 2·87), p=0·98	–1·47 (–4·27, 1·32), p=0·31	0·05 (–2·35, 2·44), p=0·97	0·86 (–2·22, 3·94), p=0·59
MST 36 months	56·07	57·74	58·31	53·13	50·31
MAU 36 months	55·51	57·66	57·90	53·98	51·83
Difference 36 months	–1·30 (–3·61, 1·02), p=0·28	–0·62 (–2·67, 1·43), p=0·56	–0·07 (–2·16, 2·03), p=0·95	–0·33 (–1·70, 1·03), p=0·64	–0·41 (–3·20, 2·39), p=0·78
MST 48 months	55·61	57·63	58·60	53·27	52·36
MAU 48 months	56·11	57·68	58·09	53·75	52·16
Difference 48 months	–0·06 (–1·77, 1·65), p=0·95	–0·66 (–2·46, 1·15), p=0·48	0·55 (–1·51, 2·61), p=0·61	0·36 (–1·35, 2·07), p=0·68	0·26 (–1·99, 2·52), p=0·82

Table B15d: Young person-rated secondary endpoints, ASR (imputed) (continued)

Variable	ASR Externalising Problems	ASR Total Problems	ASR Critical Items	ASR Tobacco Per Day	ASR Alcohol Days Drunk
MST 24 months	54·18	52·03	60·27	56·13	57·32
MAU 24 months	55·90	54·45	58·68	55·15	60·80
Difference 24 months	–1·16 (–4·26, 1·94), p=0·47	–0·49 (–3·43, 2·44), p=0·74	0·80 (–2·16, 3·76), p=0·6	1·84 (–0·56, 4·24), p=0·15	–1·41 (–4·99, 2·17), p=0·45
MST 36 months	54·92	52·41	58·13	56·87	57·19
MAU 36 months	56·62	54·66	59·24	56·38	60·28
Difference 36 months	–0·72 (–2·99, 1·54), p=0·54	–0·59 (–2·89, 1·71), p=0·62	–0·79 (–2·82, 1·24), p=0·45	0·95 (–0·99, 2·89), p=0·35	–0·61 (–3·21, 1·99), p=0·65
MST 48 months	55·36	53·43	59·57	57·91	58·49
MAU 48 months	56·53	54·36	59·39	57·07	58·77
Difference 48 months	–0·17 (–2·88, 2·53), p=0·9	–0·41 (–2·67, 1·85), p=0·72	–0·74 (–2·66, 1·19), p=0·46	0·80 (–1·23, 2·83), p=0·45	1·12 (–0·85, 3·08), p=0·27

Table B15e: Young person-rated secondary endpoints, ASR (imputed) (continued)

Variable	ASR Drug Days Used	ASR Mean Substance Use	ASR Depressive Problems	ASR Anxiety Problems	ASR Somatic Problems
MST 24 months	62·83	60·58	55·61	53·15	54·50
MAU 24 months	62·45	61·39	55·48	53·33	54·22
Difference 24 months	–2·88 (–9·66, 3·89), p=0·41	–0·88 (–3·89, 2·14), p=0·57	–0·44 (–3·00, 2·11), p=0·74	–0·32 (–2·58, 1·95), p=0·79	0·45 (–1·61, 2·52), p=0·67
MST 36 months	63·58	60·75	56·16	52·26	55·37
MAU 36 months	62·85	61·61	55·57	53·07	54·90
Difference 36 months	0·87 (–3·37, 5·11), p=0·69	0·79 (–1·43, 3·00), p=0·49	0·15 (–1·65, 1·95), p=0·87	–1·08 (–2·46, 0·29), p=0·13	0·26 (–1·48, 2·00), p=0·77
MST 48 months	60·76	60·93	57·96	53·41	55·37
MAU 48 months	62·73	61·19	55·87	53·18	55·31
Difference 48 months	–0·52 (–4·73, 3·69), p=0·81	0·73 (–1·14, 2·60), p=0·45	1·42 (0·19, 2·65), p=0·025	0·15 (–1·13, 1·42), p=0·82	–0·51 (–1·95, 0·93), p=0·49

Table B15f: Young person-rated secondary endpoints, ASR (imputed) (continued)

Variable	ASR Avoidant Personality	ASR ADH Problems	ASR Antisocial Personality	ASR Sluggish Cognitive Tempo	ASR Obsessive Compulsive Problems
MST 24 months	55·94	57·76	55·71	55·54	55·47
MAU 24 months	57·26	56·79	57·06	56·43	54·57
Difference 24 months	–0·70 (–2·52, 1·12), p=0·46	–1·12 (–5·19, 2·95), p=0·59	–0·97 (–3·22, 1·28), p=0·4	–0·09 (–2·04, 1·86), p=0·93	0·33 (–1·54, 2·20), p=0·73
MST 36 months	55·31	58·44	57·25	55·04	53·92
MAU 36 months	56·75	57·62	56·95	56·07	54·04
Difference 36 months	–0·98 (–2·57, 0·60), p=0·23	–0·84 (–3·04, 1·37), p=0·46	–0·03 (–1·81, 1·76), p=0·97	–0·74 (–2·61, 1·14), p=0·45	–0·14 (–1·90, 1·63), p=0·88
MST 48 months	55·49	57·81	57·59	55·47	53·95
MAU 48 months	55·77	57·81	56·99	55·43	54·09
Difference 48 months	–0·20 (–1·70, 1·29), p=0·79	–0·29 (–2·88, 2·30), p=0·83	–0·11 (–1·97, 1·74), p=0·91	–0·71 (–2·18, 0·76), p=0·35	–0·40 (–1·92, 1·12), p=0·61

Table B16: Young person-rated secondary endpoints, Short Mood and Feelings Questionnaire (imputed)

Variable	MFQ
MST 24 months	6·47
MAU 24 months	5·63
Difference 24 months	0·26 (–0·54, 1·06), p=0·53
MST 36 months	5·79
MAU 36 months	5·88
Difference 36 months	0·00 (–1·05, 1·05), p=0·99
MST 48 months	7·37
MAU 48 months	5·37
Difference 48 months	2·17 (0·76, 3·57), p=0·0044

Table B17: Young person-rated secondary endpoints, ARQ (imputed)

Variable	ARQ Self	ARQ Family	ARQ School	ARQ Friends	ARQ Area
MST 24 months	112·60	34·86	46·40	45·58	15·21
MAU 24 months	102·06	35·11	43·20	44·42	14·40
Difference 24 months	8·41 (–4·52, 21·35), p=0·21	1·56 (–2·40, 5·52), p=0·45	0·11 (–7·43, 7·65), p=0·98	–0·53 (–5·30, 4·24), p=0·83	0·85 (–1·86, 3·57), p=0·54
MST 36 months	92·08	34·28	45·35	43·84	13·73
MAU 36 months	104·01	33·59	43·16	43·66	14·41
Difference 36 months	–7·52 (–15·67, 0·63), p=0·075	0·50 (–2·05, 3·05), p=0·7	–0·92 (–5·43, 3·60), p=0·69	–0·59 (–3·02, 1·84), p=0·64	–1·08 (–2·56, 0·40), p=0·16
MST 48 months	116·39	35·70	45·82	46·46	15·63
MAU 48 months	115·92	34·57	45·60	46·29	16·16
Difference 48 months	2·52 (–4·73, 9·76), p=0·5	0·78 (–1·90, 3·47), p=0·57	4·26 (–1·69, 10·21), p=0·17	1·56 (–0·89, 4·01), p=0·21	0·65 (–1·13, 2·44), p=0·48

Table B18: Young person-rated secondary endpoints, SF-36 (imputed)

Variable	SF-36 Emotional Well-Being	SF-36 Energy or Fatigue	SF-36 General Health	SF-36 Limitations due to Emotional Problems	SF-36 Limitations due to Physical Health	SF-36 Pain	SF-36 Average Physical Functioning	SF-36 Social Functioning
MST 24 months	71·61	59·52	68·51	82·26	88·21	81·23	83·25	80·12
MAU 24 months	66·70	60·79	62·29	80·65	81·96	83·83	85·14	75·88
Difference 24 months	1·71 (–3·36, 6·79), p=0·51	–1·94 (–5·95, 2·06), p=0·34	4·79 (–0·53, 10·11), p=0·084	3·18 (–5·12, 11·47), p=0·46	4·78 (–2·96, 12·53), p=0·23	–0·02 (–4·79, 4·74), p=0·99	–1·95 (–8·06, 4·16), p=0·53	4·26 (–1·85, 10·37), p=0·18
MST 36 months	72·28	62·48	63·29	84·21	86·04	81·88	87·35	80·23
MAU 36 months	67·81	60·72	64·22	79·28	83·77	80·78	82·35	76·91
Difference 36 months	3·88 (0·15, 7·61), p=0·044	1·88 (–2·26, 6·01), p=0·38	0·74 (–3·86, 5·34), p=0·75	4·01 (–3·17, 11·19), p=0·28	2·89 (–2·72, 8·51), p=0·31	1·69 (–3·11, 6·49), p=0·49	3·09 (–2·10, 8·28), p=0·25	3·91 (–1·36, 9·19), p=0·15
MST 48 months	64·85	54·90	59·39	74·46	83·99	80·56	79·19	72·92
MAU 48 months	70·53	60·48	63·58	79·52	86·17	77·29	77·93	74·56
Difference 48 months	–3·49 (–8·17, 1·19), p=0·15	–3·74 (–7·99, 0·52), p=0·09	–2·21 (–6·87, 2·45), p=0·36	0·25 (–8·71, 9·20), p=0·96	–1·54 (–8·18, 5·11), p=0·65	0·51 (–4·77, 5·79), p=0·85	3·44 (–1·71, 8·59), p=0·19	–0·55 (–6·43, 5·33), p=0·85

Parenting assessment

Table B19: Parent-rated secondary endpoints, APQ (imputed)

Variable	APQ Corporal Punishment	APQ Inconsistent Discipline Score	APQ positive Parenting Score	APQ Problems of Monitoring and Supervision	APQ Parental Involvement
MST 24 months	3·32	7·74	12·65	6·20	9·73
MAU 24 months	3·33	8·22	12·85	6·46	9·91
Difference 24 months	–0·01 (–0·14, 0·13), p=0·92	–0·64 (–1·05, –0·24), p=0·0023	0·07 (–0·31, 0·45), p=0·72	–0·53 (–1·00,–0·06), p=0·028	–0·25 (–0·63, 0·13), p=0·2
MST 36 months	3·31	8·07	13·03	6·82	10·35
MAU 36 months	3·31	8·66	12·77	6·67	9·65
Difference 36 months	–0·03 (–0·19, 0·13), p=0·69	–0·45 (–1·02, 0·11), p=0·12	0·43 (0·03, 0·83), p=0·042	0·17 (–0·30, 0·64), p=0·47	0·22 (–0·22, 0·66), p=0·33
MST 48 months	3·39	7·62	12·31	6·09	9·15
MAU 48 months	3·21	8·70	12·99	6·46	9·73
Difference 48 months	0·04 (–0·17, 0·24), p=0·74	–1·08 (–1·68, –0·49), p=0·00082	0·18 (–0·50, 0·87), p=0·6	0·29 (–0·47, 1·04), p=0·46	–0·08 (–0·86, 0·70), p=0·84

Table B20: Young person-rated secondary endpoints, APQ (imputed)

Variable	APQ Corporal Punishment	APQ Inconsistent Discipline Score	APQ Positive Parenting Score	APQ Problems of Monitoring and Supervision	APQ Parental Involvement
MST 24 months	3·48	7·28	11·22	7·27	8·39
MAU 24 months	3·46	7·36	11·20	6·93	8·35
Difference 24 months	–0·06 (–0·30, 0·19), p=0·66	–0·05 (–0·52, 0·43), p=0·84	0·35 (–0·15, 0·85), p=0·17	0·26 (–0·20,0·73), p=0·27	0·25 (–0·23, 0·74), p=0·3
MST 36 months	3·58	7·80	11·38	7·30	8·22
MAU 36 months	3·47	7·45	11·33	6·98	8·44
Difference 36 months	–0·06 (–0·35, 0·22), p=0·67	0·01 (–0·63, 0·66), p=0·97	0·20 (–0·33, 0·74), p=0·46	0·15 (–0·48, 0·79), p=0·64	0·04 (–0·59, 0·68), p=0·9
MST 48 months	3·71	7·35	10·80	6·93	7·20
MAU 48 months	3·46	7·48	11·26	6·68	8·23
Difference 48 months	–0·01 (–0·36, 0·34), p=0·96	0·32 (–0·49, 1·14), p=0·44	0·37 (–0·36, 1·10), p=0·32	0·18 (–0·58,0·94), p=0·65	–0·13 (–1·01, 0·76), p=0·78

Table B21: Parent-rated secondary endpoints, Loeber (imputed)

Variable	Loeber Total
MST 24 months	45·92
MAU 24 months	46·48
Difference 24 months	–0·26 (–1·22, 0·70), p=0·6
MST 36 months	46·53
MAU 36 months	46·96
Difference 36 months	0·04 (–1·05,1·12), p=0·95
MST 48 months	46·65
MAU 48 months	46·69
Difference 48 months	0·03 (–1·11, 1·17), p=0·96

Family functioning

Table B22: Parent-rated secondary endpoints, FACES (imputed)

Variable	FACES-IV Cohesion Score	FACES-IV Family Communication	FACES-IV Family Satisfaction	FACES-IV Flexibility
MST 24 months	58·51	36·73	32·17	46·22
MAU 24 months	60·73	37·59	33·02	48·48
Difference 24 months	1·57 (–1·54, 4·69), p=0·32	–0·17 (–1·22, 0·89), p=0·76	0·25 (–1·02, 1·52), p=0·7	–2·22 (–4·37, –0·06), p=0·046
MST 36 months	60·76	38·43	33·59	47·70
MAU 36 months	56·72	37·19	32·17	48·18
Difference 36 months	2·17 (–1·26, 5·59), p=0·22	0·59 (–0·58, 1·76), p=0·32	1·32 (0·06, 2·59), p=0·042	–0·46 (–2·42, 1·50), p=0·64
MST 48 months	57·16	37·71	32·67	49·45
MAU 48 months	59·44	37·88	32·74	49·30
Difference 48 months	2·41 (–1·78, 6·59), p=0·26	1·11 (–0·22, 2·44), p=0·11	1·13 (–0·58, 2·85), p=0·2	–0·82 (–3·41, 1·76), p=0·53

Table B23: Parent-rated secondary endpoints, CTS2 (imputed)

Variable	CTS2
MST 24 months	5·16
MAU 24 months	4·56
Difference 24 months	–0·12 (–1·44, 1·20), p=0·86
MST 36 months	5·31
MAU 36 months	4·61
Difference 36 months	0·28 (–0·85, 1·41), p=0·63
MST 48 months	6·80
MAU 48 months	3·88
Difference 48 months	1·78 (–0·45, 4·00), p=0·13

Table B24: Young person-rated secondary endpoints, LEE (imputed)

Variable	LEE
MST 24 months	77·16
MAU 24 months	77·70
Difference 24 months	–1·31 (–3·81, 1·19), p=0·3
MST 36 months	77·01
MAU 36 months	78·23
Difference 36 months	0·04 (–2·60, 2·67), p=0·98
MST 48 months	78·77
MAU 48 months	76·29
Difference 48 months	–0·02 (–3·42, 3·37), p=0·99

Parental mental health

Table B25: Parent-rated secondary endpoints, GHQ (imputed)

Variable	GHQ
MST 24 months	53·63
MAU 24 months	54·32
Difference 24 months	–1·48 (–3·85, 0·88), p=0·22
MST 36 months	52·96
MAU 36 months	56·42
Difference 36 months	–2·09 (–4·71, 0·53), p=0·12
MST 48 months	55·12
MAU 48 months	56·90
Difference 48 months	–2·86 (–6·11, 0·39), p=0·089

Appendix C: Health economic analysis

Methods

The primary economic evaluation, a cost-utility analysis, compared MST and MAU at 48-month follow up using quality-adjusted life-years (QALYs) as the measure of effect. A secondary cost-effectiveness analysis compared MST and MAU in terms of the primary clinical outcome of the proportion of young people with criminal offences during the study period.

Economic analyses took a broad perspective and included the use of services during the full study period, including accommodation services, education services, NHS secondary care services, community-based services and criminal justice sector services, as well as the delivery of MST (including therapists' salaries, employer on-costs, administrative overheads, training, and licences). Total costs were calculated for each trial participant by applying nationally applicable unit costs (from the financial year 2012–13 and inflated where necessary) to all items of service use reported. QALYs were calculated with health states derived from the EQ-5D-3L measure using the area under the curve approach. Total costs and QALYs were discounted at a rate of 3·5% annually, as recommended by NICE. Differences in costs and outcomes were compared for two datasets: observed and multiply imputed. An administrative error in the early phases of the study led to extensive missing EQ-5D-3L data. To assess the impact of this error, differences in QALYs were additionally compared for a third dataset: mean imputation of baseline data, where missing EQ-5D-3L values at baseline were imputed with the mean EQ-5D-3L value from the observed sample. Multiple imputation was undertaken using chained equations with 50 imputation datasets using Predictive Mean Matching to allow for non-normal distributions of the data. In line with the clinical analysis, the economic evaluation also used all baseline and outcome variables from subsequent timepoints for multiple imputation, and was adjusted for number of offences before randomisation, sex, age at onset of criminal behaviour, and site.

Table C1: Availability of EQ-5D-3L data over 48-month follow-up period

	MST n (%)	MAU n (%)
Baseline	111 (32%)	110 (32%)
6 months	190 (55%)	158 (46%)
12 months	223 (65%)	210 (62%)
18 months	244 (71%)	218 (64%)
24 months	240 (70%)	217 (64%)
36 months	213 (62%)	184 (54%)
48 months	167 (49%)	141 (41%)
Complete	95 (27%)	72 (21%)

Cost-effectiveness was assessed by calculating incremental cost-effectiveness ratios and constructing cost-effectiveness planes using non-parametric bootstrapping, with the probability of MST being cost-effective plotted on cost-effectiveness acceptability curves for a range of willingness to-pay-thresholds for a unit improvement in outcome.

Results

Service use data were available for 313 (92%) and 298 (87%) participants in the MST and MAU groups, respectively. Complete health-related quality of life data were available for 95 (25%) and 72 (21%) participants in the MST and MAU groups, respectively. The use of services and prescribed psychotropic medication over the 48-month trial period was broadly similar between trial groups (appendix).

Costs by sector and total costs per participant are summarised for observed and multiply imputed data in Table 3. Costs in the criminal justice and community services sectors constituted the majority of the total costs. For observed data, total mean costs were not significantly different (adjusted mean difference MST–MAU: £481·51; 95% CI: –£10,374·50 to £11,337·51; p= 0·931). For imputed data, total estimates were slightly higher, but the mean difference was not statistically significant (MST–MAU: £5,629·48; 95% CI: –£11,163·70 to £22,422·67; p=0·511). Total QALYs over the 48-month follow-up period are summarised in Table 4 for the three datasets: observed data, mean imputation of baseline data, and multiply imputed data. For all three datasets, differences were comparable, small, and not statistically significant. Plotting the differences between trial arms in costs and QALYs using multiply imputed data in Figure 3 for each individual shows that the majority (51%) of points lie in the quadrant where MST was less effective and more costly than MAU. Very few points (7%) lie in the quadrant where MST was more effective and less costly than MAU. The remaining 42% is broadly equally divided between cases where MST is either more effective and more costly (24%) or where it is less effective and less costly (18%). The cost-effectiveness acceptability curve (appendix) suggests that MST is not cost-effective compared with MAU at 48 months at the NICE willingness-to-pay threshold of £20,000 per QALY.

Table C2: Differences in cost per participant over 48-month follow-up period

	MST Mean (SD)	**MAU** Mean (SD)	Mean difference (MST-MAU)	Adjusted mean difference (MST-MAU)	95% CI	p-value
Observed data	***(n=310)***	***(n=296)***				
Intervention	2132.57 (1810.46)	.	2132.57	2128.86	1888.29 to 2369.42	<0.0001
Accommodation	3972.15 (12554.36)	4133.77 (17615.73)	-161.62	-304.00	-2745.36 to 2137.36	0.807
Education	9465.69 (15968.87)	8736.11 (18457.71)	729.58	1013.44	-1645.85 to 3672.72	0.454
Secondary health care	805.74 (2064.53)	2503.71 (15617.96)	-1697.97	-1650.53	-3404.31 to 103.25	0.065
Community services	15479.16 (34953.72)	15369.85 (27817.58)	109.31	58.09	-4980.52 to 5096.70	0.982
Medication	194.92 (1871.70)	188.58 (1592.41)	6.33	4.29	-276.05 to 284.64	0.976
Criminal justice	21353.46 (42097.75)	20920.34 (38634.21)	433.12	200.92	-6105.67 to 6507.51	0.950
Total	52846.46 (69254.61)	51852.36 (67148.76)	994.10	481.51	-10374.50 to 11337.51	0.931
Multiply imputed data	***(n=342)***	***(n=341)***				
Total	62579.80 (6817.81)	55983.17 (5189.48)	6596.63	5629.48	-11163.70 to 22422.67	0.511

Figure C1: Bootstrapped mean differences in costs and effects (QALYs) of MST compared with MAU at 48-month follow-up

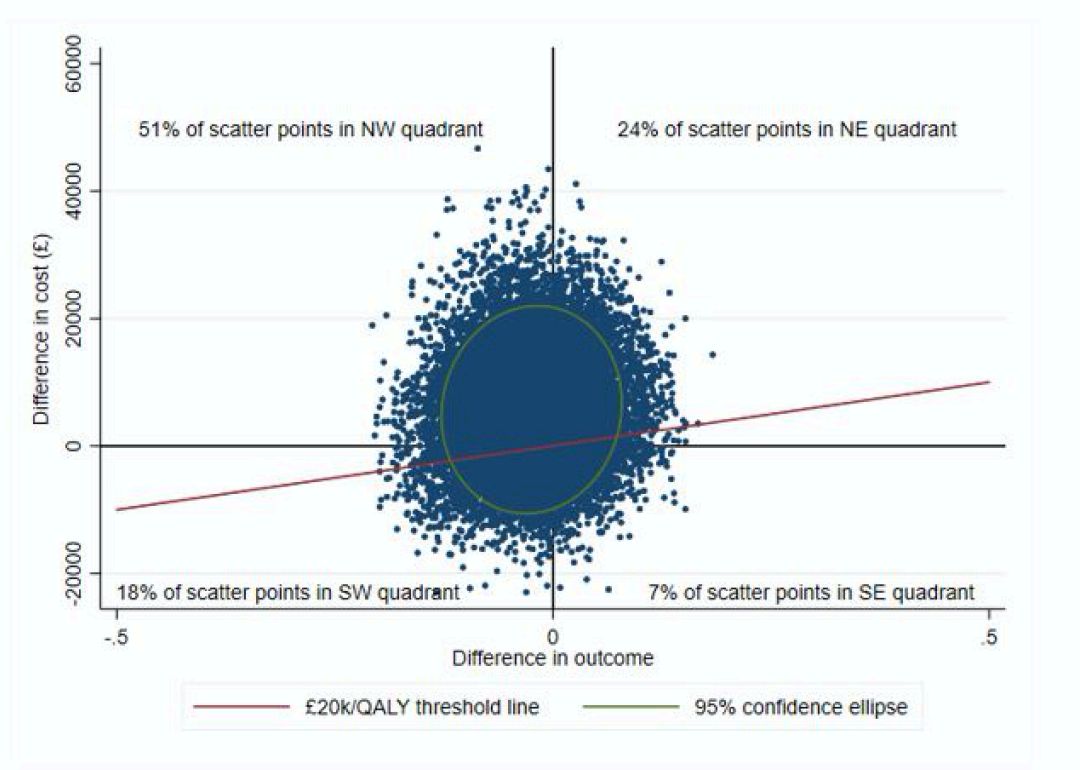


Table C3: QALYs over 48-month follow-up period

	MST		MAU					
	n	Mean (SD)	n	Mean (SD)	Mean difference (MST-MAU)	Adjusted mean difference (MST-MAU)	95% CI	p-value
Observed data	95	3.219 (0.611)	72	3.360 (0.437)	-0.142	-0.123	-0.289 to 0.042	0.142
Mean imputation of baseline data	163	3.172 (0.613)	140	3.300 (0.460)	-0.128	-0.091	-0.247 to 0.064	0.246
Multiply imputed data	342	3.328 (0.793)	341	3.596 (0.939)	-0.031	-0.025	-0.131 to 0.081	0.643

Table C4: Service use (unit) over 48-month follow-up period

	MST (n=310)			MAU (n=296)		
	Mean (SD)	**Range**	**% using**	**Mean (SD)**	**Range**	**% using**
MST						
MST (hours of direct contact)	35·65 (24·49)	0–114	75	0	0	0
Accommodation						
Foster care (days)	11·77 (64·03)	0–746	7	7·64 (40·79)	0–418	7
Residential care (days)	17·06 (79·28)	0–556	6	10·36 (68·03)	0–953	5
Staffed accommodation (days)	14·45 (56·34)	0–365	11	18·26 (72·38)	0–641	11
Other (days)	3·77 (21·90)	0–207	5	5·26 (35·59)	0–378	5
Education						
Mainstream school (hrs)	1124·56 (1453·50)	0–6020	58	958·43 (1323·47)	0–9360	57
Specialist school (hrs)	293·78 (729·36)	0–5629	26	301·94 (874·59)	0–10355	26
Residential school (hrs)	21·46 (163·25)	0–2063	3	26·38 (214·87)	0–3120	<1
Hospital school (hrs)	0	0	0	3·70 (37·47)	0–488	<1
Pupil Referral Unit (hrs)	198·00 (423·63)	0–2290	29	168·00 (370·49)	0–2275	26
Home tuition (hrs)	22·95 (135·40)	0–1430	7	10·84 (64·31)	0–780	6
Further education (hrs)	421·61 (635·50)	0–3120	50	422·47 (664·70)	0–3868	50
Secondary health care						
Inpatient stay (nights)	0·71 (3·23)	0–44	15	3·48 (26·99)	0·365	21
Outpatient appointments (contacts)	1·99 (5·20)	0–40	35	2·37 (9·15)	0–143	39
Accident and emergency (contacts)	1·40 (2·93)	0–20	53	2·03 (4·83)	0–62	56
Community based						
General practitioner – home (contacts)	0·21 (0·84)	0–7	9	0·29 (1·87)	0–28	8
General practitioner – surgery (contacts)	5·64 (10·75)	0–137	70	6·07 (9·38)	0–76	73

	MST (n=310)			MAU (n=296)		
	Mean (SD)	**Range**	**% using**	**Mean (SD)**	**Range**	**% using**
General practitioner – telephone (contacts)	0·45 (1·74)	0–20	12	0·29 (1·83)	0–28	8
Practice nurse (contacts)	0·82 (2·62)	0–25	26	1·06 (4·97)	0–76	26
District nurse, health visitor, midwife or school/college nurse (contacts)	2·16 (8·70)	0–86	18	2·31 (8·92)	0–100	22
Community paediatrician (contacts)	0·05 (0·28)	0–3	4	0·07 (0·49)	0–6	3
Care coordinator, case manager, key worker (contacts)	5·25 (28·37)	0–312	12	4·88 (21·77)	0–198	15
Psychiatrist (contacts)	0·66 (2·81)	0–35	13	1·34 (5·76)	0–55	15
Clinical psychologist (contacts)	0·56 (2·69)	0–30	12	1·75 (9·02)	0–83	14
CAMHS worker (contacts)	2·32 (8·39)	0–89	25	3·61 (9·77)	0–75	32
Community psychiatric nurse (contacts)	0·25 (1·97)	0–27	4	0·48 (4·37)	0–53	4
Counsellor (contacts)	1·71 (7·18)	0–73	12	2·74 (10·25)	0–104	17
Family therapist (contacts)	0·54 (4·19)	0–50	4	0·93 (3·96)	0–39	10
Art/drama/music/occupational therapy (contacts)	0·16 (1·57)	0–26	3	0·31 (2·28)	0–26	4
Social worker (contacts)	11·55 (24·12)	0–214	47	11·73 (20·29)	0–117	54
Family support worker (contacts)	4·97 (17·56)	0–160	22	7·19 (22·12)	0–176	26
Social services youth worker (contacts)	1·91 (11·12)	0–156	8	1·98 (10·16)	0–113	11
Accommodation key worker (contacts)	4·70 (24·26)	0–232	12	1·52 (9·76)	0–135	7
Educational psychologist (contacts)	0·53 (3·80)	0–52	7	0·33 (2·26)	0–28	6
Education welfare officer (contacts)	2·67 (11·71)	0–113	17	0·61 (2·78)	0–26	13
Connexions worker (contacts)	3·21 (9·84)	0–100	37	4·44 (11·80)	0–80	36
Mentor (contacts)	6·92 (27·53)	0–228	18	5·86 (22·37)	0–214	19
Drug/alcohol support worker (contacts)	2·42 (8·70)	0–65	15	2·10 (8·27)	0–77	15
Advice service e·g· CAB, housing association, careers advice (contacts)	1·02 (4·70)	0–52	13	0·84 (4·33)	0–52	12
Helpline (contacts)	0·52 (8·52)	0–150	3	0·03 (0·22)	0–2	2

	MST (n=310)			MAU (n=296)		
	Mean (SD)	**Range**	**% using**	**Mean (SD)**	**Range**	**% using**
Complementary therapist (contacts)	0·07 (0·79)	0–12	1	0·32 (5·23)	0–90	1
Criminal justice system						
Police custody (days)	3·93 (28·35)	0–364	28	1·20 (4·08)	0–44	30
Youth custody (days)	3·32 (20·53)	0–180	5	5·08 (28·31)	0–231	6
Probation officer (contacts)	2·27 (14·57)	0–180	6	2·09 (10·60)	0–120	9
Youth offending team worker (contacts)	16·64 (43·73)	0–396	37	17·25 (38·48)	0–264	39
Police (contacts)	11·49 (29·50)	0–305	61	14·61 (58·70)	0–675	64
Solicitor (contacts)	2·15 (6·04)	0–63	36	1·96 (4·66)	0–46	34
Court appearance as victim (number)	0·07 (0·48)	0–5	4	0·04 (0·24)	0–3	3
Court appearance as defendant (number)	1·31 (4·48)	0–63	29	1·28 (4·23)	0–46	29

Table C5: Differences in cost per participant over 48-month follow-up period

	MST Mean (SD)	MAU Mean (SD)	Mean difference (MST–MAU)	Adjusted mean difference (MST–MAU)	95% CI	p
Observed data	**(n=310)**	**(n=296)**				
Intervention	2132·57 (1810·46)		2132·57	2128·86	1888·29 to 2369·42	<0·0001
Accommodation	3972·15 (12554·36)	4133·77 (17615·73)	–161·62	–304·00	–2745·36 to 2137·36	0·807
Education	9465·69 (15968·87)	8736·11 (18457·71)	729·58	1013·44	–1645·85 to 3672·72	0·454
Secondary health care	805·74 (2064·53)	2503·71 (15617·96)	–1697·97	–1650·53	–3404·31 to 103·25	0·065
Community services	15479·16 (34953·72)	15369·85 (27817·58)	109·31	58·09	–4980·52 to 5096·70	0·982
Medication	194·92 (1871·70)	188·58 (1592·41)	6·33	4·29	–276·05 to 284·64	0·976
Criminal justice	21353·46 (42097·75)	20920·34 (38634·21)	433·12	200·92	–6105·67 to 6507·51	0·950
Total	52846·46 (69254·61)	51852·36 (67148·76)	994·10	481·51	–10374·50 to 11337·51	0·931
Multiply imputed data	**(n=342)**	**(n=341)**				
Total	62579·80 (6817·81)	55983·17 (5189·48)	6596·63	5629·48	–11163·70 to 22422·67	0·511

Table C6: Percentage of sample prescribed psychotropic medication over 48-month follow-up period

	MST (n=310) % prescribed	MAU (n=296) % prescribed
Antidepressants	12	12
ADHD	11	11
Benzodiazepines	0	<1
Sleep disturbance	4	5
Anti-psychotics	1	3
Anti-epileptics	<1	2

ADHD=attention deficit hyperactivity disorder·

Table C7: EQ-5D-3L utility scores over 48-month follow-up period

	MST		MAU	
	n	**Mean (SD)**	**n**	**Mean (SD)**
Baseline	100	0·885 (0·194)	98	0·912 (0·139)
6 months	184	0·882 (0·188)	151	0·906 (0·153)
12 months	216	0·889 (0·189)	199	0·874 (0·205)
18 months	237	0·882 (0·196)	214	0·885 (0·174)
24 months	236	0·885 (0·197)	215	0·887 (0·182)
36 months	209	0·869 (0·225)	183	0·862 (0·197)
48 months	163	0·767 (0·308)	140	0·833 (0·243)

Table C8: QALYs over 48-month follow-up period

	MST		MAU					
	n	Mean (SD)	n	Mean (SD)	Mean difference (MST–MAU)	Adjusted mean difference (MST–MAU)	95% CI	p
Observed data	95	3·219 (0·611)	72	3·360 (0·437)	–0·142	–0·123	–0·289 to 0·042	0·142
Mean imputation of baseline data	163	3·172 (0·613)	140	3·300 (0·460)	–0·128	–0·091	–0·247 to 0·064	0·246
Multiply imputed data	342	3·328 (0·793)	341	3·596 (0·939)	–0·031	–0·025	–0·131 to 0·081	0·643

Table C9: Proportion with convictions over 48-month follow-up period

	MST		MAU					
	n	Mean (SD)	n	Mean (SD)	Mean difference (MST–MAU)	Adjusted mean difference (MST–MAU)	95% CI	p
Baseline	310	0·41 (0·42)	296	0·45 (0·50)	–0·03	–0·02	–0·08 to 0·04	0·536
48 months (observed data)	308	0·54 (0·50)	294	0·52 (0·50)	0·02	0·02	–0·06 to 0·09	0·663
48 months (multiply imputed data)	342	0·53 (0·50)	341	0·51 (0·50)	0·02	0·03	–0·04 to 0·10	0·400

Table C10: Incremental cost-effectiveness

	MST (n=342)	MAU (n=341)	Adjusted mean difference
	Mean	Mean	
Total cost (£)	62,579·80	55,983·17	5,629·48
QALYs	3·328	3·596	–0·025
Proportion with convictions	0·53	0·51	0·03

Figure C2: Cost-effectiveness acceptability curve showing the probability that MST is cost-effective compared with MAU for different values of willingness-to-pay thresholds for a unit improvement in QALYs at 48-month follow-up

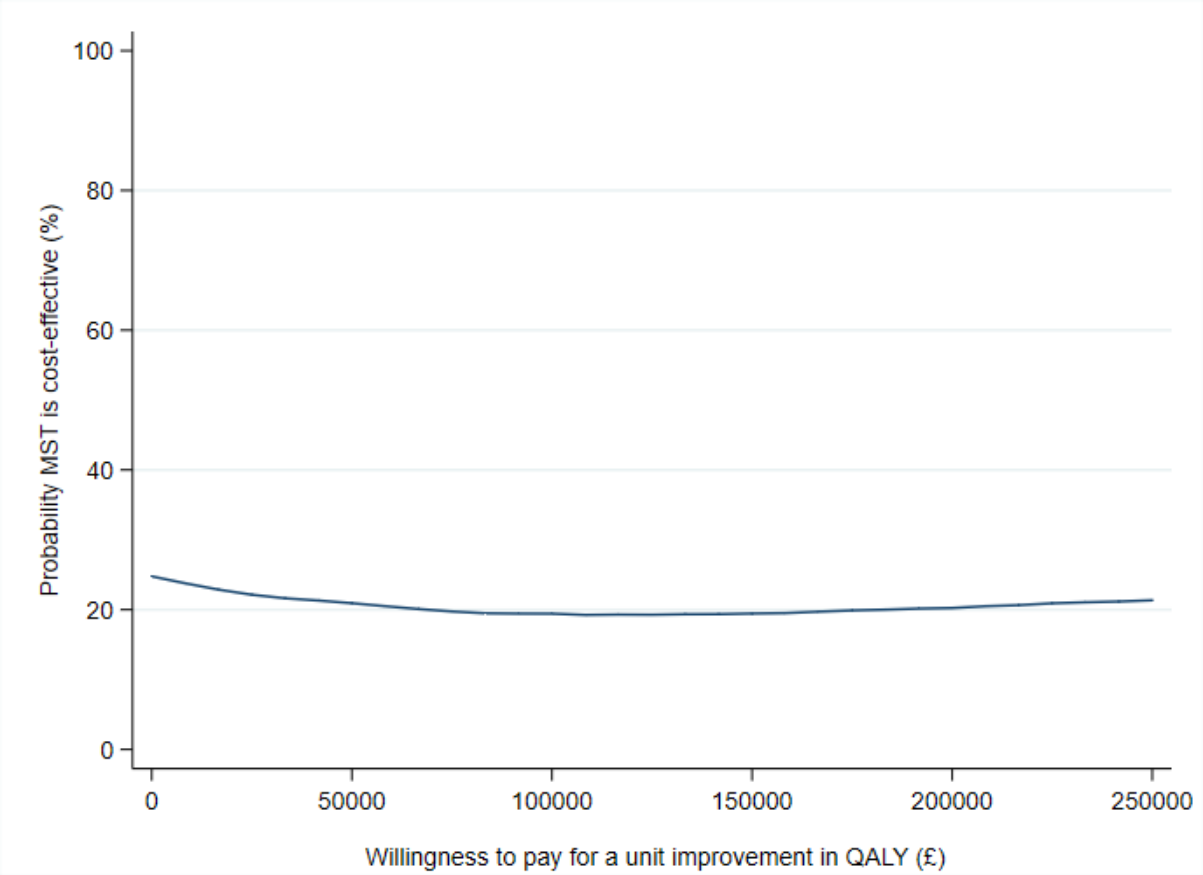


Figure C3: Bootstrapped mean differences in costs and effects (QALYs) of MST compared with MAU at 48-month follow-up

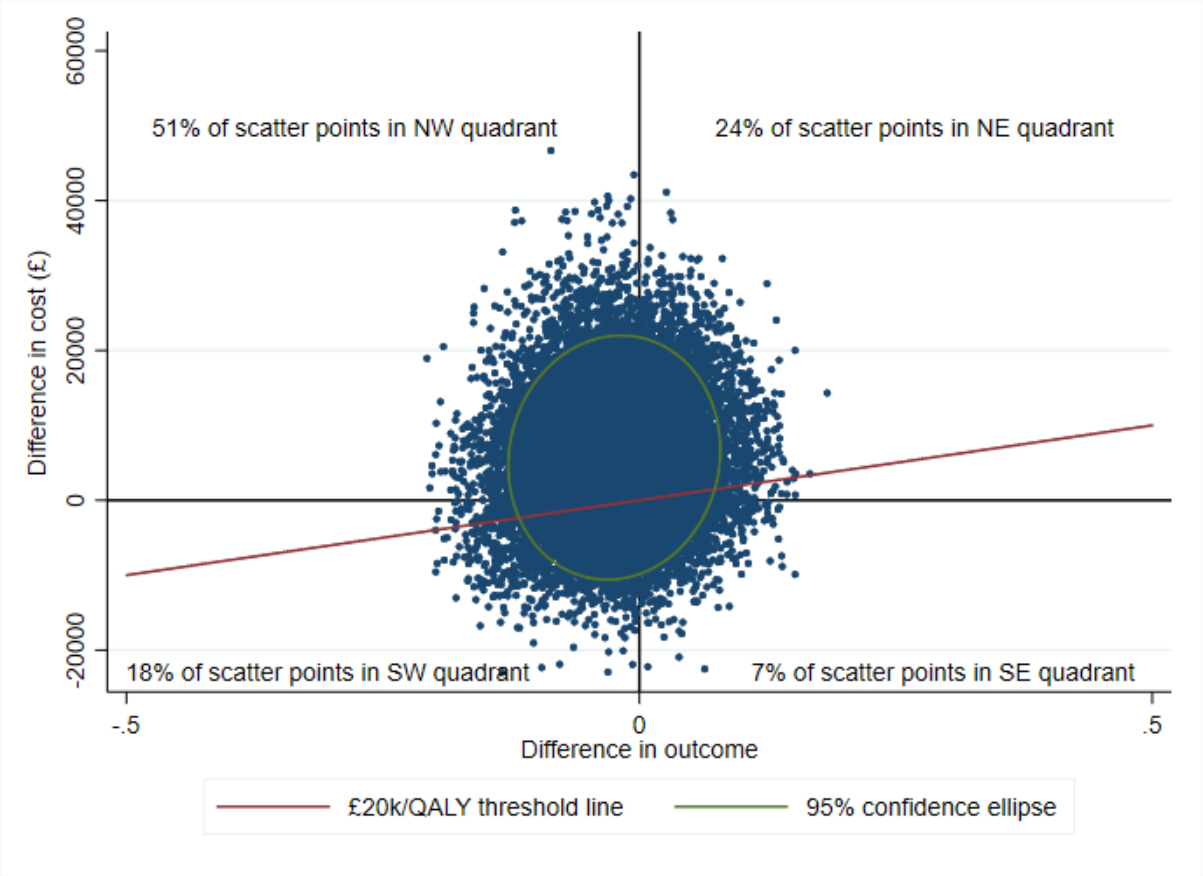


Figure C3 shows the scatterplot of bootstrapped mean differences in costs and QALYs at 48-month follow-up and indicates that MST is dominated by MAU· The y-axis indicates the difference in costs between trial arms (MST–MAU) while the x-axis presents the difference in QALYs (MST–MAU)· Points lying above the x-axis indicate that MST is more costly than MAU while points lying below the x-axis indicate that MST is less costly than MAU· Points lying to the right of the y-axis indicate that MST is more effective than MAU while points lying to the left of the y-axis indicate that MST is less effective than MAU· The majority of scatter points lie in the northwest quadrant (51%), where MST is less effective and more costly than MAU· Very few points (7%) lie in the southeast quadrant, where MST is more effective and less costly than MAU· The remaining scatter points lie in the northeast (24%; MST more effective and more costly) and southwest (18%; MST less effective and less costly) quadrants·

Figure C4: Bootstrapped mean differences in costs and effects (proportion with convictions) of MST compared with MAU at 48-month follow-up

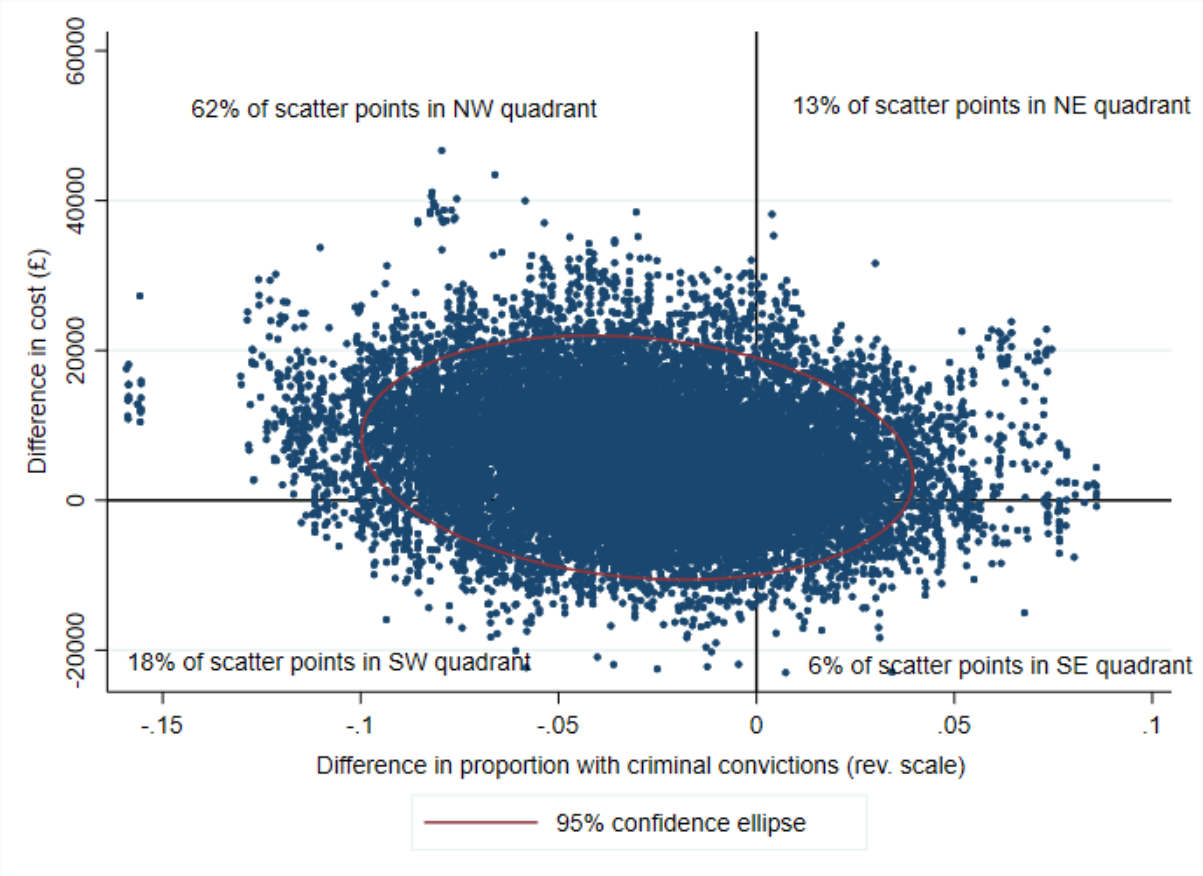
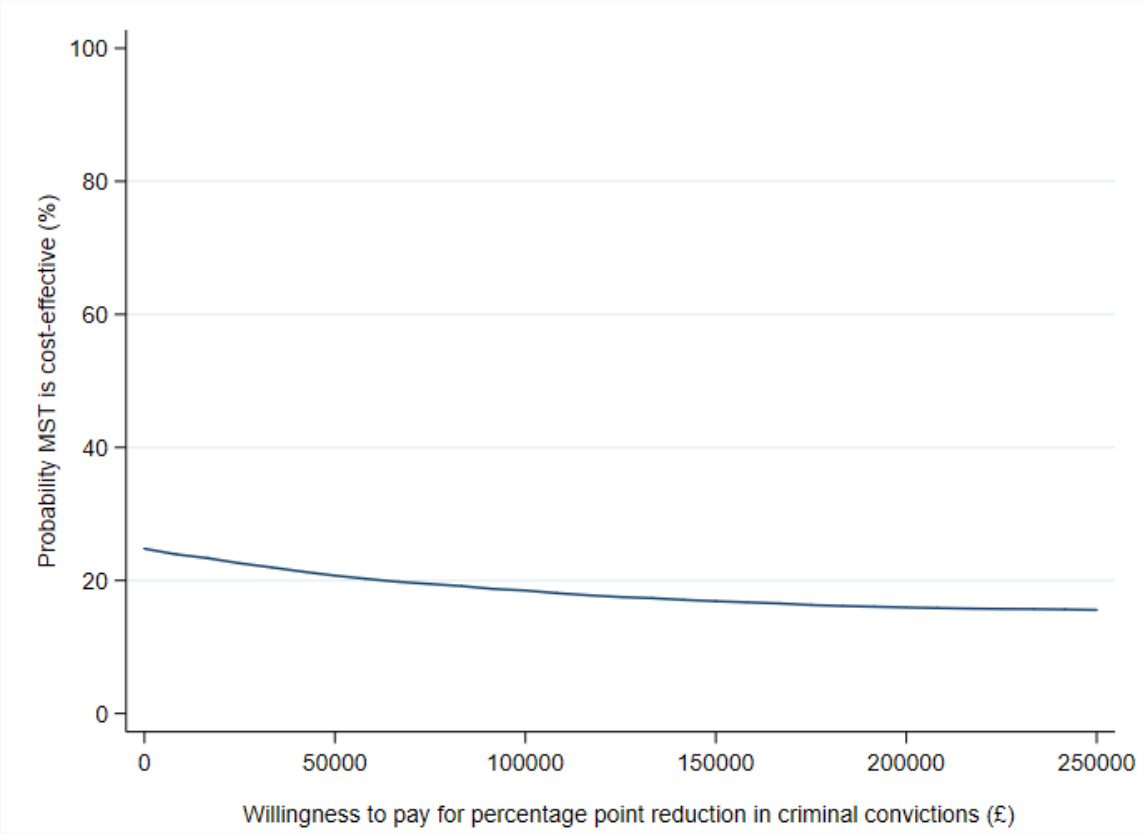


Figure C4 shows the scatterplot of bootstrapped mean differences in costs and proportion of sample with convictions· The majority of scatter points lie in the northwest quadrant (62%), where MST is less effective and more costly than MAU· Very few points (6%) lie in the southeast quadrant, where MST is more effective and less costly than MAU· The remaining scatter points lie in the northeast (13%; MST more effective and more costly) and southwest (18%; MST less effective and less costly) quadrants·

Figure C5: Cost-effectiveness acceptability curve showing the probability that MST is cost-effective compared with MAU for different values of willingness-to-pay thresholds for percentage point reduction in criminal convictions at 48-month follow-up



The cost-effectiveness acceptability curve using criminal convictions as the outcome suggests that the probability of MST being cost-effective compared with MAU remains less than 25% for a range of willingness-to-pay thresholds for percentage point reduction in criminal convictions·

Discussion

The economic analysis cast significant doubt over the putative economic benefit of MST. Higher costs and poorer outcomes in the MST group suggest that MST has a low probability of being cost-effective at 48 months. The results of the EQ-5D-3L from both groups suggest that young people's health-related quality of life actually declined over time. This may be the result of the young people's transition to adulthood and consequently no longer being able to access CAMHS.[1]

[1] NHS England. Model specification for transitions from child and adolescent mental health services. 2015. https://www.england.nhs.uk/wp-content/uploads/2015/01/mod-transt-camhs-spec.pdf (accessed 4 April 2019).