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The research reported in this issue of the journal was commissioned by the HTA programme as project number 01/17/05. The contractual start date was in February 2003. The draft report began editorial review in May 2008 and was accepted for publication in August 2009. As the funder, by devising a commissioning brief, the HTA programme specified the research question and study design. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HTA editors and publisher have tried to ensure the accuracy of the authors' report and would like to thank the referees for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this report.

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Abstract

A randomised controlled trial of cognitive behaviour therapy and motivational interviewing for people with type 1 diabetes mellitus with persistent sub-optimal glycaemic control: A Diabetes and Psychological Therapies (ADaPT) study

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Objectives: To determine whether (i) motivational enhancement therapy (MET) + cognitive behaviour therapy (CBT) compared with usual care, (ii) MET compared with usual care, (iii) or MET + CBT compared with MET was more effective in improving glycaemic control when delivered by general nurses with additional training in these techniques.

Design: A three-arm parallel randomised controlled trial as the gold standard design to test the effectiveness of psychological treatments.

Setting: The recruiting centres were diabetes clinics in seven acute trusts in south-east London and Greater Manchester.

Participants: Adults (18–65 years) with a confirmed diagnosis of type 1 diabetes for a minimum duration of 2 years and a current glycated (or glycosylated) haemoglobin (HbA_{1c}) value between 8.2% and 15.0%.

Interventions: The control arm consisted of usual diabetes care which varied between the hospitals, but constituted at least three monthly appointments to diabetes clinic. The two treatments arms consisted of usual care with MET and usual care with MET + CBT.

Main outcome measures: The primary outcome was HbA_{1c} at 12 months from randomisation. Secondary outcome measures were 1-year costs measured by the Client Service Receipt Inventory at baseline, 6 months and 12 months; quality of life-years [quality-adjusted life-years (QALYs)] measured by the SF-36 (Short Form-36 Health Survey Questionnaire) and EQ-5D (European Quality of Life-5 Dimensions) at baseline and 12 months.

Results: One thousand six hundred and fifty-nine people with type 1 diabetes were screened and 344 were randomised to MET + CBT ($n = 106$), MET ($n = 117$) and to usual care ($n = 121$). The 12-month follow-up rate for HbA_{1c} was 88% ($n = 305$). The adjusted mean 12-month HbA_{1c} was 0.45% lower in those treated with MET + CBT [95% confidence interval (CI) 0.16% to 0.79%, $p = 0.008$] than for usual care; 0.16% lower in those treated with MET (95% CI 0.20% to 0.51%, $p = 0.38$) than for usual care; and 0.30% lower with MET + CBT than with MET (95% CI –0.07% to 0.66%, $p = 0.11$). The higher the HbA_{1c}, and the younger the participant at baseline, the greater was the reduction in HbA_{1c}. The interventions had no effect on secondary outcomes such as depression and quality of life. The economic evaluation was inconclusive. Both interventions were associated with increased health care costs than for usual care alone. There was no significant difference in social costs. Cost effectiveness ratios, up to one year, varied considerably according to whether QALY estimates were based on EQ-5D or SF-36 and whether imputed or complete data were used in the analyses.

Conclusions: A combination of MET and CBT may be useful for patients with persistent sub-optimal diabetic control. MET alone appears less effective than usual care. Economic evaluation was inconclusive.
Trial registration: Current Controlled Trials ISRCTN77044517.

Contents

List of abbreviations

ACR	albumin–creatinine ratio
ADaPT	A Diabetes and Psychological Therapies Study
ANCOVA	analysis of covariance
ANOVA	analysis of variance
BMI	body mass index
CAT	cognitive analytical therapy
CBT	cognitive behaviour therapy
CEAC(s)	cost-effectiveness acceptability curve(s)
CI	confidence interval
CONSORT	CONsolidated Standards Of Reporting Trials
CSRI	Client Service Receipt Inventory
CT	cognitive therapy
CTS-R	Cognitive Therapy Scale-Revised
DAFNE	Dose Adjustment For Normal Eating
DCCT	Diabetes Control and Complications Trial
DoH	Department of Health
DQoL	Diabetes Quality of Life
DSM	*Diagnostic and Statistical Manual of Mental Disorders*
DSN(s)	diabetes specialist nurse(s)
EQ-5D	European Quality of Life-5 Dimensions
HbA_{1c}	glycated (or glycosylated) haemoglobin
HFS	Hypoglycaemic Fear Survey
ICC(s)	intra-class correlation coefficient(s)
ICER(s)	incremental cost-effectiveness ratio(s)
MET	motivational enhancement therapy
MI	motivational interviewing
MISC	Motivational Interviewing Skill Code
MITI	Motivational Interviewing Treatment Integrity
MRC	Medical Research Council
PHQ	Patient Health Questionnaire
QALY(s)	quality-adjusted life-year(s)
RCT(s)	randomised controlled trial(s)
SD	standard deviation
SF-36	Short Form-36 Health Survey
TTM	transtheoretical model

All abbreviations that have been used in this report are listed here unless the abbreviation is well known (e.g. NHS), or it has been used only once, or it is a non-standard abbreviation used only in figures/tables/appendices, in which case the abbreviation is defined in the figure legend or in the notes at the end of the table.

Executive summary

Background

Sub-optimal glycaemic control in type 1 diabetes is common despite intensive insulin therapy and education. Psychological problems such as depression, eating problems and diabetes-specific problems (such as fear of hypoglycaemia, fear of self-injecting and testing, fear of complications) are also common and associated with sub-optimal glycaemic control, complications and mortality.

There is insufficient evidence from randomised controlled trials (RCTs) that psychological treatments are effective in improving glycaemic control in adults with type 1 diabetes. The training and effectiveness of diabetes professionals in delivering brief and focused psychological treatments to help people improve their diabetes self-care has received scant attention.

Two psychological treatments, motivational enhancement therapy (MET) and cognitive behaviour therapy (CBT), were selected for their time focused duration, brevity of training and ability to be translated into the clinical setting.

Motivational enhancement therapy is a brief counselling method for enhancing motivation to change problematic health behaviours by exploring and resolving ambivalence. It has been effective in reducing substance misuse but evidence for effectiveness in improving diabetes control is lacking. CBT aims to enable the patient to identify and modify unhelpful cognitions and behaviours and is effective in the treatment of a range of psychological problems, but limited evidence in improving glycaemic control. There is emerging evidence that adding CBT to MET helps to maintain behaviour changes.

Objectives

1. To determine whether (i) MET + CBT compared with usual care, (ii) or MET compared with usual care, (iii) or MET + CBT compared with MET was more effective in improving glycaemic control when delivered by general nurses with additional training in these techniques.
2. To examine the cost-effectiveness of MET + CBT compared with MET and compared with usual diabetes care, and MET compared with CBT, for improving glycaemic control.
3. To identify pre-randomisation moderators of the effectiveness of treatment.
4. To assess the effect of treatment on secondary outcomes including depression and quality of life.

Methods

Setting

The recruiting centres were diabetes clinics in seven acute trusts in south-east London and Greater Manchester.

Study population, case definition and study criteria

The target population was adults (18–65 years) registered having type 1 diabetes with one previous glycated or glycosylated haemoglobin (HbA_{1c}) value between 8.2% and 15%. The study population was those with a confirmed diagnosis of type 1 diabetes for a minimum duration of 2 years and a current HbA_{1c} value between 8.2% and 15%. Participants were excluded if they: were not fluent in English; were pregnant; had an antidepressant initiated less than 2 months ago; had a serious/acute medical illness defined by their treating physician; had advanced diabetes complications; had known haemaglobinopathy or severe mental disorder; were in psychotherapy or within 3 months of having completed a structured diabetes education programme; or were participating in another trial.

Baseline pre-randomisation measures

These were collected as follows: sociodemographic factors (age, gender, employment status, educational level, ethnicity, marital status); lifestyle factors (current smoking status and units of alcohol intake per week); physical health [blood pressure (mmHg), body mass index (weight/height^2), total random cholesterol (mmol/l), duration of diabetes (years)]; and diabetes complication

status. We measured a range of psychological factors including depression, anxiety, eating disorders, quality of life, fear of hypoglycaemia and adherence to self-care activities.

Randomisation

A computer-generated randomisation list stratified according to centre using minimisation and blocks of random sizes was prepared in advance with allocation concealment.

Outcome measures

The primary outcome was HbA_{1c} at 12 months from randomisation. The HbA_{1c} was measured quarterly after randomisation to measure the rate of change in glycaemic control. The self-report psychological measures were repeated at 12 months. The HbA_{1c} was analysed by technicians blind to allocation.

Economic assessment: 1-year costs measured by the Client Service Receipt Inventory at baseline, 6 months and 12 months; quality of life-years [quality-adjusted life-years (QALYs)] measured by the SF-36 (Short Form-36 Health Survey Questionnaire) and EQ-5D (European Quality of Life-5 Dimensions) at baseline and 12 months.

Statistical analysis

The baseline characteristics were compared to assess the effectiveness of randomisation. We used an intention-to-treat analysis of covariance for the primary outcome of 12-month HbA_{1c} (and for quarterly HbA_{1c}), to estimate the differences in intervention group means, adjusting for the baseline HbA_{1c}. This was repeated for the secondary outcomes (depression, body mass index, fear of hypoglycaemia, diabetes self-care activities and quality of life). Effect modification of the interventions by baseline factors, such as age, education, depression, on 12-month HbA_{1c} was examined.

Interventions

Control. Usual diabetes care which varied between the hospitals but constituted at least three monthly appointments to diabetes clinic.

Usual care with MET. Participants were offered four individual sessions over a 2-month period based on a diabetes-specific patient workbook that included a standardised computerised self-assessment of diabetes relevant behaviours and rating of the level of importance, confidence, and readiness to change, discussion of options for change, homework writing tasks, and the formulation of a collaboratively completed change plan.

Usual care with MET + CBT. Participants were offered four MET sessions over a 2-month period followed by eight CBT sessions for a further 4 months. We developed a range of diabetes-specific CBT techniques. A collaborative individualised programme was developed and structured around agenda setting, homework planning and feedback around diabetes-specific problems.

Training

Training of diabetes nurses involved workshops, self-directed learning, audiovisual feedback, weekly group meetings and individual supervision of a patient caseload. Therapy integrity was increased by use of manuals, and assessed quantitatively by trained clinical psychologists blind to allocation of a random sample of tapes. Weekly supervision continued throughout the study.

Results

One thousand six hundred and fifty-nine people with type 1 diabetes were screened and 344 were randomised to MET + CBT ($n = 106$), MET ($n = 117$) and to usual care ($n = 121$). The 12-month follow-up rate for HbA_{1c} was 88% ($n = 305$). The median age was 36 years [interquartile range (IQR) 28–44]; duration of diabetes was 18 years (IQR 11–25); and HbA_{1c} was 9.4% (IQR 8.8–10.2). The adjusted mean 12-month HbA_{1c} was 0.45% lower in those treated with MET + CBT [95% confidence interval (CI) 0.16% to 0.79%, $p = 0.008$] than for usual care; 0.16% lower in those treated with MET (95% CI 0.20% to 0.51%, $p = 0.38$) than for usual care; and 0.30% lower with MET + CBT than with MET (95% CI –0.07% to 0.66%, $p = 0.11$). This changed only slightly when imputed data were used for missing values. The higher the HbA_{1c}, and the younger the participant at baseline, the greater was the reduction in HbA_{1c}. The interventions had no effect on secondary outcomes such as depression and quality of life.

The six nurse therapists who delivered the interventions achieved acceptable competencies in most of the techniques in MET and CBT. Overall there was evidence of treatment integrity in that two technologies could be distinguished from each other, but there was evidence of overlap in some of the techniques.

Both interventions were associated with higher total health and social care costs than for usual care alone, largely as a result of the additional costs of the interventions which were not offset by reductions in other health-care use. There were no significant differences in societal costs. Only MET + CBT resulted in a significantly different outcome improvement (HbA_{1c}). MET + CBT had greater probabilities of cost-effectiveness compared with usual care than did MET, if value was placed on HbA_{1c} outcomes (over 0.7 at thresholds of £5000 per additional point improvement in HbA_{1c}); but MET had a greater chance of cost-effectiveness if value was placed on QALY outcomes, although at a threshold of £20,000 per additional QALY, probabilities only reached 0.31 (based on the SF-36). MET + CBT had a good probability of cost-effectiveness compared with MET based on HbA_{1c} outcomes but, based on QALYs, it was dominated by MET and had low probabilities of cost-effectiveness. These broad conclusions apply from both a health/social care and societal perspective.

Conclusions

Implications for health care

1. Diabetes professionals can be trained to deliver diabetes-specific MET and CBT competently in the context of concurrent supervision.
2. A combined MET and CBT approach may be useful in individuals with persistent sub-optimally controlled diabetes, but MET appeared less effective than usual diabetes practises and MET + CBT.
3. Compared with usual care, at a minimum of £48,636 per QALY gain (based on the EQ-5D), neither intervention fell within a notional policy-making threshold of cost-effectiveness. MET + CBT achieved additional HbA_{1c} improvements at a lower cost (£1756 per additional point improvement) than MET. MET + CBT had a high probability of cost-effectiveness than MET based on HbA_{1c} outcomes, but MET dominated on the basis of QALYs estimated from both the EQ-5D and the SF-36. Probabilities of cost-effectiveness are higher based on HbA_{1c} outcomes than on QALY outcomes. Therefore, decisions regarding the provision of such interventions depend on the relative importance of these two outcomes.
4. The interventions had no quality of life impacts over 1 year, as measured by the EQ-5D, SF-36 and diabetes quality of life. However, it is possible that any such effects would be more evident over a longer term, beyond the time horizon of this study, alongside any reductions in future complications for instance.
5. The younger the person with diabetes and the worse his or her diabetes control, the greater was the reduction in glycaemic control in the MET + CBT group only.
6. The treatments tested do not appear to improve other markers of psychological functioning.

Recommendations for research

1. To identify quantitatively and qualitatively the components of the complex intervention that was associated with improvement in glycaemic control in order to inform future generations of RCTs.
2. To examine whether the effects are sustained for longer than 12 months.
3. To compare variations of therapy such as whether additional sessions, group format, electronic formats or adding techniques for the treatment of depression are associated with additional effectiveness or cost-effectiveness to the intervention tested here.
4. To conduct a discrete choice experiment in order to understand how people with diabetes appraise the value of psychological treatments to help improve their diabetes control, taking account of any costs falling to themselves as a result of attending such time-intensive treatments.
5. To assess whether these techniques can be adjuncts to structured diabetes education programmes to enhance their effectiveness, such as DAFNE (Dose Adjustment For Normal Eating).
6. To assess whether the techniques can be modified for use in other diabetes groups, such as adolescents with type 1 diabetes, adults with type 2 diabetes and people from different ethnic backgrounds.
7. To explore impacts for decision-making when economic evidence is based on different methods of QALY estimation.

Trial registration

This trial is registered as ISRCTN77044517.

Chapter 1
Introduction

Type 1 diabetes

Type 1 diabetes is characterised by an absolute lack of insulin production secondary to pancreatic beta cells being selectively destroyed. This report focuses on adults with type 1 diabetes, previously known as insulin-dependent, juvenile or childhood-onset diabetes, who are having difficulties in achieving optimal diabetes control. Chronic hyperglycaemia leads to micro- and macrovascular complications, affecting many of the body's systems, especially the nervous and vascular systems, resulting in increased mortality.[1]

There are two forms of type 1 diabetes: type 1A is by far the most common and is secondary to an autoimmune attack on beta cells; and type 1B is much less common, the cause is still not known and it is most common in people of black African/ Caribbean or Asian descent with varying degrees of insulin deficiency. The pathogenesis of type 1A diabetes is understood to be a combination of a varying genetic susceptibility to type 1 diabetes and exposure to one or more environmental triggers, such as viral infection, toxins or food allergens initiating β cell destruction.[2] The classic triad of symptoms that patients experience include excessive urination (polyuria), thirst (polydypsia) and weight loss. Other associated symptoms include visual changes, fatigue and constant hunger.

There are an estimated 2.35 million people with diabetes in England and there is an epidemic of diabetes.[3] Type 1 diabetes accounts for 10–15% of all cases of diabetes. The prevalence of type 1 diabetes in the UK is about 1 in 800 children up to the age of 16. There is a marked variation in the incidence of type 1 diabetes according to geographical location and ethnicity; a child in Finland is nearly 350 times more likely to be diagnosed with diabetes than a child in China.[4] The incidence of type 1 diabetes is increasing annually worldwide at around 2–5% and in the UK there has been an increase from 7.7 to 13.5 children per 100,000 from the early 1970s to the late 1980s.[5] Around 50% of all cases present before the age of 18 years, and the remainder present at a low rate throughout adulthood.

Microvascular complications include retinopathy which can lead to progressive blindness; nephropathy and progressive renal failure; and neuropathies such as peripheral neuropathy which is associated with diabetic foot disease and limb amputation and autonomic neuropathy such as gastroparesis. Macrovascular complications include coronary heart disease, cerebrovascular disease and peripheral vascular disease. While there are differences in the susceptibility to such complications between individuals, perhaps reflecting genetic influences, these complications are linked to sub-optimal glycaemic control, early onset and longer duration of diabetes, smoking, obesity and sedentary lifestyle.[2] Diabetes complications usually take many years to become clinically manifest. This is a core challenge for people with diabetes because they may not acutely suffer or be aware of symptoms of hyperglycaemia and yet are asked to modify their behaviours for a potential complication in the distant future.

Measuring glycaemic control

There are many ways to measure glycaemic control. The most common is random blood glucose testing, which measures the current level of glucose (mmol/l) and glycated (or glycosylated) haemoglobin or HbA_{1c} (%). The random blood glucose test is measured using small portable self-testing kits and allows for a rapid respond to high or low readings using a range of options such as insulin dose or dietary adjustment and this is one of the important diabetes self-care skills. Glycated haemoglobin is an indication of the percentage of red blood cells have been exposed to glucose during their 120-day life cycle and this depends on how much glucose is circulating in the blood. Once a haemoglobin molecule is glycated, it remains that way and thus can serve as a proxy marker for the level of glycaemic control especially in the last 6 weeks and less so over the last 12 weeks. The normal range of glycated haemoglobin is between 4% and 6%, and the ideal target for people with diabetes is to get as close to the non-diabetes range as possible without problematic hyperglycaemia. The current national guidelines have set a practical

target of between 7% and 8% taking into account the circumstances of the individual patient.[6]

Management of diabetes

At present there is no cure for diabetes, and management is predominantly self-care with administration of exogenous insulin for the rest of the person's life. The main aim of diabetes treatment is to optimise glycaemic control to minimise the risk of micro- and macrovascular complications. People with diabetes need to adopt a diabetes-specific diet (predominantly monitoring the amount of carbohydrates), exercise, monitor blood glucose levels and titrate their insulin injections accordingly several times a day, take additional medication to reduce their risk of macrovascular complications, self-examine injection sites and injuries to their feet and stay in touch with their diabetes team. One of the landmark studies, the Diabetes Controls and Complications Trial (DCCT) showed that intensive insulin therapy regimes involving multiple injections and frequent monitoring by diabetes teams over 6–10 years were associated with an improvement in glycaemic control sufficient to reduce the risk of diabetes complications,[7,8] although not necessarily an improvement in quality of life.[9] These interventions continued to be effective in reducing long-term complications after the study had ended and the glycaemic control in the intensively treated group had gradually returned to the baseline, suggesting that a period of good glycaemic control is associated with a resetting of 'metabolic memory'.[10,11]

Since the DCCT, intensive structured education programmes such as DAFNE (Dose Adjusted for Normal Eating) that involve titrating insulin doses with carbohydrate intake, to support people in leading flexible dietary lifestyles, are also effective in improving glycaemic control.[12,13]

Continuous subcutaneous insulin infusions, sometimes called the 'external pancreas', attempt to match endogenous insulin rhythms and may be effective in those individuals who have difficulties in managing multiple injections.[14]

While a variety of treatment options are available, they are not always preferred by the patient, and how individuals manage their self-care determines to a large extent the course of the illness.

There have also been recent hopeful advances in islet cell transplantation,[15] but these are indicated for specific groups of individuals with problematic hypoglycaemia and are still emerging technologies.

The problem of sub-optimal glycaemic control

Despite the evidence for effective intensive insulin regimes and structured education programmes, between 25% and 50% of adults with type 1 diabetes have sub-optimal glycaemic control.[16] In the DCCT, the majority of the intensive group did not achieve or sustain the target HbA_{1c} of 6.0%.[7] Despite recent reductions in the national average glycated haemoglobin, the average HbA_{1c} in most diabetes clinics is still around 9%.[17,18] In a prospective observational study of adolescents, sub-optimal glycaemic control persisted into young adulthood,[19] and a similar observation was found in Scottish university students with type 1 diabetes.[20]

Socioeconomic impact of diabetes

Diabetes, like any other chronic disease, has an impact on work, income, quality of life and social relationships. Certain jobs are excluded such as joining the military and large goods vehicle driving, and people with diabetes worry about stigma in the workplace, forming intimate relationships and their relationships with peers. Type 1 diabetes is a disease of the young and consequently affects those who are still at school and have an adult life's worth of being economically productive. Young people with diabetes are less likely to achieve academically.[21] People with diabetes are twice as likely to be admitted to hospital as the general population, and the presence of complications increases the cost to the NHS more than fivefold.[22]

Factors associated with sub-optimal glycaemic control

There are cross-sectional and a few landmark large-scale prospective studies that have investigated the sociodemographic, biological and other lifestyle factors associated with glycaemic control in adults with type 1 diabetes.

A large European cross-sectional survey ($n = 2387$) of adults (age 25–60 years), the EURODIAB Insulin Dependent Diabetes Mellitus complications study,[23] showed that the mean HbA_{1c} was higher in

adults with lower socioeconomic status as defined by age at completion of education.

The frequently cited Düsseldorf study, which evaluated the effectiveness of an intensified 5-day insulin treatment and teaching programme[24] in 697 type 1 diabetes adults with advanced diabetes complications, found that sub-optimal glycaemic control at 3 years was associated with smoking, younger age at onset of diabetes, less frequent self-monitoring, lower socioeconomic status (composite score depending on income per month, household composition, employment and educational status), less diabetes-related knowledge and perceived abilities to cope, and being female, representing 17% of the variance.[25]

In the Pittsburgh Epidemiology of Diabetes Complications study ($n = 657$),[26,27] worse glycaemic control was associated with younger age, lower income, lower educational attainment and low frequency of self-monitoring of blood glucose.

In a subgroup of participants ($n = 623$) allocated to intensive treatment in the DCCT, those who reported adhering to prescribed meal plans and adjusted food and/or insulin in response to hyperglycaemia had significantly lower HbA_{1c} results than those who did not.[28]

In 84 newly diagnosed adults with type 1 diabetes alcohol consumption and knowledge of diabetes at 4 months after diagnosis were found to be independent predictors of glycaemic control at 12 months, explaining 16% of the variance.[29] Other factors such as the General Health Questionnaire, diabetes-specific quality of life, cognitive ability and personality were not but these findings may reflect the short follow-up.

Psychological factors and their association with glycaemic control

People with diabetes are at higher risk of psychological problems such as depression and anxiety than the general population and have psychological issues specific to diabetes such as fear of hypoglycaemia.

Depression and anxiety

The essential feature of depression is a persistent lowering of mood and loss of ability to enjoy usual activities.[30] When diagnostic criteria are used the pooled prevalence of depressive disorders has been estimated to be 11% and when self-report rating scales are used the pooled prevalence of depression is 26%; these rates are twice as common as in those who do not have diabetes.[31] There is some evidence that depression follows a chronic course in diabetes.[32,33] Risk factors for depression in diabetes are similar to those in the general population such as women, lower socioeconomic status, younger age, comorbid medical problems, chronic adversity and those who are separated.[34–37] Systematic reviews have concluded that depression is associated with sub-optimal glycaemic control[38] and complications[39] in most studies, overwhelmingly in cross-sectional designs. Depression is doubly disabling in people with diabetes.[40] Cohort studies have demonstrated that depression is associated with a 1.5- to 5-fold increased risk of mortality.[41–45]

The prevalence of generalised anxiety disorder, often comorbid with diabetes, is estimated to be around 14% for patients with diabetes compared with 3–4% in the general population,[46] and is associated with sub-optimal glycaemic control.[47]

Behavioural mechanisms, such as neglect of diabetes self-care tasks, have been the preferred explanation for the association between depression and glycaemic control,[48] but there is little prospective evidence to confirm this.[38] In randomised controlled trials (RCTs) of interventions for depression in diabetes, mostly in type 2 diabetes, while depression scores tend to improve, glycaemic control does not always improve.[49–55]

Eating disorders

While the evidence for the prevalence of eating disorders, such as anorexia nervosa and bulimia nervosa is conflicting,[56,57] a systematic review suggested that the rates of the latter but not the former were probably increased,[58] and around 30% of young female adults are likely to have sub-threshold eating problems.[19] Eating disorders and eating problems are associated with sub-optimal glycaemic control and early development of complications, particularly retinopathy.[59,60] Aspects inherent in the pathophysiology and the treatment regime may lend themselves to increasing the risk of eating disorders, such as the initial weight loss before presentation and the subsequent weight gain after the administration of insulin, the attention on dietary needs and requirements, and becoming

aware that insulin omission could lead to rapid weight loss, all during adolescence.

Fear of injecting and self-testing

The evidence for an increased prevalence of diagnostic needle phobia in people with diabetes is debatable,[61] but in a large cross-sectional Dutch study, there were high rates of extreme fear of injecting and self-testing ($n = 1275$)[62] and this was associated with higher levels of depression, anxiety, diabetes-related distress and fear of hypoglycaemia, and lower adherence to the treatment regimen, such as skipping finger pricks to monitor glucose levels.[63]

Fear of hypoglycaemia

Fear of having a hypoglycaemic episode is one of the most common worries for people with type 1 diabetes and is associated with sub-optimal glycaemic control.[64–68] The fear of hypoglycaemia is related to thoughts of being out of control, being vulnerable and dependent on others and the public humiliation and embarrassment, as well as fear for one's own safety and of dying. Other factors that may lead to excessive worry include the inability to feel the symptoms of hypoglycaemia (hypoglycaemic unawareness or reduced hypoglycaemic awareness) and misattributing symptoms of anxiety to hypoglycaemia.

Fear of complications

Fear of complications has emerged as one of the most common worries for people with diabetes.[69] People with diabetes have an undue negative perception of their risk of complications; one survey found that they believed they were 1.5 times more likely to become blind, four times more likely to develop end-stage renal disease, and 13 times more likely to have lower leg amputation than they actually are.[70] Such levels of over concern can lead to fatalistic thinking and avoidance/reducing optimal care.

Burnout

Living with diabetes for many years can lead to 'burnout' which is characterised by low motivation to keep up with self-management, chronic frustration and feelings of failure to maintain optimal glycaemic control.[68] Feeling overwhelmed and burdened may negatively affect glycaemic control via the effects of stress and, indirectly, via the effects of psychological distress on self-care behaviours.[71]

Attachment styles

Sub-optimal glycaemic control has recently been associated with a 'dismissing attachment' interaction style between patients and their health-care providers, characterised by poor communication, diminished trust and use of self-reliant strategies.[16,72] Patient–provider communication predicts treatment satisfaction, adherence to treatment recommendations and health outcomes.[73] Depression and anxiety may influence the patient–provider communication, which in turn may reinforce negative self-beliefs and attitudes to self-care and have a negative effect on glycaemic control.[74]

Potential role of psychological treatments

Considering the limits of intensive medical interventions, the high rates of psychological problems in people with diabetes and their association with sub-optimal glycaemic control and other adverse outcomes, there is an a priori role for psychological treatments as adjuncts in helping to improve glycaemic control. Psychological therapies utilise the therapeutic alliance between the patient and the therapist in which the patient's problems are described in terms of his or her emotions, cognitions (or thinking) and/or behaviours, and in some therapies these are linked to early life experiences with the overall aim of improving psychological functioning. Psychological treatments are used widely in mental health settings to treat a range of emotional disorders such as depression,[75] anxiety disorders and psychosomatic disorders. The potential for psychological treatments in chronic disease setting to improve psychological and/or biological outcomes is an emerging field.[76]

A person with diabetes needs skills in, firstly, managing the practical daily routine of diabetes self-management and, secondly, coping with the burden of living with a chronic condition. The former requires diabetes knowledge delivered through diabetes education programmes such as DAFNE.[13] The latter involves multiple psychological processes that, if they go wrong, lead to psychological problems which are best managed using a psychotherapeutic approach.

Psychological interventions should be distinguished from educational interventions although they are not mutually exclusive. Educational interventions are based on didactic and social learning theory (sometimes also called collaborative, therapeutic and behavioural) to improve diabetes self-

management by increasing knowledge.[77,78] Facts and knowledge are imparted through advice, lectures and written material, and problem solving via a process of memory and testing and retesting. The relationship is based on the teacher or educator–pupil paradigm. Diabetes education is a core component of usual diabetes care but is not always sufficient in achieving glycaemic control.[79]

Psychological treatments are based on the principle that the therapist and the patient are in a collaboration and develop a therapeutic alliance within the context of which psychological processes variously associated with conscious and/or unconscious emotions, the transference, past experiences, thoughts and behaviour are evaluated using a variety of techniques such as: listening and reflecting; history taking; formulating the problem(s); giving meaning or interpretations to thoughts, feelings, and behaviours; challenging of unhelpful beliefs and assumptions; and setting goals. Psychological treatments are not a core component of usual diabetes care, although national guidelines for type 1 diabetes state that psychological care should underpin all aspects of diabetes care.

Systematic reviews of the effectiveness of psychological treatments in improving glycaemic control

Just over 10 years after insulin therapy was introduced, the first attempts at a theory-based psychotherapy in managing neurosis in diabetes were published,[80] but there was little progress for the next 40 years as the emphasis was on diabetes education. In the early 1990s, a case series of successful psychoanalytical treatments for adolescent female inpatients with brittle diabetes heralded the potential of psychotherapy for complex cases.[81] The first RCTs appeared in the early 1980s. There have been several systematic reviews of RCTs comparing the effectiveness of psychological treatments in improving diabetes control. One review included only children and adolescents with type 1 diabetes as the population of interest and did not distinguish between psychological and educational interventions.[82] They found a standardised pooled effect size of 0.33 and they interpreted this as small to medium. Another review did not distinguish between type 1 or type 2 diabetes which does not seem appropriate as the epidemiology, natural history, sociodemographic profile and treatments are different.[83]

We conducted a Cochrane Collaboration-based systematic review of RCTs comparing the effectiveness of psychological treatments for improving glycaemic control in people with type 1 diabetes. The full details of the rationale, methodology and results have been published.[84] The purpose of the review was to assess, quantify and critique the current evidence in order to model our proposed interventions. We aimed to focus on those interventions that were either solely or predominantly psychotherapeutic.

Psychological treatments were categorised into those most commonly used in health-care settings as follows: supportive or counselling therapy;[85,86] cognitive behaviour therapy (CBT) or cognitive and behavioural techniques;[87,88] psychoanalytically informed therapies;[89–91] and family systems therapy.[92] Studies that did not explicitly label their intervention as above were still included if they used one or more psychological techniques that could be coded into one of the above categories. Techniques such as relaxation, activity scheduling, problem solving, goal setting, contract setting, cognitive restructuring and stress management were categorised as variants of the CBT model.[93,94] Techniques such as motivational interviewing (MI) were categorised under the counselling model.[95]

There were 13 RCTs for adults included in the systematic review. Most RCTs had small sample sizes (< 100 participants) and did not adequately describe the study progress according to the CONsolidated Standards of Reporting Trials (CONSORT) guidelines.[96] The most common clinical subgroup was sub-optimal glycaemic control;[97–100] there was one RCT each for newly diagnosed diabetes,[101] complications,[102] and obesity.[103] The mean duration of diabetes was 14.12 [standard deviation (SD) 6.85] years. Eight studies used either groups or a combination of group and individual format. The majority of RCTs assessed CBT techniques, one RCT tested cognitive–analytical therapy and another was based on psychodynamic techniques, [98,101] and two RCTs tested counselling.[104,105]

There were 11 adult studies ($n = 516$) with data that could be pooled. Using random effects meta-analyses, there was a small pooled estimate of the mean standardised effect sizes which was non-significant [–0.17, 95% confidence interval (CI) –0.45 to 0.10; $p = 0.22$] that, translated into absolute reductions in HbA_{1c}, represented a 0.22% reduction (–0.13% to 0.56%) for adults. In a sensitivity analysis, restricting the adults to CBT

worsened the pooled standardised effect size for adults (0.02, CI –0.41 to 0.44; $p = 0.95$).

Treatment manuals and treatment fidelity

In psychotherapy intervention studies, assessment of treatment integrity (whether treatment was delivered adequately and as intended) and treatment discrimination or specificity (whether techniques from other therapies were included) is important to validate and translate the intervention. Methods include specifying the techniques and the condition to be treated, standardising these in a manual and testing the therapists' abilities.[106–109] Poor integrity may be associated with poor outcomes and study hypotheses cannot be validly tested.

In our systematic review, only two RCTs in adults with type 1 diabetes reported using a manual.[110,111] Three RCTs assessed treatment fidelity. Halford and colleagues[110] videotaped the treatment sessions for adherence to the treatment manual procedures, but the results were not reported. Didjurgeit and colleagues[102] stated that the therapist was supervised by one of the co-authors. In Van der Ven and colleagues,[111] one of the authors observed the intervention and control group sessions through a one-way mirror.

Assessment of moderators (predictors)

The joint report by the Department of Health (DoH) and the Medical Research Council (MRC) and the MRC framework for evaluating complex interventions identified a need for theory-based research to identify key moderators and mediators of different behaviours associated with optimal and sub-optimal glycaemic control.[112,113] We identified two studies that attempted a moderator analysis.

Glasgow and colleagues[104] found no significant correlations between baseline variables (sex, age, education, duration of diabetes, insulin taking, type of diabetes, number of comorbid chronic diseases, perceived barriers and perceived importance to dietary self-care, perceived seriousness of disease, subjective desire for involvement in diabetes management) and glycated haemoglobin at 3 months.

Didjurgeit and colleagues[102] found that their intervention was more effective for those with high (> 8.0%) baseline HbA_{1c} levels 6 months later, but they did not adjust for baseline differences in HbA_{1c}.

Health professionals as therapists

Conventionally, psychological treatments are delivered by mental health professionals who have had training of varying intensity and quality depending on the type of therapy being offered. There are several problems for using the conventional mental health therapist in the chronic disease seeing. First, it tends to be too costly and, with the increasing prevalence of certain conditions such as obesity, diabetes and cardiovascular disease, there are insufficient numbers of therapists to meet the need. Second, the therapist may not be sufficiently knowledgeable of chronic disease and its manifestation to help the patient tackle disease-specific cognitions and behaviours, although this can be overcome with experience. A diabetes specialist on the other hand is already delivering a care package, and adding skills may be a better use of resources and relational continuity. Third, the patient may have additional concerns about seeing mental health experts or being stigmatised especially as he or she may appraise his or her difficulties as a consequence of having to live with a chronic condition rather than a separate mental health problem and, anecdotally, patients prefer to have all their care within one setting.

A model for psychological treatments for adults with type 1 diabetes

Based on this review and clinical experience, we developed two manual diabetes-specific psychological interventions which included elements of motivational enhancement therapy (MET) and CBT technique that targeted beliefs and behaviours that maintained poor glycaemic control.

The rationale for conducting an RCT of psychological treatments to improve glycaemic control is justified on the following grounds: sub-optimal glycaemic control in adults with type 1 diabetes is a common problem despite the patient's and the diabetes team's best endeavours; and it is associated with multiple psychological problems (depression, anxiety, eating problems and diabetes-specific coping problems), increased morbidity and mortality, and reduced quality of

life. A systematic synthesis of RCTs of psychological treatments to help people improve their diabetes self-care and subsequently their diabetes control found that the evidence for their effectiveness in improving glycaemic control was limited, but the explanation for this may be due to methodological limitations in reducing biases, and the nature and validity of psychological techniques. The lack of psychotherapists trained in diabetic medicine limits the availability for people with diabetes, but there is potential to increase the skills of diabetes professionals which has not been evaluated.

Two psychological treatments widely practised are MET and CBT.

Motivational enhancement therapy

Definitions

The principles and theoretical background of MET are based on MI. MI is defined as a brief client-centred, directive method of enhancing intrinsic motivation to change by exploring and resolving ambivalence focusing on the three key components of motivation: readiness, willingness and ability to change.[114]

In its original format, MI is a brief intervention usually consisting of one session lasting for about 1 hour. MET is a four-session adaptation of MI which was developed for a multicentre trial for the treatment of alcohol abuse and dependence which incorporates assessment feedback.[115,116] In Project MATCH (Matching Alcoholism Treatments to Client Heterogeneity), patients underwent a standardised assessment called the Drinker's Check-Up and feedback (session 2) with follow-up sessions 3 and 6 at 6 and 12 weeks respectively.[86] Modified versions have been developed, for instance, for diabetes (Accu-Chek® developed by Welch)[117] and polydrug misuse[118] and, after the evidence of the effectiveness of MET, MET manuals have also been developed for the treatment of drug abuse and bulimia nervosa.[119]

Theoretical framework

Motivational interviewing and MET are based on humanistic, client-centred, non-directive counselling developed by Rogers in the 1950s.[85] The client-centred philosophy is retained but the style and techniques are directive. MI developed through extensive clinical work but it lacked a theoretical backbone.[120] In order to provide it with a theoretical and research framework it has been linked mainly to four different theories: the dissonance theory,[121] the self-perception theory,[122,123] the self-efficacy component of social learning theory[78] and more recently the transtheoretical model (TTM) of change.[124,125]

Miller and Rollnick[114] applied Festinger's[121] dissonance theory to emphasise the patient's inherent motivation to reduce the emotional discomfort of holding beliefs that do not 'fit' with one another and Bem's self-perception theory to emphasise the key role of motivational self-talking in the context of the therapeutic relationship and how this can help patients to think and behave in ways more consistent with their core values, (and to emphasise) the interplay between cognitions, motivation, emotions and behaviours.[122,123,126,127]

The TTM developed separately from MI and there has been an attempt to fuse the two together.[128] The model was developed for smoking cessation and alcohol problems and it incorporates many theoretical constructs such as self-efficacy and perceived advantages and disadvantages of changing. According to the model's most popular version, individuals change their behaviours by progressing upwards through a spiral following five distinct stages in the following order: pre-contemplation, contemplation, preparation, action and, finally, maintenance. By completing self-report measures,[129,130] individuals can be allocated to the stage at a given point with the assumption that matching the intervention to the stage of change will be more effective than mismatched, action-oriented stages.[131,132]

A considerable amount of research has focused on both the conceptual and empirical problems of the TTM and the doubts about its use as a framework for the process of change during MI and/or MET.[133–135] The main points of criticism focus on the definition and measurement of the proposed stages, the processes that are proposed to facilitate the progression through the stages and the lack of evidence from prospective studies to support the theory's predictions.[136–138] In spite of the criticisms of the TTM, there is face validity for its clinical usefulness as it is a construct that is easily measured and understood by patients.[139]

Self-efficacy is a central construct to the process of change.[133] It is a dynamic construct, bringing together cognitions, behaviour and environmental factors, which reflects the judgements one makes of one's own capacity to carry out a specific action.

The concepts of perceived importance of change and verbalisation of intention to act and action plans[140,141] are also components of models known as social cognition models, such as the protection motivation theory[142] and the theory of planned behaviour.[143] A common criticism of these models is the limited power to explain the intention–behaviour gap.

Evidence for motivational interviewing based therapies

Dunn and colleagues[144] reviewed 29 RCTs in substance abuse, smoking, HIV risk, and diet and exercise. They found that MI-based interventions tended to be more effective in substance use settings than other brief interventions when delivered by non-specialists in substance abuse treatment and when delivered as a prelude or enhancement to more intensive treatment. For other health settings the evidence was inconclusive. Burke and colleagues[139] updated Dunn and colleagues' review and found that MI-based interventions had moderate effects (0.25–0.57) and were equivalent to other active treatments when compared with no treatment or treatment-as-usual groups. Their effects did not seem to fade significantly over time, and higher treatment doses resulted in better study outcomes. Hettema and colleagues[141] conducted a meta-analysis of 72 trials. They concluded that the effect of MI as a standalone intervention tends to be observed early and to diminish over time (within 1 year). When MI is added at the beginning of a standard or specified treatment, its effect tends to persist. Rubak and colleagues[145] found that the combined effect estimates of MI on glycaemic control in diabetes studies were not significant ($n = 243$, effect size 0.43, 95% CI –0.16 to 1.01).

Diabetes studies of MI-based therapies have been varied in their findings. A pilot study of adolescents with type 1 diabetes patients compared a group-based MI/solution-focused intervention with a control group. Results showed that the intervention resulted in a 1.5% improvement in HbA_{1c} at 4–6 months compared with no change in the control group. However, at 7–12 months the improvement was not maintained.[146] More recently, Channon and colleagues[147] conducted a multicentre RCT which allocated adolescents (14–17 years) to receive either four sessions of MI ($n = 38$) or support visits ($n = 28$). After adjusting for baseline HbA_{1c} (mean range 8.8–10.3% for all participants), participants in the MI group at both the 12- and 24-month follow-ups had significantly improved their glycaemic control on average by about 0.6% (SD about 1.8) compared with the support visits/control group. Studies defined as MI techniques in type 2 diabetes have given conflicting results.[148,149]

Cognitive behaviour therapy

Definition

Cognitive therapy (CT) has been defined[87,150,151] as 'an active, directive, time-limited, structured approach used to treat a variety of psychiatric disorders such as depression and anxiety based on the principle that these are largely determined by cognitive representations of the world'. The core principle of CT is that emotions, behaviours and thoughts are inter-related, and changes in one part of this system are going to bring about changes in another. Beck's model of emotion (depression and anxiety) incorporates a developmental perspective while Lang's model focuses on the here and now and the breakdown of the fear response, and is widely used in the treatment of anxiety disorders and phobias.[152–154]

Theoretical framework

The theory suggests there are three interlinked 'levels or layers of cognition': the core beliefs, the assumptions, and the automatic thoughts and images.[87,155] Core beliefs or schemas are stable cognitive patterns that provide a basis for screening out, differentiating and coding the stimuli that confront the individual. Underlying assumptions or conditional beliefs refer to the rules we use to evaluate our experiences, regulate our behaviours and manage the behaviours of others. We are not aware of our 'rule-book' although it applies structure to our day-to-day experiences. Automatic thoughts are easier to identify than core and intermediate beliefs, and have certain characteristics: they 'do not arise as a result of deliberation, reasoning or reflection' their content is idiosyncratic and entirely plausible, and they tend to precede emotions.

The following diabetes-specific example illustrates these three layers of cognition: 'I will become blind' (automatic), 'If I don't manage to bring my blood sugars down I am a failure' (assumption), 'I will never manage to control my diabetes as well as I should' (core schema).

According to Beck we can understand emotions by examining the 'specific content of the

interpretation of an event'.[150] His theory also emphasises the events that trigger certain thoughts and behavioural patterns. In the example above the triggering event may have been a blood test result or a story a patient may have heard at the diabetes clinic. Schemas are relatively 'enduring organising structures' which may be dormant until they are activated by stressful events.[156]

Memory and information-processing biases also influence thoughts and emotions and, at a deeper level, the establishment and role of schemas. These biases can systematically distort the individual's construction of his or her experiences, leading to a variety of cognitive errors, for instance, dichotomous/polarised thinking, overgeneralisation, selective abstraction and magnification. These biases are linked to early life experiences which form personal schemas, basic attitudes or assumptions and core beliefs. Developmental psychology and the body of research on attachment theory[157] on loss and abandonment have informed the establishment of schemas on, for instance, unlovability and failure (such as 'I'm worthless').

In diabetes, enabling patients to make cognitive and behavioural changes to their self-care could help improve their glycaemic control. For example, fears about having a hypoglycaemic episode and perceptions about the degree of control over it (cognition) lead to avoiding appropriate diabetes self-care (behaviour), which leads to sub-optimal diabetic control (physiological). Fearful cognitive responses to previous hypoglycaemic episodes may be reactivated during times of stress.

Evidence for cognitive behaviour therapy effectiveness

The variety of cognitive and behavioural techniques that fall under the umbrella of CBT have face validity in being applied to people with anxieties relating to their diabetes self-care behaviours. CT should be distinguished from CBT. In CBT, the therapist plays a pivotal role in facilitating new experience and behaviour as well as supporting cognitive changes, maintaining clients' awareness of their success experiences and the differences between their present and past functioning.[158] In CT there is less focus on behavioural antecedents and consequences.[159] The aim of CBT would be to enable the patient to identify and modify unhelpful diabetes-specific cognitions and behaviours which may be contributing to sub-optimal glycaemic control.

There have been many reviews that demonstrate that CBT is effective in treating depression[75,160–162] and general anxiety disorder[163] and somatising conditions such as chronic fatigue syndrome.[164] CBT is the treatment of choice for bulimia nervosa.[165]

In a recent Cochrane review there was evidence that CBT may be helpful for patients with asthma.[166] There is also evidence from an RCT of rheumatoid arthritis patients that usual care enhanced by CBT compared with usual care alone can significantly reduce symptoms of depression and joint inflammation.[167]

Our systematic reviews of RCTs of psychological therapies for diabetes found that, while CBT was the most common type of therapy, the range of techniques used were limited and predominantly behavioural or the focus was treating depression.[52,84]

Summary

Cognitive behaviour therapy and MI-based interventions have yet to be fully evaluated in adults with type 1 diabetes. MET and CBT have a number of differences. Very briefly, MET does not explicitly socialise patients into a specific model of behaviour change and it does not introduce thought and activity homework. MET and the creative writing tasks are focused on resolving ambivalence about behaviour change, whereas in CBT a variety of cognitive and behavioural interventions are used to identify, reality test and correct distorted conceptualisations and the dysfunctional beliefs underlying these cognitions.

The literature review appeared to suggest that a period of motivational work may be a pre-requisite for effective CBT.[168] This had clinical validity as, when CBT is delivered as a standalone intervention, its initial assessment phase often includes issues of motivation and ambivalence to change. MET and CBT share common features; both are patient-centred approaches requiring a strong therapeutic alliance aiming to nurture the willingness to change. This novel method of integrating the two approaches has yet to be tested in diabetes settings.

In designing the current trial we trained diabetes nurses to deliver the treatments, as psychologists are a scarce resource in the diabetes setting. We added CBT to MET as one of the interventions

rather than testing CBT alone, as we were aiming to reach a group with persistent problems with diabetes control and likely to be ambivalent about change. The primary aim of this RCT was to determine whether MET + CBT was more effective than usual diabetes care in improving glycaemic control in adults with type 1 diabetes and persistent sub-optimal glycaemic control. The second aim was to assess whether MET was more effective than usual diabetes care in improving glycaemic control.

Chapter 2
Methods

Main aims and objectives

The study project is titled 'A Diabetes and Psychological Therapies Study (ADaPT)'. Our study population was derived from adults with type 1 diabetes. We selected two psychological treatments, MET and CBT, to test in an RCT. The control group was usual diabetes care. The treatments were adapted to be diabetes-specific and were manual. We used a range of diabetes, psychological and economic measures. The main statistical approach was analysis of covariance (ANCOVA) and we also used methods to impute missing data. The main aims were as follows:

1. To test the effectiveness and cost–utility of MET + CBT compared with MET and compared with usual care in helping patients with type 1 diabetes improve their glycaemic control and quality-adjusted life-years (QALYs).
2. To examine the cost-effectiveness of MET + CBT and MET compared with usual care for improving glycaemic control.
3. To identify cognitive, behavioural and biological predictors of glycaemic control.
4. To assess the effectiveness of MET + CBT compared with MET and with usual care in other secondary outcomes (depression, quality of life, diabetes cognitions and diabetes self-care activities).

Hypotheses

The main hypothesis was that MET + CBT would be more effective than usual care at improving glycaemic control in adults with type 1 diabetes at 12 months' follow-up.

The subsidiary hypotheses were that (1) MET would be more effective than usual care at improving glycaemic control at 12 months' follow-up and (2) MET + CBT will be more effective than MET at improving glycaemic control at 12 months' follow-up.

Design

We used a three-arm parallel RCT as the gold standard design to test the effectiveness of psychological treatments. Following randomisation, participants remained in the study for 12 months. We followed the CONSORT guidelines to inform the conduct of the study and in the reporting of the trial.[169]

Setting

ADaPT was co-ordinated by the Clinical Trials Unit, Institute of Psychiatry, King's College London and registered with Current Controlled Trials (www.controlled-trials.com; International Standard Randomised Controlled Trial Number 77044517). The recruiting centres were based in south-east London (King's College Hospital, Guy's and St Thomas' Hospitals, Lewisham University Hospital and Mayday University Hospital) and Greater Manchester (Manchester Royal Infirmary, North Manchester General Hospital and Stockport General Hospital/Stepping Hill Hospital). The advantage of two geographical sites was that this increased the generalisability of the study findings and focused resources in recruitment in high population density areas. According to the Commission for Racial Equality these sites represent some of the most ethnic and socioeconomic diverse populations in England (www.census.gov.uk).

Ethics approval

Approval was obtained from the South-west Multi-Centre Research Ethics Committee, UK (reference 02/6/101) and the ethics committees of all participating centres. A Trial Steering Committee and Data Monitoring and Ethics Committee oversaw the conduct of the study. All participants provided signed informed consent being given a

three-page patient information sheet, a summary leaflet, a face-to-face information giving session and an opportunity to consider with a follow-up telephone call.

Study population, case definition and study criteria

Diabetes mellitus was defined according to the World Health Organization criteria.[170] Participants with type 1 diabetes were recruited between September 2003 and August 2005. The study population consisted of adults (18–65 years) registered as having type 1 diabetes with one previous HbA_{1c} of between 8.2% and 15.0%, identified by the local investigators using the clinic diabetes database and resident within the recruiting hospital's health authorities. As there were variations in the administrative and procedural organisation of patient registers between the study sites, the screening and recruitment methods were adapted to each site.

The target population who were assessed for trial eligibility were adults with type 1 diabetes, defined by (a) onset at younger than 35 years of age and (b) onset of insulin therapy within 6 months of diagnosis or ketones in the urine, for a minimum duration of 2 years and their current (measured at time of screening or 1 week before or after the screening assessment) HbA_{1c} was between 8.2% and 15.0%

Participants were excluded if they:

1. were not fluent in English as this was necessary for psychotherapeutic communication
2. were pregnant or attending a pre-pregnancy clinic
3. had an antidepressant initiated less than 2 months ago to reduce the bias of recovery from depression
4. had an acute or serious medical illness as defined by treating physician
5. had advanced diabetes complications (such as registered blind or serum creatinine values > 300 mmol/l)
6. had known haemaglobinopathy or severe mental disorder; were in psychotherapy or within 3 months of having completed a structured diabetes education programme; or were participating in another trial.

Analysis of glycated haemoglobin

The HbA_{1c} was measured by ion-exchange high-pressure liquid chromatography using the following analysers at each participating clinic: Menarini HA-8140, HA-8121 or HA-8160 (Menarini Diagnostics, Florence, Italy) or Tosoh 2.2 Plus (Tosoh Medics, Foster City, California, USA) or Variant II HPLC System (Bio-Rad Laboratories, Hercules, California, USA) using methodology aligned to the DCCT.

Baseline measures

Prior to randomisation, data on the five following baseline characteristics were collected.

Sociodemographic factors

1. Age at randomisation.
2. Gender.
3. Current employment status was categorised as full-time (more than 30 hours per week), part-time (less than 30 hours per week) or unemployed (student, unemployed, medically retired, retired/redundant or specified other).
4. Current level of education was defined as level of qualifications: none; high school (O-Levels/GCSEs/CSEs); college level (A-Levels/Scottish Highers/technical diplomas or certificates); or university level (undergraduate and postgraduate degrees) qualifications.
5. Self-report ethnicity defined as white, African/Caribbean, Chinese, South Asian (Indian/Pakistani/Bangladeshi) or other.
6. Marital status categorised as single, married/cohabiting, separated/divorced or widowed.
7. Current smoking status defined as non-smoker, ex-smoker or smoker.

Physical status

1. Year of diagnosis of diabetes and duration of diabetes (years).
2. Body mass index [BMI = weight (kg) / height $(m)^2$]: height and weight were measured using clinic equipment which are regularly recalibrated. Weight was measured with the participant wearing only one layer of clothes with empty pockets and no shoes unless he or she had foot plasters and orthotic shoes.

3. Blood pressure: was taken from either the left or right arm while sitting. The first reading was recorded. Clinic electronic sphygmomanometers were used.
4. Peripheral neuropathy was assessed using the 10-g monofilament for both feet. The researchers were trained by clinic foot specialists to carry out this assessment. Absence of sensation in two out of three tests on any of the sites tested was defined as probable presence of peripheral neuropathy. The sites tested were the apex of one, four, five toes and plantar aspect of one, four, five metatarsal phalangeal joints. When this measure could not be conducted, the medical records were consulted to record the last assessment of neuropathy by the diabetes doctor.
5. Retinopathy was coded according to most current assessment recorded by either digital photography (Diabetes Eye Complications Screening facility), if available, or fundoscopy. Assessments were coded by the study diabetologist (SMT) as follows: no retinopathy; treated retinopathy (laser/protocoagulation, vitrectomy and quiescent retinopathy); non-sight threatening retinopathy (background, mild/minimal pre-proliferative and mild/moderate non-proliferative); and sight-threatening retinopathy (maculopathy, moderate and severe pre-proliferative, pre-proliferative maculopathy, non-proliferative maculopathy, at risk of and with clinically significant macula oedema). Patients with cataract were also coded.
6. Microalbuminuria: the albumin–creatinine ratio (ACR) level was assessed by requesting early morning urine samples if these had not been conducted within 3 months of recruitment. Macro-albuminuria is defined as present when ACR levels exceed 2.5 mg/mmol for adult men and 3.5 mg/mmol for adult women.
7. Hyperlipidemia: assessed by checking total random cholesterol (mmol/l).
8. The number of severe hypoglycaemic attacks that required third-party assistance over the last year reported by the patients.
9. Any non-diabetes related health problems reported by the patients were recorded.
10. Participation in a structured education programme: if patients had previously attended a structured education programme such as the DAFNE programme, the date of attendance (month/year) was recorded.

Diabetes-specific psychological factors

1. Fear of hypoglycaemia: this was assessed with the revised Hypoglycaemic Fear Survey (HFS-II)[64,171] which consists of 10 behaviour and 13 worry items. All items are self-rated on a five-point Likert scale ranging from 1 'never' to 5 'always'. The higher the score for the behaviours subscale, the higher the patient's tendency to maintain high blood glucose levels. The higher the score for the worry subscale, the greater the fear about suffering a hypoglycaemic attack.
2. Diabetes self-care behaviours: this was assessed with a subsection of the revised Summary of Diabetes Self-Care Activities.[172] We included items on diet, exercise, blood sugar testing and foot care as well as an additional item on diet under the self-care recommendations section. Patients had to indicate how many days in the last 7 days they had engaged in each of the activities (from 0 to 7 days). Diabetes adherence: we used four items from the Medication Adherence Scale (MARS 5) developed by Horne and colleagues.[173] The items were 'I forget to take my insulin', 'I alter the dose of my insulin', 'I stop taking my insulin for a while', and 'I decide to miss out a dose of insulin', and these were coded by patients on a five-point Likert scale from 'never true' to 'always true' over the past month.

Psychiatric morbidity

These were assessed on the self-report Patient Health Questionnaire (PHQ), designed to screen for depressive, anxiety, somatoform, and eating and alcohol disorders. It has established reliability and validity.[174] The questions on eating were supplemented with a diabetes-specific item; patients were asked whether or not in the last 3 months they have often omitted their insulin injections in order to avoid gaining weight.

Quality of life

This was measured using the core items from the satisfaction and impact subscales Diabetes Quality

of Life (DQoL) originally developed for the DCCT.[175]

Randomisation

Randomisation was conducted by the Clinical Trials Unit at the Institute of Psychiatry, King's College, London. The researchers gave the following information: clinic name and patient initials, hospital number, date of birth and sex. A randomisation list stratified according to centre using minimisation and blocks of random sizes (three, six, nine and twelve) was prepared in advance to ensure a roughly equal number of patients allocated in each of the three arms of the trial while avoiding possible predictability associated with blocks of fixed sizes. If randomised to either the MET or MET + CBT intervention, that participant was assigned to a nurse therapist depending on her availability. One nurse was allocated to the Manchester sites, and at any one time between one and three nurses were allocated to the London sites. Allocation concealment was ensured as the Clinical Trials Unit held the randomisation list in a password-locked computer and a password-locked ACCESS program. Once a participant was recruited, the researcher would contact the Clinical Trials Unit data manager who would only then reveal the allocation to himself and to the researcher. Researchers contacted participants by telephone to inform them of the randomisation allocation, to clarify study participation issues and concerns and to allocate a nurse therapist to those receiving therapy sessions. A standard letter was also sent with the dates of their 3-, 6-, 9- and 12-month follow-ups for the HbA_{1c} blood tests.

Outcome measures

Main outcome

The main outcome was HbA_{1c} at 12 months from randomisation. In addition the HbA_{1c} was measured at 3, 6 and 9 months after randomisation to measure the rate of change in glycaemic control.

In the first instance, we selected a range of subsidiary outcomes at 12 months' follow-up based on balancing the need to minimise multiple testing with capturing the most directly clinically relevant dimensions associated with diabetes control. These were as follows:

1. Biological: BMI.
2. Diabetes-specific beliefs: The Diabetes Specific Health Beliefs-Experience of Treatment and Benefit Barriers; Fear of Hypoglycaemia Questionnaire.
3. Adherence to diabetes self-care: The Summary of Diabetes Self-Care Activities.
4. Psychiatric morbidity: PHQ.
5. Quality of life: the DQOL.

Adverse events

A list of adverse events if and when they are voluntarily reported was compiled. Potential adverse events presently identified include death, psychiatric admission, medical admission, and onset of complication secondary to rapid glycaemic control (painful neuropathy, accelerated retinopathy, hypoglycaemic episodes).

Blinding

At baseline all measures were collected before randomisation. The nurses and technicians who conduct the anthropometry and laboratory analysis were blind to allocation and therefore blind to the main outcome measure of A_{1c} at each time point. All psychological assessments were included in a self-report questionnaire, therefore blinding of participants was not possible. The nature of psychological treatments as a talking therapy means that participants and therapists cannot be blind to their allocation.

Strategies used to maximise follow-up rate

A number of strategies were used to optimise response rates such as reminder telephone calls and letters of blood test and missed appointments; liaising with GPs for blood test and results and changes in contact details; checking hospital registers and local health authorities for changes in contact details; participants who had dropped out of therapy were still contacted for the final follow-up blood test; handwritten personalised Christmas

and birthday cards and newsletters were sent to trial participants.

Adverse events monitoring

All participants were asked about the number of severe hypoglycaemia episodes requiring third-party assistance in the 6 months preceding randomisation and the 6 months preceding the 12-month follow-up. In addition, an open-ended question on any adverse events was asked at each 3-month HbA_{1c} follow-up.

Sample size calculation

This was based on a hypothesised 0.8% difference in HbA_{1c} in the MET + CBT (or MET) group compared with usual diabetes care. We assumed that the SD of the changes was approximately 1.65 based on systematic reviews we had previously conducted.[84] At a power of 90%, a type 1 error rate of 0.05 (two-tailed), a randomisation ratio of 1:1:1 and a 20% drop-out rate, we estimated that a sample size of 339 participants ($n = 113$ in each group) was required.

Statistical analysis

Data were analysed using STATA 9 (Stata, College Station, Texas, USA), R (www.r-project.org) and SAS version 9.1 (SAS Institute Inc, Cary, NC, USA). Baseline characteristics were compared to assess the effectiveness of randomisation. Patients were analysed according to randomised groups, following the intention-to-treat principle. For the primary outcome of 12-month HbA_{1c} we used ANCOVA to estimate the differences in intervention group means, adjusting for the baseline glycated haemoglobin based on those who completed their 12-month HbA_{1c} measurement. We calculated mean within-group changes by subtracting the mean glycated haemoglobin at 12 months from the mean HbA_{1c} at baseline for completers. We repeated this for the intermediate quarterly HbA_{1c} outcomes.

We used logistic regression to estimate the odds for any severe hypoglycaemia episode at 12 months, adjusting for whether participants had any severe hypoglycaemia episodes or not at baseline in each intervention group compared with usual care. We assessed whether 12-month HbA_{1c} varied according to therapist in the intervention arms by fitting ANCOVA models in the two intervention arms, allowing for a therapist effect.

To assess the sensitivity of the results for glycated haemoglobin to missing data, we used multiple imputation to impute missing three, six, nine and twelve measurements.[176] A general location model was used for imputations, assuming multivariate normality for continuous variables and a log linear model for categorical variables, which was fitted using Markov chain Monte Carlo in R.[176] Imputation was performed separately in the three arms and used information from variables associated with missing glycated haemoglobin measurements and those strongly associated with glycated haemoglobin, including ethnicity, employment status, depression, age and, in the intervention arms, whether patients completed their therapy.[177] The distribution of observed HbA_{1c} at follow-up time points was approximately normal, suggesting our imputation model was reasonable.

For the assessment of baseline moderators or predictors of outcome, we used the 'glm' (general linear model) command to fit the ANCOVA models, where 12-month HbA_{1c} was the dependent variable and baseline HbA_{1c} was a covariate. An interaction term between the potential moderator and treatment group was used to estimate effect moderation. The ANCOVA model assumes that the residuals of the model predictive of 12-month HbA_{1c} adjusted for the covariates (baseline HbA_{1c} and the moderators) are normally distributed and that the variance is the same in each treatment group. The 'lmatrix' command was used to estimate the difference in 12-month HbA_{1c} (adjusted for baseline HbA_{1c}) at specific levels of the moderators. The treatment effects are reported for each category of each categorical moderator, such as gender. For continuous moderators the treatment effects are reported at a range of levels. The tests for the interaction between treatment group and moderator were carried out for each of the following three pairs: MET + CBT versus usual care; MET versus usual care; and MET + CBT versus MET. The results are reported in the following format: F-ratio value, degrees of freedom for effect of model, degrees of freedom for the residuals of the model, 95% CIs and p-value. Full details of the statistical analysis plan approved

by the Trial Steering Committee and the Data Monitoring and Ethics Committee are given in Appendix 1.

Delivery of interventions

Prior to randomisation, all participants were given a fact sheet containing the minimum level of diabetes knowledge expected in people with type 1 diabetes as recommended by UK guidelines and were then randomised to one of the following three.

1. Usual care

All participants continued to receive usual diabetes care. Usual care was based on a consensus protocol of minimum standards of diabetes care based on the UK's DoH guidelines with a common aim towards optimal glycaemic control ($HbA_{1c} \leq 7.0\%$) with no problematic hypoglycaemia.[6]

2. Motivational enhancement therapy

Motivational enhancement therapy consisted of four individuals sessions lasting 50 minutes over a 2-month period. We developed a diabetes-specific MET manual for therapists and an accompanying patient workbook based on MI techniques. The first session was a standardised computerised self-assessment of diabetes relevant behaviours (exercise, smoking, diet, diabetes medication, blood testing) followed by feedback and an assessment of the rating of the level of importance, confidence, and readiness to change based on the Accu-Chek Interview.[117] In the remaining sessions, nurses used the patient workbook, tailoring it to the individual. A menu of diabetes-focused writing tasks was offered, aimed at helping patients explore their ambivalences about change and strengthening their argumentation in favour of change.[178–180] In the final session, a collaboratively completed change plan was negotiated tailored to individual need and level of motivation.[114,181]

3. Motivational enhancement therapy and cognitive behavioural therapy

Participants were offered 12 sessions over 6 months in addition to their usual care. The first four sessions were individual MET sessions lasting 50 minutes over a 2-month period as described above.

The second eight sessions were individual CBT sessions for a further 4 months. We developed a diabetes-specific CBT manual for patients based on Lange's three systems' model and Beck's cognitive model of emotional disorders.[151,152] For each patient, a collaborative individualised programme was developed and structured around agenda setting, homework planning and feedback. Techniques used included: normalising dietary-, exercise- and lifestyle-related behaviours; anxiety, worry and stress management; challenging diabetes-specific negative automatic thoughts; improving impulse control; behavioural experiments; activity scheduling; strategies for eliciting social support; and assertiveness training.

The initial phase involved a formulation, goal setting and socialisation of the patient to the CBT model.[182] In the first session a CBT assessment was completed. An idiosyncratic formulation of the patient's problem was shared with the patient and included diabetes-specific cognitions relating to their self-care which may have been maintaining high blood sugars. In keeping with the developmental model, early life experiences and events around diagnosis were identified which may have been important in maintaining unhelpful coping behaviours.

The middle phase involved utilising a number of cognitive and behavioural strategies to improve glucose control. This overlapped with the end phase where unhelpful rules and assumptions were elicited to prevent relapse. Techniques used included: normalising dietary-, exercise- and lifestyle-related behaviours; anxiety, worry and stress management; challenging diabetes-specific negative automatic thoughts; improving impulse control; behavioural experiments; activity scheduling; strategies for eliciting social support; and assertiveness training. End-of-treatment goals were reviewed and a relapse blueprint (or plan) highlighting high-risk situations was developed collaboratively between the nurse and the therapist. The overall aim was to help patients consolidate any gains they had made and potentially generalise aspects of the therapy to future situations.

Protocol changes

We made changes to the protocol that was submitted for funding. All changes were approved by the Trial Steering Committee and given ethics approval.

1. Minimum age for participate in the study increased from 16 to 18 years.
2. The minimum duration of type 1 diabetes at recruitment was increased from 1 to 2 years to reduce the bias of a protracted honeymoon period during which there is fluctuation in pancreatic insulin secretion and exogenous insulin administration.
3. Upgrade to minimum level of disease on entry into the trial. Patients were screened for end-stage diabetes-related complications and serious health problems.
4. We added excluding women who were actively receiving medical help in planning to become pregnant during the trial as this requires intensive input from the diabetes health-care team. We clarified that we did not withdraw participants who become pregnant during the trial unless there was a medical reason to do so.
8. We did not assess perceived social support from health professionals at baseline as the questionnaire was too long.
9. It was not possible to measure total dose of insulin every 3 months. Dosage, type of insulin and number of injections per day were assessed at baseline, and at 6 and 12 months. We replaced social support at 6 months with an assessment of psychological well being (General Health Questionnaire-12)[183] and items from the Summary of Diabetes Self-Care Activities Questionnaire[172] in order to potentially test any process effects of health technologies on glycaemic control.

Chapter 3

The training programme

Introduction

To the best of our knowledge, there was no formal training programme for teaching general nurses psychological skills that are specific to diabetes. We recruited six nurses and developed a training programme for the purposes of ADaPT. A key component was to assess the nurses competency and ensure this was deemed satisfactory prior to and during the delivery of MET and CBT. We established that general nurses can be trained to deliver a range of diabetes-focused psychological techniques.

Training programme

Six nurses were recruited and trained to deliver the study interventions. Three nurses were H Grade diabetes specialist nurses (DSNs) with experience as DSNs for 4–10 years prior to joining the study. The fourth and fifth nurses collectively had previous working experience in eating disorders and nutrition, community rehabilitation and family planning. The sixth nurse was a CBT nurse therapist who had extensive experience in working with type 1 and 2 diabetes, she was also the main CBT supervisor for the study and trained in MET. All nurses were based in London except one H Grade DSN who saw all patients recruited in the Manchester area. We aimed to develop a training programme that was brief, focused on skills transferable to primary and secondary care settings and with components that would ensure competency and adherence to the study protocol.

Nurses underwent training in MET and CBT simultaneously and in parallel. Training in each of the therapies included a 2- to 5-day course followed by self-directed learning and regular supervision and coaching. This ensured that nurses were given a holistic training incorporating theory, practice and reflection.

Training also involved studying written material and the trial manuals, watching standard MI video training tapes, scoring session transcripts and role play. Each nurse was assigned a caseload of 10–11 practice patients with type 1 diabetes and sub-optimal glycaemic control in keeping with the study population. Supervisors gave feedback on audio-taped sessions and at least one videotaped session. Competency levels were reached before the onset of trial recruitment using the Motivational Interviewing Treatment Integrity (MITI)[184] Rating Scale and the Revised 12-item Cognitive Therapy Scale (CTS-R).[185]

During the training programme, nurses attended weekly individual and group supervision sessions, using video conferencing to include the nurse based in Manchester and this continued during the trial.

Nurses were trained specifically in the following skills:

- Basic psychotherapy skills, such as an ability to communicate and empathise with people from different backgrounds, using a non-judgemental approach during all interactions.
- Assessing the burden of diabetes and the presence of depression using the Accu-Chek.
- Being able to reflect on their interactions with patients and having the ability to recognise and keep to appropriate boundaries.
- MET skills in how to use complex and simple reflections to demonstrate warmth and empathy while attending to patient levels of motivation and self-efficacy; refrain from confronting and criticising; attend to signs of change; and strengthen the alliance by agreement of tasks and therapy goals.
- Assessment of suicide risk and signs for deteriorating mental state.
- CBT techniques taught to the nurses included identifying and evaluating negative automatic thoughts, developing alternatives to unhelpful rules and assumptions, behavioural experiments, activity scheduling, continuums, responsibility pie charts, examining advantages and disadvantages of different types of coping, anxiety management, assertiveness training with role play and problem solving. We involved significant others when appropriate. Nurses were trained in how to structure each

session. This involved agreeing an agenda, reviewing homework, summarising previous sessions and creating a bridge with the current session and reverting to their MI style when resistance interrupted the process of change.
- Studying a written curriculum of key texts and landmark papers and the trial protocol, watching standard MI video training tapes, scoring session transcripts and role play.
- A training caseload of 10–11 patients with type 1 diabetes and sub-optimal glycaemic control who were similar to the trial participants, but not participating in the study. Supervisors gave feedback on audio-taped sessions and at least one video-taped session.
- Skills needed in participating in clinical supervision (see below).

Clinical supervision during conduct of the study

During the training programme, nurses attended weekly group and individual supervision sessions including the use of video conferencing and telephone supervision to include the nurse based in Manchester. As the skills of the nurse therapists and their case loads increased, weekly individual supervision eventually replaced the group sessions. Nurses prepared for supervision choosing a specific difficulty or question (supervisory road map).[186,187] The supervisors modelled reflective practice and nurses were asked to listen to their own audio-taped therapy sessions and to reflect on their strengths and weaknesses. Informal peer supervision and support contributed towards the development of their skills. The aim was to help them develop the ability to think more about the process of change. Nurses' beliefs about their patients and the therapy were explored to highlight their own contribution to the session and enhance a deeper sense of knowledge of the CBT techniques. We supported them to resist the 'righting reflex'[114,120] which would normally enable them to provide advice and education on improving glycaemic control.

Assessing treatment fidelity

There are many different methods and techniques for the assessment of treatment fidelity. We developed a framework using the following steps:

Measures of competency

We selected measures that could measure qualitatively whether treatment was being delivered competently according to our training manuals. The measures had to have appropriate reliability and validity for the assessment of treatment fidelity. We used the second version of the MITI, the first page of the second version of the MI Skill Code (MISC) and the CTS-R.[185,188] We included the MISC to capture dimensions of therapeutic alliance found in both interventions. All three measures are user friendly and have satisfactory reliability and validity.[189] Raters were also asked to 'guess' whether the tapes they were rating were MET or CBT.

Identifying the sessions to rate

Different studies have used different sessions to assess competency depending on the purpose of each study, but choosing different sessions would make it difficult to remove the effect of continuity of care as a bias so we opted for defining numbered sessions.

We selected a numbered session in MET that would, in face validity, overcome the 'settling in period', capture a therapeutic alliance that should by now be established and being maximally utilised to bring about behaviour change. The first MET session included the Accu-Chek assessment and the fifth session in MET + CBT was an assessment session. The third session of MET (from both the MET only and the MET + CBT groups) was identified as probably the most representative of MET. Likewise, the seventh session in the MET + CBT group (which is the equivalent of the third session of CBT) was chosen as this was most likely to be when the formulation was being discussed, agenda and homework techniques were being familiarised, and goals were being set. We considered that later sessions were more likely to be missing as patients dropped out as therapy progressed.

Method for selecting sessions

We used the principle that random selection of tapes would ensure the minimum of observer and investigator bias in the assessment of therapy. A random sub-sample of the available tapes was picked using a custom written STATA program by Jonathan Bartlett (trial statistician). Tapes that were inaudible (checked by the author) were replaced. We aimed to sample an equal number

of MET and CBT tapes, with 50% of the MET tapes from the MET group and 50% from the MET + CBT group. We sampled tapes from the six nurses in proportion to their patient load, that is in proportion to the amount of therapy they delivered. Each rater rated 50% of the tapes. Raters were not given two tapes from the same patient for rating. Allocation of rater to tapes was made using minimisation to ensure balance with respect to nurse and treatment group. The systematic sampling approach ensured balance between rater and treatment group, rater and nurse, and as best as possible nurse and treatment group. Every audio-taped session lasted approximately between 40 and 60 minutes. The raters listened to a selected 20-minute segment from the middle of the tape to complete the MITI. The first 10 minutes were not included to increase the potency of the rated section.[107] For the CTS-R and the first page of the MISC, the raters listened to the entire taped session. We estimated that every tape would take 2 hours to listen to and rate.

Assessment of inter-rater reliability

Two clinical psychologists were recruited and trained to use the three selected measures as recommended by the authors of the rating manuals. They attended training sessions in both MET (with Professor Janet Treasure) and CBT (with Professor Trudie Chalder), although the training focused mainly on MET principles and techniques as both raters were already competent in CBT.

They were given the two gold standard transcripts based on two fictional patients named 'Ponytail' and 'Rounder' and standard MI training audio-tapes.[190] They scored the transcripts and compared their responses to the scored versions. In addition they scored sections of other standardised transcripts and rated two randomly selected MET and CBT diabetes sessions to practise recognising and rating behaviours within the diabetes context.

We asked raters to rate the same audio-tapes to enable assessment of their agreement and reliability. This was carried out initially for 10 randomly selected tapes with the possibility of rating more following unsatisfactory agreement. To ensure drifting did not occur, raters met with either of the two trainers to discuss their rating scores on a weekly basis. Two-hour sessions were needed to train the raters to use the CTS-R. Four hourly sessions were needed to train them to use the MITI and MISC rating documents.

Statistical analysis

Data was analysed using SPSS, version 15, and STATA. To assess inter-rater reliability, intra-class correlation coefficients (ICCs) were estimated using a one-way analysis of variance (ANOVA) model for each of the measure's components, initially using the tapes rated in the inter-rater reliability stage. The ICC estimates the proportion of variability in observed scores that is due to genuine between-tape differences, as opposed to differences between raters. We report ICCs estimated using all tapes, as the batch of 40 tapes rated contain information about between-tape variability. The internal reliability of all three scales was estimated using Cronbach's alpha coefficient. Approximate 95% CIs were found using bias-corrected bootstrap resampling.[191]

We used the 40 tapes rated after the inter-rater reliability stage to investigate differences due to therapy type, rater, and therapist. To compare whether scores differed between MET and CBT tapes we used a two-sample *t*-test with allowance made for unequal variances in the two groups. Similarly, *t*-tests were used to test whether mean scores differed between the two raters. A one-way ANOVA model was used to test whether scores differed depending on the therapist delivering the therapy.

The measures used were ordinal and their distributions sometimes skewed. Although the *t*-test and ANOVA assume normality, the *t*-test has been shown to be robust in small samples for ordinal data with a small number of levels.[192] To assess whether our results were robust to the normality assumptions, we reran our analyses using the non-parametric Mann–Whitney *U*-test and Kruskal–Wallis ANOVA, the results of which were very similar to those from the *t*-tests and conventional ANOVA.

Results

One hundred and four (88.9%) and 83 (78.3%) participants attended the third sessions in the MET and MET + CBT treatment groups respectively and 70 (66.0%) from the seventh session in the MET + CBT group only (*Figure 1*). We randomly selected a total of 72 tapes, of which 55 were usable, 17 (23.6%) were unusable due to poor or no sound. Fifteen of the 55 tapes were used for the inter-rater agreement stage.

Scale reliability

All scales had very good reliability. The estimated Cronbach alpha for the MISC Global Therapist Rating Scales was 0.87 (95% CI 0.77 to 0.92) ($n = 40$) and for the Global Client Rating Scales it was 0.87 (95% CI 0.65 to 0.95) ($n = 40$). The estimated CTS-R alpha was 0.84 (95% CI 0.72 to 0.91) ($n = 37$).

Inter-rater reliability

The raters achieved satisfactory inter-rater reliability after 15 tapes. Using all rated tapes, the estimated ICC for the empathy and understanding component of the MITI was 0.61 (95% CI 0.13 to 0.88), while for the spirit component it was 0.76 (95% CI 0.42 to 0.89), indicating relatively good reliability. The reliability of some of the behaviour counts was poor [number of MI adherent behaviours ICC 0.14 (95% CI 0 to 0.58)], while for some it was good [giving information ICC 0.93 (95% CI 0.78 to 0.98)]. For the MISC the estimated reliability was generally good, with the estimated ICC for collaboration of 0.70 (95% CI 0.25 to 0.90).

For the CTS-R, while some components had good reliability [agenda setting ICC 0.84 (95% CI 0.64 to 0.94); pacing and efficient time use ICC 0.79 (95% CI 0.45 to 0.96); conceptual integration ICC 0.85 (95% CI 0.57 to 0.95); total CTS-R ICC 0.66 (95% CI 0.04 to 0.89)], others had poor reliability, such as eliciting and planning behaviours [ICC 0.26 (95% CI 0 to 0.78)] and eliciting key cognitions [ICC 0.42 (95% CI 0 to 0.83)].

Raters correctly identified MET sessions 70% of the time (21/30) and CBT sessions 96.7% of the time (29/30). Thus 30% of the MET sessions were thought to be CBT whereas only one CBT session was incorrectly identified as MET.

Using the 40 tapes rated following the inter-rater reliability stage there was evidence of systematic rater effects on certain measures, meaning that one rater consistently rated higher than the other. The effects were statistically significant ($p < 0.05$) for two of the MISC components (affect, genuineness/congruence), the following MITI behaviour counts (giving information, simple and complex reflections), and the following CTS-R items (items 4, 6, 7, 8 and 11; see *Table 2*).

Treatment fidelity

The mean (SD) MITI scores for the MET and CBT tapes are shown in *Table 1*. There was evidence of allegiance to the prescribed intervention. There was evidence of more empathy/understanding and MI spirit (range 1–7) in the MET tapes than in the CBT tapes. We found no evidence that simple and complex reflections or open and closed questions occurred more frequently in MET than in CBT. As expected, there was evidence that more MI-adherent behaviours occurred in MET than in CBT. The mean (SD) reflection-to-question ratio was 1.8 (0.9) and the mean (SD) of complex reflections was 63.6% (11.5%).

The mean (SD) CTS-R scores for the CBT and the MET tapes are shown in *Table 2*. The mean total CTS-R score for the CBT was greater than for the MET tapes. As expected, CBT had higher scores for eliciting of key cognitions, higher conceptual integration and application of change methods (the CTS-R components most specific to CBT) than MET, although MET had higher collaboration.

The mean (SD) therapeutic alliance scores as assessed with components of the MISC scale for the CBT and MET tapes are shown in *Table 3*. There was no evidence that MET tapes differed from CBT tapes on all but three of the components. There was evidence of higher mean empathy and acceptance demonstrated by the therapist and patient–therapist collaboration in the MET tapes than in the CBT tapes.

Nurse effects

We had evidence that nurses varied in terms of specific components from the three measures. We found evidence of a nurse effect for the 'spirit' component of the MITI ($p = 0.025$). From the CTS-R there was evidence of a nurse effect for only the item on giving feedback (item 2; $p = 0.005$). In addition we found nurse effects for the MISC components on disclosure ($p = 0.013$) and genuineness ($p = 0.045$).

Discussion

The ADaPT study demonstrated that general medical nurses can be trained to clinically satisfactory levels of competency in psychotherapy skills based on MET and CBT.

Motivational enhancement therapy and CBT had shared and specific techniques. They shared techniques of pacing and use of time, eliciting

TABLE 1 *Mean (SD) MITI components scores for MET and CBT tapes and* p*-value for test of difference in means*

	Mean (SD)			
MITI components	**MET tapes, *n* = 20**	**CBT tapes, *n* = 20**	***t*-statistic**	***p*-value**
Global ratings				
Empathy/understanding	5.1 (0.7)	4.6 (0.8)	2.24	0.019[a]
Spirit	4.6 (1.0)	3.4 (1.1)	3.37	0.002[a]
Behaviour counts				
Giving information	3.5 (3.7)	2.9 (3.2)	0.59	0.56
MI adherent	3.3 (2.7)	1.9 (1.3)	2.07	0.047[a]
MI non-adherent	0.6 (1.1)	1.8 (2.7)	–1.84	0.08
Closed questions	8.8 (4.6)	8.6 (5.4)	0.15	0.87
Open questions	7.2 (3.3)	8.7 (6.3)	–0.93	0.36
Simple reflections	8.3 (2.2)	7.4 (5.1)	0.68	0.50
Complex reflections	15.2 (5.1)	13.8 (5.8)	0.80	0.43
Total reflections	23.6 (5.4)	21.2 (7.2)	1.19	0.27

Ranges of values per global items 1–7.

TABLE 2 *Mean (SD) CTS-R items and total score for MET and CBT tapes and* p*-value for test of difference in means*

	Mean (SD)			
CTS-R components	**MET tapes, *n* = 20**	**CBT tapes, *n* = 20**	***t*-statistic**	***p*-value**
Item 1: Agenda setting	3.2 (1.2)	3.8 (1.3)	–1.56	0.13
Item 2: Feedback	4.6 (0.7)	4.5 (0.7)	0.43	0.66
Item 3: Collaboration	4.7 (0.6)	4.1 (1.0)	2.17	0.038[a]
Item 4: Pacing and efficient time use	4.7 (0.7)	4.3 (1.1)	1.21	0.24
Item 5: Interpersonal effectiveness	4.7 (0.6)	4.4 (0.8)	0.95	0.35
Item 6: Eliciting emotional expression	3.9 (1.1)	4.2 (1.1)	–0.79	0.43
Item 7: Eliciting key cognitions	3.3 (0.9)	4.4 (1.0)	–3.66	0.001[a]
Item 8: Eliciting and planning behaviours	4.2 (1.0)	4.5 (0.7)	–1.22	0.23
Item 9: Guided discovery	4.2 (0.7)	4.5 (0.7)	–1.56	0.13
Item 10: Conceptual integration	3.7 (0.7)	4.4 (0.7)	–3.21	0.003[a]
Item 11: Application of change methods	3.7 (0.9)	4.4 (0.9)	–2.63	0.012[a]
Item 12: Homework setting (*n*=18)	3.1 (1.2)	3.8 (1.4)	–1.65	0.11
Total CTS-R score (range 0–72) (*n*=19)	47.8 (5.0)	52.1 (7.5)	–2.06	0.048[a]

Ranges of values per CTS-R components are 1–6.

of emotional expression and interpersonal effectiveness, and pragmatic use of open and closed questions and of simple and complex reflections.

The two therapies were broadly distinguishable in that practically all CBT and 70% of the MET sessions were accurately recognised as such. MET as expected included more MI-adherent behaviours and CBT included more CBT-relevant techniques such as eliciting key cognitions and application of change methods. Overall, for the group that received MET + CBT it appeared that a more accurate description of what was delivered was that

TABLE 3 *Mean (SD) MISC components for MET and CBT tapes and* p*-value for test of difference in means*

MISC components	Mean (SD) MET tapes, *n* = 20	Mean (SD) CBT tapes, *n* = 20	*t*-statistic	*p*-value
Global Therapist Rating Scales				
Acceptance	5.3 (0.7)	4.4 (0.8)	3.97	<0.005
Egalitarianism	4.8 (0.8)	4.2 (1.1)	1.82	0.08
Empathy/understanding	5.1 (0.7)	4.6 (0.8)	2.45	0.019
Genuineness/congruence	5.2 (0.6)	5.0 (0.8)	1.06	0.29
Warmth	4.9 (0.7)	4.7 (0.7)	1.10	0.28
Global Client Rating Scales				
Affect	5.2 (0.9)	4.7 (1.2)	1.30	0.20
Co-operation	5.3 (1.2)	4.9 (1.2)	0.95	0.35
Disclosure	5.4 (0.7)	5.1 (1.2)	0.79	0.43
Engagement	5.2 (1.2)	4.7 (1.2)	1.34	0.19
Global Interaction Rating Scale				
Collaboration	5.1 (1.0)	4.5 (0.9)	2.08	0.044

Ranges of values per MISC components are 1–7.

CBT was combined with MET rather than being completely separate from it.

Previous research on MI skills[193,194] assessed with the MITI and the MISC show that MI experts exceed the five-point level on the seven-point (range 1–7) Likert rating scale for the MISC global dimensions such as acceptance and egalitarianism, and have a reflection-to-question ratio > 2 and a percentage of complex reflections > 50. In our study the mean MISC global dimensions for the MET tapes ranged from 4.8–5.3. The mean reflection-to-question ratio was close to 2 and the mean percentage of complex reflections was above 60. Our results show the nurses were above average in almost all MITI and MISC components. Our findings are similar to the skills scores obtained in a trial of MET delivered by trained clinicians in the field of substance abuse.[106]

Previous research has suggested that the cut-off point for competency in CT/CBT using the CTS-R is 39.[195] As the nurses scored a mean of 52.1 with an SD of 7.5, we can assume they probably delivered CBT skilfully.

The assessment of fidelity is further strengthened for the following reasons. First, the statistical program we used to select the subset of the audio-taped sessions for the inter-rater and treatment fidelity assessment ensured that the results are likely to be representative of the therapy delivered throughout the trial. Second, the raters were blind to the intervention being delivered. We rated a total of 40 tapes (around 20% of all the approximately usable 80% of third MET and seventh CBT sessions). Because of the sampling scheme used to select taped sessions (balanced with respect to rater/therapy type), observed differences between therapy types are less likely to be due to rater differences. Similarly, differences between therapy types are unlikely to be confounded by nurse differences (therapy type and nurse factors were reasonably balanced by design). The estimated ICC for the total CTS-R score was similar to the Pearson's product moment correlation ($r = 0.67$) reported by Reichelt and colleagues[196] who trained cognitive therapy supervisors to use the CTS-R to rate cognitive therapy video-taped sessions. The ICCs for the two global MITI components in our study were more satisfactory than those published by other researchers in the field. Moyers and colleagues[188] obtained ICCs of 0.52 and 0.58 for the 'empathy/understanding' and 'spirit' items respectively, although this could be due to greater variability in treatment delivery, and half of the ICCs for the behaviour counts in our trial were also similar.

The ICC did not have uniformly acceptable values across all MI and CBT domains. The ICC for the number of MI adherent behaviours was low and

for CBT, eliciting and planning behaviours and eliciting key cognitions was borderline low. This raises the question as to whether longer training, enhanced training or more careful selection of health professionals could have demonstrated better ICCs and larger effects on glycaemic control. The sample of six nurses was not a representative sample of diabetes nursing, they are likely to have self-selected as being more psychologically aware, although this is not the same as being more skilled in psychological care. These caveats suggest that further study of the training required and the level of competency that needs to be achieved to elicit the largest effect is needed.

There is no standardised consensus on fidelity assessment, therefore we designed our own approach for this RCT. In view of resources and project milestones we developed an initial protocol to allow us to assess fidelity within the resources and project milestones. Our results may have been affected by the sessions and the session segments we chose to rate. Carroll and colleagues[197] rated all their MI and standard treatment taped sessions with the help of 15 independent raters. Also, as the raters rated more tapes it is possible they became unblinded through recognition of the voices of the therapists. Rating more tapes may have increased the power to detect further differences between MET and CBT and also examine differences between MET delivered in the MET only and the MET + CBT groups. Finally, the statistical power needed to detect such differences was limited for some components by their low inter-rater reliability. If raters had used transcripts of the sessions as well as the audio-tapes, reliability may have been higher and further differences may have been found. Further work in this area is ongoing and clearly needed in order to best inform the interpretation of this study and modifications to the next generation of technologies.

Chapter 4
Results

This chapter summarises the CONSORT chart and the baseline characteristics of the ADaPT sample. One thousand six hundred and fifty-nine patients with type 1 diabetes were screened from clinic registers and 344 were randomised to usual diabetes care ($n = 121$), MET ($n = 117$) or MET + CBT ($n = 106$). The average age was 36.4 years (SD 10.3), the average duration of diabetes was 18.5 years (SD 9.8) and the average glycated haemoglobin (HbA_{1c}) was 9.6% (SD 1.2). Sixty per cent were female, 80.2% were white and 63.2% were employed. The prevalence of depressive syndrome and anxiety syndrome was 29.3% and 13.0% respectively. More than 80% of the participants in the MET group attended all four allocated sessions compared with 56% in the MET + CBT group who attended all 12 sessions. The 12-month follow-up for glycated haemoglobin was 88.0% ($n = 305$).

Trial CONSORT diagram

We identified a target population of 1659 potentially eligible patients of adults (age 18–65 years) with a probable diagnosis of type 1 diabetes who had at least one HbA_{1c} in the previous year between 8.2% and 15.0% (*Figure 1*). A third ($n = 578$) refused to consent to screening (having their current HbA_{1c} checked) or their eligibility status could not be completed due to clinic non-attendance and appointment cancellations. A total of 1081 patients underwent further screening. We excluded patients ($n = 574$) who did not meet our case definition of type 1 diabetes (type 2 diabetes patients, gestational diabetes, latent autoimmune diabetes in adults, maturity-onset diabetes of the young), and people with type 1 diabetes who fell into one of the following categories: current HbA_{1c} of lower than 8.2%, or diagnosed within the previous 2 years and aged over 35 years at the time of diagnosis.

There were 507 patients with persistent sub-optimal glycaemic control diagnosed with type 1 diabetes in the previous 2 years and aged over 35 years at the time of diagnosis who constituted the eligible sample, and these were fairly proportionately distributed amongst the sites (*Table 4*). From these, 344 patients were randomised to MET ($n = 117$), MET + CBT ($n = 106$) and to usual care ($n = 121$).

Baseline characteristics

Sociodemographic characteristics

The baseline characteristics are shown in *Table 5*. There were slightly more females and the majority were in their mid 30s, were in employment and had the equivalent of high school qualifications or above (16 years of age). A fifth came from a non-white ethnic background. The mean duration of diabetes was nearly 18 years (interquartile range 10.6–24.8) and the current mean HbA_{1c} was 9.4% (interquartile range 8.8–10.2). There were no significant statistical differences between the intervention arms for any of the baseline characteristics.

Biological sample characteristics

The biological sample characteristics are shown in *Table 6*. The average duration of diabetes was over 18 years (SD 9.8). The average glycated haemoglobin (HbA_{1c}) was 9.6% (SD 1.2%). The average blood pressure was close to the optimal 120/80 mmHg and the average BMI was 25.9 kg m^2 (SD 4.4). In terms of diabetes-related complications we had some incomplete data. Most participants either had no retinopathy or non-sight threatening retinopathy. Most participants did not have neuropathy. The average random cholesterol was 4.9 mmol/l (SD 1.0). We had data on 187 participants (54%) on nephropathy with the mean ACR at 9.44 μg/mg (SD 38.58); four participants had ACRs above 100 and when their results were excluded the mean ACR remained above 3.0 μg/mg at 5.12 μg/mg (SD 10.87). The majority of the participants did not report any severe hypoglycaemia in the 12 months prior to randomisation. A small number had attended the DAFNE course ($n = 41$) and the majority of these ($n = 38$) were recruited from King's College Hospital.

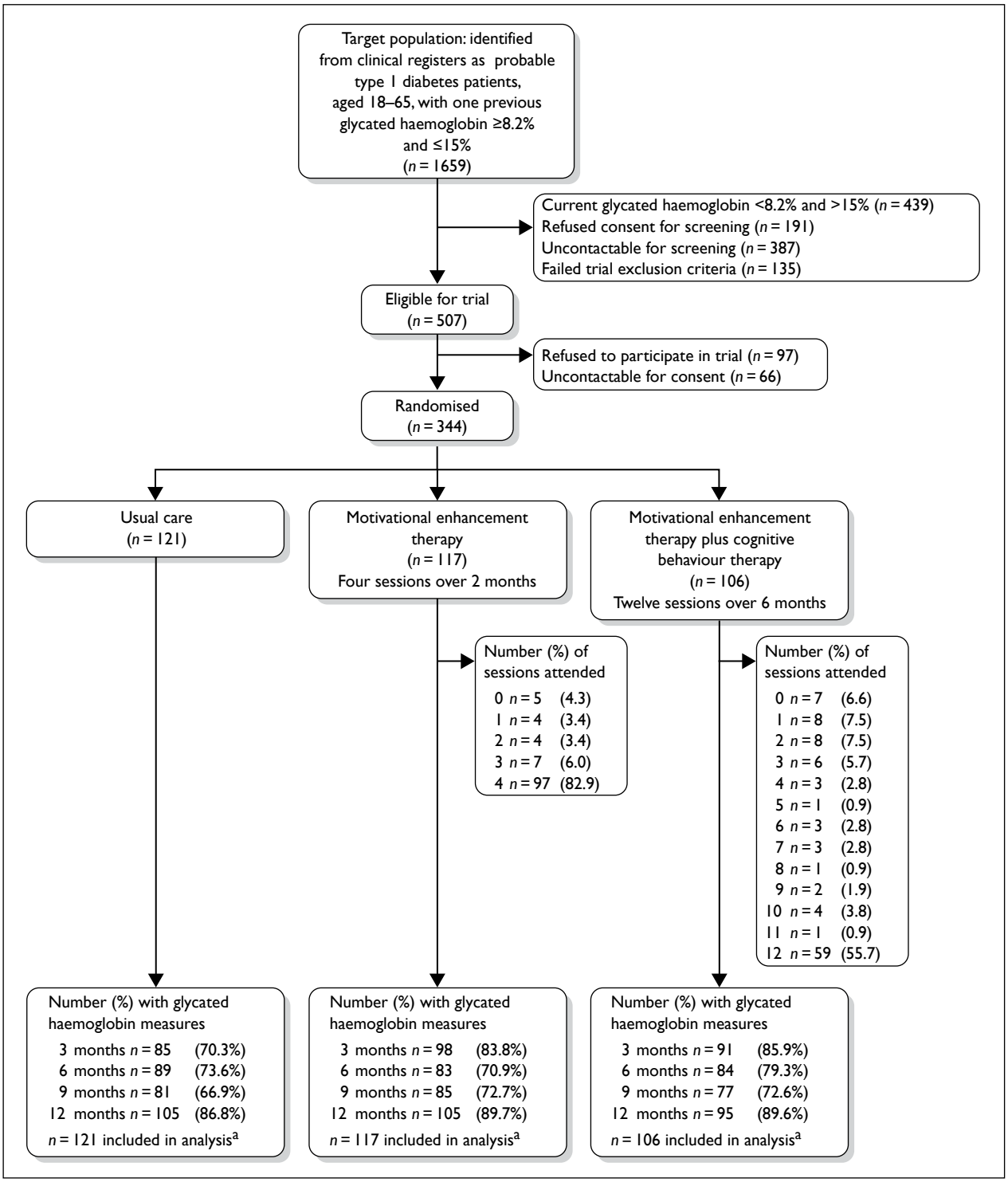

FIGURE 1 *Study flowchart. A primary analysis based on linear-mixed models used data from all participants, as all participants had at least baseline glycated haemoglobin measured.*

Psychological characteristics

The psychological characteristics are shown in *Table 7*. Twenty-nine per cent ($n = 97$) met the criteria for the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) major or other depressive syndrome as assessed with the PHQ. When the PHQ total depression score was treated as a continuous variable (range 0–27) the mean (SD) was 7.7 (6.4). Thirteen per cent met the criteria for

TABLE 4 *Numbers of patients screened for eligibility and subsequently recruited (%)*

Hospital Trusts	Recruitment period (month/year)	Number of patients screened	Number of patients recruited	Percentage of participants per centre
London				
King's College Hospital	01/2004–08/2005	286	85 (29.7)	24.7
St Thomas' and Guy's Hospital	09/2003–06/2004; 11/2003–08/2005	264	79 (29.9)	23.0
Mayday Hospital	11/2004–08/2005	209	42 (20.1)	12.2
Lewisham Hospital	01/2005–08/2005	105	24 (22.9)	7.0
Total London		864	230 (26.6)	66.9
Manchester				
North Manchester General	12/2003–11/2004	178	41 (23.0)	11.9
Manchester Royal Infirmary	02/2004–07/2005	189	50 (26.5)	14.5
Stockport General	12/2004–06/2005	84	23 (27.4)	6.7
Total Manchester		451	114 (25.3)	33.1
Total		1315	344 (26.2)	100

DSM-IV anxiety disorder ($n = 40$) and 6.7% ($n = 23$) reported symptoms indicative of bulimia nervosa or binge-eating disorder. Overall, 4.1% ($n = 14$) answered 'yes' to the question 'in the last 3 months have you omitted your insulin injections in order to avoid gaining weight?'

Participants demonstrated a tendency to maintain high blood sugars in HFS-II. The mean behaviour subscale score was 28.7 (range 10–50). They also reported being moderately worried about their risk of having a hypoglycaemic episode; the mean worry subscale score was 32.5 (range 15–55).

Participants tended to report following diabetes self-care recommendations around half the time as measured by revised Summary of Diabetes Self-Care Activities scale except for foot inspection which averaged at 2 days per week. Nearly a third were current smokers (29.6%, $n = 99$) smoking on average 13.4 (SD 10.7) cigarettes per day.

The three study groups did not differ substantially on any of the sociodemographic, biological or psychological variables presented *Tables 5*–7. All six nurses delivered therapy to both MET and MET + CBT patients and most therapists had a good balance of these patients.

Therapy session attendance

Most participants allocated to either MET or MET + CBT attended at least one session ($n = 211$; 94.6%) (*Figure 1*). The majority of participants allocated to MET (82.9%) attended all four sessions compared with just over half of those allocated to the MET + CBT group who completed all 12 sessions (55.7%). The proportion of patients in the MET + CBT group who completed the MET component was also lower than the proportion of patients in the MET group who completed all their sessions (72.6% versus 82.9%), although not statistically significant [χ^2 (1) = 3.42, $p = 0.08$]. The average duration of MET, calculated from the date of the first session to the fourth, was 9.7 weeks (SD 6.5) and likewise the average duration of MET + CBT, calculated from the date of the first session until the twelfth, was 26.5 weeks (SD 11.0) for those who completed all allocated sessions. It took approximately 1 month longer than anticipated to deliver the interventions [mean 3.0 months (SD 1.8) for MET and mean 6.8 months (SD 2.6) for MET + CBT].

Quarterly follow-up rates for glycated haemoglobin

Participants with missing glycated haemoglobin values at 12 months ($n = 39$) did not differ from

TABLE 5 *Baseline sociodemographic characteristics according to intervention group*

	Intervention group [mean (SD)]		
Sociodemographic measure	**Usual care, *n* = 121**	**MET, *n* = 117**	**MET + CBT, *n* = 106**
Mean (SD) age (years)	36.4 (11.3)	35.6 (9.6)	37.2 (9.9)
Gender			
Female	66 (54.6)	76 (65.0)	66 (62.3)
Male	55 (45.4)	41 (35.0)	40 (37.7)
Marital status			
Married/cohabiting	47 (38.8)	55 (47.0)	56 (53.3)
Single	61 (50.4)	51 (43.6)	38 (36.2)
Separated/divorced/widowed	13 (10.7)	11 (9.4)	11 (10.5)
Ethnic background			
White	104 (86.0)	88 (75.2)	84 (79.3)
Black	11 (9.1)	19 (16.2)	15 (14.2)
Other	6 (5.0)	10 (8.6)	7 (6.6)
Educational status			
Degree and higher	76 (63.3)	64 (56.6)	61 (60.4)
A-Levels[a]	30 (25.0)	32 (28.3)	26 (25.7)
No formal qualifications	14 (11.7)	17 (15.1)	14 (13.9)
Employment status			
Full-time	61 (50.4)	52 (45.2)	58 (54.7)
Part-time	19 (15.7)	11 (9.6)	15 (14.2)
Unemployed[b]	41 (33.9)	52 (45.2)	33 (31.1)

a The A-Levels category also includes the following qualifications: Ordinary National Certificate/Business and Technology Education Council/Highers/O-Levels/General Certificate of Secondary Education and Certificate of Secondary Education.
b Unemployed includes the following categories: student/voluntary work/retired/looking for job/not looking for job.
There are 1, 10 and 2 missing values for marital status, educational status and employment status respectively.

completers ($n = 305$) on baseline characteristics except for employment status, significant others and general health perceptions. In particular, missing HbA_{1c} values at 12 months were not statistically associated with baseline HbA_{1c} ($p = 0.95$). Participants who were unemployed were more likely to not complete their 12-month blood test than those in full- or part-time employment [16.7% versus 8.3% respectively, χ^2 (1) = 5.47, $p = 0.02$]. Participants who attended the final assessment reported on average a significantly higher number of people they felt close to [$t(327) = 1.89$, $p = 0.006$] and better positive general health perceptions [$t(327) = 1.90$, $p = 0.05$] than participants who did not attend. Non-completers were also younger [$t(342) = 1.77$, $p = 0.08$] and suffered from greater role limitation due to physical problems as assessed by the SF-36 (Short Form-36 Health Survey Questionnaire) [$t(334) = 1.97$, $p = 0.06$], but these findings were not statistically significant.

Protocol recruitment violations

After randomisation it became apparent that two study participants did not meet the criteria for type 1 diabetes. One participant was diagnosed with gestational diabetes and later with type 2 diabetes that required insulin therapy. The second participant was diagnosed with steroid-induced diabetes. A third participant who had denied a

TABLE 6 *Baseline biological characteristics according to intervention group*

	Intervention group [mean (SD)/number (%)]		
Biological measure	**Usual care, *n* = 121**	**MET, *n* = 117**	**MET + CBT, *n* = 106**
Duration of diabetes (years)	19.5 (10.4)	17.3 (9.6)	18.7 (9.2)
HbA_{1c} (%)	9.7 (1.2)	9.6 (1.0)	9.6 (1.3)
Body mass index (kg/m^2)	26.0 (4.5)	26.1 (4.4)	25.8 (4.2)
Blood pressure (systolic/diastolic mmHg)	126.7/76.4 (14.7/7.6)	125.6/75.9 (15.3/10.3)	126.8/75.1 (18.3/10.5)
Random cholesterol (mmol/l)	4.8 (0.9)	4.9 (0.9)	5.1 (1.1)
Albumin–creatinine ratio (μg/mg)	5.8 (10.8)	7.0 (21.5)	17.7 (68.9)
Retinopathy			
None	29 (28.7)	32 (32.7)	28 (29.8)
Treated	17 (16.8)	14 (14.3)	18 (19.2)
Non-sight threatening	46 (45.5)	43 (43.9)	36 (38.3)
Sight threatening	9 (8.9)	9 (9.2)	12 (12.8)
Neuropathy			
None	74 (61.2)	73 (62.4)	55 (51.9)
Present	16 (17.8)	21 (22.3)	19 (25.7)
Number of severe hypoglycaemic episodes[a]			
0	75 (77.3)	76 (73.8)	59 (66.3)
1–5	17 (17.5)	21 (20.4)	24 (27.0)
> 5	5 (5.2)	6 (5.8)	6 (6.7)

a Number of severe hypoglycaemic episodes in the 12 months prior to trial entry.
There are 3, 4, 51, 86, 33, 157 and 55 missing values for BMI, BP, retinopathy, neuropathy (by 10-g monofilament), random cholesterol, ACR and hypoglycaemic episodes respectively.

history of serious mental disorder had a relapse of his manic depression and became lost to follow-up. All three patients remained in the study and were included in the analyses.

Mean change in glycated haemoglobin between groups

The mean HbA_{1c} at quarterly intervals in each group is shown in *Table 8*. For the main outcome in the intention-to-treat analysis in those who completed their 12-month follow-up, the 12-month glycated haemoglobin levels adjusted for baseline HbA_{1c} levels were significantly lower in the MET + CBT group ($n = 95$) than for usual diabetes care ($n = 105$) (adjusted mean difference 0.45%, 95% CI 0.12% to 0.79%; $p = 0.008$); non-significantly lower in the MET group ($n = 105$) than for usual care ($n = 105$) (adjusted mean difference 0.16%, 95% CI –0.20% to 0.51%; $p = 0.38$); and non-significantly lower in the MET + CBT group than in the MET group (adjusted mean difference 0.30%, 95% CI –0.07% to 0.66%; $p = 0.11$).

Mean change in glycated haemoglobin within each group

There was a significant reduction in the mean HbA_{1c} from baseline to 12 months within the MET + CBT group (mean difference 0.59%, 95% CI 0.31% to 0.87%; $p = 0.0001$), but not within the MET (mean difference 0.24%, 95% CI –0.04% to 0.52%; $p = 0.10$) or the usual care (mean difference 0.12%, 95% CI –0.10% to 0.35%; $p = 0.28$) groups.

Sensitivity analysis

For the sensitivity analysis, the mean glycated haemoglobin values based on multiple imputed glycated haemoglobin data at quarterly intervals in each group is shown in *Figure 2*. The glycated

TABLE 7 *Baseline psychological characteristics according to intervention group*

Psychological measure	Intervention group [mean (SD)]		
	Usual care, *n* = 121	**MET, *n* = 117**	**MET + CBT, *n* = 106**
Patient Health Questionnaire			
Depression syndrome	34 (28.1)	34 (29.1)	29 (27.4)
Anxiety syndrome	14 (11.6)	13 (11.1)	13 (12.3)
Eating disorders	12 (9.9)	6 (5.1)	5 (4.7)
Somatoform disorder	16 (13.2)	22 (18.8)	16 (15.1)
Hypoglycaemic Fear Survey II			
Behaviour subscale	29.4 (5.6)	28.0 (5.8)	28.7 (5.8)
Worry subscale	31.7 (10.2)	33.9 (11.7)	31.8 (11.1)
Summary of Diabetes Self-Care Activities (0–7 days/week)			
Diet	4.0 (1.6)	3.6 (1.8)	3.9 (1.6)
Exercise	2.9 (2.2)	2.4 (2.0)	2.9 (2.1)
Blood testing	4.4 (2.7)	4.1 (2.7)	4.6 (2.4)
Foot care	1.9 (2.2)	2.1 (2.2)	2.0 (2.2)
Smoking status			
Current smoker	30 (25.2)	32 (28.3)	37 (36.3)
Ex-smoker	22 (18.5)	17 (15.0)	11 (10.8)
Non-smoker	67 (56.3)	64 (56.6)	54 (52.9)
Alcohol			
Alcohol consumption units per week	7.6 (11.3)	7.1 (9.5)	6.4 (9.9)
Significant Others Scale			
Emotional support	6.0 (1.5)	6.1 (1.2)	6.0 (1.6)
Practical support	5.7 (1.7)	5.7 (1.4)	5.7 (1.7)
Number of people in social support network	8.2 (8.7)	7.9 (7.4)	7.1 (6.2)
Diabetes-specific quality of life (DQoL)			
Satisfaction subscale	2.7 (0.6)	2.8 (0.6)	2.6 (0.6)
Impact subscale	2.3 (0.6)	2.3 (0.5)	2.3 (0.5)

There are 13, 36, 64, 63, 14, 70, 17, 8, 10, 25, 21, 3, 50, 56 missing values for depression, anxiety, eating disorders, somatoform disorder, HFS-II behaviour and worry subscale, each of the diabetes self-care activities items, smoking status, alcohol consumption, satisfaction subscale (DQoL) and impact subscale (DQoL) respectively.
The Hypoglycaemia Fear Survey (II) behaviour and worry subscale ranges are 10–50 and 13–65 respectively (higher scores indicate greater fear).
The DQoL satisfaction subscale range is 15–75 and DQoL impact subscale range score is 20–100 (scores divided by number of items in each subscale; higher scores indicate lower quality of life).

haemoglobin values tended to reduce in all groups at 3 months but only in the MET + CBT group was there a persistent and, at 12 months, a significant reduction in HbA_{1c}. The 12-month HbA_{1c} levels adjusted for baseline HbA_{1c} levels were significantly lower in the MET + CBT group than for usual diabetes care (adjusted mean difference 0.43, 95% CI 0.10 to 0.77); non-significantly lower in the MET group than in usual diabetes care (adjusted mean difference 0.20, 95% CI –0.15 to 0.55); and non-significantly lower in the MET + CBT group than in the MET group (adjusted mean difference 0.23%, 95% CI –0.13% to 0.59%; $p = 0.21$). The mean HbA_{1c} based on the observed measurements

TABLE 8 *Mean glycated haemoglobin (SD) by intervention arm (MET + CBT, MET and usual care in participants who completed their quarterly follow-ups*

	Glycated haemoglobin (%), mean (SD), number of participants				
Intervention	**0 months**	**3 months**	**6 months**	**9 months**	**12 months**
MET + CBT	9.61 (1.26), *n* = 106	9.35 (1.42), *n* = 91	9.16 (1.30), *n* = 84	9.04 (1.32), *n* = 77	9.11 (1.38), *n* = 95
MET	9.57 (1.03), *n* = 117	9.29 (1.08), *n* = 98	9.21 (1.36), *n* = 83	9.29 (1.36), *n* = 85	9.30 (1.61), *n* = 105
Usual care	9.70 (1.18), *n* = 121	9.37 (1.10), *n* = 85	9.35 (1.42), *n* = 89	9.16 (1.17), *n* = 81	9.54 (1.52), *n* = 105

is generally lower than when based on the imputation, suggesting that participants who missed the 3-, 6- and 9-month assessments tended to have higher HbA_{1c}.

Harmful events monitoring

In the 233 participants with data, there was no significant difference in the reporting of one or more severe hypoglycaemia episodes at 12 months in the MET + CBT group or the MET group than in the usual care group [adjusted odds ratio 0.50 (95% CI 0.17 to 1.45; $p = 0.20$) and adjusted odds ratio 1.15 (95% CI 0.43 to 3.08; $p = 0.78$) respectively].

Assessment of potential predictors associated with main outcome

The following factors were assessed: age (in years) at randomisation, gender, marital status, ethnicity, educational qualifications, employment status, age at diagnosis of type 1 diabetes, duration of diagnosis (in years), baseline HbA_{1c}, diabetes complications (neuropathy and retinopathy only as too many missing values for nephropathy), depression (continuous), anxiety (categorical), somatising disorder (categorical), eating disorders (categorical), fear of hypoglycaemia (HFS-II behaviour and worry subscales), dietary and exercise on the Summary of Diabetes Self-Care Activities, smoking status (ex- and non-smokers versus current smokers), and number of alcohol units consumed per week. The results are summarised in *Tables 9–11* and for the purposes of parsimony only the statistically significant findings are highlighted in the text.

There was weak evidence that the effectiveness of MET + CBT compared with usual care depended on baseline HbA_{1c} ($p = 0.062$), but not for MET when compared with usual care ($p = 0.50$) ($n = 305$). For those who completed their 12-month follow-up, the reduction in 12-month HbA_{1c} in the MET + CBT group compared with usual care was estimated to increase by 0.32% (95% CI –0.02% to 0.66%) for each 1% increase in baseline HbA_{1c}.

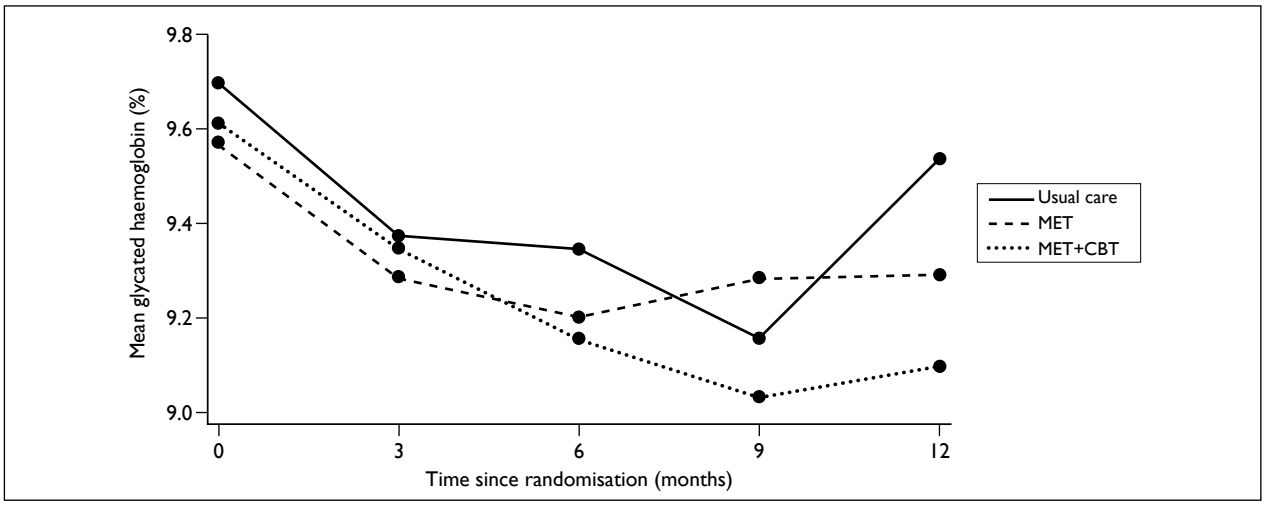

FIGURE 2 *Mean glycated hemoglobin levels based on available measurements at each time point (n = 344)*

TABLE 9 *Mean difference (95% CI; p-value) in 12-month HbA_{1c} (%) adjusted for baseline HbA_{1c} stratified by potential baseline sociodemographic moderator*

		MET + CBT vs usual care		MET vs usual care		MET + CBT vs MET	
Moderator variable	**Levels/categories of moderator variable**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**
Age (years) at randomisation	20	0.007	–1.20 (–1.84 to –0.57); $p < 0.001$	0.97	–0.19 (–0.84 to 0.46); $p = 0.56$	0.03	–0.97 (–1.70 to –0.23); $p = 0.01$
	30		–0.77 (–1.17 to –0.37); $p < 0.001$		–0.19 (–0.60 to 0.22); $p = 0.37$		–0.55 (–1.00 to –0.10); $p = 0.02$
	40		–0.33 (–0.67 to 0.02); $p = 0.06$		–0.18 (–0.56 to 0.19); $p = 0.34$		–0.13 (–0.53 to 0.27); $p = 0.53$
	50		0.11 (–0.41 to 0.63); $p = 0.68$		–0.18 (–0.75 to 0.40); $p = 0.55$		0.29 (–0.34 to 0.93); $p = 0.37$
	60		0.55 (–0.25 to 1.34); $p = 0.18$		–0.17 (–1.01 to 0.70); $p = 0.70$		0.71 (–0.26 to 1.69); $p = 0.15$
Gender	Female	0.94	–0.46 (–0.91 to –0.02); $p = 0.04$	0.68	–0.21 (–0.68 to 0.26); $p = 0.38$	0.61	–0.21 (–0.68 to 0.26); $p = 0.38$
	Male		–0.49 (–1.02 to 0.04); $p = 0.07$		–0.06 (–0.62 to 0.50); $p = 0.83$		–0.42 (–1.05 to 0.22); $p = 0.20$
Ethnicity	White	0.76	–0.48 (–0.85 to –0.11); $p = 0.01$	0.03	–0.39 (–0.78 to –0.00); $p = 0.05$	0.08	–0.07 (–0.49 to 0.35); $p = 0.74$
	Non-white		–0.34 (–1.17 to 0.50); $p = 0.43$		0.63 (–0.20 to 1.47); $p = 0.14$		–0.85 (–1.63 to –0.08); $p = 0.03$
Marital status	Single	0.71	0.50 (–0.03 to 1.03); $p = 0.06$	0.59	–0.25 (–0.77 to 0.28); $p = 0.36$	0.90	–0.24 (–0.85 to 0.37); $p = 0.43$
	Married/cohabiting/ divorced/separated/ widowed		0.37 (–0.07 to 0.82); $p = 0.01$		–0.05 (–0.53 to 0.44); $p = 0.84$		–0.30 (–0.78 to 0.19); $p = 0.24$
Employment status	Full-time	0.03	–0.70 (–1.15 to –0.24); $p = 0.003$	0.33	–0.38 (–0.90 to 0.13); $p = 0.14$	0.007	–0.29 (–0.81 to 0.23); $p = 0.28$
	Part-time		0.59 (–0.23 to 1.42); $p = 0.16$		–0.52 (–1.49 to 0.46); $p = 0.30$		1.27 (0.21 to 2.32); $p = 0.02$
	Unemployed		–0.59 (–1.20 to 0.03); $p = 0.06$		0.15 (–0.44 to 0.73); $p = 0.63$		–0.73 (–1.36 to –0.10); $p = 0.02$
Educational qualifications	Degree	0.36	–0.48 (–0.99 to 0.02); $p = 0.06$	0.86	–0.35 (–0.96 to 0.28); $p = 0.27$	0.39	–0.11 (–0.74 to 0.52); $p = 0.73$
	A-Levels		–0.47 (–0.97 to 0.03); $p = 0.07$		–0.12 (–0.63 to 0.38); $p = 0.63$		–0.32 (–0.87 to 0.24); $p = 0.26$
	No formal qualifications		0.25 (–0.68 to 1.17); $p = 0.60$		–0.19 (–1.16 to 0.78); $p = 0.70$		0.46 (–0.49 to 1.42); $p = 0.34$

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TABLE 10 *Mean difference (95% CI; p-value) in 12-month HbA_{1c} (%) adjusted for baseline HbA_{1c} stratified by potential baseline biological moderators*

		MET + CBT vs usual care		**MET vs usual care**		**MET + CBT vs MET**	
Moderator variable	**Levels/categories of moderator variable**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**
Duration of diagnosis (years)	5	0.28	–0.74 (–1.34 to –0.14); $p = 0.02$	0.41	0.00 (–0.59 to 0.60); $p = 0.84$	0.15	–0.65 (–1.29 to –0.01); $p = 0.05$
	10		–0.64 (–1.11 to –0.18); $p = 0.007$		–0.07 (–0.54 to 0.40); $p = 0.77$		–0.50 (–0.99 to –0.11); $p = 0.05$
	15		–0.54 (–0.91 to –0.18); $p = 0.004$		–0.14 (–0.52 to 0.23); $p = 0.45$		–0.36 (–0.75 to 0.04); $p = 0.08$
	20		–0.45 (–0.79 to –0.11); $p = 0.01$		–0.22 (–0.58 to 0.14); $p = 0.23$		–0.21 (–0.59 to 0.17); $p = 0.28$
	25		–0.35 (–0.75 to 0.04); $p = 0.08$		–0.29 (–0.71 to 0.13); $p = 0.17$		–0.06 (–0.53 to 0.40); $p = 0.79$
	30		–0.26 (–0.77 to 0.25); $p = 0.33$		–0.36 (–0.90 to 0.17); $p = 0.18$		0.08 (–0.52 to 0.68); $p = 0.79$
	35		–0.16 (–0.81 to 0.49); $p = 0.63$		–0.44 (–1.11 to 0.23); $p = 0.20$		0.23 (–0.54 to 0.99); $p = 0.56$
	40		–0.06 (–0.87 to 0.75); $p = 0.88$		–0.51 (–1.34 to 0.31); $p = 0.22$		0.38 (–0.59 to 1.32); $p = 0.43$
Age at onset of diabetes	Childhood/adolescence	0.09	–0.73 (–1.19 to –0.27); $p = 0.002$	0.22	–0.35 (–0.84 to 0.14); $p = 0.16$	0.55	–0.40 (–0.94 to 0.13); $p = 0.14$
	Adulthood		–0.14 (–0.63 to 0.35); $p = 0.57$		0.10 (–0.42 to 0.63); $p = 0.70$		–0.17 (–0.71 to 0.37); $p = 0.53$
HbA_{1c} (%)	9	0.02	–0.24 (–0.61 to 0.14); $p = 0.22$	0.53	–0.08 (–0.49 to 0.32); $p = 0.69$	0.19	–0.15 (–0.58 to 0.27); $p = 0.48$
	10		–0.56 (–0.90 to –0.22); $p = 0.002$		–0.19 (–0.57 to 0.19); $p = 0.33$		–0.37 (–0.77 to 0.03); $p = 0.07$
	11		–0.88 (–1.36 to –0.40); $p < 0.001$		–0.29 (–0.87 to 0.29); $p = 0.32$		–0.59 (–1.19 to 0.00); $p = 0.05$
	12		–1.20 (–1.91 to –0.50); $p = 0.001$		–0.39 (–1.25 to 0.46); $p = 0.37$		–0.81 (–1.69 to 0.07); $p = 0.07$
	13		–1.53 (–2.47 to –0.58); $p = 0.002$		–0.50 (–1.65 to 0.66); $p = 0.40$		–1.03 (–2.21 to 0.15); $p = 0.09$
BMI (kg/m^2)	20	0.43	–0.31 (–0.90 to 0.28); $p = 0.31$	0.98	–0.18 (–0.78 to 0.43); $p = 0.57$	0.44	–0.10 (–0.75 to 0.55); $p = 0.76$
	25		–0.47 (–0.83 to –0.12); $p = 0.009$		–0.17 (–0.54 to 0.20); $p = 0.37$		–0.28 (–0.66 to 0.11); $p = 0.16$
	30		–0.64 (–1.11 to –0.16); $p = 0.009$		–0.16 (–0.66 to 0.33); $p = 0.52$		–0.45 (–0.97 to 0.07); $p = 0.09$
Neuropathy	None	0.73	–0.55 (–0.98 to –0.13); $p = 0.01$	0.32	–0.44 (–0.90 to 0.03); $p = 0.07$	0.26	–0.11 (–0.61 to 0.38); $p = 0.66$
	Neuropathy		–0.72 (–1.56 to 0.12); $p = 0.09$		0.08 (–0.83 to 1.00); $p = 0.86$		–0.72 (–1.64 to 0.21); $p = 0.13$
Retinopathy	None	0.77	–0.34 (–1.07 to 0.39); $p = 0.36$	0.23	–0.62 (–1.42 to 0.17); $p = 0.12$	0.10	0.33 (–0.42 to 1.07); $p = 0.39$
	Retinopathy		–0.47 (–0.90 to –0.04); $p = 0.03$		–0.05 (–0.54 to 0.45); $p = 0.86$		–0.42 (–0.92 to 0.09); $p = 0.10$

TABLE 11 *Mean difference (95% CI; p-value) in 12-month HbA_{1c} (%) adjusted for baseline HbA_{1c} stratified by potential baseline psychological moderators*

		MET + CBT vs usual care		MET vs usual care		MET + CBT vs MET	
Moderator variable	**Levels/categories of moderator variable**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**	***p*-value for effect moderation**	**Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value**
Depression	5	0.14	–0.39 (–0.76 to –0.02); $p = 0.04$	0.51	–0.18 (–0.57 to 0.22); $p = 0.38$	0.04	–0.18 (–0.60 to 0.25); $p = 0.42$
	10		–0.62 (–1.01 to –0.22); $p = 0.002$		–0.08 (–0.48 to 0.32); $p = 0.69$		–0.51 (–0.94 to –0.09); $p = 0.02$
	15		–0.85 (–1.44 to –0.25); $p = 0.005$		0.02 (–0.55 to 0.58); $p = 0.96$		–0.85 (–1.48 to –0.22); $p = 0.008$
	20		–1.07 (–1.93 to –0.22); $p = 0.01$		0.11 (–0.69 to 0.92); $p = 0.78$		–1.19 (–2.09 to –0.28); $p = 0.01$
	25		–1.30 (–2.44 to –0.17); $p = 0.03$		0.21 (–0.86 to 1.28); $p = 0.70$		–1.52 (–2.72 to –0.32); $p = 0.01$
Anxiety	No anxiety syndrome	0.96	0.54 (0.18 to 0.91); $p = 0.004$	0.99	–0.23 (–0.57 to 0.11 to); $p = 0.19$	0.99	–0.28 (–0.65 to 0.08); $p = 0.13$
	Anxiety syndrome		–0.51 (–0.62 to 1.64); $p = 0.38$		–0.22 (–1.21 to 0.77); $p = 0.66$		–0.29 (–1.36 to 0.78); $p = 0.59$
Eating disorders (bulimia nervosa/binge eating disorder)	No eating disorders	0.45	–0.39 (–0.74 to –0.04); $p = 0.03$	0.50	–0.15 (–0.52 to 0.22); $p = 0.43$	0.38	–0.99 (–2.63 to 0.64); $p = 0.23$
	Eating disorders		–0.91 (–2.19 to 0.37); $p = 0.16$		0.31 (–0.99 to 1.62); $p = 0.64$		–0.24 (–0.63 to 0.15); $p = 0.22$
Somatoform disorder	No somatoform	0.60	0.37 (–0.03 to 0.77); $p = 0.07$	0.26	–0.26 (–0.71 to 0.18); $p = 0.24$	0.12	–0.09 (–0.56 to 0.38); $p = 0.70$
	Somatoform disorder		0.64 (–0.30 to 1.58); $p = 0.18$		0.34 (–0.62 to 1.29); $p = 0.49$		–0.93 (–1.88 to –0.02); $p = 0.06$
Glucose self-monitoring (days/week)	1	0.001	–1.16 (–1.73 to –0.60); $p < 0.001$	0.63	–0.24 (–0.82 to 0.35); $p = 0.43$	0.02	–0.88 (–1.51 to –0.26); $p = 0.006$
	4		–0.52 (–0.86 to –0.18); $p = 0.003$		–0.14 (–0.51 to 0.23); $p = 0.47$		–0.37 (–0.75 to 0.02); $p = 0.06$
	7		0.13 (–0.34 to 0.59); $p = 0.60$		–0.04 (–0.55 to 0.48); $p = 0.89$		0.15 (–0.40 to 0.71); $p = 0.59$
Exercising (days/week)	3	0.097	–0.34 (–0.69 to 0.00); $p = 0.05$	0.69	–0.12 (–0.62 to 0.39); $p = 0.65$	0.097	–0.001 (–0.53 to 0.53); $p = 0.10$
	6		–0.69 (–1.15 to –0.23); $p = 0.004$		–0.03 (–0.40 to 0.35); $p = 0.89$		–0.40 (–0.79 to –0.00); $p = 0.05$
Diet (days/week)	3	0.02	–0.65 (–1.03 to –0.27); $p = 0.001$	0.10	–0.18 (–0.74 to 0.37); $p = 0.52$	0.03	–0.76 (–1.32 to –0.19); $p = 0.009$
	6		–0.16 (–0.60 to 0.24); $p = 0.43$		–0.18 (–0.55 to 0.18); $p = 0.32$		–0.27 (–0.66 to 0.12); $p = 0.17$

Moderator variable	Levels/categories of moderator variable	MET + CBT vs usual care		MET vs usual care		MET + CBT vs MET	
		p-value for effect moderation	Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value	*p*-value for effect moderation	Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value	*p*-value for effect moderation	Baseline adjusted mean difference HbA_{1c} (95% CI); *p*-value
HFS-II: worry subscale	20	0.82	–0.31 (–0.85 to 0.23); $p = 0.26$	0.03	–0.57 (–1.18 to 0.04); $p = 0.07$	0.03	0.24 (–0.39 to 0.86); $p = 0.45$
	30		–0.35 (–0.72 to 0.02); $p = 0.07$		–0.16 (–0.58 to 0.25); $p = 0.44$		–0.18 (–0.62 to 0.25); $p = 0.40$
	40		–0.39 (–0.85 to 0.07); $p = 0.10$		0.24 (–0.24 to 0.72); $p = 0.32$		–0.61 (–1.11 to –0.11); $p = 0.02$
	50		–0.43 (–1.15 to 0.30); $p = 0.25$		0.65 (–0.09 to 1.39); $p = 0.09$		–1.03 (–1.80 to –0.26); $p = 0.009$
HFS-II: behaviour subscale	20	0.57	–0.27 (–0.90 to 0.37); $p = 0.41$	0.74	–0.17 (–0.85 to 0.50); $p = 0.61$	0.39	–0.06 (–0.74 to 0.62); $p = 0.87$
	30		–0.44 (–0.78 to –0.09); $p = 0.01$		–0.07 (–0.44 to 0.31); $p = 0.73$		–0.35 (–0.75 to 0.06); $p = 0.09$
	40		–0.60 (–1.33 to 0.12); $p = 0.10$		0.04 (–0.77 to 0.85); $p = 0.92$		–0.64 (–1.51 to 0.23); $p = 0.15$
Substance use							
Smoking	Non-/ex-smokers	0.88	–0.47 (–0.88 to –0.06); $p = 0.02$	0.76	–0.18 (–0.61 to 0.25); $p = 0.40$	0.97	–0.27 (–0.74 to 0.21); $p = 0.26$
	Current smokers		–0.41 (–1.07 to 0.25); $p = 0.22$		–0.05 (–0.76 to 0.65); $p = 0.88$		–0.29 (–0.98 to 0.41); $p = 0.42$
Alcohol use (units/week)	10	0.16	–0.36 (–0.73 to –0.00); $p = 0.05$	0.28	–0.06 (–0.44 to 0.32); $p = 0.75$	0.98	–0.29 (–0.70 to 0.13); $p = 0.17$
	15		–0.24 (–0.68 to 0.20); $p = 0.39$		0.04 (–0.42 to 0.50); $p = 0.86$		–0.29 (–0.79 to 0.22); $p = 0.27$
	20		–0.12 (–0.68 to 0.45); $p = 0.69$		0.14 (–0.45 to 0.74); $p = 0.64$		–0.28 (–0.93 to 0.36); $p = 0.39$
	25		0.01 (–0.70 to 0.72); $p = 0.98$		0.24 (–0.51 to 1.00); $p = 0.52$		–0.28 (–1.09 to 0.53); $p = 0.50$

There was tentative evidence that age was an effect modifier: the younger the participant the larger the reduction in HbA_{1c} in those who received MET + CBT than in those under usual diabetes care ($p = 0.0008$), but this was not observed when comparing MET with usual care ($p = 0.93$).

While MET + CBT compared with usual care did not appear to be any more effective for white than for non-white participants, MET compared with usual care was significantly better for white participants with a 1.03% lower HbA_{1c} than for non-white participants ($p = 0.03$).

Participants who reported more worry about hypoglycaemia were more likely to benefit from MET + CBT by a 0.04% decrease in HbA_{1c} than from usual care [$F(1, 156) = 0.05$, $p = 0.82$]. For every one point increase in worry about hypoglycaemia, the MET group had a significantly higher HbA_{1c} by 0.04% than usual care [$F(1, 165) = 4.90$, $p = 0.03$]. This was not paralleled by high risk behaviours aiming to reduce risk of hypoglycaemia.

For every additional day in the week that participants in the MET + CBT group checked their glucose levels there was a 0.22% increase in their HbA_{1c} ($p = 0.001$) compared with the control group. For every additional day in the week that participants spaced their carbohydrates evenly through their day, MET + CBT was associated with a 0.16% increase in HbA_{1c} [$F(1, 191) = 5.35$, $p = 0.02$] compared with the control group and the difference was statistically significant. For every additional day per week that participants in the MET + CBT group engaged in 30 minutes of physical exercise there was a 0.12% decrease in their HbA_{1c} [$F(1, 193) = 2.78$, $p = 0.09$] compared with the control group and this difference was marginally significant.

There was no evidence that the effectiveness of MET + CBT or MET on 12-month glycated haemoglobin varied according to gender, marital status, educational status, employment status, duration or age of diagnosis of type 1 diabetes, BMI, diabetes complications, baseline PHQ-9 depression score, presence of syndromal anxiety, eating disorder or somatoform disorders. After adjusting for baseline glycated haemoglobin, 12-month glycated haemoglobin did not vary according to therapist in either the MET + CBT ($p = 0.63$) or the MET ($p = 0.34$) groups.

Change in other secondary outcomes

Change in depression scores

There were 235 participants with both baseline and 12-month PHQ-9 depression symptom scores. Participants with missing 12-month PHQ-9 were more likely to have higher depression scores at baseline ($p = 0.002$). There was no evidence that 12-month depression scores were affected by the interventions; the 12-month score (adjusted for baseline) was 1.10 (95% CI –0.34 to 2.54; $p = 0.14$) higher in the MET + CBT group and 0.02 (95% CI –1.18 to 1.21; $p = 0.98$) higher in the MET group than usual care. Results based on multiple imputation of missing 12-month depression scores in those patients who had only a baseline depression score ($n = 315$) were similar.

Change in Hypoglycaemia Fear Survey

Worries about hypoglycaemia did reduce in people randomised to MET + CBT compared with those under usual care, but this was not significant [change score –1.79 (95% CI –4.31 to 0.72)] and there was no similar trend in the comparison between MET and usual diabetes care [change score –2.45 (95% CI –5.33 to 0.43)]. Again there was a non-significant trend in reduction of behaviours to avoid hypoglycaemia for MET + CBT [change score –0.35 (95% CI –1.56 to 0.85)] and for MET [change score –0.42 (–1.63 to 0.78)] compared with usual care.

Change in body mass index

There was a non-significant trend for MET + CBT to be associated with mean reduction in BMI of 0.21 (95% CI –0.62, 0.20) compared with usual care and even larger and almost significant reduction in weight in the MET group than in usual care [change score –0.35 (95% CI –0.77 to 0.07)].

Change in Summary of Diabetes Self-Care Activities

In the self-care activities, neither of the interventions were effective in improving adherence to diet [MET + CBT versus usual care: change score 0.05 (95% CI –0.31, 0.42) and MET versus usual care: change score 0.11 (95% CI –0.26 to 0.48)], exercise [MET + CBT versus usual care: change score 0.004 (95% CI –0.55 to 0.56) and

MET versus usual care: change score –0.04 (95% CI –0.57 to 0.49)], or self-monitoring of blood glucose [MET + CBT versus usual care: change score –0.06 (95% CI –0.60 to 0.49) and MET versus usual care: change score 0.14 (95% CI –0.44 to 0.71)] recommendations.

Change in diabetes quality of life

There was no evidence that either interventions improved quality of life as measured by the DQoL [MET + CBT versus usual care: change score 0.04 (95% CI –0.10 to 0.18) and MET versus usual care: change score 0.12 (95% CI –0.03 to 0.26)].

Chapter 5
Economic evaluation

Introduction

As previously discussed in Chapter 1 (Socioeconomic impact of diabetes), diabetes and its complications incur substantial costs for health services. Costs can also fall upon patients themselves and wider society. For example, given that people with type 1 diabetes commonly develop the condition at a young age, they may experience various employment-related impacts throughout their lives, which could translate into important productivity losses for society. Such high costs, alongside high prevalence and the chronic nature of the condition, necessitate a need for cost-effective approaches to treatment and long-term management. To the best of our knowledge, there have been no previous RCT-based economic evaluations of psychological interventions for adults with type 1 diabetes. This chapter reports a comprehensive economic evaluation carried out as part of this trial to assess the cost-effectiveness and cost–utility of MET and MET + CBT in addition to usual care compared with usual care alone.

Methods

Data collection

Data needed to estimate individual-level costs were collected using the Client Service Receipt Inventory (CSRI),[198] adapted to this study to ensure that all resources specific to diabetes and related illnesses (e.g. equipment for insulin injecting and blood glucose monitoring; specialist clinics) were collected. It included questions about participants': sociodemographic profile and current living situation; educational attainment, employment, income (including social security benefits) and time off work; use of health care, social care and voluntary care resources; informal care received from friends and family and any time that such carers took off work to provide such care; and out-of-pocket expenses. Questions were related to impacts due to diabetes or related illness.

The CSRI was administered retrospectively at three assessment points: by face-to-face interview at baseline (for the previous 3-month period), and by telephone interview at 6 months after randomisation (for the previous 6-month period) and 12 months after randomisation (for the previous 6-month period). Interviewers were blind to participants' randomisation status.

Additionally, a post-intervention CSRI was developed for use with participants in the two intervention groups to measure economic impacts related to attending a typical intervention session. This included questions about: the time taken to attend a typical session; whether the participant took time off work to attend and, if yes, what method they used (annual leave, sick leave, unpaid leave, made up the time or other arrangement); lost pay; and travel costs. This was administered as a self-complete questionnaire at their last therapy session (or posted for self-completion if the participant did not attend all intervention sessions) to avoid revealing randomisation allocation to assessors carrying out the main CSRI follow-up interviews.

Health-related quality life for the purpose of estimating QALY gains was measured using the SF-36.[199] However, as general population utility weights based on this measure were in development but not yet available at the time this study was designed, we additionally included the EQ-5D (European Quality of Life-5 Dimensions),[200] for which utility weights were available, as a stand-by. Both measures were included in the main study assessment booklet which was administered at baseline and 12 months.

Costs

Individual-level resource volumes obtained from the CSRI were combined with unit costs to calculate a cost per participant. Unit cost estimates, their sources and any assumptions made for their estimation are detailed in Appendix I and summarised in *Table 12*. Total costs were computed for each participant at each assessment point from two perspectives: health and social care; and societal. Health and social care costs included: hospital inpatient and outpatient services, primary care services, other community-based services, social services, medications, insulin-related equipment, other equipment and adaptations

and the cost of the interventions. Societal costs included all of these costs plus: informal care; out of pocket expenses incurred by patients and their families (including travel expenses to attend the intervention sessions); lost productivity due to absence from work; and lost productivity, lost leisure time and lost pay due to attending the intervention sessions.

Costs based on the 6-month and 12-month CSRIs were summed to represent 1-year costs. All costs are reported in pounds sterling at 2005–6 prices. Discounting was not necessary as all costs are related to a 1-year period.

Cost of the interventions

Unit costs of MET and CBT were estimated as an average cost per session/person for each intervention, rather than as a variable cost, under the assumption that resource inputs for one session of each intervention did not significantly vary from session to session, or from person to person. Unit costs were calculated by identifying all time and material resource components directly associated with an average session of each therapy, including training and supervision, and estimating the costs of each of those components (including relevant on-costs and overheads). Resources and costs are detailed in Appendix 2 and summarised in *Table 13*. Unit costs were estimated from a health-care perspective and, in line with all other unit costs, were based on 2005–6 price levels.

The unit cost for a 50-minute MET session was estimated as £49 and £48 per session including and excluding training respectively. The respective estimates for a 50-minute session of CBT were £81 and £73. CBT cost more than MET because of greater training and supervision inputs. For several resource components, it was necessary to take a top-down costing approach, by which total costs were divided by the total number of sessions actually attended by study participants. As neither therapy was fully attended by all participants, we also present alternative unit costs under a more optimistic assumption of 20% higher attendance.

Individual-level intervention costs were calculated by multiplying these unit costs with the number of each type of therapy session attended by each participant.

Outcome measures

The trial's primary outcome measure was diabetes control as measured by HbA_{1c} levels. Improvement in HbA_{1c} between baseline and 12 months was used as the outcome measure for the cost-effectiveness analyses.

Cost–utility analyses were based on QALYs. Although we could proceed with calculating SF-36 based QALYs because general population utility weights for that measure were available by the end of the study, we nevertheless additionally calculated EQ-5D-based QALYs because that remains the more widely used measure for this purpose. Therefore, utility weights appropriate to each measure[201,202] were attached to health states at baseline and 12 months, and QALYs were calculated using the total area under the curve approach with linear interpolation between assessment points (and baseline adjustment for comparisons).

Analyses

Data were analysed using SPSS for Windows Release 12.0.1 (SPSS Inc., 1989–2001), STATA 8.2 for Windows (StataCorp LP, 1985–2004) and STATA for Windows 10.1 (StataCorp LP, 1985–2008). Participants were analysed according to the groups to which they were randomised regardless of the number or type of intervention sessions they attended.

Costs and outcomes were compared at 6 months, at 12 months and for 1 year and are presented as mean values with SDs. Mean differences and 95% CIs were obtained by non-parametric bootstrap regressions (1000 repetitions) to account for the non-normal distribution commonly found in economic data. Although this was an RCT and participants in all groups were expected to be balanced at baseline, baseline costs and outcomes were expected to be predictors of follow-up costs. As adjusting for these was likely to provide more relevant treatment-effect estimates,[203] regressions to calculate mean differences in the various cost categories included covariates for the baseline value for the same cost category and baseline HbA_{1c}. Similarly, regressions to calculate mean differences in outcomes included covariates for the baseline value of the same outcome. All trial arms were compared against each other in turn.

CSRI data from responders contained minimal item non-response because data were collected by interview rather than self-completed. In the few instances of missing items, values were imputed to enable the estimation of cost subtotals/totals. If there was any information to indicate use of a particular resource (e.g. duration of contact was

TABLE 12 *Summary of unit costs*

Category	Unit	Unit cost (£) 2005–6 prices
Accident & emergency	Investigation	77
Inpatient services	Night	Range 26–567
Outpatient services	Visit	Range 3–244
DAFNE course	Course	636
Ambulance/paramedic	Call-out	171
Angioplasty	Finished consultant episode	1648
Various other hospital-based services	Visit	Range 25–412
Primary care/community-based services	Minute	Range < 1 to 3 (plus travel costs for some)
Other primary care/community-based services	Visit	Range 20–25
Meals on wheels	Meal	4
Medication (including insulin)	1 mg/ml	Range < 0.01 to 11.52
Diabetes testing/monitoring equipment	Item	Range 0.03–1000
Other equipment/aids	Item	Range 0.65–55
Lost productivity/leisure	Hour	Range 5–13

TABLE 13 *Summary of resource inputs and unit costs for one session of MET and CBT*

	Resources	MET unit cost (£)	CBT unit cost (£)	MET assuming 20% higher attendance	CBT assuming 20% higher attendance
Delivery to patient	Therapist[a] contact and non-contact time	24	26	24	26
Therapist supervision	Therapist and supervisor[b] contact and non-contact time	22	46	20	40
Therapist training	Therapist and trainer[b] contact and non-contact time	1	8	1	7
Materials	Manual, information sheets, Accu-Test CD-ROM, tape recorder and tapes	1	1	1	1
Other inputs	Therapist time to chase non-attendees	1	< 1	1	< 1
Total cost per 50-minute session		49	81	46	73
Total cost per 50-minute session excluding training costs		48	73	45	66

a Therapist costs were based on salary and on-costs for a nurse on the mid-point of Band 6 (£0.39 per minute).
b MET supervisor/trainer costs were based on a clinical psychiatrist on the mid-point of Band 8A (£0.75 per minute); CBT supervisor/trainer costs were based on a senior CBT therapist on the mid-point of Band 8A (£0.75 per minute) and a junior CBT therapist on the low-point of Band 8A (£0.55 per minute).

provided, but number of contacts was missing), the mean value for other users of that resource in the same randomisation group at the same assessment point was assumed. If it was not known whether a resource was used, it was assumed not and a zero cost was allocated for that resource. For medication data, if the medication name was missing, but other information (e.g. dose) indicated some use, an average prescription cost was assumed.[204] If a medication name was provided but usage quantity was missing, an average prescription cost for that particular medication was assumed.[204]

Non-responders to the CSRI at the 6-month and/or 12-month assessment were excluded from the analyses because data for both of these time points were necessary for the computation of 1-year costs. Similarly, those who lacked either baseline or 12-month values for any of the three outcome measures were also excluded. To explore the potential impact of the exclusion of these cases, we examined basic sociodemographic and clinical characteristics for those included and excluded from the analyses. We also imputed missing 1-year costs and outcomes using the multiple imputation procedure in STATA for Windows 10.1. Imputations of costs were based on variables expected to predict follow-up costs: randomisation group, age at baseline, sex, baseline HbA_{1c}, baseline value for the same cost category and the number of therapy sessions attended. Predictor variables for the imputation of outcomes were the same except that they included the baseline value of the same outcome rather than cost. Cost and outcome data for the imputed full sample are also presented as mean values with SDs and mean differences with 95% CIs obtained by non-parametric bootstrap regressions (1000 repetitions) which included the baseline value of the same cost or outcome as a covariate.

Cost-effectiveness and cost–utility analyses

The economic evaluation examined all possible cost–outcome combinations. Accounting for the two study perspectives, three outcomes and three-way group comparisons resulted in 18 possible combinations. We planned to calculate incremental cost-effectiveness ratios (ICERs) for any combination which showed both higher costs and better outcomes in either of intervention groups than in the usual care group.

Uncertainty around the cost-effectiveness/cost–utility of the interventions was explored using cost-effectiveness acceptability curves (CEACs) based on the net-benefit approach.[205] These curves are an alternative to CIs around ICERs and show the probability that one intervention is cost-effective (or optimal) compared with the other, for a range of values that a decision-maker would be willing to pay for an additional unit of each outcome (i.e. per additional QALY or per additional point improvement in HbA_{1c}). Net benefits for each participant were calculated using the following formula, where λ is the willingness to pay for one additional unit of outcome:

$$\text{Net benefit} = (\lambda \times \text{outcome}) - \text{cost}$$

A series of net benefits were calculated for each individual for λ values ranging between £0 and £45,000 per unit improvement in outcome. After calculating net benefits for each participant for each value of λ, coefficients of differences in net benefits between the two comparison groups were obtained through a series of bootstrapped linear regressions (1000 repetitions) of group upon net benefit which included the baseline value of the same cost category and the same outcome as covariates. The resulting coefficients were then examined to calculate for each value of λ the proportion of times that the MET group and MET + CBT group had a greater net benefit than the usual care group and the proportion of times that the MET + CBT group had a greater net benefit than the MET group. These proportions were then plotted to generate CEACs. CEACs were plotted for all 18 cost–outcome combinations.

Results

Response rates

Table 14 summarises CSRI response rates. Two hundred and sixteen (62.8%) of the 344 study participants had cost data from both the 6-month and 12-month follow-up assessment, i.e. the data required for the calculation of 1-year costs and therefore inclusion in the economic evaluation. Those included in the economic evaluation on this basis were older and had better HbA_{1c} levels at 12 months than the full study sample (*Table 15*), although differences were not explored statistically. The economic evaluation may therefore present more optimistic outcomes than would a full sample evaluation. This is further explored later through imputation of missing costs and outcomes.

Resource use

Resource use differences were not compared statistically, firstly because the economic evaluation was focused on costs and cost-effectiveness and, secondly, to avoid problems associated multiple testing. Therefore, resource use patterns are described without statistical comparisons.

Tables 16–18 show resource use at each assessment point only for those items that were used by at least 10% of responders in any trial arm at that time point. Full resource use data are provided in Appendices 3, 4 and 5. Resource use appeared

TABLE 14 *CSRI response rates*

	Baseline		6 months		12 months		All time points	
	n	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
Usual care (*n* = 121)	121	(100)	77	(64)	102	(84)	70	(58)
MET (*n* = 117)	117	(100)	84	(72)	96	(82)	73	(62)
MET + CBT (*n* = 106)	106	(100)	82	(77)	88	(83)	73	(69)
All (*n* = 344)	344	(100)	243	(71)	286	(83)	216	(63)

TABLE 15 *Characteristics of full sample and sub-sample with 1-year cost data*

	Full sample (*n* = 344)	**Sub-sample with 1-year cost data (*n* = 216)**
Mean age (years)	36	38
Male (*n*, %)	136 (39.5)	87 (40.3)
Female (*n*, %)	208 (60.5)	129 (59.7)
HbA_{1c} at baseline	9.63	9.60
HbA_{1c} at 12 months	9.32[a]	9.13[b]

a *n* = 305.
b *n* = 207.

broadly comparable between the three groups at baseline, 6 months and 12 months. Participants were high users of hospital-based specialist diabetes services, services provided by GP surgeries, chiropody and opticians. Use of other community-based services such as dietetics, occupational therapy and mental health services were rare.

Costs

Total costs over the course of the study are summarised in *Table 19*. Costs were broadly balanced between the three groups, except that the MET + CBT group had lower lost productivity costs at baseline than the MET group. Mean intervention costs were £195 for the MET group and £660 for the MET + CBT group. Other costs in the intervention groups did not appear to significantly differ compared with the usual care group at any of the individual assessment points, although CIs around mean cost differences at 6 months suggest a balance towards higher costs in the MET + CBT group than in usual care.

Although no differences were apparent at the individual assessment points, summing costs for the 1 year of follow-up and including intervention costs led to higher health and social care costs in both intervention groups than in usual care. Health and social care costs were £178 higher in the MET + CBT group than in the MET group, but this was not statistically significant. One-year health and social care costs excluding the costs of the interventions showed no differences compared with usual care, which suggests that the additional costs of the interventions neither were fully offset by savings elsewhere nor led to any additional costs; however, the MET + CBT group had (non-significantly) lower total health and social care costs (–£287) than the MET group which may suggest that the two interventions had differential impacts. Patient/family and lost productivity costs, which were small compared to health and social care costs, did not differ between the groups. Taking these into account for the estimation of total societal costs led to no differences between the groups. The balance of the CIS did suggest a tendency towards higher societal costs for both intervention arms than for usual care, but no significant difference against each other.

Lost productivity and informal care costs were estimated using the national minimum wage (£5.05 per hour). Alternative calculations based on the higher unit cost of the national average wage (£13.04 per hour) did not alter any conclusions based on these costs.

TABLE 16 *Resource use at baseline (in previous 3 months)*

		MET ($n = 117$)			MET + CBT ($n = 106$)			Usual care ($n = 121$)		
	Unit	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD
Secondary care										
Inpatient ward admission	Nights	8	4	1.24	4	5	1.10	7	5	1.44
Diabetic clinic	Visits	103	4	1.03	90	1	1.37	106	1	0.97
Diabetes foot clinic	Visits	13	3	1.92	9	3	1.31	13	4	2.41
Diabetes eye clinic	Visits	38	1	0.51	40	1	0.68	49	1	0.54
Phlebotomy	Visits	12	1	0.30	9	1	0.36	13	1	0.49
Primary and community-based services										
GP surgery visit	Minutes	47	11	7.79	50	15	9.43	46	14	11.73
Diabetes specialist nurse surgery visit	Minutes	11	24	7.08	6	24	18.58	7	27	16.75
Diabetic clinic surgery visit	Minutes	11	31	16.39	6	31	17.43	5	27	13.04
Practice nurse surgery visit	Minutes	11	13	7.16	9	16	8.56	10	17	14.95

a Mean for users only..

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TABLE 17 *Resource use at 6 months (in previous 6 months)*

		MET ($n=84$)			MET+CBT ($n=82$)			Usual care ($n=77$)		
	Unit	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD
Secondary care										
Inpatient ward admission	Nights	8	12	8.80	6	7	2.45	3	11	3.10
Outpatient service										
Diabetic clinic	Visits	56	2	1.35	59	2	1.31	52	1	1.02
Diabetes foot clinic	Visits	6	6	9.83	9	3	3.84	5	5	4.93
Diabetes eye clinic	Visits	27	1	0.58	31	1	1.18	24	1	1.02
Ophthalmology	Visits	7	1	0.76	8	1	0.35	5	1	-
Phlebotomy	Visits	2	2	1.41	8	2	1.36	3	2	1.00
Primary and community-based services										
GP surgery visit	Minutes	27	12	6.00	26	13	9.98	30	12	5.13
Diabetes specialist nurse surgery visit	Minutes	6	19	5.83	8	18	10.33	7	26	8.37
Practice nurse surgery visit	Minutes	9	10	5.00	14	12	10.21	8	16	9.15
Chiropodist surgery visit	Minutes	7	18	7.36	9	27	19.54	8	16	3.16

a Mean for users only.

TABLE 18 *Resource use at 12 months (in previous 6 months)*

		MET ($n=96$)			MET + CBT ($n=88$)			Usual care ($n=102$)		
	Unit	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD	Number of users	Mean[a]	SD
Secondary care										
Inpatient ward admission	Nights	9	8	3.02	7	5	1.77	9	6	1.92
Diabetic clinic	Visits	72	2	1.87	64	2	1.61	72	2	2.56
Diabetes eye clinic	Visits	23	1	1.16	21	1	0.36	26	1	0.46
Ophthalmology	Visits	13	1	0.44	9	1	0.67	14	1	0.84
Primary and community-based services										
GP surgery visit	Minutes	40	14	9.24	36	11	6.00	48	15	15.86
Diabetes specialist nurse surgery visit	Minutes	15	20	7.67	12	17	9.25	13	20	10.66
Diabetic clinic surgery visit	Minutes	13	30	7.36	10	15	2.36	7	25	2.89
Practice nurse surgery visit	Minutes	14	15	11.25	8	13	8.68	17	10	6.79
Chiropodist surgery visit	Minutes	12	17	14.28	9	25	12.34	9	16	6.30
Optician surgery visit	Minutes	16	38	28.91	16	40	22.51	15	31	14.42

a Mean for users only.

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TABLE 19 *Mean costs and mean cost differences at baseline, 6 months, 12 months and over 1 year*

	MET, *n* = 73		**MET + CBT, *n* = 73**		**Usual care, *n* = 70**		**MET vs usual care**		**MET + CBT vs usual care**		**MET vs MET + CBT**	
Cost category	**Mean (£)**	**SD**	**Mean (£)**	**SD**	**Mean (£)**	**SD**	**Adjusted mean difference[a] (£)**	**95% CI**	**Adjusted mean difference[a] (£)**	**95% CI**	**Adjusted mean difference[a] (£)**	**95% CI**
MET/MET + CBT interventions	195	57	660	301	0	–	195	183 to 208	660	590 to 727	465	390 to 536
Baseline												
Health/social care[b]	540	605	564	561	497	301	43	–102 to 213	67	–60 to 228	24	–166 to 215
Patient/family[c]	66	247	97	414	49	246	17	–66 to 94	49	–53 to 174	32	–64 to 157
Lost productivity[d]	129	531	22	54	65	382	63	–87 to 212	–43	–160 to 17	–106	–243 to –2
Societal[e]	734	1024	684	831	611	602	124	–146 to 403	73	–141 to 329	–50	–354 to 237
6 months												
Health/social care,[b] excluding MET/CBT	721	988	705	812	551	323	111	–36 to 249	96	–28 to 221	–44	–233 to 142
Patient/family[c]	66	298	181	699	67	436	–23	–117 to 93	71	–69 to 251	100	–44 to 278
Lost productivity[d]	119	746	114	750	23	78	53	–41 to 155	88	–16 to 299	92	–28 to 285
Societal,[e] excluding MET/CBT	906	1433	1001	1508	641	688	138	–102 to 350	281	–10 to 573	139	–210 to 490
12 months												
Health/social care,[b] excluding MET/CBT	1090	1238	869	758	805	713	230	–38 to 499	31	–187 to 267	–242	–542 to 68
Patient/family[c]	652	1959	342	1034	524	2766	6	–584 to 730	–384	–982 to 164	–365	–863 to 26
Lost productivity[d]	29	88	35	113	34	106	–6	–39 to 27	–1	–35 to 34	8	–23 to 40
Societal,[e] excluding MET/CBT	1771	2376	1246	1328	1364	2879	263	–593 to 1103	–215	–1075 to 400	–496	–1103 to 41

continued

TABLE 19 *Mean costs and mean cost differences at baseline, 6 months, 12 months and over 1 year (continued)*

	MET, *n* = 73		MET + CBT, *n* = 73		Usual care, *n* = 70		MET vs usual care		MET + CBT vs usual care		MET vs MET + CBT	
Cost category	**Mean (£)**	**SD**	**Mean (£)**	**SD**	**Mean (£)**	**SD**	**Adjusted mean difference[a] (£)**	**95% CI**	**Adjusted mean difference[a] (£)**	**95% CI**	**Adjusted mean difference[a] (£)**	**95% CI**
1-year follow-up												
Health/social care,[b] excluding MET/CBT	1811	2032	1574	1305	1356	851	340	–23 to 646	127	–155 to 404	–287	–690 to 146
Health/social care, including MET/CBT	2006	2034	2234	1326	1356	851	535	171 to 857	790	507 to 1072	178	–229 to 619
Patient/family[c]	766	1982	605	1474	592	3195	30	–638 to 825	–229	–919 to 432	–231	–751 to 226
Lost productivity[d]	149	749	150	757	57	126	48	–56 to 156	88	–32 to 303	100	–28 to 305
Societal,[e] excluding MET/CBT	2725	3180	2329	2405	2005	3504	449	–599 to 1357	149	–848 to 914	–323	–1044 to 416
Societal, including MET/CBT	2920	3179	2989	2442	2005	3504	643	–414 to 1549	814	–176 to 1586	144	–581 to 894

a Comparisons of 6-month, 12-month and 1-year costs include covariates for the baseline value of the same cost category and baseline HbA_{1c}.
b Health/social care cost (excluding intervention cost) includes costs of secondary care, primary/community-based care, medications and equipment due to diabetes and related illnesses.
c Patient/family costs include costs of informal care and out-of-pocket expenses due to diabetes or related illnesses, and lost pay, lost leisure time and travel costs to attend intervention sessions.
d Lost productivity costs include the costs of participants' time off work and their family's/friends' time off work to provide care for them due to diabetes or related illnesses and time off work to intervention sessions.
e Societal cost is the sum up of health/social care, patient/family and lost productivity costs.

Outcomes

There was no significant difference in HbA_{1c} improvement between the MET and usual care groups or between the MET and MET + CBT groups, but there was between the MET + CBT and usual care group (mean difference = 0.45, 95% CI = 0.10 to 0.78; *Table 20*).

Neither the EQ-5D nor SF-36 suggested any significant differences in mean QALYs between either of the intervention groups compared with usual care, or the intervention groups against each other, confirming the quality of life findings based on the DQoL (see Chapter 4, Change in other secondary outcomes). While there were some quantitative differences in the results derived from the two measures (with the EQ-5D indicating greater mean total QALYs per group and thus slightly greater mean differences between groups), they both suggested the same direction of difference and thus the same broad conclusions.

It should be noted that these outcomes data are based on those with available data for each outcome, regardless of the availability of cost data. However, for the cost-effectiveness and cost–utility analyses, cases were included only if they also had 1-year cost data. As seen in *Table 21*, this resulted in variable sample sizes for analyses based on each outcome and between the randomisation groups. Of particular note, the EQ-5D based analyses used only 50% of the MET group and the SF-36 based analyses used only 49% of the usual care group.

The potential impact of excluding these cases from the cost-effectiveness and cost–utility analyses was explored by imputing missing 1-year costs and outcomes and comparing the resulting means and mean differences against those obtained in the main analyses (see *Tables 19* and *20*). Imputed full sample means, mean differences and 95% CIs were broadly similar (*Table 22*), suggesting that results for the incomplete sample were likely to be broadly representative of those for the full study sample. The only notable difference was that the partial sample analyses showed a very small QALY advantage (0.003 QALYs) for the MET + CBT group compared with usual care, but the imputed analyses instead showed a very small QALY disadvantage (–0.0001 QALYs). This alters cost-effectiveness conclusions based on that particular comparison, but the meaningfulness of this is unclear given the small size and lack of statistical significance of the QALY differences.

Cost-effectiveness and cost–utility

Of the 18 cost–outcome combinations examined for the cost-effectiveness and cost–utility analyses, only one showed statistical between-group differences for both cost and outcome elements: the MET + CBT group had higher health and social care costs (mean difference = £790, 95% CI £507 to £1072) and greater HbA_{1c} improvement (mean difference = 0.45 points, 95% CI 0.11 to 0.80) than usual care. This translated into an ICER of £1756 (*Table 23*).

In other cost–outcome combinations, both intervention groups had numerically higher costs and better outcomes than usual care. The MET + CBT group had higher costs and better HbA_{1c} outcomes than the MET group, but the MET group dominated with regard to QALY outcomes. Where relevant, indicative ICERs are presented for information, but should be interpreted with caution given that they are based on point estimates which (a) do not represent any uncertainty surrounding these and (b) showed that, aside from the MET group having higher health and social care costs than usual care and the MET + CBT group having better HbA_{1c} outcomes than usual care, all other costs and outcomes were not statistically different.

Incremental cost-effectiveness ratios for HbA_{1c} improvements were lower for MET + CBT compared with usual care than for MET alone. ICERs for QALYs notably differed for the two interventions and all far exceeded the acceptable threshold implicitly suggested in the National Institute for Health and Clinical Excellence's decision-making.[206] In comparisons of the two interventions against each other, MET + CBT cost an additional £514 or £636 per additional point improvement over MET, depending on the cost perspective taken.

Figures 3–8 show probabilities of cost-effectiveness for each intervention compared with usual care and for the two interventions against each other, again for all cost–outcome combinations. Probabilities of cost-effectiveness for both interventions were generally higher when based on the outcome of HbA_{1c} improvements than on QALY gains, reaching over 0.7 at thresholds of £5000 or higher for each additional point improvement on HbA_{1c} for MET + CBT compared with usual care from both health and social care (*Figure 5*) and societal (*Figure 6*) perspectives. Equivalent probabilities for MET compared with usual care did not exceed 0.51

TABLE 20 *Mean outcomes and mean outcome differences over 1 year*[a]

	MET			MET + CBT			Usual care			MET vs usual care		MET + CBT vs usual care		MET vs MET + CBT	
Outcome	***n***	**Mean**	**SD**	***n***	**Mean**	**SD**	***n***	**Mean**	**SD**	**Mean difference**	**95% CI**	**Mean difference**	**95% CI**	**Mean difference**	**95% CI**
Baseline utility based on EQ-5D	114	0.76	0.25	106	0.78	0.27	119	0.79	0.25	–0.03	–0.10 to 0.03	–0.006	–0.08 to 0.06	0.02	–0.04 to 0.09
12-month utility based on EQ-5D	90	0.79	0.26	83	0.78	0.28	94	0.79	0.27	–0.001	–0.07 to 0.08	–0.01	–0.09 to 0.07	–0.01	–0.08 to 0.07
Baseline utility based on SF-36	117	0.70	0.12	106	0.70	0.14	121	0.71	0.12	–0.02	–0.05 to 0.01	–0.01	–0.04 to 0.02	0.01	–0.03 to 0.04
12-month utility based on SF-36	96	0.74	0.13	85	0.73	0.14	89	0.74	0.11	–0.001	–0.04 to 0.04	–0.01	–0.04 to 0.03	–0.01	–0.05 to 0.03
QALYs based on EQ-5D	90	0.780	0.22	83	0.780	0.25	92	0.804	0.22	0.011	–0.02 to 0.04	0.003	–0.03 to 0.03	–0.008	–0.04 to 0.02
QALYs based on SF-36	96	0.721	0.11	85	0.719	0.13	89	0.729	0.10	0.004	–0.01 to 0.02	0.0002	–0.01 to 0.01	–0.004	–0.02 to 0.01
HbA_{1c} improvement	105	0.24	1.46	95	0.59	1.38	105	0.12	1.17	0.14	–0.22 to 0.48	0.45	0.11 to 0.80	0.28	–0.05 to 0.66

a Outcome comparisons included covariates for the baseline value of the same outcome.

TABLE 21 *Sample sizes for cost-effectiveness analyses*

	Have 1-year cost data and EQ-5D data		Have 1-year cost data and SF-36 data		Have 1-year cost data and HbA_{1c} data	
	n	**%**	***n***	**%**	***n***	**%**
Usual care (*n* = 121)	63	52	59	49	68	56
MET (*n* = 117)	59	50	64	55	67	57
MET + CBT (*n* = 106)	63	59	66	62	72	68
All (*n* = 344)	185	54	189	55	207	60

at the thresholds of £45,000 per additional point improvement in HbA_{1c}. MET + CBT had high probabilities of cost-effectiveness compared with MET alone, reaching 0.8 at thresholds of £5000 per additional point improvement in HbA_{1c} from both cost perspectives.

Probabilities of cost-effectiveness based on QALYs were generally very low for all comparisons. At thresholds of £20,000 per additional QALY, probabilities of cost-effectiveness for MET compared with usual care were 0.08 (EQ-5D) and 0.03 (SF-36) from the health and social care perspective; probabilities from the societal perspective were higher than this, but still low. At the same threshold, MET + CBT had zero probability of cost-effectiveness compared with usual care from the health and social care perspective and 0.06 (EQ-5D) and 0.11 (SF-36) probability of cost-effectiveness from the societal perspective. Again for the same threshold of £20,000, probabilities of cost-effectiveness for MET + CBT compared with MET were 0.11 (for both the EQ-5D and SF-36) from the health and social care perspective and 0.13 (EQ-5D) and 0.24 (SF-36) from the societal perspective. Although the two approaches to QALY estimation produced very different ICERs, they resulted in very similar CEACs.

Limitations

The economic evaluation had some limitations. The cost data carried a risk of error due to participant recall bias. CSRI questions asked about resource use and other economic impacts for the previous 3 months at baseline, and for the previous 6 months at the 6- and 12-month assessments. The reliability of self-reporting over such durations is unclear. However, this data collection approach seemed appropriate for three reasons. Firstly, given the multisite nature of this study and the broad evaluation perspective taken (due to the breadth of health and other impacts of diabetes), it was infeasible to examine the records of multiple care providers, and some participant self-reporting still remained necessary (e.g. for measuring time off work and out-of-pocket expenses). Secondly, measuring resource use for less than a 1-year period risked finding artificially differential costs simply because of differences in the timing of patient care reviews. There is a potential for a temporary 'flurry' of health-care activity around the time of these reviews, and cost estimates could vary depending on whether they included or excluded such a period. Using a 1-year measurement period without breaks reduced the likelihood of this. Thirdly, we tried to maximise quality by collecting these data by interview (in person at the baseline assessment and by telephone at 6 and 12 months), rather than self-complete and, due to resource constraints, it was not possible to collect the data any more frequently than we did. It could generally be assumed that the impact of such bias was even across the randomisation groups, and the lack of difference in costs when the intervention costs were excluded supports this assumption. However, we cannot discount the possibility that costs were double-counted if intervention group participants mistakenly reported therapy sessions as part of their usual diabetes care, in which case health-care costs for those two groups may be over-stated and any potential savings resulting from the interventions concealed.

Table 15 suggested that the partial sample used for the economic analyses may not have been fully representative of the full study sample. However, when those potentially differing characteristics were used to impute missing costs and outcomes to generate a full sample with complete data, the findings suggest that values obtained from the partial sample were a good representation of the full sample. Further analyses, perhaps based on

TABLE 22 *Mean and mean differences in 1 year costs and outcomes for imputed full sample*

	MET (*n* = 117)		MET + CBT (*n* = 106)		Usual care (*n* = 121)		MET vs usual care		MET + CBT vs usual care		MET vs MET + CBT	
	Mean	SD	Mean	SD	Mean	SD	Adjusted mean difference[a]	95% CI	Adjusted mean difference[a]	95% CI	Adjusted mean difference[a]	95% CI
Costs												
Health/social care, excluding MET/CBT	1809	1748	1694	1303	1511	1115	258	39 to 456	144	–88 to 364	–141	–397 to 128
Health/social care, including MET/CBT	1999	1744	2250	1261	1501	1112	458	242 to 653	707	474 to 926	226	–17 to 492
Societal, including MET/CBT	2607	2620	2488	2371	2248	2998	350	–340 to 895	154	–474 to 636	–186	–666 to 289
Societal, including MET/CBT	2797	2617	3044	2363	2239	2995	550	–142 to 1104	718	90 to 1197	182	–309 to 656
Outcomes												
QALYs based on EQ-5D	0.770	0.23	0.782	0.25	0.789	0.23	0.007	–0.01 to 0.03	–0.0001	–0.02 to 0.02	–0.007	–0.03 to 0.02
QALYs based on SF-36	0.714	0.11	0.716	0.13	0.726	0.11	0.002	–0.01 to 0.01	0.0002	–0.01 to 0.01	–0.002	–0.02 to 0.01
HbA_{1c} improvement	0.25	1.39	0.55	1.32	0.12	1.09	0.16	–0.17 to 0.47	0.45	0.15 to 0.75	0.28	–0.04 to 0.64

a Cost comparisons included covariates for the baseline value of the same cost category and baseline HbA_{1c}. Outcome comparisons included covariates for the baseline value of the same outcome.

TABLE 23 *Cost-effectiveness ratios*

	MET vs usual care	MET + CBT vs usual care	MET vs MET + CBT
Cost per additional point improvement on HbA_{1c}, health/social care perspective	3821	1756	636
Cost per additional point improvement on HbA_{1c}, societal perspective	4593	1809	514
Cost per additional QALY (EQ-5D), health/social care perspective	48,636	311,970	MET dominates
Cost per additional QALY (EQ-5D), societal perspective	160,750	271,333	MET dominates
Cost per additional QALY (SF-36), health/social care perspective	133,750	3,950,000	MET dominates
Cost per additional QALY (SF-36), societal perspective	160,750	4,070,000	MET dominates

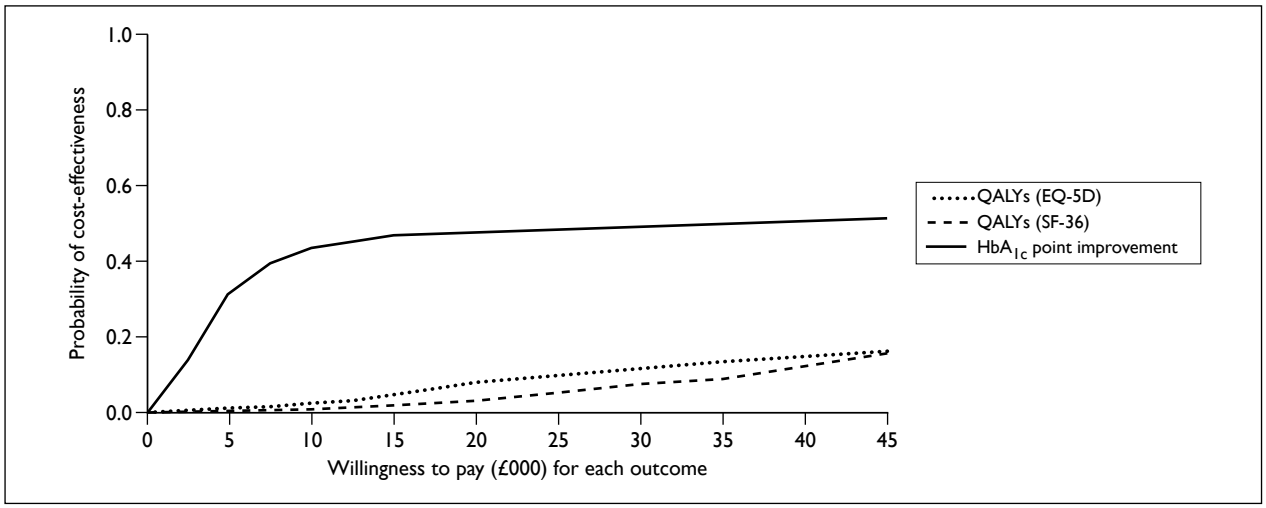

FIGURE 3 *CEACs for MET versus usual care, health/social care perspective.*

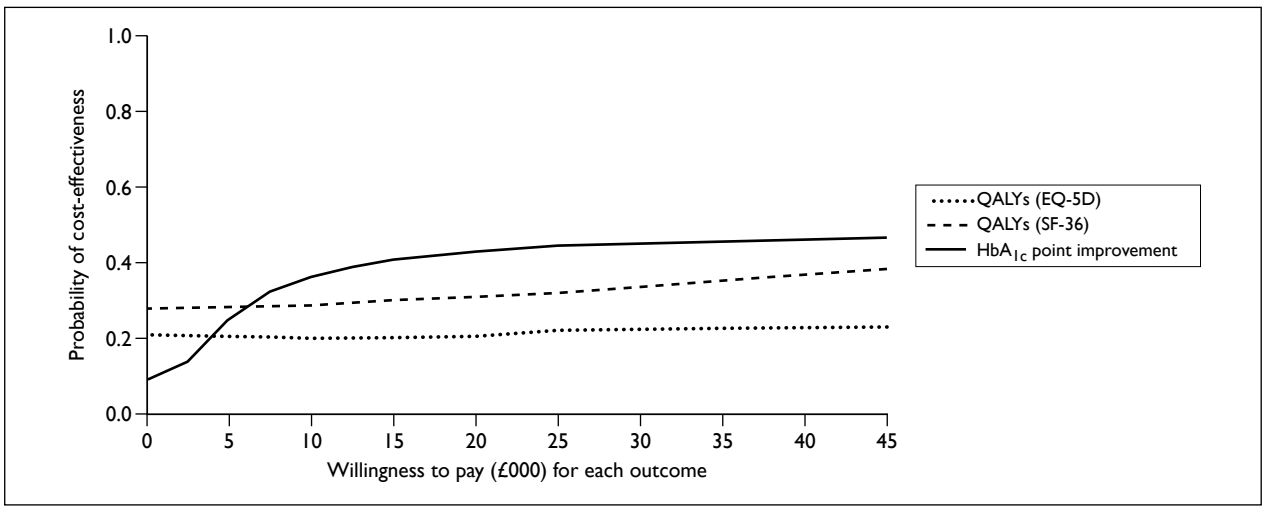

FIGURE 4 *CEACs for MET versus usual care, societal perspective.*

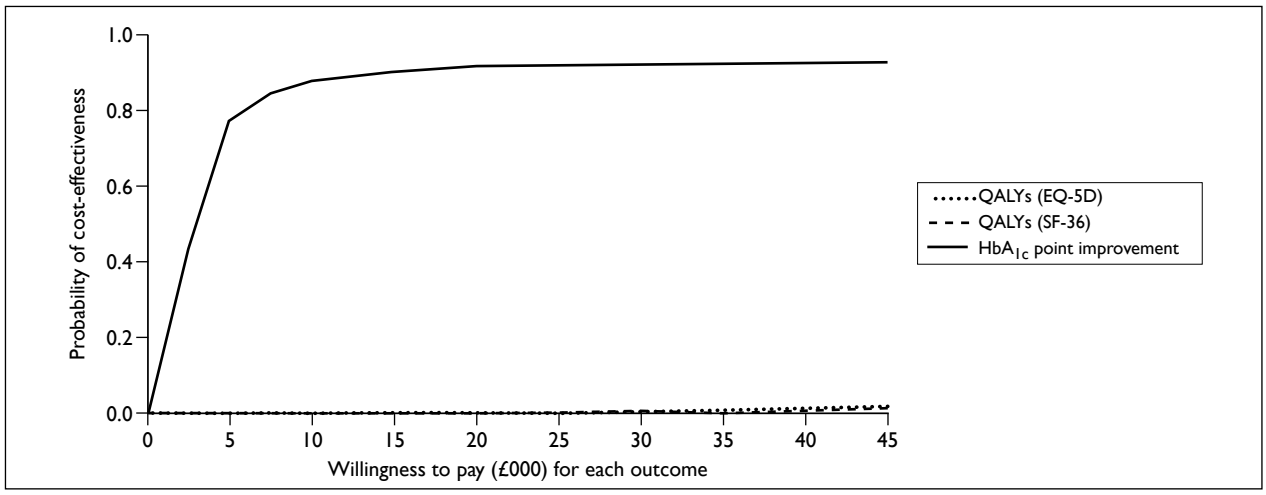

FIGURE 5 *CEACs for MET + CBT versus usual care, health/social care perspective.*

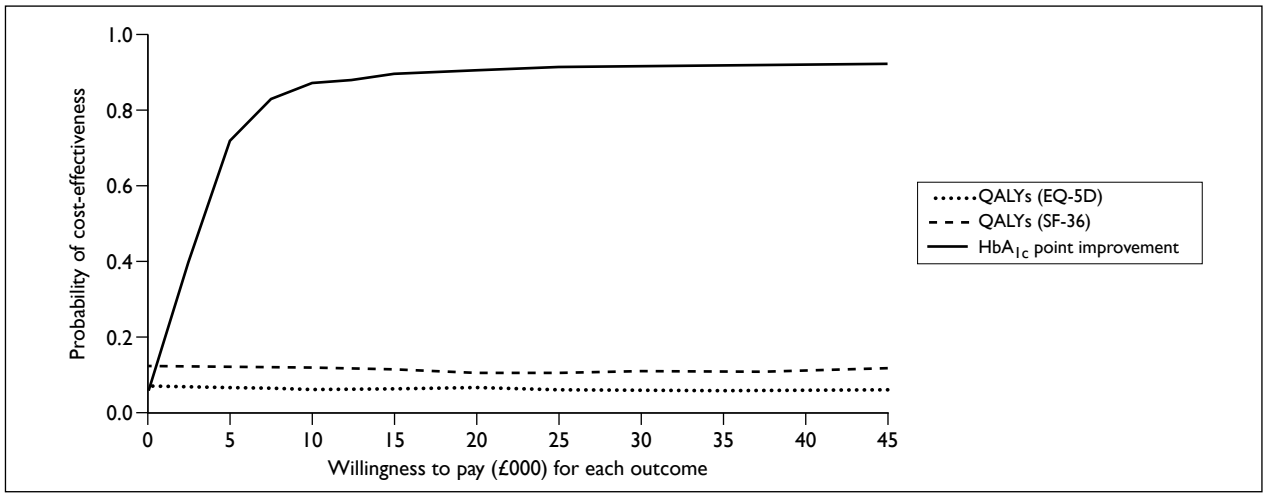

FIGURE 6 *CEACs for MET + CBT versus usual care, societal perspective.*

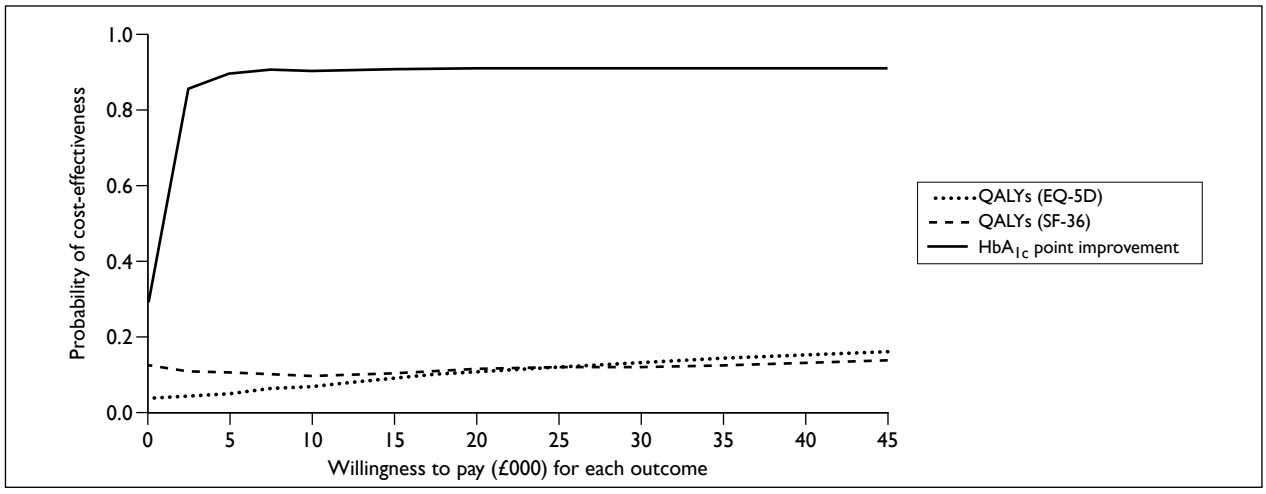

FIGURE 7 *CEACs for MET versus MET + CBT, health/social care perspective.*

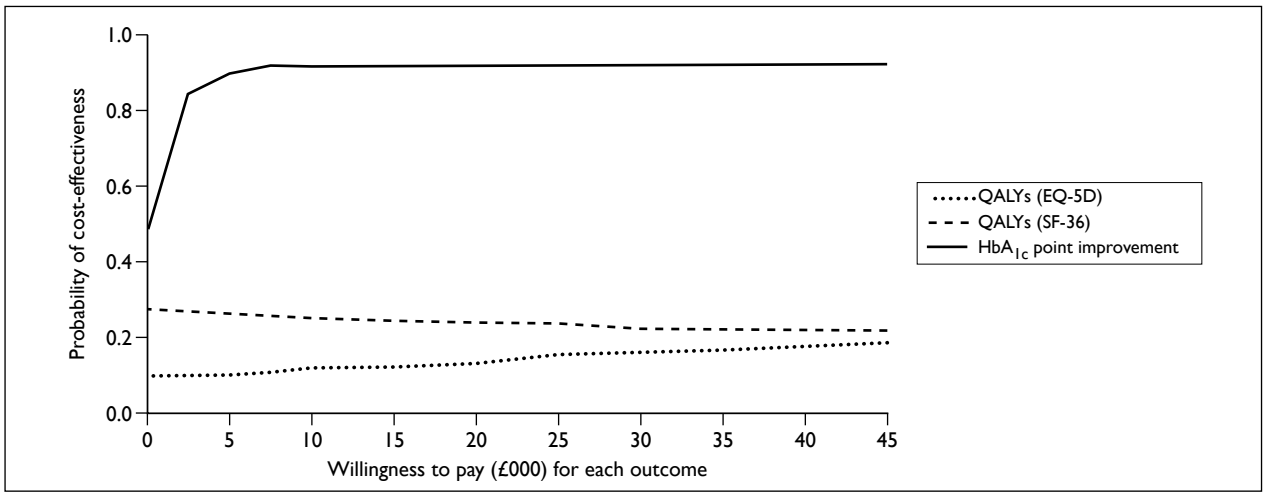

FIGURE 8 *CEACs for MET versus MET + CBT, societal perspective.*

alternative imputation techniques, may be needed to check the robustness of this conclusion.

Finally, the time horizon of the evaluation is likely to have been insufficient to identify relevant longer term outcomes for this patient group. For example, reductions in HbA_{1c} may result in fewer complications in the future, which may in turn impact on longer term quality of life. A cost–utility analysis within a longer term evaluation may therefore suggest quite different conclusions.

Discussion and conclusions

Discussion

It should be noted that the more favourable conclusions from this economic evaluation are related to one-point improvements in HbA_{1c} (e.g. the smallest ICER was £514 for an additional point improvement in HbA_{1c}). This raises the question of how meaningful such a small improvement is in terms of patient outcomes and in relation to the additional costs of achieving this. While this study found only a few significant associations between the interventions and secondary outcome measures within the study period, there is evidence to suggest that if small improvements are sustained for a reasonable duration, they can reduce development of complications (see Chapter 6, Clinical significance of findings). They may also confer significant savings in health-care costs within a relatively short time.[207] A longer term evaluation would be needed to capture all relevant outcomes for this patient group.

The unit costs of the interventions were estimated as an average of £48/49 per MET session and £73/81 per CBT session, depending on whether or not training costs were included. Accounting for attendance rates, and the combination of MET and CBT as one treatment option, the average total cost of each treatment approach was estimated at £195 for MET and £660 for MET + CBT. These estimates should assist decisions about implementing either intervention within the health service.

A component of our complex intervention was paradoxically to increase the use of diabetes resources. For instance, both MET and CBT covered topics that included making the best use of your diabetes team and how to be assertive in getting the help that is needed to optimise self-care, and some participants would visit their nurse before or after a session. Therefore, contrary to being a 'negative' finding, any additional costs may have been a reflection of improved self-care and use of services appropriate to need. However, analyses that excluded the cost of the interventions showed no significant differences in other health and social care costs, suggesting that any such effects were either absent or too subtle to affect the overall costs of care.

We planned to use the SF-36 for the estimation of QALYs because the appropriateness of the EQ-5D to detect changes in health-related quality of life in people with diabetes was unclear because of its more limited scope. The use of both measures enabled an informal comparison of findings between them. While both approaches resulted in very similar CEACs because the overall direction of QALY differences between groups was the same, they led to vastly different ICERs because the EQ-5D generated higher absolute QALY values

than the SF-36, which in turn affected the size of QALY differences. Although the broad finding of no significant effect on quality of life is likely to be robust, especially given that the DQoL also detected no such effect, it does raise an interesting and important issue concerning the choice of health-related quality of life measure in economic evaluations, and questions about the comparability of variably produced QALYs for decision-making.

Conclusions

This economic evaluation suggests that neither MET alone nor MET + CBT is an undisputedly cost-effective treatment approach compared with usual care alone in the short term. Both interventions led to significantly higher health and social care costs over 1 year because the additional costs of the MET and CBT did not appear to be offset by savings elsewhere. Only MET + CBT produced a significantly better health outcome (improved HbA_{1c}) and neither intervention significantly increased QALYs. ICERs based on point estimates and CEACs representing the potential variability around the findings suggest that:

- ICERs and probabilities of cost-effectiveness are more favourable in relation to HbA_{1c} improvements than for QALY gains.
- MET + CBT has more favourable ICERs and greater probabilities of cost-effectiveness compared with usual care than does MET alone, if HbA_{1c} is the outcome of interest.
- MET alone has more favourable cost-effectiveness ratios and greater probabilities of cost-effectiveness compared with usual care than does MET + CBT, if QALYs are the outcome of interest.
- MET + CBT has a good probability of cost-effectiveness compared with MET alone based on HbA_{1c} outcomes but, based on QALYs, it is dominated by MET and has low probabilities of cost-effectiveness.
- These conclusions are broadly similar from both health/social care and societal perspectives, thus avoiding the potential dilemma of trading off alternative impacts between different stakeholders.

Chapter 6
Discussion

Outline of discussion

The main aim of this study was to compare the effectiveness of two types of psychological treatments to be delivered by nurses specially trained in these technologies, with usual diabetes care in improving glycaemic control in a group of people with persistent difficulties with diabetes control. In this chapter, the main findings will be summarised, the advantages and limitations of the study design will be examined, this study will be compared with other published literature and suggestions for future research will be put forward.

Main findings

Our first finding was that MET + CBT was associated with a statistically significant reduction of nearly 0.5% of HbA_{1c} compared with usual diabetes care. The second finding was that the reduction in HbA_{1c} in the MET group compared with usual diabetes care was not significant, but the upper confidence limit did suggest that some people improved. The quarterly measurements of HbA_{1c} showed that there were initial reductions in the HbA_{1c} in all three groups, but these persisted at 12 months in only the MET + CBT group. The pattern of results did not change when we conducted sensitivity analyses by using imputed data for missing values of HbA_{1c}.

Our third finding was that baseline HbA_{1c} and age were significant moderators of the treatment effect, but only when MET + CBT was compared with usual diabetes care. The worse the glycaemic control at baseline, the greater was the reduction in HbA_{1c}. For instance, participants with HbA_{1c} of 12% on average had a reduction in the region of 1.5–2% if they were in the MET + CBT group compared with usual care. Those in their 20s had larger reductions in HbA_{1c}, again in the region of 1–2% points compared with usual diabetes care than those in their 40s who had reductions in the region of 0.3%.

The fourth finding was that MET was associated some improvement in body weight which almost reached significance, but otherwise neither of the experimental technologies were associated with any significant improvement in any of the other secondary outcomes.

The fifth finding was that neither MET nor MET + CBT is an undisputedly cost-effective treatment approach compared with usual care alone in the short term. Both interventions led to significantly higher health and social care costs over 1 year because the additional costs of MET and CBT did not appear to be offset by savings elsewhere. MET + CBT had greater probabilities of cost-effectiveness compared with usual care than did MET, if value was placed on HbA_{1c} outcomes (over 0.7 at thresholds of £5000 per additional point improvement in HbA_{1c}); but MET had a greater chance of cost-effectiveness if value was placed on QALY outcomes [although at a threshold of £20,000 per additional QALY, probabilities only reached 0.31 (based on the SF-36)]. MET + CBT had a good probability of cost-effectiveness compared with MET alone based on HbA_{1c} outcomes but, based on QALYs, it was dominated by MET and had low probabilities of cost-effectiveness. Therefore, cost-effectiveness conclusions are dependent on the relative importance of these two outcomes. These broad conclusions apply from both a health/social care and societal perspective.

Methodological issues

Advantages

There are a number of strengths to this trial. We used a randomised controlled design to evaluate the treatments. We targeted a relatively young group of people who may be regarded as having persistent difficulties in optimising their glycaemic control with at least two sub-optimal glycated haemoglobin values in the preceding year and a mean duration of diabetes of nearly 18 years, and who were at high risk of developing serious diabetes complications as evidenced by two-thirds of the sample having at least one early microvascular complication. This group also had high rates of psychiatric morbidity. We used a multicentre consecutive screening of diabetes registers to minimise selection biases. We had

a diverse socioeconomic sample with a large representation of participants from ethnic minority backgrounds. We established competency of nurses in delivering the psychological treatments and provided quality assurance during the study with regular supervision. We achieved excellent follow-up rates for the 12-month outcome assessments. We developed manuals and workbooks to ensure the two interventions were delivered according to a standardised format and provided clinical supervision, and the combination of the two are deemed more effective than simply a manual.[208] The study was also conducted in the NHS setting helping to establish its potential translatability.

We included a range of biological, psychological and social factors to assess the role of moderators and subgroup analysis.

The usual care group appeared to be an appropriate control group for this trial. A waiting list control group was deemed as increasing the risk of bias as the group would be expecting treatment whether it worked or not and perhaps the type of participant interested in the study would have been more 'psychologically minded' – we can recall a few volunteers who were hoping they would be randomised to the control group so that they would not need to take any more time out. A diabetes education control group would have made interpreting the findings difficult as modern educational programmes include a degree of counselling styles and group therapy even if they are not theoretically informed to do so. An attention control group could also have been appropriate to assess whether the non-specific components of the psychological interventions would have had an impact on long-term glycaemic control (perhaps in the form of unstructured sessions with a nurse who would show empathy to difficulties without the more structured exploration of the idiosyncratic motivational difficulties and unhelpful coping styles).

We had adequate statistical power to provide statistical validity of our findings especially as we slightly over-recruited and achieved a higher response rate than we had expected.

There are many models for assessing the methodological quality of studies. We met 25 of the 30 quality criteria proposed by Lacker and colleagues.[209] Those we did not meet are discussed as limitations below.

Limitations of this study

It is likely that a small proportion of patients who did meet the criteria for recruitment were not identified during the screening phase. Time and resource constraints and limited access to and existence of electronic databases during the screening and recruitment phase prevented constant coverage of all clinics. There were probably also a very small proportion of patients who were not registered at their local hospital. It is unlikely that this led to a significant bias as this handful of patients were likely to have very good diabetes control and therefore would not have met the inclusion criteria.

Another limitation is that for the initial analysis we rated only 20% of the usable audio-tapes and important data on treatment fidelity, which may potentially alter the findings of therapy integrity, probably remain on the remaining tapes. The tapes also contain material that would help unravel the therapy process. Had we rated a larger percentage of or all the available sessions we would have had the opportunity to investigate nurse differences, and assess whether or not and in what ways their skills changed across time.

Our assessment of potentially harmful or adverse events was limited to assessing rates of severe hypoglycaemia. We did not systematically collect data on all side effects or unwanted effects as we did not anticipate many biological side effects from a non-pharmacological intervention. We did not collect data on the proportion of patients who became worse on the outcome measures in each arm. We had a large number of missing data and we could not reliably differentiate between severe and non-severe hypoglycaemic episodes as this was self-report, but severe episodes do require third-party assistance and it is unlikely that a participant would not have recollection of this after the event.

We did not formally assess the credibility of the treatments nor patients' expectancy for improvement. In routine care, patients' expectancies vary according to the different technologies being offered, such as seeing different specialists. With this in mind, we can argue that patient expectation was implicit in the interventions being tested in this study and is likely to have been discussed within the therapeutic alliance.

While we aimed to have a baseline assessment of all diabetes complications, this was not possible as sometimes participants were not due for their annual review for some time and it would have involved more financial and staff resources. Furthermore, to evaluate whether a psychological intervention has an effect on the delay of onset or progression of complications we would require a larger RCT with a much longer follow-up as complications take a long time to develop. The follow-up was 12 months which may not be a sufficient duration to 'reset the glycaemic memory'.[10,11]

The two psychological treatments are not controlled for treatment duration, and observed differences could be due to the length of the intervention. It is difficult to design two psychological treatments that are sufficiently different technologies and have the same duration of treatment. For instance 12 sessions of MET would defeat the basic principle of MET which is that it is a short and focused intervention and, vice versa, four sessions of CBT would not be considered a sufficient number of sessions to bring about change. One potential solution would have been to have continued with some form of attention control, such as group attendance for dietary education, for those participants allocated to MET who had completed their four sessions. Another alternative would have been to compare CBT with a similarly focused such as cognitive analytical therapy (CAT) (which is usually longer) or with interpersonal therapy, but both of these require much more intensive training which is not a pragmatic option for the general health professional and the latter therapy applies only for the treatment of depression. A simple solution would have been to compare MI, CBT and usual care, but this would remain confounded by treatment duration, unless a way of dealing with attention control in the MI group was worked out.

There may have been relevant residual factors that could have influenced the findings that we did not measure and therefore do not know about. The Summary of Diabetes Self-Care measure does not include an item that measures a person's ability to adjust insulin according to mealtimes and carbohydrate counting as in those who completed the DAFNE programme so we have underestimated improved adherence to the diabetes regime in this subgroup. We also did not include a measure of personality and coping styles.

Comparison with other intervention studies

The RCTs identified in our review[84] that perhaps seem most similar appear to be those by Glasgow and colleagues,[104] Fosbury and colleagues,[98] Pouwer and colleagues[105] and van der Ven and colleagues.[111]

In terms of the target population, Fosbury and colleagues[98] and van der Ven and colleagues[111] were the only studies that to the best of our knowledge included adults with persistent sub-optimal glycaemic control. Persistent sub-optimal control was defined as having HbA_{1c} > 9.0% for the former study and ≥ to 8.0% for the latter on two or more consecutive clinic visits over a period > 12 months.

Glasgow and colleagues'[104] intervention is the most similar to the MET intervention we evaluated. They developed a diabetes-specific intervention which used the transtheoretical model of stages of changes, the concept of self-efficacy component and a computer-based assessment and feedback, which included the standardised Summary of Diabetes Self-Care Scale, patient beliefs about barriers to self-care and readiness to change, and a one-page feedback form. The main themes were then discussed and advice was given. In our intervention nurses also reviewed the feedback form with their patients but, in keeping with the MI spirit, they were advised to refrain from giving advice unless they first requested and received permission. This intervention was similar to our MET arm.

Pouwer and colleagues[105] trained DSNs to use a computer-based well-being questionnaire and to explore the results with their patients in a non-judgemental way using active listening and exploration of feelings. This intervention was similar to our MET arm and likewise they did not find a significant reduction in glycaemic control, but this group did not have significant sub-optimal glycaemic control at baseline and were not selected on this basis and this was not the main outcome.

Fosbury and colleagues[98] compared CAT with individual diabetes-specific counselling and education sessions with a DSN. An experienced CAT therapist saw all patients allocated in the intervention group for between 16 and 20 50-minute sessions. CBT techniques, mainly cognitive such as diary keeping and self-

monitoring, were integrated with approaches theoretically derived from object relations that aimed to address resistance to therapy and the persistence of 'seriously (self-)damaging behaviours'. CAT is a unique intervention, but if it has to be grouped it was most similar to our MET + CBT arm. They did find a significant difference between CAT and nurse education, again supporting our findings that the more intense (by either type or duration) therapy package is associated with better outcomes.

Our findings contrast with a recent study that found that six sessions of a group CBT intervention did not significantly reduce glycated haemoglobin in adults with type 1 diabetes.[111] Our study suggests that a therapy tailored to the individual may be more effective than a group setting, which may explain the difference in the results of the two studies.

An important aspect of our study that distinguishes it from others was whether with appropriate training, psychological techniques specific to problems with diabetes self-care could be delivered by non-mental health-care professionals to improve diabetes outcomes, as access to both specialist nurses and psychotherapists is usually not possible nor always desirable. We demonstrated that specialist nurses could be trained to deliver diabetes-specific psychological treatments competently and effectively in terms of reducing glycaemic control. Whether extended or enhanced understanding of therapist styles would further improve competencies and lead to better effect on glycaemic control warrants further inquiry.

Another difference between our study and the majority of previous RCTs was that we compared two psychological treatments with usual care. MET failed to improve glycaemic control compared with usual care, but when combined with CBT the combination was effective. This could be due to the techniques specific to CBT. Alternatively it may be that longer rather than shorter treatment is required to improve glycaemic control; the possibility that treatment effect is confounded by treatment dose cannot be tested in this study and therefore cannot be ruled out. In the clinical setting, CBT is most effective when patients are motivated to change their behaviours, and supporting motivational change initially in a group of people who have found it difficult to change their diabetes self-care behaviours has face validity. There have been recent similar advances in the medical and behavioural management of alcohol abuse and dependence where a state-of-the-art individualised therapy titled 'COMBINE' that begins with motivational enhancement techniques and is followed by cognitive behavioural techniques is currently being evaluated.[210]

Clinical significance of findings

There are several clinical implications of our study considering that there are national and international recommendations supporting psychological care in type 1 diabetes[6,211] and yet there is a severe shortage of psychotherapists to meet this demand. First, we achieved a clinically meaningful reduction in glycated haemoglobin. In the DCCT study, although normalisation of blood glucose values was not achieved in the intensive treatment group, the reduction in glycaemic control that was achieved was associated with a 40–60% reduction in the development of microvascular complications over the 7 years of follow-up.[9–11] It should be noted that if the reduction of 0.5% that was achieved in this study was maintained over a longer period, e.g. of several years, this significantly reduces the risk of diabetes microvascular complications. A longer term follow-up is needed for this, but these findings do hold promise in suggesting that an initial outlay of setting up psychotherapy services in diabetes could lead to longer term health benefits than those measured here.

Second, with appropriate manual skills training, diabetes nurses can make a significant contribution in improving glycaemic control.

Third, the effectiveness of combining MET with CBT in improving glycaemic control may be related to its focus on diabetes-specific problems rather than on general psychological distress.

Fourth, we observed in subgroup analysis that those with the worst glycaemic control appeared to make the largest gains in reducing their glycaemic control. This finding should be interpreted with caution as it was underpowered, but suggests potential clinical subgroups into which this intervention could be translated.

Fifth, the economic evaluation found greater health and social care costs in the intervention groups than in the usual care group. This appeared to be

a result of the additional costs of the interventions, rather than increased use of other services. Therefore, although a component of our complex intervention was paradoxically to increase the use of diabetes resources through improved and greater responsibility for self-care, there was no evidence of this occurring.

The average reduction in glycaemic control was small in absolute numbers and it could be argued that this was not of sufficient clinical significance. We consider this reduction as clinically significant based on the evidence that there is a continuous association between glycaemic control and diabetes complications such that any reduction in the former is associated with a reduction in the risk of the latter. It also needs to be emphasised that the study population was a difficult to treat group of patients who despite attending clinics are still not achieving optimal control. Further, if the focus is on the average HbA_{1c}, we risk ignoring the possibilities of change suggested by the CI which includes the possibility of nearly 1% reduction. The strength of this study is that psychological treatments clearly seem to have a positive effect and it is likely that further refinement of the intervention may lead to larger effects.

Half the sample completed all 12 sessions in the MET + CBT arm and over two-thirds completed at least half the sessions. This is similar to rates reported in other RCTs of CBT.[212] This raises several questions; if the completion rate for all sessions had been higher, would this have translated to a larger effect size? This is difficult to answer as people drop out of psychotherapy for many different reasons. We did not measure this qualitatively or quantitatively, but in translating into the clinical setting it would be important to evaluate this and develop techniques to reduce attrition to therapy, such as better preparation for therapy and better identification of patients who are more likely to benefit. This intervention asked people with diabetes to take time out of their week when they are already taking time out of their many social roles and responsibilities for various medical appointments. There needs to be a culture shift in both the medical teams and the patients to accepting the need for psychological care as a dimension of diabetes care. Incorporating explicit well-defined psychological care and psychological outcomes as objectives in national guidelines would be a way forward in improving the acceptability of psychological treatments in diabetes.

Research significance of findings

We developed a training programme within a research context to train general medical nurses to deliver the interventions. With input from experts in those fields of clinical practice and research we developed treatment manuals, patient workbooks and a training programme that, in a short period of time, gave nurses basic psychotherapy skills as well as MET- and CBT-specific skills. The training had active learning components and a treatment fidelity assessment component to ensure nurses were competent before the onset of the study recruitment. The syllabus is relatively easy to replicate and adapt and indeed we have already translated the MET component into a postgraduate/Masters course design at King's College London (www.kcl.ac.uk/nursing) which can be taught and can certify health professionals and with supervision can be used in clinical settings.

This was a definitive phase III intervention, but there are aspects of it that probably need further study in order to understand what are the key components of the intervention. The two main, not mutually exclusive, interpretations, whether it was treatment type or treatment duration, cannot be fully answered in this study. Our opinion is that it is more likely to be treatment type as we found that there was adequate treatment fidelity and that the two therapies could be distinguished. The underlying philosophy of our study was that MET would bring about change in motivation and that once the person with diabetes was ready to change, this was when CBT would be most effective as the person was in a better position to use the therapeutic alliance to develop new psychological skills in managing diabetes. This can be partially addressed if a process evaluation of the sessions that were taped was conducted.

Given that the improvements in glycaemic control were small and there were no improvements in psychological outcomes, the question is raised as to how the intervention could be improved. We adapted standard CBT techniques to diabetes and accordingly this raises the question as to whether there should be a more flexible approach by including psychological problems, such as depression and anxiety, in the assessment and through problem formulation such that the intervention incorporates treatment of key mental health problems. In the original protocol, including

common mental disorders would have intensified and prolonged the training and therefore the costs. However, considering the increasing recognition of depression as a comorbidity in diabetes and other chronic metabolic conditions and that primary care and (non-mental) health professionals are increasingly expected to have basic skills in psychological assessment and psychological care, translation of the intervention should perhaps include components to deal with the assessment and management of common mental disorders.

We could conduct qualitative analyses of all the therapy sessions to throw more light onto the content of the sessions and identify recurrent themes. It would also be interesting to investigate the role of 'sudden gains' or rapid improvements which usually occur early in therapy and have been found to be associated with better long-term outcomes in depression.[213,214] For the development and evaluation of brief and time-limited psychological interventions, the sudden gain effect may prove to be particularly useful in terms of cost-effectiveness, the introduction of such interventions to clinical settings, and improvement in attendance rates. We could improve our baseline assessment to include better measures of social support and other psychological measures, ensure we have less missing data on the diabetes-related complications, introduce techniques to improve therapy attendance and have longer follow-up. We could also refine our recruitment strategies and improve the follow-up assessments even more.

The fact that participants in the intervention arms received their intervention from different therapists potentially complicated the analysis and conclusions in two ways. First, differences in effectiveness between the intervention groups could be due to imbalance in the distribution of MET and MET + CBT patients between the therapists. For example, if all the MET + CBT patients received therapy from the first three therapists while all the MET patients received therapy from the other three therapists, differences between the groups could merely reflect the difference in ability of therapists. In this study all six nurses delivered therapy to both MET and MET + CBT patients and most therapists had a good balance of MET and MET + CBT patients and there was no statistical evidence that 12-month HbA_{1c} varied according to therapist. The second potential complication is that if outcomes did vary according to therapist, this should be accounted for in regression models, to allow for the clustering of patients within therapists. However, as there was no evidence of differences between outcomes by therapist, a model with a random therapist effect could not be estimated.

Future research

Transcribing of all the available audio-taped sessions would help analyse their contents to obtain a more in-depth idea of recurring themes and the process of behavioural, cognitive change and change in effect as it occurs within and across sessions. This thorough investigation might also shed more light on the nature and timing of 'sudden gains' and the possible reasons for therapy non-attendance. There is an existing significant body of research that has looked at such processes that we could use to form and test hypotheses in diabetes-specific MET and CBT and assess whether these factors are associated with outcome.[181,195,214,215]

User feedback of the therapeutic process and participating in the study could be collected to help inform how to improve identifying potentially eligible participants, to reduce the follow-up rates and to improve the delivery of any future intervention.

There is more scope to study the type of training needed for optimal level of competency to deliver the maximum effect on glycaemic control. We also need to understand in more detail why younger people and those with worse control made bigger changes than those with better control.

The technologies evaluated here focused on glycaemic control rather than psychiatric morbidity. Previous RCTs in diabetes have tended to focus on improving psychological well-being, and perhaps it is better to include improving psychological outcomes as a primary outcome and not just glycaemic control as they are more likely to be 'patient important' outcomes.[216] It is possible that the values and preferences of patients are different to the medical team's values of achieving optimal clinical targets.

In designing future RCTs, attention needs to be given to the components of usual care. Diabetes education is part of usual care and should be incorporated into future studies that aim to compare true usual care with additional psychological interventions.

The patterns of change in mean glycated haemoglobin at 3, 6 and 9 months showed that MET was effective up to a certain time point. It is possible that the effect of brief MET could be maintained up to 12 months and longer if 'booster' MET sessions after a few months from the end of therapy were added instead of CBT.

There is also scope for exploring the utility and effectiveness of self-help materials and for web-based therapies versus face-to-face interventions. A recent study evaluated an interactive CD-ROM for depression and although only a quarter of those who were given the option to use it actually did so, those who did had a clinically and statistically significant reduction in their symptoms of depression.[217] It is possible that a CD-ROM with diabetes-specific components could have a similar impact. In the same line of thought, it would be helpful in terms of service availability and use to explore the potential of replacing some or all face-to-face sessions with telephone ones. Sacco and colleagues'[218] small pilot study ($n = 10$) showed some encouraging results. They evaluated a brief, regular, semi-structured, CBT-based telephone 'coaching' intervention designed to be delivered by trained psychology undergraduates. Patients found the intervention acceptable and effective in reducing the percentage of glycated haemoglobin. Such an intervention could potentially increase the response rate particularly to extended therapy interventions.

Quality-adjusted life-years estimated from the SF-36 and EQ-5D resulted in similar CEACs, but different ICERs because of differences in the size of utility estimates generated by the two instruments. Further work is needed to explore the appropriateness and reliability of each approach for different contexts and what the implications for decision-making are when faced with comparing evidence based on a mixture of such approaches.

Conclusion

This *Health Technology Assessment* report evaluated the effectiveness of improving glycaemic control of two types of diabetes-specific psychological interventions compared with usual care for adults with type 1 diabetes and persistent sub-optimal glycaemic control. Patients were randomly allocated to one of the three groups: usual diabetes care, MET and MET + CBT. Both interventions were delivered competently by nurses. Compared with usual care, glycaemic control as measured with glycated haemoglobin at 12 months significantly improved in the MET + CBT group, but not in the MET group. It was not possible to fully distinguish the independent effects of treatment duration and treatment type on the main outcome.

Neither intervention fell within a notional policy-making threshold of cost-effectiveness (i.e. £20,000 per QALY gain) in a 1-year evaluation. In comparisons against usual care, MET + CBT achieved HbA_{1c} improvements at a lower cost (£1756 per additional point improvement) than MET. Probabilities of cost-effectiveness were higher based on HbA_{1c} outcomes than on QALY outcomes. Therefore, decisions regarding the provision of such interventions depend on the relative importance of these two outcomes.

This study substantially adds to the evidence that psychological treatments can have as effective a role to play as adjunct therapies to help improve diabetes control. This study also raises a number of important questions about how to translate these findings, such as whether to broaden the training of nurse therapists to include psychological techniques for the assessment and management of psychiatric comorbidity. There are a number of research opportunities, such as modifications of the intervention and focusing on specific subgroups in diabetes, that arise from this study that may be associated with better outcomes.

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Contribution of authors

Dr Khalida Ismail (Diabetes and Psychiatry) developed the study hypotheses and was the principal investigator and guarantor. Dr Ismail, Professor Janet Treasure (Pyschiatry), Professor Ulrike Schmidt (Psychiatry), Professor Trudie Chalder (Cognitive Behaviour Therapy), Dr Stephen Thomas (Diabetologist) and Dr Anita Patel (Health Economics) contributed to the design and supervision of the study protocol. Professor Chalder led the design of the CBT intervention and the training of the nurses. Professor Treasure and Professor Schmidt led the design of the MET intervention and the training of the nurses. Ms Esther Maissi was the trial co-ordinator for the whole study and carried out the recruiting and the follow-ups and data collection in the London sites. Dr Chris Dickens (Liaison Psychiatry) and Professor Francis Creed (Liaison Psychiatry) were the lead investigators for the Manchester sites. Mr Jonathan Bartlett developed the statistical plan and performed the statistical analyses. Dr Ismail drafted the manuscript, and all authors contributed to the writing and approval of the final manuscript. The corresponding author had full access to all the data in this study and had final responsibility for the decision to submit it for publication.

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Appendix 1

Unit costs

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Inpatient services				
Accident and emergency	Investigation	77	3	Lower cost investigation (referred/discharged). If the inpatient day is more than 1 day, then assumed general inpatient cost
Cardiology	Night	101	3	
Dermatology	Night	243	3	General inpatient cost
Diabetes	Night	243	3	General inpatient cost
Endocrinology	Night	243	3	General inpatient cost
Foot ulcer clinic	Night	26	3	Podiatry
Gastroenterology	Night	243	3	General inpatient cost
General medicine	Night	243	3	General inpatient cost
Gynaecology	Night	243	3	General inpatient cost
High dependency unit	Night	567	1	High dependency unit – level 1 for intensive care; NHS Trusts and Primary Care Trusts combined; sheet TCCS, specialty code CC8L1
Neurology	Night	243	3	General inpatient cost
Opthamology	Night	243	3	General inpatient cost
Orthopaedics	Night	243	3	General inpatient cost
Pain	Night	243	3	General inpatient cost
Palliative care	Night	243	3	Assumed pain care and general inpatient unit cost
PIU	Night	149	3	Rehabilitation
Psychiatry	Night	243	1	NHS Trusts and Primary Care Trusts combined; sheet TMHi, specialty code MHIPA2
Radiology	Night	243	3	General inpatient cost
Rehabilitation	Night	225	1	NHS Trusts and Primary Care Trusts combined; sheet TREHAB, specialty code RH30
Renal	Night	243	3	General inpatient cost
Rheumatology	Night	243	3	General inpatient cost
Surgery	Night	93	3	General surgery
Urology	Night	243	3	General inpatient cost
Vascular	Night	243	3	General inpatient cost
Vascular surgery	Night	93	3	General surgery
Outpatient services				
Accident and emergency	Visit	96	1	First attendance – accident & emergency; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code 180F
Antenatal pregnancy clinic	Visit	62	1	Follow-up attendances for other expectant mothers; NHS Trusts and Primary Care Trusts combined; sheet TOPS MAT, specialty code MOANFU

continued

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Anticoagulant clinic	Visit	27	1	First attendance – anti-coagulant clinic; NHS Trusts & Primary Care Trusts combined; sheet TOPS FA, specialty code HACCF
Blood test	Visit	3	1	Direct access pathology services – haematology (excluding anticoagulant services); NHS Trusts; sheet TPATH, specialty code DAP823.
Cardiology	Visit	103	1	Adult follow-up attendance – cardiology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 320F
Chiropody	Visit	26	1	Community services – chiropody; NHS Trusts and Primary Care Trusts combined; sheet TOCS, specialty code N905
DAFNE course	Course	636	4	2001–2 unit cost of £545 uprated to 2005–6 rate using HCHS pay and prices inflator; cost per person per course delivered over 5 days
Dentistry	Visit	72	1	First attendance – dental medicine specialities; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code 450F
Dermatology	Visit	64	1	Adult follow-up attendances in dermatology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 330F
Diabetes clinic	Visit	108	1	Adult follow-up attendance – diabetic medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 307F
Diabetes eye clinic	Visit	25	1	Direct access clinical measurement – diabetic retinal screening; NHS Trusts and Primary Care Trusts combined; sheet TCMTESTS, specialty code DA11
Diabetes foot clinic	Visit	108	1	Adult follow-up attendance – diabetic medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 307F
Diabetic antenatal clinic	Visit	116	1	Follow-up attendances – expectant mothers with diabetes; NHS Trusts and Primary Care Trusts combined; sheet TOPS MAT, specialty code MDANFU
Dietetics	Visit	38	1	Adult follow-up attendance – dietetics services; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code DTSSF
Ear, nose and throat	Visit	69	1	Adult follow-up attendance – ear, nose and throat; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 120F
Early pregnancy clinic	Visit	62	1	Adult follow-up attendance – other expectant mothers; NHS Trusts and Primary Care Trusts combined; sheet TOPS MAT, specialty code MOANFU
Endoscopy	Visit	235	2	Diagnostic endoscopy; NHS Trusts; sheet TCMTESTS, Specialty code DA06. 2004/5 cost of £226 uprated to 2005–6 rate using HCHS pay and prices inflator
Fracture clinic	Visit	118	1	Adult follow-up attendance – general medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 300F
Gastroenterology	Visit	96	1	Adult follow-up attendance – medical gastroenterology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 301MF
General medicine	Visit	118	1	Adult follow-up attendance – general medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 300F
Genital-urinary	Visit	136	1	First attendance – genito-urinary medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code 360F

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Gynaecology	Visit	85	1	Adult follow-up attendance – gynaecology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 502F
Haematology	Visit	3	1	Direct access pathology services – haematology (excluding anticoagulant services); NHS Trusts and Primary Care Trusts combined); sheet TPATH, specialty code DAP823
Hand clinic	Visit	118	1	Adult follow-up attendance – general medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 300F
Iron transfusion	Visit	93	1	Follow-up attendance: blood transfusion; NHS Trusts and Primary Care Trusts combined; sheet TOPS FU, specialty code 821F
Liaison psychiatry	Visit	134	1	Follow-up attendance – mental health other services for adults; NHS Trusts and Primary Care Trusts combined; sheet TMHiii, specialty code MHOPFUA2
MRI scanning	Visit	244	1	Adult follow-up attendance – direct access radiology services; NHS Trusts and Primary Care Trusts combined; sheet TRADIO, specialty code RBF1
Neurology	Visit	241	1	First attendance – neurology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code 400F
Opthamology	Visit	60	1	Adult follow-up attendance – ophthalmology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 130F
Orthopaedics	Visit	84	1	Adult follow-up attendance – trauma and orthopaedics (non-trauma); NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 110NF
Paramedic	Call-out	171	1	Paramedic services provided by urban NHS Trusts for diabetic problems; sheet Tuambincii, specialty code PS13B
Phlebotomy	Visit	3	1	Direct access pathology services – phlebotomy; NHS Trusts and Primary Care Trusts combined; sheet TPATH, specialty code DAP839
Physiotherapy	Visit	28	1	Adult follow-up attendance – physiotherapy; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code TPHAF
Pre-pregnancy clinic	Visit	50	1	First attendance – family planning clinic; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code FPCF
Psychiatry	Visit	134	1	Follow-up attendance – mental health other services for adults; NHS Trusts and Primary Care Trusts combined; sheet TMHiii, specialty code MHOPFUA2
Psychology	Visit	134	1	Follow-up attendance – mental health other services for adults; NHS Trusts and Primary Care Trusts combined; sheet TMHiii, specialty code MHOPFUA2
Renal	Visit	118	1	Adult follow-up attendance – general medicine; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 300F
Rheumatology	Visit	124	1	Adult follow-up attendance- rheumatology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 410F
Surgery	Visit	88	1	Adult follow-up attendance – general surgery; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 100F

continued

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Ultrasound	Visit	74	1	Direct access radiology services – Band C2 ultrasound; NHS Trusts and Primary Care Trusts combined; sheet TRADIO, specialty code RBC2
Urology	Visit	87	1	Adult follow-up attendance – urology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 101F
Vascular	Visit	101	1	Adult follow-up attendance – vascular surgery; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 107F
X-ray	Visit	19	1	Direct access radiology services – Band A; NHS Trusts and Primary Care Trusts combined; sheet TRADIO, specialty code RBA1
Other hospital services				
Accident and emergency	Visit	96	1	First attendance – accident and emergency; NHS Trusts and Primary Care Trusts combined; sheet TOPS FA, specialty code 180F
Ambulance/paramedic	Call-out	171	1	Paramedic services provided by urban NHS Trusts for diabetic problems; sheet Tuambincii, specialty code PS13B
Angioplasty	Finished consultant episode	1648	1	Elective inpatient – cardiac catheterisation and angiography without complications; NHS Trusts and Primary Care Trusts combined, sheet TELIP, specialty code E14
Cardiology	Visit	103	1	Adult follow-up attendance – cardiology; NHS Trusts and Primary Care Trusts combined; sheet TOPS FUA, specialty code 320F
Counselling	Visit	134	1	Follow-up attendance – mental health other services for adults; NHS Trusts and Primary Care Trusts combined; sheet TMHiii, specialty code MHOPFUA2
Day dental surgery	Visit	412	1	Day case – other procedures and health-care problems; NHS Trusts and Primary Care Trusts combined; sheet TDC, specialty code S34
Day hospital	Visit	114	1	Day care facilities – other patients; NHS Trusts and Primary Care Trusts combined; sheet TDCF, specialty code DCF30
Day surgery	Visit	412	1	Day case – other procedures and health-care problems; NHS Trusts and Primary Care Trusts combined; sheet TDC, specialty code S34
Diabetes eye clinic	Visit	25	1	Direct access clinical measurement – diabetic retinal screening; NHS Trusts and Primary Care Trusts combined; sheet TCMTESTS, specialty code DA11
Sigmoidoscopy	Visit	191	1	Outpatient procedure data – rigid sigmoidoscopy; NHS Trusts and Primary Care Trusts combined; sheet TOPS PROC, specialty code OPRS11
Community-based/primary care services				
GP surgery visit	Minute	2	3	Based on cost per surgery/clinic minute including direct care staff costs. Excluding qualification costs
GP home visit	Minute	3	3	Based on cost per home visit minute including direct care staff costs and travel costs. Excluding qualification costs
GP telephone contact	Minute	2	3	Including direct care staff costs. Excluding qualification costs
Diabetes specialist nurse surgery visit	Minute	1	3	Assumed unit cost for community nurse specialist. Based on cost per hour of client contact. Excludes qualification costs

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Diabetes specialist nurse home visit	Minute	1.05 + 1.30 travel per visit	3	Assumed unit cost for community nurse specialist. Based on cost per hour of client contact. Excludes qualification costs
Diabetes specialist nurse telephone contact	Minute	1	3	Assumed unit cost for community nurse specialist. Based on cost per hour of client contact. Excludes qualification costs
Diabetic clinic surgery visit	Minute	2	3	Assumed GP clinic. Based on cost per surgery/clinic minute including direct care staff costs. Excluding qualification costs
Diabetic clinic home visit	Minute	3	3	Based on cost per home visit minute including direct care staff costs and travel costs. Excluding qualification costs
Diabetic clinic telephone contact	Minute	2	3	Including direct care staff costs. Excluding qualification costs
Practice nurse surgery visit	Minute	0	3	Based on cost per hour in clinic. Excluding qualification costs
Practice nurse home visit	Minute	0.53 + 0.60 travel per visit	3	Based on cost per hour of home visits. Excluding qualification costs
Practice nurse telephone contact	Minute	0	3	Based on cost per hour of client contact. Excluding qualification costs
District nurse surgery visit	Minute	1	3	Based on cost per hour in clinic. Excludes qualification costs
District nurse home visit	Minute	0.93 + 1.30 travel per visit	3	Based on cost per hour spent on home visiting. Excludes qualification costs
District nurse telephone contact	Minute	1	3	Based on cost per hour spent with a patient. Excludes qualification costs
Chiropodist surgery visit	Minute	0	3	Excludes qualification costs
Chiropodist home visit	Minute	0.30 + 1.30 travel per visit	3	Excludes qualification costs
Chiropodist telephone contact	Minute	0	3	Excludes qualification costs
Optician surgery visit	Visit	20	11	Assumed cost per eye test
Dietician surgery visit	Minute	0	3	Based on cost per hour in clinic. Excludes qualification costs
Dietician home visit	Minute	0.78 + 2.30 travel per visit	3	Based on cost per hour of home visiting. Excludes qualification costs
Dietician telephone contact	Minute	0	3	Based on cost per hour of client contact. Excludes qualification costs
Physiotherapist surgery visit	Minute	0	3	Based on cost per hour in clinic. Excluding qualification costs
Physiotherapist home visit	Minute	0.62 + 2.50 travel per visit	3	Based on cost per hour of home visiting. Excluding qualification costs
Physiotherapist telephone contact	Minute	1	3	Based on cost per hour of client contact. Excluding qualification costs
Occupational therapist surgery visit	Minute	0	3	Based on cost of clinic visit. Excluding qualification costs
Occupational therapist home visit	Minute	1.20 + 2.50 travel per visit	3	Based on cost per hour of home visiting. Excluding qualification costs
Occupational therapist telephone contact	Minute	1	3	Based on cost per hour of client contact. Excluding qualification costs

continued

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Psychiatrist surgery visit	Minute	1	3	Based on cost per patient-related hour for medical consultant. Excluding qualification costs
Psychiatrist home visit	Minute	1.32 + 5.00 travel per visit	3	Based on cost per patient-related hour for medical consultant. Travel cost based on travel costs for GPs. Excluding qualification costs
Psychiatrist telephone contact	Minute	1	3	Based on cost per patient-related hour for medical consultant. Excluding qualification costs
Psychologist surgery visit	Minute	1	3	Based on cost per hour of client contact. Excluding qualification costs
Psychologist home visit	Minute	1.10 + 1.30 travel per visit	3	Based on cost per hour of client contact. Excluding qualification costs
Psychologist telephone contact	Minute	1	3	Based on cost per hour of client contact. Excluding qualification costs
Psychotherapist surgery visit	Minute	1	3	Based on cost per hour of client contact for clinical psychologist. Excluding qualification costs
Psychotherapist home visit	Minute	1.10 + 1.30 travel per visit	3	Based on cost per hour of client contact for clinical psychologist. Excluding qualification costs
Psychotherapist telephone contact	Minute	1	3	Based on cost per hour of client contact for clinical psychologist. Excluding qualification costs
Counsellor surgery visit	Minute	1	3	Assumed unit cost for clinical psychologist. Based on cost per hour of client contact. Excludes qualification costs
Counsellor home visit	Minute	1.10 + 1.30 travel per visit	3	Assumed unit cost for clinical psychologist. Based on cost per hour of client contact. Excludes qualification costs
Counsellor telephone contact	Minute	1	3	Assumed unit cost for clinical psychologist. Based on cost per hour of client contact. Excludes qualification costs
Social worker home visit	Minute	2	3	Based on cost per hour of face-to-face contact. Excluding qualification costs
Social worker telephone contact	Minute	1	3	Based on cost per hour of client-related work
Home help home visit	Minute	0	3	Based on cost per hour of face-to-face weekday contact for a local authority home care worker
Home help telephone contact	Minute	0	3	Based on cost per weekday hour for a local authority home care worker
Meals on wheels	Meal	4	3	
Other health services				
Eye screening unit	Visit	25	1	Direct Access Clinical Measurement – Diabetic Retinal Screening; NHS Trusts and Primary Care Trusts combined, sheet TCMTESTS, specialty code DA11
GP repeat prescription collection	Minute	1	3	Based on cost per hour of GMS activity including direct care staff costs. Excluding qualification costs
Homeopath	Minute	1	10	
Massage	Minute	1	10	
NHS walk-in centre	Visit	22	3	Assumed cost of accident and emergency walk-in centre
Osteopath	Minute	1	10	
Pharmacist	Minute	1	3	Based on time for direct clinical activities, including travel to visits. Excludes qualification costs

Item	Unit	Unit cost (£) 2005–6 prices	Source	Notes/assumptions
Medication and equipment				
Medication (including insulin)	1 mg/ml	< 0.01–11.52	12, 13	
Diabetes testing/ monitoring equipment	Item	0.03–1000	12, 13, 14, 15, 16, 17	
Other equipment/aids	Item	0.65–55	13, 18, 19, 20, 21	
Values for time				
National average wage	Hour	13	8	Average gross hourly earnings, excluding overtime, for full-time employees on adult rates whose pay was not affected by absence, in all industries and services in the UK in April 2002. 2002 rate of 11.73 inflated using the Gross Domestic Product inflator
National minimum wage	Hour	5	9	2006 rate for workers aged 22 and over
Leisure time	Hour	5	7	Market price for value of non-working time for 'other' purpose. 2002 unit cost of £4.46 per hour uprated to 2005–6 rate using Gross Domestic Product inflator

FA, first attendance; FUA, follow-up attendance; GMS, General Medical Service; HCHS, Hospital and Community Health Services; MAT, maternity; MRI, magnetic resonance imaging; PIU, Patient Investigation Unit; PROC, procedures; TCCS, critical care services; TCMTESTS, clinical measurement test data; TELIP, elective inpatient healthcare resource group data; TMHi, mental health services inpatient data; TOCS, community services other attendance data; TOPS, ; TPATH, pathology services test data; TRADIO, radiology services test data; TREHAB, rehabilitation services data.

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Appendix 2

Unit costs of MET and CBT

	Unit/quantity[a]	MET	CBT	Assumptions
Delivery to patients				
Therapist – contact time	50 minutes for each therapy	19.75	19.75	
Therapist – non-contact time	10 minutes for MET; 15 minutes for CBT	3.95	5.92	
Therapist supervision				
Therapist – contact time	8.44 minutes for MET; 33.10 minutes with junior supervisor and 1.99 minutes with senior supervisor for CBT	3.33	13.86	MET: 1 hour of supervision per week. Assuming 108.5 working weeks between June 2003 and December 2006, this equates to a total of 108.5 hours of supervision. Dividing this by the total number of MET sessions attended (771) equates to 8.44 minutes per session. CBT: 294 hours provided by junior supervisor and 17.68 hours (2 days from a 44.2-hour week) by senior supervisor between June 2003 and December 2006. Dividing these hours by the total number of CBT sessions attended (533) equates to an average of 33.10 minutes and 1.99 minutes per session with each supervisor respectively, or a total of 35.09 minutes
Therapist – non-contact time	15 minutes for each therapy	5.92	5.92	
Supervisor – contact time	8.44 minutes for MET; 33.10 minutes for junior supervisor and 1.99 minutes for senior supervisor for CBT	6.56	19.69	Same as therapist contact time
Supervisor – non-contact time	8.44 minutes for MET; 12.21 minutes for CBT	6.56	6.85	For both therapies, assumed 1 hour for listening to tapes for each supervision session and one supervision session per week for 108.5 working weeks between June 2003 and December 2006. Dividing this total time input by 771 MET sessions and 533 CBT sessions attended equates to 8.44 minutes per MET session and 12.21 minutes per CBT session. For the purposes of costing staff time for CBT, the 12.21 minutes has been proportionately allocated between the junior and senior supervisors using their relative total supervision contact times (294 hours for junior supervisor, which forms 94.33%, and 17.68 hours for senior supervisor, which forms 5.67%)
Therapist training				
Therapist – contact time	1.17 minutes for MET; 6.64 minutes for CBT	0.46	2.62	MET: 2 days (15 hours based on a 37.5-hour working week) across study period. Divided by 771 MET sessions attended equates to 1.17 minutes per session. CBT: 36.5 hours provided by junior trainer and 22.5 hours (3 days based on a 37.5-hour working week) by senior trainer across study period. Divided by 533 CBT sessions attended equates to an average of 4.11 minutes and 2.53 minutes per session with each supervisor respectively, or a total of 6.64 minutes
Therapist – non-contact time		0	0	

	Unit/quantity[a]	MET	CBT	Assumptions
Trainer – contact time	1.17 minutes for MET; 6.64 minutes for CBT	0.91	4.22	MET: 2 days (15 hours based on therapists' 37.5 hour working week) across study period. Divided by 771 MET sessions attended equates to 1.17 minutes per session. CBT: 36.5 hours provided by junior trainer and and 22.5 hours (3 days from a therapists' 37.5-hour working week) by senior trainer across study period. Divided by 533 CBT sessions attended equates to an average of 4.11 minutes and 2.53 minutes per session with each supervisor, respectively, or a total of 6.64 minutes
Trainer – non-contact time	0.08 minutes for MET; 1.84 minutes for CBT	0.06	1.24	MET: 1 hour total, divided by total of 771 MET sessions attended equates to 0.08 minutes per session. CBT: 1 day for each trainer. This is equivalent to 7.5 hours for the junior trainer based on a 37.5-hour week and 8.84 hours for the senior trainer based on a 44.2 hour week, or a total of 16.34 hours. Dividing these hours by the total number of CBT sessions attended (533) equates to an average of 0.84 minutes and 1.0 minutes per session for each trainer respectively, or a total of 1.84 minutes
Materials				
Patient manuals/ information sheets	2.5 sheets for each therapy	0.25	0.25	Assumed £0.10 per sheet for paper and photocopying
Accu-test CD-ROM for MET	One CD for MET	0	0	This was supplied to the project at no charge. Although there are production and distribution costs associated with this product, they are not included here as they do not fall into the NHS perspective
Tape recorder	Portion of total cost of tape recorder	0.02	0.02	Assumed the study duration to be its lifetime. Total cost of £20.75/total of 1304 MET and CBT sessions attended = £0.02 per session[b]
Tape	50 minutes of tape	0.45	0.45	Assumed single use of tapes[b]
Other resources				
Therapist time to chase non-attendees	10 minutes for each therapy	0.91	0.32	A total of 771 MET sessions were attended (regardless of study group). A total of 178 did not attend (DNAs) for MET appointments equates to 0.23 DNAs per session attended. A total of 533 CBT sessions were attended. A total of 45 DNAs for CBT appointments equates to 0.08 DNAs per session attended. These portions have been used to allocate DNA costs to a session of each therapy
Total cost per session	One 50-minute session	49.14	81.12	
Total cost per session (excluding training costs)	One 50-minute session	47.71	73.04	

Sources:

a Curtis L, Netten A. *Unit costs of health & social care 2006*. PSSRU, University of Kent. Therapist costs were based on salary and on-costs for a nurse on the mid-point of Band 6 (£0.39 per minute). MET supervisor/trainer costs were based on a clinical psychiatrist on the mid-point of Band 8A (£0.75 per minute); CBT supervisor/trainer costs were based on a senior CBT therapist on the mid-point of Band 8A (£0.75 per minute) and a junior CBT therapist on the low-point of Band 8A (£0.55 per minute).

b Office Depot Business Solutions Catalogue, accessed 11 December 2007.

Appendix 3

Resource use at baseline (for previous 3 months)

		MET (n = 117)			MET + CBT (n = 106)			Usual care (n = 121)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Secondary care										
Inpatient ward admission	Nights	8/117	4.13	1.24	4/106	5.00	1.10	7/121	5.14	1.44
Outpatient service										
Diabetic clinic	Visits	103/117	1.39	1.03	90/106	1.36	1.37	106/121	1.38	0.97
Diabetes foot clinic	Visits	13/117	3.62	1.92	9/106	2.78	1.31	13/121	4.00	2.41
Diabetes eye clinic	Visits	38/117	1.05	0.51	40/106	1.13	0.68	49/121	1.04	0.54
Ophthalmology	Visits	9/117	1.33	0.40	6/106	2.50	0.99	6/121	1.00	0.22
Gastroenterology	Visits	1/117	1.00	0.10	5/106	1.00	0.21	1/121	1.00	–
Phlebotomy	Visits	12/117	1.00	0.30	9/106	1.22	0.36	13/121	1.38	0.49
Dietician	Visits	5/117	1.20	0.26	1/106	1.00	–	4/121	1.50	0.31
Renal	Visits	2/117	2.00	0.29	2/106	1.50	0.22	1/121	1.00	–
Cardiology	Visits	–	–	–	2/106	1.50	0.22	–	–	–
Surgery	Visits	3/117	1.00	0.16	1/106	1.00	–	1/121	2.00	–
X–ray	Visits	5/117	1.40	0.30	2/106	1.00	0.14	6/121	1.17	0.27
Accident and emergency	Visits	5/117	1.00	0.20	2/106	2.00	0.31	3/121	1.34	0.22
Other[b]	Visits	5/117	1.00	0.20	6/106	2.00	0.59	6/121	2.17	0.57
Other hospital service[c]	Visits	1/117	1.00	–	4/106	1.50	1.00	4/121	1.25	0.50
Primary and community–based care										
GP										
Surgery visit	Minutes	47/117	11.36	7.79	50/106	15.30	9.43	46/121	14.13	11.73
Home visit	Minutes	–	–	–		–	–	1/121	20	–
Telephone contact	Minutes	5/117	6.20	3.80	3/106	10.10	5.15	3/121	21.67	17.56
Diabetes specialist nurse										
Surgery visit	Minutes	11/117	23.94	7.08	6/106	24.45	18.58	7/121	26.67	16.75
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	2/106	23.34	4.72	–	–	–
Diabetic clinic										
Surgery visit	Minutes	11/117	31.43	16.39	6/106	31.25	17.43	5/121	27.00	13.04
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

continued

		MET (*n* = 117)			MET + CBT (*n* = 106)			Usual care (*n* = 121)		
	Unit	Valid *n*	Mean[a]	SD	Valid *n*	Mean[a]	SD	Valid *n*	Mean[a]	SD
Practice nurse										
Surgery visit	Minutes	11/117	12.50	7.16	9/106	16.00	8.56	10/121	16.80	14.95
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
District nurse										
Surgery visit	Minutes	–	–	–	1/106	15.00	–	–	–	–
Home visit	Minutes	–	–	–	1/106	15.00	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Chiropodist										
Surgery visit	Minutes	7/117	21.67	4.71	4/106	20.00	–	9/121	22.14	9.96
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Optician										
Surgery visit	Minutes	6/117	40.00	10.95	6/106	30.00	–	4/121	25.00	7.07
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Dietician										
Surgery visit	Minutes	–	–	–	2/106	20.00	14.14	1/121	60.00	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Physiotherapist										
Surgery visit	Minutes	–	–	–	2/106	42.50	24.75	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Occupational therapist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychiatrist										
Surgery visit	Minutes	–	–	–	–	–	–	1/121	15.00	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychologist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychotherapist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Counsellor										
Surgery visit	Minutes	1/117	45.00	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

		MET (*n* = 117)			MET + CBT (*n* = 106)			Usual care (*n* = 121)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Social worker										
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Home help										
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Meals on wheels	Minutes	–	–	–	–	–	–	–	–	–
Other[d]	Minutes	–	–	–	–	–	–	–	–	–
Informal care										
Personal care	Weekly hours	1/117	24.00	–	2/106	1.25	0.35	–	–	–
DIY/home maintenance	Weekly hours	–	–	–	1/106	1.00	–	3/121	1.50	0.87
Housework/laundry	Weekly hours	3/117	2.67	1.53	3/106	8.00	1.73	3/121	4.83	2.75
Providing transport	Weekly hours	5/117	2.40	2.28	5/106	5.80	5.54	2/121	3.50	0.71
Preparing meals	Weekly hours	3/117	10.33	4.73	3/106	5.00	2.60	3/121	5.83	1.04
Gardening	Weekly hours	–	–	–	1/106	1.00	–	2/121	1.00	0.71
Shopping	Weekly hours	6/117	1.70	0.54	3/106	1.33	0.58	3/121	2.83	1.44
Taking care of pets	Weekly hours	–	–	–	1/106	7.00	–	1/121	7.00	–
Emotional support	Weekly hours	4/117	3.90	4.27	7/106	6.29	4.35	2/121	2.25	1.06
Other[e]	Weekly hours	1/117	0.5	–	1/106	1.00	–	3/121	2.33	1.16

a Mean for users only.
b Other outpatient service includes antenatal pregnancy clinic, anticoagulant clinic, chiropody, DAFNE course, dentistry, dermatology, diabetic antenatal clinic, ear nose and throat, early pregnancy clinic, endoscopy, fracture clinic, general medicine, genital-urinary, gynaecology, haematology, hand clinic, iron transfusion, liaison psychiatry, magnetic resonance imaging, neurology, orthopaedics, physiotherapy, pre-pregnancy clinic, psychology, psychiatry, rheumatology, ultrasound, urology, vascular and paramedic.
c Other hospital service includes accident and emergency, ambulance/paramedic, angioplasty, day hospital, day dental, surgery, day surgery, counselling, diabetes eye clinic, cardiology and sigmoidoscopy.
d Other hospital service includes eye screening unit, GP repeat prescription collection, homeopath, massage, NHS walk-in centre, osteopath and pharmacist.
e Other informal care includes family/friends call the ambulance, occasional help when not feeling well or during hypoglycaemia, collect prescription and stay at parents house overnight.

Appendix 4

Resource use at 6 months (in previous 6 months)

		MET ($n=84$)			MET + CBT ($n=82$)			Usual care ($n=77$)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Secondary care										
Inpatient ward admission	Nights	8/84	11.75	8.80	6/82	7.33	2.45	3/77	10.67	3.10
Outpatient service										
Diabetic clinic	Visits	56/84	1.86	1.35	59/82	1.71	1.31	52/77	1.48	1.02
Diabetes foot clinic	Visits	6/84	6.33	9.83	9/82	3.44	3.84	5/77	4.60	4.93
Diabetes eye clinic	Visits	27/84	1.22	0.58	31/82	1.42	1.18	24/77	1.21	1.02
Ophthalmology	Visits	7/84	1.29	0.76	8/82	1.13	0.35	5/77	1.00	–
Gastroenterology	Visits	–	–	–	2/82	2.50	0.71	1/77	1.00	–
Phlebotomy	Visits	2/84	2.00	1.41	8/82	2.13	1.36	3/77	2.00	1.00
Dietician	Visits	2/84	1.50	0.71	6/82	1.50	0.55	1/77	1.00	–
Renal	Visits	2/84	1.50	0.71	2/82	1.50	0.71	–	–	–
Cardiology	Visits	–	–	–	1/82	1.00	–	1/77	1.00	–
Surgery	Visits	1/84	1.00	–	1/82	1.00	–	–	–	–
X–ray	Visits	4/84	2.00	–	4/82	1.25	0.50	1/77	1.00	–
Accident and emergency	Visits	3/84	1.00	–	3/82	2.67	1.15	5/77	2.20	2.17
Other[b]	Visits	5/84	2.00	0.71	5/82	2.20	2.17	7/77	1.71	0.76
Other hospital service[c]	Visits	–	–	–	3/82	1.33	0.58	1/77	3.00	–
Primary and community–based care										
GP										
Surgery visit	Minutes	27/84	12.38	6.00	26/82	13.46	9.98	30/77	12.33	5.13
Home visit	Minutes	–	–	–	1/82	10.00	–	–	–	–
Telephone contact	Minutes	–	–	–	2/82	5.00	–	–	–	–
Diabetes specialist nurse										
Surgery visit	Minutes	6/84	19.00	5.83	8/82	18.13	10.33	7/77	25.83	8.37
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	2/84	24.50	7.78	2/82	25.00	14.14	–	–	–
Diabetic clinic										
Surgery visit	Minutes	4/84	11.67	6.24	7/82	27.14	16.80	6/77	17.50	11.18
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

continued

		MET ($n=84$)			MET + CBT ($n=82$)			Usual care ($n=77$)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Practice nurse										
Surgery visit	Minutes	9/84	10.00	5.00	14/82	12.46	10.21	8/77	16.43	9.15
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
District nurse										
Surgery visit	Minutes	1/84	15.00	–	2/82	25.00	7.07	–	–	–
Home visit	Minutes	1/84	60.00	–	1/82	20.00	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Chiropodist										
Surgery visit	Minutes	7/84	17.50	7.36	9/82	27.22	19.54	8/77	16.00	3.16
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Optician										
Surgery visit	Minutes	5/84	35.00	18.37	5/82	43.00	17.89	2/77	10.00	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Dietician										
Surgery visit	Minutes	–	–	–	1/82	30.00	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Physiotherapist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Occupational therapist										
Surgery visit	Minutes	–	–	–	–	–	–	1/77	10.00	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychiatrist										
Surgery visit	Minutes	1/84	60.00	–	1/82	30.00	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychologist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychotherapist										
Surgery visit	Minutes	1/84	20.00	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Counsellor										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

		MET ($n = 84$)			MET + CBT ($n = 82$)			Usual care ($n = 77$)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Social worker										
Home visit	Minutes	–	–	–	1/82	30.00	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Home help										
Home visit	Minutes	–	–	–	1/82	20.00	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Meals on wheels	Minutes	–	–	–	–	–	–	–	–	–
Other[d]	Minutes	–	–	–	–	–	–	4/77	15.00	17.32
Informal care										
Personal care	Weekly hours	–	–	–	–	–	–	–	–	–
DIY/home maintenance	Weekly hours	1/84	2.00	–	2/82	2.00	–	2/77	1.25	1.06
Housework/laundry	Weekly hours	–	–	–	4/82	3.75	1.26	2/77	3.50	2.12
Providing transport	Weekly hours	–	–	–	2/82	1.50	0.71	1/77	3.00	–
Preparing meals	Weekly hours	–	–	–	4/82	4.00	4.08	2/77	4.75	1.06
Gardening	Weekly hours	–	–	–	1/82	2.00	–	1/77	0.50	–
Shopping	Weekly hours	1/84	5.00	–	2/82	3.50	2.12	2/77	3.00	1.41
Taking care of pets	Weekly hours	–	–	–	2/82	1.50	0.71	1/77	3.50	–
Emotional support	Weekly hours	2/84	8.00	9.90	7/82	4.57	3.92	1/77	8.00	–
Other[e]	Weekly hours	2/84	13.85	14.36	2/82	5.23	1.74	–	–	–

a Mean for users only.
b Other outpatient service includes antenatal pregnancy clinic, anticoagulant clinic, chiropody, DAFNE course, dentistry, dermatology, diabetic antenatal clinic, ear, nose and throat, early pregnancy clinic, endoscopy, fracture clinic, general medicine, genital-urinary, gynaecology, haematology, hand clinic, iron transfusion, liaison psychiatry, magnetic resonance imaging, neurology, orthopaedics, physiotherapy, pre-pregnancy clinic, psychology, psychiatry, rheumatology, ultrasound, urology, vascular and paramedic.
c Other hospital service includes accident and emergency, ambulance/paramedic, angioplasty, day hospital, day dental, surgery, day surgery, counselling, diabetes eye clinic, cardiology and sigmoidoscopy.
d Other hospital service includes eye screening unit, GP repeat prescription collection, homeopath, massage, NHS walk-in centre, osteopath and pharmacist.
e Other informal care includes family/friends call the ambulance, occasional help when not feeling well or during hypoglycaemia, collect prescription and stay at parents house overnight.

Appendix 5

Resource use at 12 months (in previous 6 months)

		MET (*n* = 96)			MET + CBT (*n* = 88)			Usual care (*n* = 102)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Secondary care										
Inpatient ward admission	Nights	9/96	7.56	3.02	7/88	5.14	1.77	9/102	5.78	1.92
Outpatient service										
Diabetic clinic	Visits	72/96	1.68	1.87	64/88	1.56	1.61	72/102	1.99	2.56
Diabetes foot clinic	Visits	4/96	9.25	11.35	6/88	2.67	2.73	7/102	3.43	4.39
Diabetes eye clinic	Visits	23/96	1.43	1.16	21/88	1.14	0.36	26/102	1.15	0.46
Ophthalmology	Visits	13/96	1.23	0.44	9/88	1.22	0.67	14/102	1.36	0.84
Gastroenterology	Visits	–	–	–	2/88	3.00	2.83	–	–	–
Phlebotomy	Visits	4/96	1.00	–	4/88	1.25	0.50	9/102	2.11	1.76
Dietician	Visits	4/96	1.25	0.50	4/88	1.50	0.58	3/1002	2.00	1.73
Renal	Visits	4/96	2.00	2.00	3/88	2.67	2.08	1/102	2.00	–
Cardiology	Visits	1/96	1.00	–	3/88	1.00	–	1/102	1.00	–
Surgery	Visits	2/96	1.50	0.71	–	–	–	–	–	–
X–ray	Visits	5/96	1.40	0.55	3/88	1.33	0.58	2/102	1.00	–
Accident and emergency	Visits	7/96	2.29	1.98	4/88	2.25	2.50	7/102	1.29	0.49
Other[b]	Visits	7/96	2.29	2.63	7/88	2.00	1.53	6/102	6.50	9.75
Other hospital service[c]	Visits	9/96	1.11	0.33	–	–	–	2/102	3.50	3.54
Primary and community–based care										
GP										
Surgery visit	Minutes	40/96	13.85	9.24	36/88	10.67	6.00	48/102	14.96	15.86
Home visit	Minutes	–	–	–	1/88	22.00	–	–	–	–
Telephone contact	Minutes	1/96	5.00	–	–	–	–	1/102	20.00	–
Diabetes specialist nurse										
Surgery visit	Minutes	15/96	19.64	7.67	12/88	17.00	9.25	13/102	19.92	10.66
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	3/96	16.67	11.55	–	–	–	–	–	–
Diabetic clinic										
Surgery visit	Minutes	13/96	30.00	7.36	10/88	15.00	2.36	7/102	25.00	2.89
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Practice nurse										
Surgery visit	Minutes	14/96	14.50	11.25	8/88	12.63	8.68	17/102	9.53	6.79
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

continued

		MET ($n=96$)			MET + CBT ($n=88$)			Usual care ($n=102$)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
District nurse										
Surgery visit	Minutes	–	–	–	–	–	–	1/102	10.00	–
Home visit	Minutes	–	–	–	–	–	–	1/102	10.00	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Chiropodist										
Surgery visit	Minutes	12/96	16.83	14.28	9/88	25.00	12.34	9/102	16.33	6.30
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Optician										
Surgery visit	Minutes	16/96	38.44	28.91	16/88	40.00	22.51	15/102	30.57	14.42
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Dietician										
Surgery visit	Minutes	3/96	23.33	20.21	5/88	28.00	17.89	2/102	27.50	17.68
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Physiotherapist										
Surgery visit	Minutes	2/96	30.00	–	–	–	–	2/102	32.50	17.68
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Occupational therapist										
Surgery visit	Minutes	1/96	20.00	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychiatrist										
Surgery visit	Minutes	1/96	60.00	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychologist										
Surgery visit	Minutes	–	–	–	–	–	–	1/102	60.00	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Psychotherapist										
Surgery visit	Minutes	–	–	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Counsellor										
Surgery visit	Minutes	1/96	60.00	–	–	–	–	–	–	–
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Social worker										
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–

		MET ($n=96$)			MET + CBT ($n=88$)			Usual care ($n=102$)		
	Unit	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**	**Valid *n***	**Mean[a]**	**SD**
Home help										
Home visit	Minutes	–	–	–	–	–	–	–	–	–
Telephone contact	Minutes	–	–	–	–	–	–	–	–	–
Meals on wheels	Minutes	–	–	–	–	–	–	–	–	–
Other[d]	Minutes	–	–	–	–	–	–	–	–	–
Informal care										
Personal care	Weekly hours	5/96	11.40	10.26	4/88	11.75	10.05	5/102	5.70	2.86
DIY/home maintenance	Weekly hours	4/96	11.50	11.62	1/88	2.00	–	3/102	1.83	0.29
Housework/laundry	Weekly hours	6/96	4.00	3.63	4/88	8.75	6.29	6/102	4.08	1.69
Providing transport	Weekly hours	8/96	10.75	9.97	2/88	5.00	1.41	4/102	3.75	4.29
Preparing meals	Weekly hours	7/96	5.93	4.75	2/88	4.00	–	8/102	5.81	6.02
Gardening	Weekly hours	2/96	0.63	0.53	1/88	2.00	–	1/102	2.00	–
Shopping	Weekly hours	10/96	3.00	2.49	2/88	7.00	4.24	4/102	2.25	0.96
Taking care of pets	Weekly hours	–	–	–	1/88	1.00	–	1/102	2.00	–
Emotional support	Weekly hours	13/96	10.81	22.57	7/88	10.07	11.62	11/102	19.45	49.34
Other[e]	Weekly hours	1/96	55.50	–	1/88	0.15	–	–	–	–

a Mean for users only.
b Other outpatient service includes antenatal pregnancy clinic, anticoagulant clinic, chiropody, DAFNE course, dentistry, dermatology, diabetic antenatal clinic, ear, nose and throat, early pregnancy clinic, endoscopy, fracture clinic, general medicine, genital-urinary, gynaecology, haematology, hand clinic, iron transfusion, liaison psychiatry, magnetic resonance imaging, neurology, orthopaedics, physiotherapy, pre-pregnancy clinic, psychology, psychiatry, rheumatology, ultrasound, urology, vascular and paramedic.
c Other hospital service includes accident and emergency, ambulance/paramedic, angioplasty, day hospital, day dental, surgery, day surgery, counselling, diabetes eye clinic, cardiology and sigmoidoscopy.
d Other hospital service includes eye screening unit, GP repeat prescription collection, homeopath, massage, NHS walk-in centre, osteopath and pharmacist.
e Other informal care includes family/friends call the ambulance, occasional help when not feeling well or during hypoglycaemia, collect prescription and stay at parents house overnight.

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