

The Dose Adjustment for Normal Eating (DAFNE) education programme

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Article points

1. The DAFNE (Dose Adjustment for Normal Eating) programme provides education on flexible, intensive insulin therapy for adults with type 1 diabetes.
2. DAFNE is evidence-based, centrally coordinated, standardised and validated, meeting the criteria set by the Department of Health.
3. Evidence on outcomes is still accumulating and there is an ongoing research programme aiming to evaluate and develop the education provided.

Key words

- Education
- Glycaemic control
- Intensive insulin therapy
- Type 1 diabetes

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DAFNE (Dose Adjustment for Normal Eating) is perhaps the best known of a number of structured education programmes for adults with type 1 diabetes introduced into the UK over the last 12 years. This article is a review of the development of DAFNE, the achievements to date and some of the current limitations. The author also outlines the research which has been fundamental to the development and subsequent evaluation of DAFNE, and which will underpin future clinical development.

DAFNE (Dose Adjustment for Normal Eating) is a structured education programme that teaches the use of flexible intensive insulin therapy to optimise glycaemic control through independent self-management. The aims of DAFNE and similar programmes are to improve overall glycaemic control, to minimise hypoglycaemia and to improve the quality of life for those living with type 1 diabetes.

The concept of flexible, fast-acting, meal-related insulin dose adjustment dates back to the 1930s and was originally based on urine glucose tests. However, this approach really only became practicable with the advent of home blood glucose monitoring. Modern structured education programmes were first developed in Germany as the Diabetes Teaching and Treatment Programme (DTTP), which is based on a residential 1-week course

(Mühlhauser et al, 1983; Assal et al, 1985). Interest in and observation of the DTTP by a multidisciplinary diabetes team from the UK led to a trial in England of structured education for adults with type 1 diabetes. The German programme was translated and modified as a 5-day, non-residential course. The UK course was then tested using a controlled (delayed entry) three-centre trial (DAFNE Study Group, 2002). This showed an improvement in HbA_{1c} of 11 mmol/mol (1.0 percentage points) at 6 months, regressing to 5 mmol/mol (0.5 percentage points) at 12 months. There was no change in weight or rates of severe hypoglycaemia but there were considerable improvements in the adverse impact of diabetes on the quality of life, freedom of eating and the Diabetes Treatment Satisfaction questionnaire score. The success of the initial DAFNE research project led to the programme being rolled out to seven other centres in 2002.

DAFNE is now provided by 69 centres in 132 locations across the UK and there are currently approximately 25 000 graduates (www.dafne.uk.com) representing around 10% of the UK population with type 1 diabetes, which has an estimated prevalence of 0.4% (NHS Information Centre, 2011). DAFNE education programmes are also now established in Eire, Australia, Kuwait, New Zealand and Singapore.

The DAFNE programme

Principles

The fundamental principle underlying DAFNE and other structured education programmes teaching flexible intensive insulin therapy is the separation of basal- and meal-related insulins. The basal or background insulin dose is kept relatively constant to maintain the blood glucose level within the given target range in the “fasting state” or after carbohydrate-free meals. The most important skill taught in DAFNE concerns the calculation of the meal-time, fast-acting insulin dose. The dose required to cover the meal itself is determined by estimating the carbohydrate content of the food to be eaten in terms of the number of 10 g carbohydrate portions (CPs) and multiplying by an individualised ratio of the number of insulin units to each CP (often 1:1). A correction to the insulin dose may be required if the relevant pre-meal blood glucose level is outside of the target range, and further adjustments may be necessary, for example, before exercise. DAFNE diaries are provided so that blood glucose levels can be recorded, along with the CPs of the meals consumed and the insulin doses used, in order to aid reflection and, hence, refine future insulin dose adjustment.

Courses

Individual courses are led by two trained educators (usually one DSN and one dietitian) in a group with six to eight people with type 1 diabetes. The courses are run along adult education principles, encouraging inclusivity, and participation and involvement by all. The education sessions outline carbohydrate counting and the adjustment of meal-related, fast-acting insulin doses. Group feedback sessions on insulin adjustment and achieving

target blood glucose levels take place at the beginning and end of each day. During the week-long course, there are additional sessions on:

- Insulin types.
- Duration and action.
- Blood glucose monitoring.
- Hypoglycaemia.
- Diabetes complications.
- The annual review.
- Diabetes in special situations, e.g. illness, alcohol and exercise.

A follow-up is provided in a single session at 6–12 weeks after each course, but is thereafter not specified and left to individual centres. A simple dataset is collected at pre-course assessment and then annually for audit purposes.

Quality control

DAFNE educators, specifically trained for their role, are required to teach on at least one course every 6 months to maintain their skills and are intermittently peer-reviewed. Participating centres are audited on a 3-year cycle for the process on delivering the DAFNE programme and on local outcomes, particularly the recorded changes in HbA_{1c}.

Central organisation

The DAFNE programme is coordinated by a central organisation that is funded by annual payments from individual centres. DAFNE Central is responsible for curriculum revision, training and peer review for educators, centre audits, course materials, a centralised database for audit of outcomes and a website (www.dafne.uk.com). All participating DAFNE centres in the UK are invited to send representatives to the annual collaborative meeting, and regional educator meetings take place biannually. There is a patient support network called the DAFNE User Group, with a sub-group of elected representatives, the DAFNE User Action Group, having input into DAFNE planning and research development (Ward, 2011).

Outcomes

One of the principles underlying the DAFNE programme is that this is evidence-based,

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2. Individual courses are led by two trained educators (usually one DSN and one dietitian) in a group with six to eight people with type 1 diabetes.
3. The DAFNE programme is coordinated by a central organisation that is funded by annual payments from individual centres.

quality assured and subject to audits. On the premise that there should be ongoing research to refine diabetes education for the ultimate benefit of people with diabetes, DAFNE is not a fixed and unchanging educational package. Research and audits within the DAFNE programme have been facilitated by the programme being standardised, centrally organised and run on a collaborative basis.

HbA_{1c}

In the original DAFNE trial, the baseline HbA_{1c} of 79 mmol/mol (9.4%) improved by 11 mmol/mol (1.0 percentage point) at 6 months, rising to 74 mmol/mol (8.9%) at 12 months (DAFNE Study Group, 2002). In a subsequent study of as many of the original DAFNE participants who could be contacted, it was demonstrated that the mean HbA_{1c} remained, on average, 4 mmol/mol (0.36 percentage points) below the baseline nearly 4 years post-education (Speight et al, 2010). In a single-centre study, participants in the earliest DAFNE courses in Nottingham had a persistent improvement in HbA_{1c} from baseline of 3 mmol/mol (0.3 percentage points) at 7 years compared with matched controls, with no differences in weight change over time between the groups (Gunn and Mansell, 2012). In a cohort of all the participants undergoing DAFNE education in the UK in 2005, the overall HbA_{1c} fell from 69 mmol/mol (8.5%) to 66 mmol/mol (8.2%) at a 1-year follow-up (Hopkins et al, 2012).

To date, longer-term improvements in HbA_{1c} following DAFNE have been moderate and less than that indicated by the original trial. There are, however, differences between more recent audits and the original DAFNE study. In the trial, there was a greater potential scope for improvement in HbA_{1c}, as the participants were relatively poorly controlled with a baseline HbA_{1c} of 79 mmol/mol (9.4%), those with an initial HbA_{1c} below 58 mmol/mol (7.5%) being excluded. It is also likely that a higher proportion of people with type 1 diabetes taking part in a trial over 10 years ago may not have been using a basal-bolus insulin regimen prior to entry compared with later cohorts. However, it is not as yet entirely clear why central European education programmes generally achieve lower outcome HbA_{1c} levels than is the case with DAFNE in the UK (Mühlhauser et al, 1983; Pieber et al, 1995).

Hypoglycaemia

Rates of hypoglycaemia were unchanged after structured education in the original DAFNE trial, despite a marked improvement in HbA_{1c} (DAFNE Study Group, 2002). In contrast, in the intensively treated group in the Diabetes Control and Complications Trial, the improvement in HbA_{1c}

was accompanied by a much higher rate of hypoglycaemia (the Diabetes Control and Complications Trial Research Group, 1993). In the audit of the national DAFNE cohort in 2005, the rate of severe hypoglycaemia fell from 1.7 to 0.6 episodes per person per year between baseline and the 12-month follow-up, and hypoglycaemia recognition improved in 43% of those initially reporting unawareness (Hopkins et al, 2012).

Patient-reported quality of life and outcome measures

As discussed previously, there were significant improvements in certain reported outcome measures and the quality of life at 12 months post-DAFNE education in the original trial. These improvements were maintained some 4 years later (Speight et al, 2010). In the UK DAFNE cohort in 2005, psychological distress was evident at baseline with a PAID (Problem Areas in Diabetes) score of 25.2 and HADS (Hospital Anxiety and Depression Scale) scores of 5.3 (“anxiety”) and 4.8 (“depression”). These scores improved to 16.7 (PAID), 4.6 (HADS anxiety) and 4.2 (HADS depression) 1 year following DAFNE education, with the prevalence of clinically relevant anxiety and depression (HADS score ≥ 8) falling from 24.4 to 18.0% and 20.9 to 15.5%, respectively (Hopkins et al, 2012).

Limitations

A potential threat to DAFNE and, indeed, to all similar programmes in the UK comes from current suggestions that the bulk of type 1 diabetes management should take place in the community rather than in secondary care, as this may make coordination of education more difficult. It has, however, been demonstrated that a “hub-and-spoke” model can be used to provide such education successfully (Rogers et al, 2009).

DAFNE clearly brings benefits to many people with type 1 diabetes, most notably perhaps in terms of the improved quality of life, but there are certain limitations to the programme at present. Firstly, the only modest improvement in overall blood glucose control following DAFNE in the UK means that many will remain above the target HbA_{1c} of 58 mmol/mol (7.5%) and, hence, at a higher risk of tissue complications. Secondly, DAFNE is sometimes seen as “exclusive” or expensive, but this may be an unfortunate perception associated with the necessity for a central organisation to maintain standards with a uniform, validated curriculum with common teaching materials, peer review and audit in accordance with nationally agreed standards for structured education (Department of Health and Diabetes UK, 2005). Thirdly, the current education package is not suitable for all – for example, those who do not choose a flexible insulin regimen or who are unable to access the course owing to disability, language issues or simply the

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1. Until recently, there has been little evidence as to the behaviour that people with diabetes adopt following participation in the DAFNE programme.
2. There is an active multidisciplinary research group within DAFNE, including clinicians, DSNs, dietitians, clinical psychologists, sociologists and health economists.
3. DAFNE education has been associated with significant improvements in psychosocial outcomes, rates of severe hypoglycaemia and, to a lesser extent, overall glycaemic control.

inability to free up the time required. Finally, it is increasingly recognised that a substantial proportion of the adult population does not possess the arithmetical ability necessary to calculate insulin bolus doses as required in flexible intensive insulin therapy (Cavanaugh et al, 2008). This may be related to the observation that numeracy below the equivalent of grade C GCSE Mathematics is independently associated with a higher HbA_{1c} (Marsden et al, 2012).

DAFNE education has so far been deliberately discussed in terms of course delivery and teaching. However, teaching is not necessarily the same as learning and practice, and until recently there has been little evidence as to the behaviour that people with diabetes adopt following participation in the DAFNE programme or other structured diabetes education programmes, and how this may influence outcomes. This is a major component of current research in DAFNE.

Current research

The ethos underlying the DAFNE programme is that it should be evidence-based, and so evolve through the application of audit and research. There is an active research group within DAFNE, which has been in receipt of an NIHR (National Institute for Health Research) programme grant from 2007 to 2012. The research group is multidisciplinary and includes clinicians, DSNs, dietitians, clinical psychologists, sociologists and health economists, and involves representative adults with type 1 diabetes who have undertaken DAFNE education. Research takes place at many DAFNE centres. The current research programme includes randomised trials of providing DAFNE on 1 day per week over the course of 5 weeks, rather than over 1 week, using DAFNE with an insulin pump rather than multiple subcutaneous injections, and a pilot study of an intervention to assist those who continue to experience severe hypoglycaemia following DAFNE. These projects are either just complete or underway but are not yet published.

A research database study using a self-management questionnaire has shown that the self-care behaviours recommended during

a DAFNE course vary considerably 1 year later (Mansell et al, 2012). In-depth interviews have confirmed the following:

- The frequency of blood glucose recording and reflection tends to decrease with time (Lawton et al, 2011; Rankin et al, 2011).
- Individual blood glucose targets tend to shift upwards from those originally set (Rankin et al, 2012b).
- Some people may require more support following DAFNE than that which is currently provided (Rankin et al, 2012a).

Further issues being studied include the rates of hypoglycaemia post-DAFNE education, the use of insulin pumps, outcomes in relation to the duration of diabetes, and an extensive health economics evaluation.

Conclusion

DAFNE is a widely available education programme for adults with type 1 diabetes. Following the undertaking of DAFNE education, there are significant improvements in psychosocial outcomes, rates of severe hypoglycaemia and, to a lesser extent, overall glycaemic control. The relatively modest improvement observed in the HbA_{1c} of participants is a challenge to DAFNE and similar structured education programmes. It is interesting to consider whether glycaemic control following DAFNE could be improved by one or more of the following ways:

- Refining the education programme itself.
- Introducing a more structured follow-up, including the reinforcement of target setting.
- Embracing new technologies, particularly insulin bolus dose calculators, continuous blood glucose monitoring and insulin pump technology.

A further multidisciplinary research programme has been proposed to ensure that DAFNE education remains evidence-based and progressive. ■

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