The diabetes pandemic: is structured education the solution or an unnecessary expense?

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Abstract

Structured education is a recommended clinical and cost-effective approach that adds value to traditional medical care. A clinical trial demonstrated that the X-PERT Diabetes Programme significantly improves health and quality of life. In order to determine if the national implementation of the X-PERT Programme meets standards identified in the published trial, it is necessary to conduct continuous audit.

To meet the key criteria to implement National Institute for Health and Clinical Excellence guidance, educators are trained to deliver X-PERT Diabetes and X-PERT Insulin Programmes and submit baseline, six-month and annual results onto the X-PERT Audit Database.

Forty-seven percent of X-PERT centres (55/118) have submitted data for 16 031 people with diabetes. Audit standards have been met with excellent attendance, evaluation and empowerment scores. All outcomes improved at one year: glycated haemoglobin (-0.6%); body weight (-3.0kg); waist circumference (-2.1cm); systolic (-0.9mmHg) and diastolic (-2.2mmHg) blood pressure; total (-0.2mmol/L) and LDL (-0.1mmol/L) cholesterol; triglycerides (-0.2mmol/L); HDL cholesterol (+0.1mmol/L); requirement for prescribed diabetes medication (23% less likely to increase medication, number needed to treat [NNT] = 4; 5% more likely to reduce medication, NNT = 19).

National implementation of the X-PERT Programme has met audit standards. X-PERT increases skills, knowledge and confidence for diabetes self-management, resulting in intensification of glycaemic control and reducing cardiovascular disease risk factors in people with newly diagnosed and existing diabetes. Structured education is a clinical and cost-effective approach that should be offered to all people with diabetes as an integral part of their diabetes treatment and management, potentially saving the NHS £367 million per annum.

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Key words

X-PERT; structured education; diabetes; self-management; empowerment; audit; NHS; clinically effective; cost effective; cost saving

Introduction

In England the estimated prevalence of diabetes (diagnosed and undiagnosed) in people aged 16 and over is 7.4%.[1] The prevalence of diabetes has now reached 3.65 million in the UK with 2.8 million people being aware that they have the condition,[2] adding to stress on the health care budget at a time of financial stringency. NHS efficiency savings have been proposed aiming for a £15–20 billion saving between 2011 and 2014 and it is anticipated that these can only be achieved through quality improvements and advances in innovation.[3]

Diabetes is a costly condition taking up 10% of the NHS budget; a significant part of this cost is attributable to inpatient care and treating the devastating, but largely preventable, diabetes-related conditions.[4] Intensifying glycaemic control has been shown to reduce the onset of diabetes-related complications but there is emerging evidence from clinical trials that achieving target blood glucose levels through prescribed diabetes medication may cause harm.[5] In the UK, although prescription costs for type 2 diabetes have increased by 89% between 1997 and 2007, glycaemic control has only improved by 0.1% from 8.8% to 8.7% (73mmol/mol to 72mmol/mol).[6] This may be due to poor adherence to medication regimens.[7]

The clinical and cost effectiveness of both structured education[8–24] and medical nutrition therapy[25–28] has been established. National Institute for Health and

Clinical Excellence (NICE) guidance states that all newly diagnosed people with diabetes should have an opportunity to attend a structured patient education programme with annual follow up.[29] Up to 90% of people will access structured education if offered as an integral part of diabetes treatment and management.[30] The NICE quality standard defines both personalised advice on nutrition and physical activity and structured education as specific quality statements.[31] However, in England 50% of primary care trusts do not monitor whether people are offered structured education and 58% do not have sufficient places on the programmes they commission.[32]

The X-PERT Programme has been shown to improve clinical, lifestyle and psychosocial outcomes in people with newly diagnosed and existing diabetes,[17] and has been demonstrated to be a cost-effective strategy to implement both structured education and medical nutrition therapy/physical activity advice for the treatment and management of diabetes in a clinical trial setting.[22] The cost for four educators to deliver the X-PERT Diabetes Programme to 432 people with diabetes is £65/participant including health care professional and administrative time, and £26 excluding human resource (HR) costs. If those four educators delivered more sessions to benefit 3456 people with diabetes, the cost/participant would reduce to £55 including HR and £12 excluding HR costs. These calculations include educator training, equipment, recruitment materials, participant handbooks, travel, refreshments, quality assurance and audit.[33]

Continuous audit is conducted in order to ensure that the national implementation of the X-PERT Programme continues to be clinically and cost effective. Audit standards have been identified from the published randomised controlled trial (RCT) and national targets (Appendix 1 [all appendices are available online at www.practicaldiabetes.com.]).

Materials and methods

To prepare for national implementation the structured curriculum (Educator's Manual) was printed and the X-PERT Diabetes Educator's Course developed. Competencies to deliver the content of the structured education programmes using the theories that support adult education and person-centred care are documented in a framework for continual professional development.[34] Educators deliver the structured education programmes to people living with type 1 and type 2 diabetes within their geographical areas. Each programme consists of six weekly sessions lasting 2.5 hours (the total length of the structured education programme is 15 hours). It is recommended that one trained educator delivers to groups of 15–18 people with diabetes plus carers.[17] The content of X-PERT Diabetes and X-PERT Insulin can be seen in Table 1.

Educators submit attendance data (the number of sessions attended), and the audit report shows the percentage of participants who attended at least one session and the percentage who attended four or more sessions.

Participant satisfaction is recorded by participants completing an evaluation questionnaire that scores the structured education programme for enjoyment, usefulness, degree of self-management obtained and impact on living with diabetes. The mean satisfaction score for each programme is calculated from the total questionnaire scores and entered onto the database. The audit report presents the mean score and percentage for participant satisfaction.

Participant empowerment is assessed at baseline, six weeks and thereafter annually by participants completing a validated questionnaire.[35] The mean empowerment score is calculated for the group from individual questionnaires and is entered onto the audit database. The audit report provides the mean score for each time point and the percentage change from baseline.

The following clinical outcomes are recorded at baseline, six months and thereafter annually and entered onto the audit database: glycated haemoglobin (HbA_{1c} %), body weight (kg), body mass index (BMI kg/m^2), waist circumference (cm), blood pressure (systolic and diastolic BP mmHg) and lipid profile (total, LDL, HDL and triglyceride cholesterol mmol/L). The audit report presents the number of participants for each outcome and the mean value at each time point.

Dara regarding prescribed diabetes medication are collected at baseline, six months and thereafter annually and entered on to the audit database. A medication increase is defined as commencing on, or an increase in, oral hypoglycaemic agents (OHAs) or insulin. A medication decrease is defined as a reduction in the type or quantity of OHAs or the number of units of insulin injected.

Audit reports can be generated for any time period per programme, per educator, per organisation, or for all participants. Standard reports present the number of participants (n) and the mean values for each outcome. Outcomes are compared to audit standards identified from the published RCT[17] and national targets.[29,36]

The raw data were analysed by statisticians and where the full subset of data was available; standard deviations were applied to the mean outcomes; confidence intervals using the 95% rule were applied to the mean differences; and statistical tests (repeated measures analysis of variance, ANOVA) were applied to test significance between means. IBM SPSS version 19 was used.

Results

On 31 January 2011, 144 organisations had registered on the national X-PERT audit database. Eighteen organisations had merged and eight organisations had also registered for X-PERT Insulin. Thus, there were 118 registered organisations for X-PERT Diabetes and 55 of these (47%) had started to submit data. Outcomes for 16 031 participants had been entered on to the audit database.

Attendance, participant satisfaction and participant empowerment outcomes. Fifty-three organisations had submitted attendance scores. The mean attendance score was 95.3% (range 65.8–100) for participants attending at least one of the six

X-PERT Diabetes	X-PERT Insulin
Week 1 – What is diabetes? • What is diabetes? • Digestion and blood glucose • Healthy lifestyle for looking after diabetes • Health results – what do they mean? • Medications for diabetes • Care planning: lifestyle experiment to address the diabetes health profile	**Week 1 – Diabetes, insulin and healthy living** • What is diabetes, the role of insulin and the diabetes health profile? • Healthy living for diabetes: eat well plate and physical activity • Care planning: lifestyle experiment to address the diabetes health profile • Exploring: what am I eating?
Week 2 – Weight management • Energy balance • Eating for good health and blood glucose control • Myths and misconceptions • The benefits of physical activity • Weight management and the 500 calorie deficit • How to assess what I am eating • Care planning: lifestyle experiment to explore my diet	**Week 2 – All about insulin** • Insulin-specific challenges with self-management • Hypoglycaemia/hyperglycaemia – ketoacidosis (DKA) and HONK • Exploring insulin – onset, peak and duration, regimens and devices • Care planning: lifestyle experiment to address insulin specific challenges • Exploring: my insulin injection technique
Week 3 – Carbohydrate awareness • Carbohydrate – an important nutrient in diabetes • What are carbohydrate (starchy and sugary) foods? • The quantity (amount) and quality (type) of carbohydrate foods • What carbohydrates are you having? • Care planning: lifestyle experiment to explore the carbs I am eating	**Week 3 – Know your carbs** • Identification of carbohydrate foods and drinks • Carbohydrate counting: estimation, calculation and reading food labels • Self-monitoring blood glucose • Care planning: lifestyle experiment – how many carbs am I having? • Exploring: my 'what should I do?' scenarios
Week 4 – Reading and understanding food labels • Traffic-light system • Guideline daily amounts (GDAs) • What do the nutritional claims mean? • Omega-3 fatty acids, sterols and stanols, types of fat, cholesterol, alcohol and so much more… • Care planning: lifestyle experiment to explore the foods I buy	**Week 4 – Inspiration for insulin** • Troubleshooting: strategies to take control • 'Inspiration' the game to address travel, holidays, driving and work legislation, sick day rules, insulin techniques and sharps disposal • Care planning: lifestyle experiment – what troubleshooters may work for me? • Exploring the MATCH IT Diary
Week 5 – Possible complications • Hypo- and hyperglycaemia • Possible complications of diabetes • Prevention of complications • Importance of regular check ups • Living with diabetes: work, driving, insurance, travel... • Care planning: lifestyle experiment to keep healthy	**Week 5 – MATCH IT – taking control** • MATCH IT: my diary, my diabetes – 'A day in the life of...'. A chance to share MATCH IT diaries, identify challenges and learn diabetes self-management troubleshooters together • Care planning: lifestyle experiment to apply troubleshooters to MATCH IT challenges • Exploring: MATCH IT challenges
Week 6 – Are you an X-PERT? • X-PERT Game – re-cap and assess learning • Questions and answers • Comments and feedback • Have the self-management challenges been addressed? • Care planning to take charge and self-manage my diabetes • How to continue…	**Week 6 – Are you an Insulin X-PERT?** • Game: 'MATCH IT 24/7' to challenge real 'living with diabetes on insulin' situations • What did I learn from troubleshooting the MATCH IT challenges? • Have the self-management challenges been addressed? • Programme evaluation and planning the way forward...

Table 1. The content of X-PERT Diabetes and X-PERT Insulin structured education programmes

sessions, and 80.9% (range 51–100) for those attending four or more sessions. The audit standard of 95% of participants attending at least one session and 80% of participants attending four or more sessions has been met. However, this varied between organisations with 34 organisations (64%) meeting the audit standard and 19 organisations (36%) not meeting the audit standard (Appendix 2).

Forty-four organisations had submitted participant satisfaction scores. The mean participant evaluation score was 94.2% (range 86.7–100). The audit standard of 90% has been met with 42 organisations (95%) meeting the audit standard and two organisations (5%) not meeting the standard (Appendix 3).

Forty-three organisations submitted empowerment scores at six weeks and 13 organisations at one year. Mean empowerment scores increased by 22.9% (range -2.4 to 82.6) at six weeks and by 25.7% (range 2.6–104.3) at 12 months. Thirty-five organisations (81%) achieved the audit standard at six weeks (Appendices 4 and 5).

Clinical outcomes. There was an improvement in all clinical outcomes at six months, one and two

years (Appendices 6 and 7). Audit standards were applied to the one-year data. At one year, 23 organisations had submitted HbA_{1c} data. The mean reduction was 0.6% (range 0.2–0.9) meeting the audit standard of 0.5%. Seventeen organisations (74%) achieved the audit standard (Appendix 8).

Twenty organisations had submitted body weight data at one year. The mean reduction in body weight at one year was 3.0kg (range -2.9 to 7.4), which met the audit standard of no increase in body weight. There was variation with 17 organisations (85%) meeting the audit standard and five organisations (25%) reporting mean weight losses between 5–10% body weight in line with the national target (Appendix 9). Twenty organisations had also submitted BMI data and the mean reduction was 1.0kg/m^2 (range -0.9 to 2.5) with 15 organisations (75%) meeting the audit standard and nine organisations (45%) reporting a mean reduction of ≥1.0kg/m^2 (Appendix 10). Eighteen organisations reported a mean reduction in waist circumference of 2.1cm (range -3.9 to 8.5) at one year. Thirteen organisations (72%) reported a mean reduction of ≥2cm meeting the audit standard (Appendix 11).

Twenty organisations reported a mean reduction in systolic BP of 0.9mmHg (range -7.4 to 6.2) at one year. The audit standard of a reduction of 5mmHg or more did not apply as the mean baseline systolic BP was within target at 134.1mmHg. Two organisations (20%) achieved a mean reduction greater than 5mmHg (Appendix 12). Twenty organisations submitted diastolic BP data and a mean reduction of 2.2mmHg (range -1.4 to 5.8) (Appendix 13).

Twenty-one organisations submitted total cholesterol data. The mean reduction in total cholesterol was 0.2mmol/L (range 0.0–0.9). Fifteen organisations (71%) reported a ≥5% in total cholesterol from baseline and five organisations (24%) met the national target with a mean total cholesterol ≤4mmol/L (Appendix 14). LDL cholesterol was reported by 19 organisations at one year. The mean reduction in LDL cholesterol was 0.1mmol/L (range -0.1 to 0.6). Sixteen organisations (84%) reported a 4–23% reduction in LDL cholesterol and seven organisations (37%) reported a reduction >10%. Two organisations (11%) achieved the national target with a mean LDL cholesterol ≤2mmol/L (Appendix 15). Twenty organisations reported HDL cholesterol at one year and there was a mean increase of 0.1mmol/L (range -0.4 to 0.3). Seven organisations (35%) reported an increase in HDL cholesterol between 0.1 and 0.3mmol/L (Appendix 16). Triglycerides were reported by 20 organisations at one year. The mean reduction in triglyceride levels was 0.2mmol/L (range 0–0.8). Nineteen organisations (95%) reported a reduction of ≥5%, 16 organisations (80%) reported a percentage reduction between 11–35% and 13 organisations (65%) achieved the national target of ≤1.7mmol/L (Appendix 17).

Statistical significance. There was a full set of clinical outcomes for 2474 participants at six months, 1980 participants at one year and 216 participants at two years (Appendix 7).

There was a statistically significant ($p<0.001$) reduction in HbA_{1c} of 0.6% (95% CI 0.5–0.7) at six months, 0.5% (95% CI 0.4–0.6) at one year and 0.5% (95% CI 0.2–0.7) at two years.

Systolic BP statistically significantly reduced ($p<0.001$) by 1.7mmHg (95% CI 0.8–2.5) at six months, 3.8mmHg (95% CI 2.7–4.8) at one year and 2.5mmHg (95% CI -0.8 to 5.8) at two years. Diastolic blood pressure statistically significantly reduced ($p<0.001$) by 1.1mmHg (95% CI: 0.5 to 1.6) at six months, 2.1mmHg (95% CI 1.5–2.7) at one year and 0.7 mmHg (95% CI -1.3 to 3.0) at two years.

There was a statistically significant ($p<0.001$) reduction in total cholesterol of 0.2mmol/L (95% CI 0.1–0.3) at six months and one year and 0.3mmol/L (95% CI 0.1–0.5) at two years. HDL cholesterol remained the same at 1.2mmol/L at six months and increased, but not statistically significantly (p=0.9), by 0.1mmol/L (95% CI -0.1 to 0.1) at one year. LDL cholesterol statistically significantly reduced (p=0.002) by 0.1mmol/L (95% CI 0.1–0.2) at six months, 0.1mmol/L (95% CI 0.0–0.2) at one year and 0.3mmol/L (95% CI 0.1–0.5) at two years. Triglycerides statistically significantly reduced (p=0.005) by 0.2mmol/L (95% CI 0.1–0.3) at six months and 0.1mmol/L (95% CI -0.1 to 0.3) at two years.

There was a statistically significant ($p<0.001$) reduction in body weight of 1.7kg (95% CI 0.6–2.8) at six months, 2.4kg (95% CI 1.1–3.7) at one year and 1.2kg (95% CI -2.1 to 4.5) at two years. BMI statistically significantly reduced (p=0.001) by 0.6kg/m^2 (95% CI 0.2–0.9) at six months, 0.8kg/m^2 (95% CI 0.5–1.1) at one year and 0.9kg/m^2 (95% CI -0.2 to 2.0) at two years. Female waist circumference statistically significantly reduced ($p<0.001$) by 2.8cm (95% CI 1.1–4.5) at six months, 3.1cm (95% CI 1.4–4.8) at one year and 4.3cm (95% CI -3.4 to 11.9) at two years. There was a non-statistically significant (p=0.08) reduction in male waist circumference of 0.6cm (95% CI -1.2 to 2.4) at six months, 3.4cm (95% CI 1.7–5.1) at one year and 0cm (95% CI -5.8 to 5.8) at two years.

Prescribed diabetes medication. Audit data used for the number needed to treat (NNT) calculations are compared against the RCT data. There were diabetes medication data entered for 1788 participants at baseline, 974 participants at six months, 814 participants at year one and 87 participants at year two. Forty-eight participants (5%) reduced diabetes medication at six months, 48 participants (6%) at one year, and seven participants (8%) at two years; 692 participants (71%) remained on the same dose at six months, 577 participants (71%) at one year and 39 participants (45%) at two years; 234 participants (24%) increased diabetes medication at six months, 189 participants (23%) at one year and 41 participants (47%) at two years.

Participants who have attended the X-PERT Programme are 23% less likely to increase prescribed diabetes medication (absolute risk reduction 95% CI 14.31–31.69). Therefore, for every four participants who attended the X-PERT Programme one participant could expect to prevent an

increase in their diabetes medication by 14 months, NNT = 4 patients (95% CI 3.2–7.0).

Participants who have attended the X-PERT Programme are 5.3% more likely to reduce medication (absolute benefit 95% CI 3.17–7.43). Therefore, for every 19 participants who attended the X-PERT Programme, one participant could expect to have reduced their diabetes medication by 14 months, NNT = 4 patients (95% CI 13.5–31.6).

Discussion

Benefits of X-PERT structured education. National implementation of the X-PERT structured education programme has been successful with all relevant audit standards identified from the RCT being met, leading to significant health improvement. The mean attendance rate was better than that for individual diabetes appointment.[37]

Participants rate the programme as enjoyable and useful and found that it had supported them in developing knowledge, skills and confidence for diabetes self-management which resulted in greater personal empowerment. All clinical outcomes improved with statistically significant reductions in: HbA1c; body weight, BMI and waist circumference; systolic and diastolic BP; total cholesterol, LDL cholesterol and triglycerides; and a reduced requirement for prescribed diabetes medication.

Limitations of the findings. National implementation of the X-PERT Programme has been assessed by conducting an audit where the trained X-PERT educators submit data onto the national audit database. Structured education is a complex intervention and there are many confounding variables that impact on outcomes such as standard diabetes care, the taking of medication and educator skills. Outcomes were benchmarked to the results in the published RCT but it could be advantageous if future audits were compared to a control group of people with diabetes not receiving X-PERT structured education.

There were considerable variations between organisations. Therefore, there is a need for those organisations that are achieving outstanding results to share good practice and to support those organisations that are performing less well, with further training and advice as required. There were 63 organisations (53%) that have not submitted data onto the audit database. As national and international implementation increases, it is considered necessary to introduce licence agreements to ensure standards are maintained and to protect outcomes from being diluted.

Interpretation compared to other approaches to intensify glycaemic control. Type 2 diabetes is considered a progressive disease characterised as a triad of insulin resistance, beta-cell dysfunction and impaired hepatic glucose production.[38] It is accepted that people with the condition will require increased prescribed diabetes medication over time to obtain target glycaemic control.[39]

However, the mean reduction in HbA1c from attending X-PERT structured education is similar to that reported in the UK Prospective Diabetes Study (UKPDS). The difference between the two methods to intensify glycaemic control is that, in the UKPDS, targets were achieved through traditional medical management. Patients were assessed individually in clinics where verbal advice was followed up with written material and increased prescription of diabetes medication leading to weight gain and increased risk of hypoglycaemia.[39] In contrast, X-PERT structured education demonstrated a significant improvement in all health results and cardiovascular disease risk factors with a 23% less chance of increasing medication and a 5.3% greater chance of reducing diabetes medication.

It has been demonstrated that the incidence of clinical complications is significantly associated with glycaemia. Each 1% reduction in mean HbA1c is associated with reductions in risk of 21% for any endpoint related to diabetes, 21% for deaths related to diabetes, 14% for myocardial infarction and 37% for microvascular complications.[40]

Recent clinical trials have succeeded in intensifying glycaemic control through increased prescribed medication but have reported one or more significant negative outcomes: weight gain of up to 7.8kg; an increased risk of hypoglycaemia; increased cardiovascular disease; and increased death.[41–43] It has been suggested that current strategies for treating hyperglycaemia may have counterbalancing consequences for cardiovascular disease such as weight gain, hypoglycaemia or other metabolic changes, but that this should not lead clinicians to abandon the general target of an HbA1c of <7% (53mmol/mol).[5] There should be an emphasis on strategies such as structured education which emphasise nutrition, physical activity and weight loss that do not give rise to weight gain, hypoglycaemia and other metabolic consequences.

X-PERT structured education is cost saving. X-PERT structured education has been shown to be cost effective with 1 QALY gained costing <€20 000 in an independent and international economic evaluation,[22] but the latest audit data suggest that it may also be cost saving. The average cost of prescribing one diabetes medication per year has been calculated at £433 (Table 2).[44] Average insulin requirements have been estimated at 80 units per day,[45] although mean requirements have been shown to be 105 units per day when treating to target.[41] Based on the audit data, one organisation delivering X-PERT to 432 people with diabetes in one year could save £28 643/year (including health care professional and administration costs) and £45 491/year (excluding human resource costs). Increasing delivery to 3456 people with diabetes could save £262 838/year and £411 446/year respectively (Table 3). Extrapolating from these findings to the 2.8 million people with diabetes shows potential annual savings of £367 million per year. This is in addition to reducing future NHS costs on treating the preventable but deadly complications of diabetes.

The X-PERT Audit Database is undergoing an upgrade and in the future it will be possible to audit further outcomes such as type of diabetes, ethnicity, blood pressure and lipid medication, kidney function and depression.

	Metformin	Sulphonylurea	Thiazolidinediones	DPP-4 inhibitors	Insulin	Incretin mimetics
Cost/year (average = £433)	850mg twice daily £21	160mg twice daily £42	45mg once daily £475	100mg once daily £400	80 units/day £840	10µg twice daily £820

Table 2. Cost of prescribed medication

	4 X-PERT educators delivering a total of 24 programmes/year to 432 people with diabetes	4 X-PERT educators delivering a total of 192 programmes/year to 3456 people with diabetes
Cost A Cost of X-PERT implementation*	£26/participant Total: £11 232	£12/participant Total: £41 472
Cost B Cost of X-PERT implementation plus health care professional and admin time	£65/participant Total: £28 080	£55/participant Total: £190 080
Cost C Cost savings from preventing an increase in medication (NNT = 4)	108 participants prevented from increasing medication: £433 x 108 = £46 764	864 participants prevented from increasing medication: £433 x 864 = £374 112
Cost D Cost savings from reducing medication (NNT = 19)	23 participants will reduce medication: £433 x 23 = £9959	182 participants will reduce medication: £433 x 182 = £78 806
Cost E *Total cost savings* from implementing X-PERT (Cost C + Cost D)	£56 723 cost saving/year	£452 918 cost saving/year
Cost F Cost of X-PERT minus medication savings (Cost A minus Cost E)	£45 491 cost saving/year	£411 446 cost saving/year
Cost G Cost of X-PERT and staff time minus medication savings (Cost B minus Cost E)	£28 643 cost saving/year	£262 838 cost saving/year
Proposed cost saving if implemented to 2.8 million people	X-PERT structured education may prevent 700 000 people from increasing medication: 700 000 x £433 = £303 100 000 saved X-PERT structured education may assist 148 000 people in reducing medication: 148 000 x £433 = £64 084 000 saved Total saved = £367 184 000 (£367 million)	

*Includes training, equipment, participant handbooks, travel, refreshments, quality assurance and audit.

Table 3. Cost savings from delivering X-PERT structured education

Conclusion

National implementation of the X-PERT Programme has met audit standards.

The structured education programme increases skills, knowledge and confidence for diabetes self-management, resulting in intensification of glycaemic control in addition to other health and well-being benefits among individuals with newly diagnosed and existing diabetes.

Structured education is a clinically and cost-effective approach that should be offered to all people with diabetes as an integral part of their diabetes treatment and management. Receiving the right education, at the right time, delivered in the right way, can reverse the progression of type 2 diabetes – resulting in improved health, reduced prescribed medication and decreased risk of developing preventable microvascular and macrovascular complications with significant benefits to length and quality of life and the NHS budget.

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Declaration of interests

Trudi Deakin is the chief executive of the X-PERT Health charitable organisation.

References

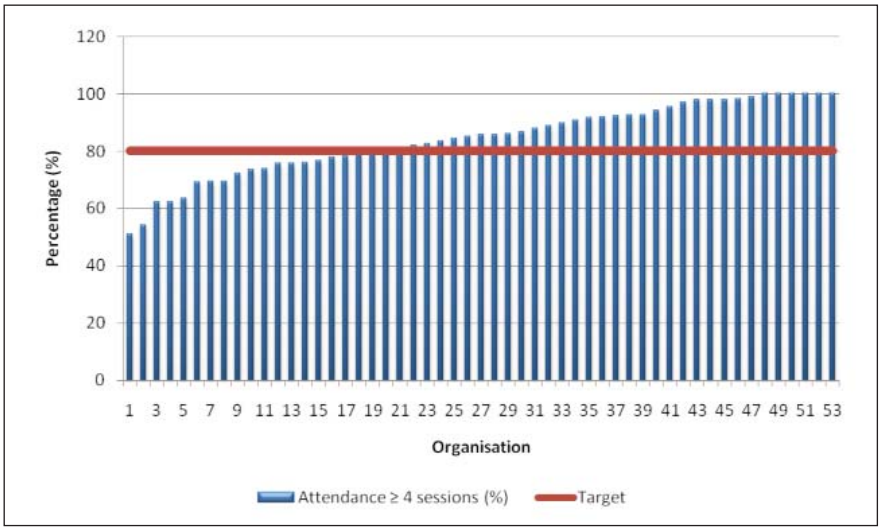
References are available in *Practical Diabetes* online at www.practicaldiabetes.com.

References

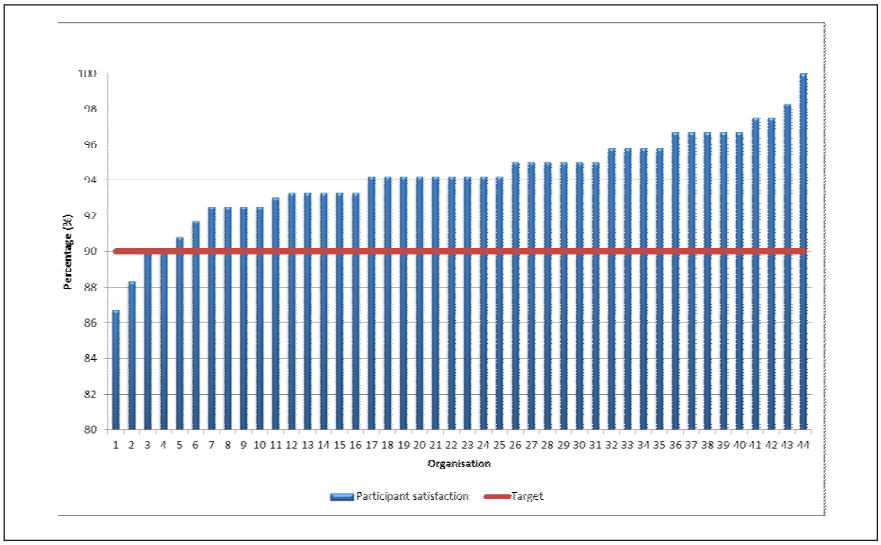
1. The Association of Public Health Observatories (APHO). Diabetes Prevalence Model: Key Findings for England. June 2010. [accessed 29/04/11 at: www.yhpho.org.uk/resource/view.aspx?RID=81090].
2. Diabetes UK. Reports and statistics: Diabetes prevalence 2010. Diabetes UK website [accessed 5/5/11 at www.diabetes.org.uk/Professionals/ Publications -reports-and-resources/Reports-statistics-and-case-studies/Reports/Diabetes-prevalence-2010/].
3. Nicholson D. The Year: NHS Chief Executive's annual report 2008/09. Department of Health 2009 Gateway reference 11880.
4. Department of Health. Turning the Corner: Improving Diabetes Care – Report from Sue Roberts, National Clinical Director for Diabetes to the Secretary of State for Health. June 2006.
5. Skyler JS, *et al.* Intensive Glycemic Control and the Prevention of Cardiovascular Events: Implications of the ACCORD, ADVANCE, and VA Diabetes Trials. A position statement of the American Diabetes Association and a scientific statement of the American College of Cardiology Foundation and the American Heart Association. *Diabetes Care* 2009; 32:187–92.
6. Currie CJ, *et al.* Estimation of primary care treatment costs and treatment efficacy for people with type 1 and type 2 diabetes in the UK from 1997–2007. *Diabet Med* 2010:27:938–48.
7. Donnan PT, *et al.* Adherence to prescribed oral hypoglycaemic medication in a population of patients with type 2 diabetes: a retrospective cohort study. *Diabet Med* 2002;19:279–84.
8. Norris SL, *et al.* Effectiveness of self-management training in type 2 diabetes: a systematic review of randomised controlled trials. *Diabetes Care* 2001;24:561–87.
9. Norris SL, *et al.* Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycaemic control. *Diabetes Care* 2002;25:1159–71.
10. Gary TL, *et al.* Meta-analysis of randomized educational and behavioral interventions in type 2 diabetes. *Diabetes Educ* 2003;29:488–501.
11. Steed L, *et al.* A systematic review of psychosocial outcomes following education, self-management and psychological interventions in diabetes mellitus. *Patient Educ Couns* 2003,51:5–15.
12. Ellis SE, *et al.* Diabetes patient education: a meta-analysis and meta-regression. *Patient Educ Couns* 2004;52:97–105.
13. Warsi A, *et al.* Self-management education programs in chronic disease: a systematic review and methodological critique of the literature. *Arch Intern Med* 2004;164:1641–9.
14. Deakin TA, *et al.* Group based training for self-management strategies in people with type 2 diabetes mellitus. *Cochrane Database Syst Rev* 2005; Issue 2. Art.No.:CD003417.pub2.DOI: 10.1002/14651858. CD003417.pub2.
15. Loveman E, *et al.* The clinical effectiveness of diabetes education models for Type 2 diabetes: a systematic review. *Health Technol Assess* 2008; 12(9):1–116, iii.
16. Hawthorne K, *et al.* Culturally appropriate health education for type 2 diabetes in ethnic minority groups: a systematic and narrative review of randomized controlled trials. *Diabet Med* 2010;27:613–23.
17. Deakin TA, *et al.* Structured patient education: the diabetes X-PERT Programme makes a difference. *Diabet Med* 2006;23:944–54.
18. DAFNE Study Group. Training in flexible, intensive insulin management to enable dietary freedom in people with type 1 diabetes: dose adjustment for normal eating (DAFNE) randomised controlled trial. *BMJ* 2002;325(7367):746.
19. Speight J, *et al.* Long-term biomedical and psychosocial outcomes following DAFNE (Dose Adjustment For Normal Eating) structured education to promote intensive insulin therapy in adults with sub-optimally controlled type 1 diabetes. *Diabetes Res Clin Pract* 2010;89:22–9.
20. Bastiaens H, *et al.* Supporting diabetes self-management in primary care: pilot-study of a group-based programme focusing on diet and exercise. *Primary Care Diabetes* 2009;3(2):103–9.
21. Davies MJ, *et al.* Effectiveness of the diabetes education for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cluster randomised controlled trial. *BMJ* 2008;336(7642):491–5.
22. Jacobs-Van Der Bruggen MAM, *et al.* Cost-effectiveness of lifestyle modification in diabetic patients. *Diabetes Care* 2009;32:1453–8.
23. Gillett M, *et al.* Delivering the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cost effectiveness analysis. *BMJ* 2010:341;c4093.
24. Shearer A, *et al.* Cost-effectiveness of flexible intensive insulin management to enable dietary freedom in people with type 1 diabetes in the UK. *Diabet Med* 2004;21:460–7.
25. Pastors JG, et al. The evidence for the effectiveness of medical nutrition therapy in diabetes management. *Diabetes Care* 2002;25:608–13.
26. Franz MJ. Evidence-based medical nutrition therapy for diabetes. *Nutr Clin Pract* 2004;19:137–44.
27. Sheils JF, *et al.* The estimated costs and savings of medical nutrition therapy: the Medicare population. *J Am Diet Assoc* 1999;99:428–35.
28. Franz MJ, *et al.* Cost-effectiveness of medical nutrition therapy provided by dietitians for persons with non-insulin dependent diabetes mellitus. *J Am Diet Assoc* 1995;95:1018–24.
29. National Institute for Health and Clinical Excellence Clinical Guideline 66: Type 2 diabetes. National guideline for management in primary and secondary care (update). National Collaborating Centre for Chronic Conditions. London: Royal College of Physicians, 2008.
30. National Institute for Health and Clinical Excellence. Assumptions used in estimating a population benchmark. NICE [accessed 29/04/11 at: www.nice.org.uk/usingguidance/commissioningguides/type2diabetes/assumptions.jsp.]
31. National Institute for Health and Clinical Excellence. Quality Standards Programme: Diabetes in Adults. NICE Centre for Clinical Practice March 2011 [accessed 29/04/11 at: www.nice.org.uk/media/FCF/87/DiabetesInAdultsQualityStandard.pdf.]
32. Innove. Findings from DiabetesE: Fifth National Report. Innove, February 2010.
33. Deakin TD. X-PERT: The Cost Effective Solution to Diabetes. X-PERT Health Community Interest Company, 2009.
34. Deakin TA, on behalf of the Diabetes UK Professional Education Working Group. An integrated career and competency framework for dietitians and frontline staff. Diabetes UK, 2010.
35. Anderson RM, *et al.* The diabetes empowerment scale-short form (DES-SF). *Diabetes Care* 2003;26: 1641–3.
36. DoH. National Service Framework for Diabetes: Standards. London: Department of Health, 2001.
37. Deakin TA. Expert Patient Education versus Routine Treatment (X-PERT). PhD Thesis: 1-346; 2004. Nuffield Institute for Health, University of Leeds.
38. Ramlo-Halsted BA, Edelman SV. The natural history of type 2 diabetes: practical points to consider in developing prevention and treatment strategies. *Clin Diabetes* 2000;18:80–5.
39. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352(9131): 837–53.
40. Stratton IM, *et al.*, on behalf of the UK Prospective Diabetes Study Group. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 2000;321: 405–12.
41. Holman RR, *et al.*, for the 4-T Study Group. Three-year efficacy of complex insulin regimens in type 2 diabetes. *N Engl J Med* 2009;361:1736–47.
42. Action to Control Cardiovascular Risk in Diabetes Study Group, Gerstein HC, *et al.* Effects of intensive glucose lowering in type 2 diabetes. *N Engl J Med* 2008;358:2545–59.
43. Duckworth W, *et al.* Intensive glucose control and complications in American veterans with type 2 diabetes. *N Engl J Med* 2009;360:129–39.
44. *MIMS*. The prescribing reference for general practice. March 2011.
45. Crasto W, *et al.* Insulin U-500 in severe insulin resistance in type 2 diabetes mellitus. *Postgrad Med J* 2009;85:219–22.

Outcome	Audit standard from RCT	Audit standard from national target
Number of participants	–	Structured education should be offered to every person and/or their carer at diagnosis, with annual reinforcement and review Over 3 years = ~5,000 existing + ~500 new diagnosed
Participant attendance	≥95% attend at least 1 session ≥80% attend 4 or more sessions	–
Participant satisfaction	≥90%	NHS Outcomes Framework 'proportion of people who feel supported to manage their condition'
Participant empowerment	≥10% increase from baseline (6 weeks) and ≥20% at 1 year	Standard 3, Diabetes National Service Framework 2001
Glycated haemoglobin	≥0.5% reduction at 1 year	7% (individual variation between 6.5% and 7.5%)
Body weight/BMI	No increase at 1 year	5–10% weight loss BMI reduced from obese to overweight (≤29.9 kg/m^2) or normal weight (≤24.9 kg/m^2)
Waist circumference	≥2cm reduction at 1 year	<80cm females; <94cm males
Systolic blood pressure	≤5mmHg reduction at 1 year	<130mmHg type 1 and type 2 with microvascular complications <140mmHg type 2 (no complications)
Diastolic blood pressure	–	<80mmHg
Total cholesterol	–	<4.0mmol/L
LDL cholesterol	–	<2.0mmol/L
HDL cholesterol	–	≥1.2mmolL females ≥1.0mmol/L males
Triglycerides	–	<1.7mmol/L
Prescribed medication	50% of participants will have either reduced diabetes medication or have remained on the same dose	–

Appendix 1. Audit standards from the published randomised controlled trial (RCT) and national targets



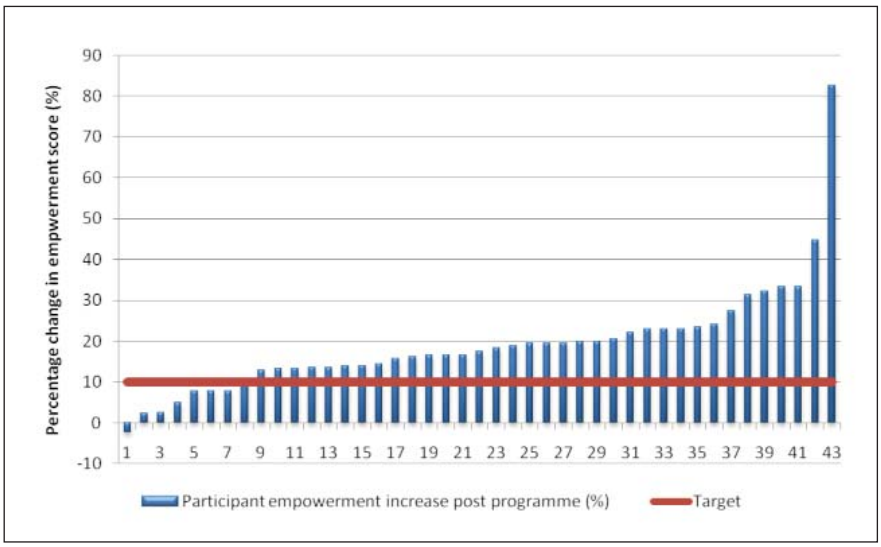
Appendix 2. Percentage of participants attending 4 or more sessions



Appendix 3. Participant satisfaction (%)

Variable	Result		
Number of X-PERT programmes	2055		
Mean programme evaluation score (4–12)	11.3 (94.2%)		
Number of attendees	16 031		
Total percentage who attended at least 1 session	95.3%		
Total percentage who attended ≥4 sessions	80.9%		
Attended Annual Update Module	1277/16 031 (7.9%)		
	Baseline	**6 weeks**	**1 year**
Patient empowerment score (1–5) Patient empowerment score (% change):	3.5	4.3 22.9%	4.4 25.7%

Appendix 4. X-PERT audit report for all centres 31 January 2011: attendance, satisfaction and empowerment



Appendix 5. Participant empowerment: change from baseline to 6 weeks

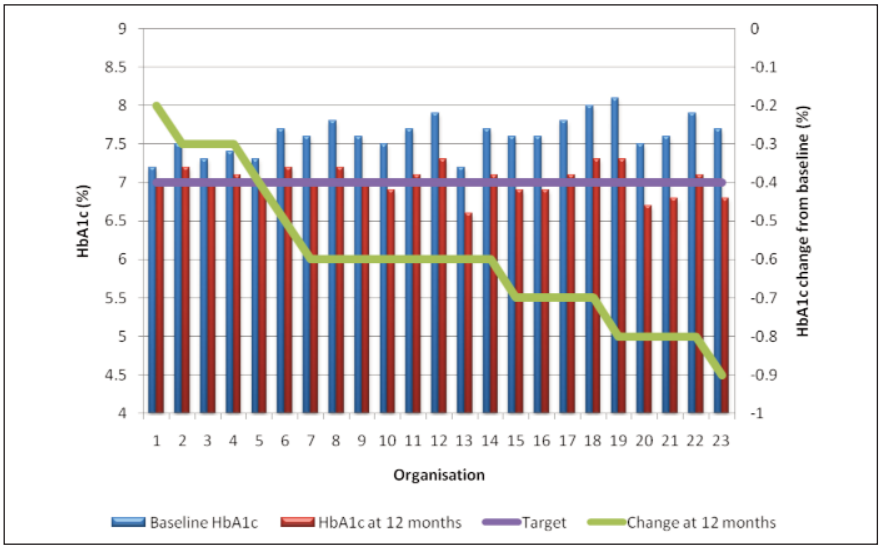
Variable	Baseline	6 months post course	1 year post course	2 years post course
HbA_{1c} (%)	7.7	7.1	7.1	7.1
Weight (kg)	88.5	86.3	85.5	86
BMI (kg/m^2)	31.8	30.8	30.8	30.3
Systolic blood pressure (mmHg)	134.1	133.4	133.2	132.9
Diastolic blood pressure (mmHg)	77.4	76.1	75.2	75.3
Waist circumference (cm)	102.9	101.4	100.8	101
Total cholesterol (mmol/L)	4.4	4.2	4.2	4
LDL cholesterol (mmol/L)	2.4	2.3	2.3	2.1
HDL cholesterol (mmol/L)	1.2	1.2	1.3	1.3
Triglycerides (mmol/L)	1.9	1.8	1.7	1.7

Appendix 6. X-PERT audit report 31 January 2011: clinical outcomes for 16 031 participants. (Values are presented as means)

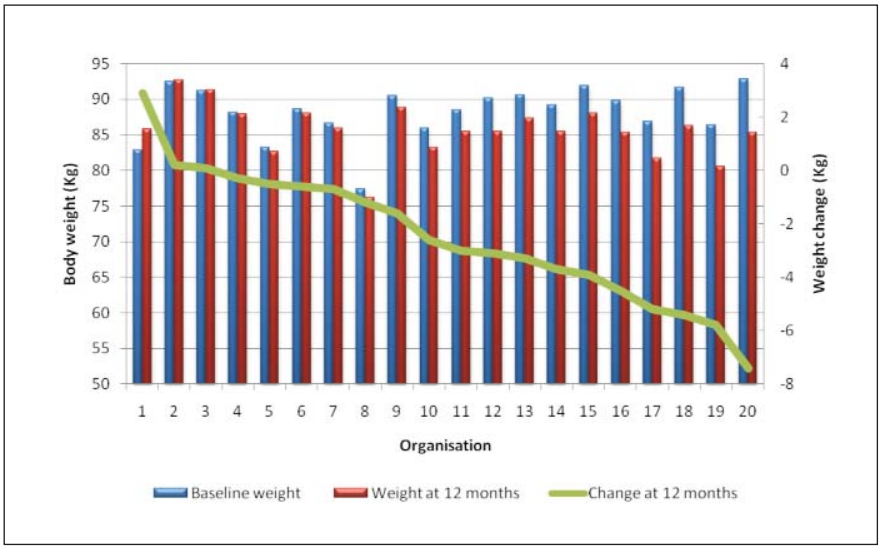
Variable	6-month data				1-year data			2-year data			Overall
	Baseline group (SD) (n=13 311)	Pre course group subset baseline (SD) (n=2474)	Post course group (SD) (n=2474)	Difference in means (95% CI)	Pre course group subset baseline (SD) (n=1980)	Post course group (SD) (n=1980)	Difference in means (95% CI)	Pre course group (SD) (n=216)	Post course group (SD) (n=216)	Difference in means (95% CI)	Repeated measure ANNOVA P-value
HbA_{1c} (%)	7.7 (1.7)	7.7 (1.7)	7.1 (1.2)	0.6 (0.5, 0.7)	7.6 (1.6)	7.1 (1.2)	0.5 (0.4, 0.6)	7.5 (1.6)	7.0 (1.1)	0.5 (0.2, 0.7)	<0.001
SBP (mmHg) DBP (mmHg)	134.1 (15.5) 77.4 (9.6)	135.1 (15.5) 77.3 (9.5)	133.4 (14.8) 76.2 (9.0)	1.7 (0.8, 2.5) 1.1 (0.5, 1.6)	136.9 (16.4) 77.3 (9.7)	133.1 (15.1) 75.2 (9.1)	3.8 (2.7, 4.8) 2.1 (1.5, 2.7)	136.0 (17.9) 76.0 (10.5)	133.5 (13.7) 75.3 (9.0)	2.5 (-0.8, 5.8) 0.7 (-1.3, 3.0)	<0.001 <0.001
TC (mmol/L) HDL-C (mmol/L) LDL-C (mmol/L) TG (mmol/L)	4.4 (1.1) 1.2 (0.5) 2.4 (0.9) 1.9 (1.4)	4.4 (1.1) 1.2 (0.4) 2.4 (0.9) 1.9 (1.2)	4.2 (0.9) 1.2 (0.5) 2.3 (0.8) 1.7 (0.9)	0.2 (0.1, 0.3) 0.0 (-0.3, 0.3) 0.1 (0.1, 0.2) 0.2 (0.1, 0.3)	4.4 (1.1) 1.2 (0.4) 2.4 (1.0) 1.9 (1.1)	4.2 (0.9) 1.3 (0.4) 2.3 (0.8) 1.7 (0.9)	0.2 (0.1, 0.3) -0.1 (-0.1,0.1) 0.1 (0.0, 0.2) 0.2 (0.1, 0.3)	4.3 (1.1) 1.2 (0.3) 2.4 (0.9) 1.8 (0.9)	4.0 (0.9) 1.2 (0.5) 2.1 (0.7) 1.7 (1.3)	0.3 (0.1, 0.5) 0.0 (-0.8, 0.1) 0.3 (0.1, 0.5) 0.1 (-0.1, 0.3)	<0.001 0.9 0.002 0.005
Bodyweight (kg) BMI (kg/m^2)	88.5 (20.2) 31.8 (6.4)	88.0 (19.5) 31.4 (6.2)	86.3 (19.2) 30.8 (6.1)	1.7 (0.6, 2.8) 0.6 (0.2, 0.9)	88.0 (19.6) 31.6 (6.5)	85.6 (18.8) 30.8 (1.1)	2.4 (1.1, 3.7) 0.8 (0.5, 1.1)	87.4 (16.5) 31.3 (5.7)	86.2 (16.8) 30.4 (5.5)	1.2 (-2.1, 4.5) 0.9 (-0.2, 2.0)	<0.001 0.001
Waist size (cm) Female Male	 101 (17.3) 105 (16.9)	 102 (16.3) 104 (17.1)	 98 (15.2) 104 (15.3)	 2.8 (1.1, 4.5) 0.6 (-1.2, 2.4)	 102 (14.7) 106 (14.4)	 99 (14.5) 103 (13.9)	 3.1 (1.4, 4.8) 3.4 (1.7, 5.1)	 103 (16.7) 104 (14.0)	 99 (14.8) 104 (16.9)	 4.3 (-3.4, 11.9) 0.0 (-5.8, 5.8)	 <0.001 0.08

Values are means (standard deviations) unless stated otherwise. SBP = Systolic blood pressure; DBP = Diastolic blood pressure; TC = Total cholesterol; HDL-C = High density lipoprotein cholesterol; LDL-C = Low density lipoprotein cholesterol; TG = Triglycerides.

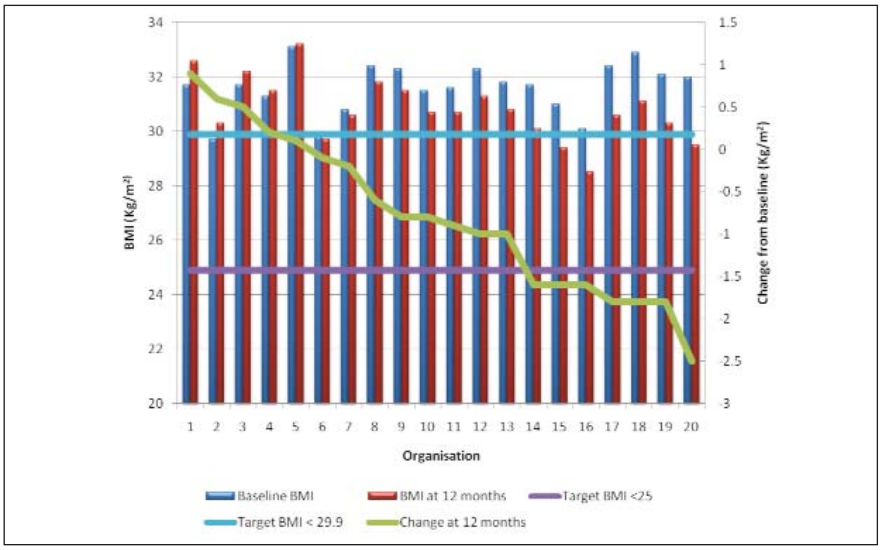
Appendix 7. Clinical outcomes: differences between baseline and post course (for participants where a full set of data was available)



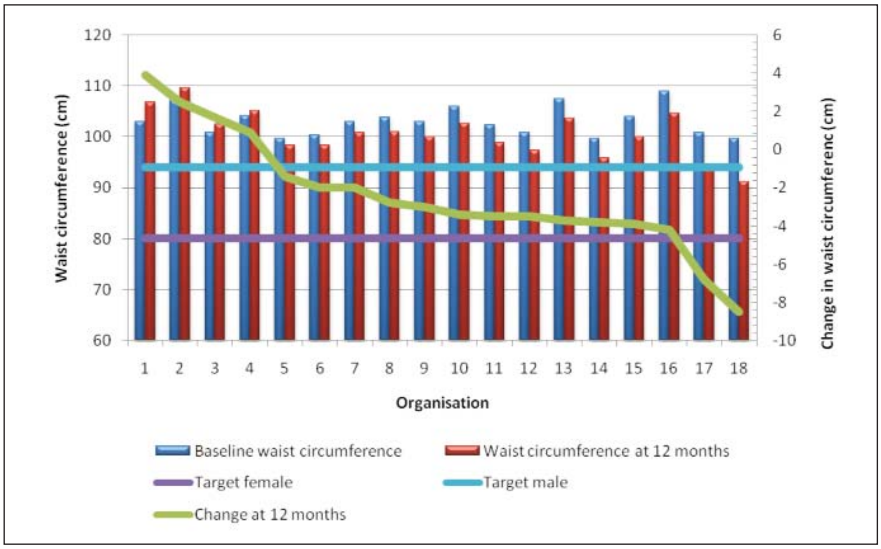
Appendix 8. HbA1c change from baseline to 12 months



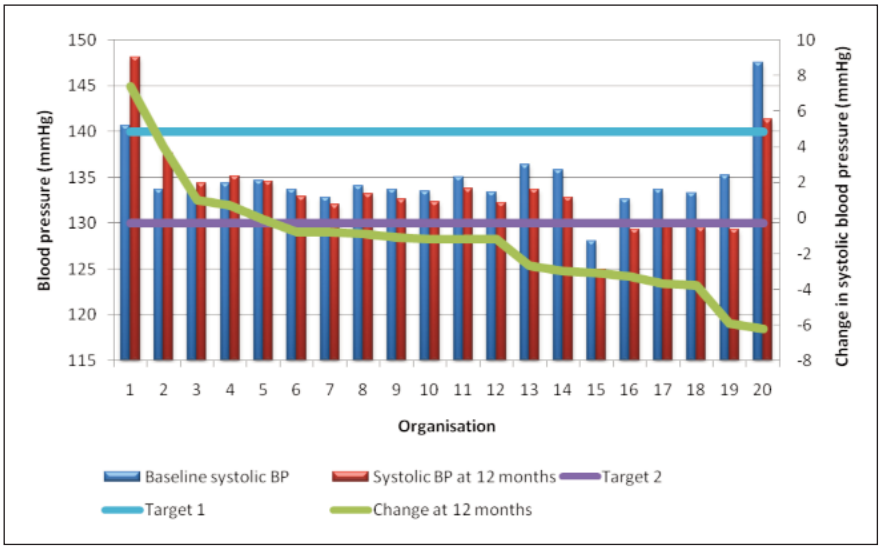
Appendix 9. Weight change from baseline to 12 months



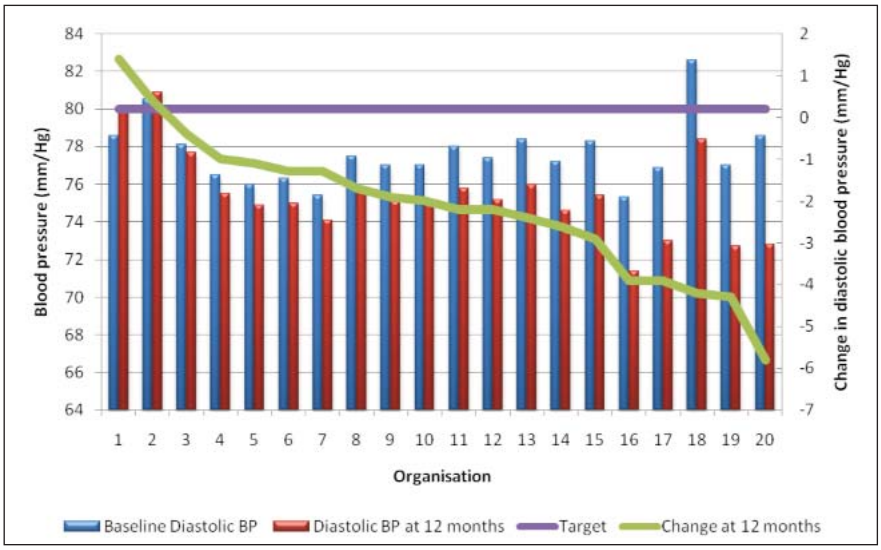
Appendix 10. BMI change from baseline to 12 months



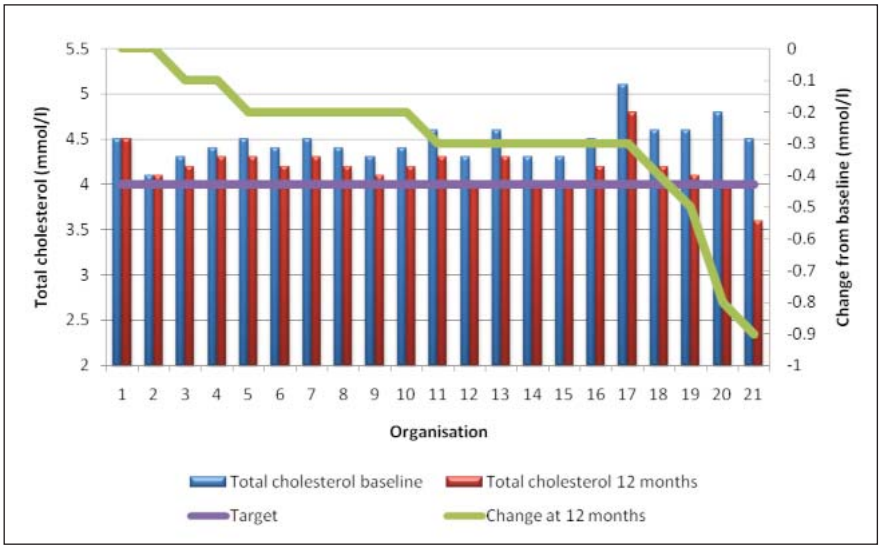
Appendix 11. Waist circumference change from baseline to 12 months



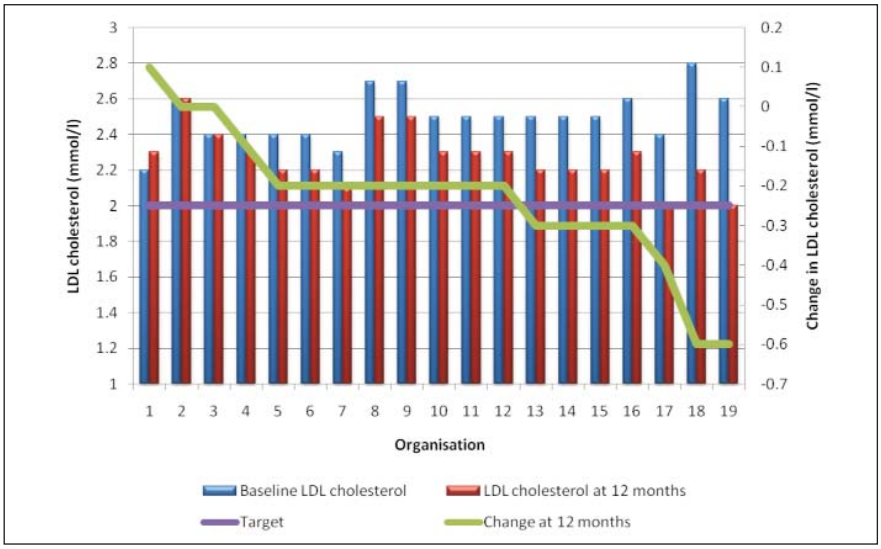
Appendix 12. Systolic blood pressure change from baseline to 12 months



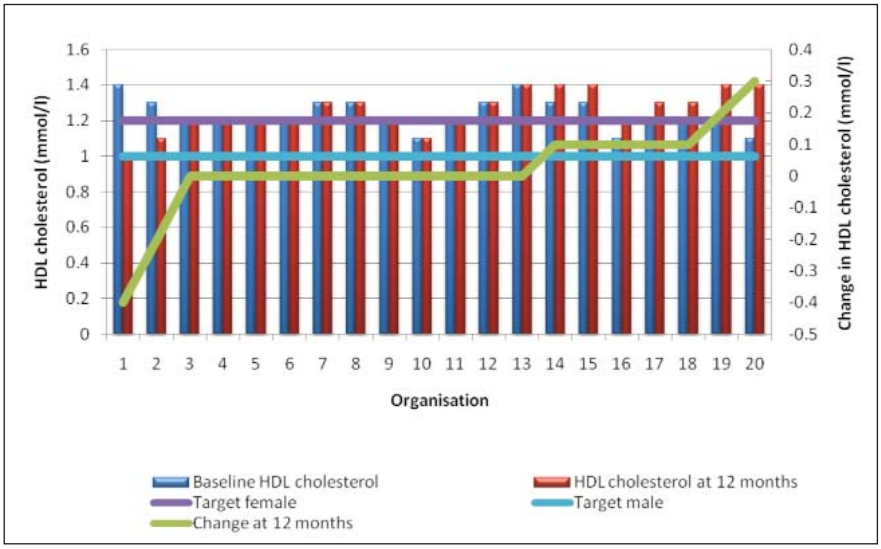
Appendix 13. Diastolic blood pressure change from baseline to 12 months



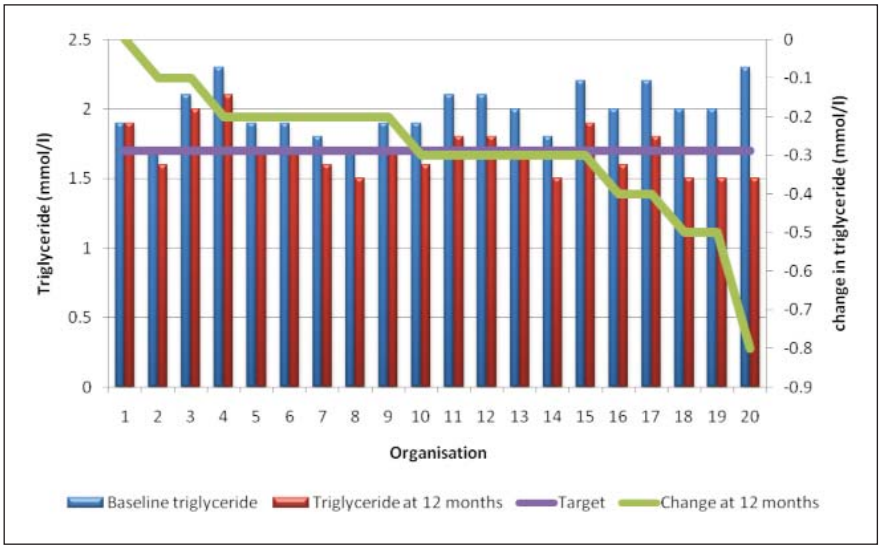
Appendix 14. Total cholesterol change from baseline to 12 months



Appendix 15. LDL cholesterol change from baseline to 12 months



Appendix 16. HDL cholesterol change from baseline to 12 months



Appendix 17. Triglyceride cholesterol change from baseline to 12 months