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Incorporating psychosocial characteristics in cost-effectiveness modelling of Type 1 diabetes

Introduction

The Dose Adjustment for Normal Eating (DAFNE) course is a structured education programme that aims to teach individuals with Type 1 diabetes to change their self-care behaviours by estimating the carbohydrate content of food and adjusting their insulin doses accordingly in order to maintain acceptable metabolic control. DAFNE has been found to improve quality of life and glycosylated haemoglobin (HbA1c) levels in UK Type 1 diabetes patients¹ and a cost-effectiveness modelling analysis concluded that DAFNE was cost-effective and would pay for itself within four years². As with the majority of other economic models in Type 1 diabetes, this analysis had a clinical rather than behavioural focus. The progression of diabetes and its complications was modelled, with clinical and sociodemographic factors as the model inputs, to predict costs and quality-adjusted life years (QALYs) based on the long-term incidence of diabetic complications.

Despite positive clinical and cost-effectiveness outcomes from DAFNE there is variability in how patients respond, with some patients continuing to experience problems with high HbA1c levels or frequent hypoglycaemia after receiving the intervention. There is currently no method for predicting how an individual patient will respond to the DAFNE course.

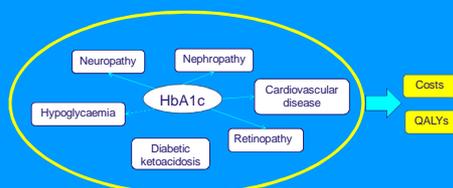
As part of a national DAFNE research team we are developing a new economic model of Type 1 diabetes that incorporates psychosocial and behavioural patient characteristics as predictive variables. Our study aims to account for heterogeneity in patient response to DAFNE within the model and investigate how predictions can be made prior to or shortly after the DAFNE course about how a patient's metabolic control will be affected by the intervention.

Methods

This study takes place within the wider context of the National Institute for Health Research (NIHR) DAFNE Research Programme and we are working alongside clinicians from a number of UK healthcare trusts and psychologists from the University of Edinburgh and University College London.

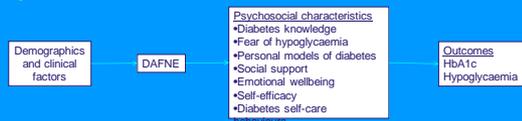
We have developed a traditional patient-level simulation model of Type 1 diabetes and its long-term complications in Simul8® (Fig. 1). HbA1c is the key input variable that drives the incidence of long-term diabetic complications (along with other clinical and demographic variables such as blood pressure, smoking status, age and diabetes duration) which in turn affect costs and QALY outcomes. The treatment effect of DAFNE is incorporated via changes in HbA1c.

Figure 1. Traditional models of Type 1 diabetes



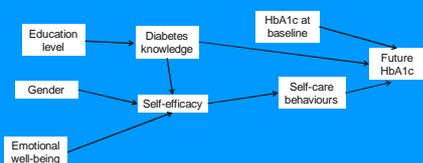
Literature reviews were undertaken to investigate what methods have been used to model the link between psychosocial characteristics and diabetes outcomes in published economic models of Type 1 diabetes and in the psychological literature. Our collaborators at University College London and University of Sussex (see Acknowledgements) have used structural equation modelling and multilevel modelling to analyse psychosocial and clinical data collected as part of the NIHR DAFNE Research Programme. These models explore the relationships between demographic variables, psychosocial characteristics and clinical outcomes (Fig. 2).

Figure 2. Key features of behavioural model



An illustrative example of the structural equation modelling process is presented in Fig. 3. Knowledge gained from the literature reviews and the DAFNE psychosocial models has been used to explore methods to incorporate psychosocial predictors (e.g. diabetes knowledge, self-efficacy, beliefs about diabetes) into our cost-effectiveness model alongside clinical and demographic predictors.

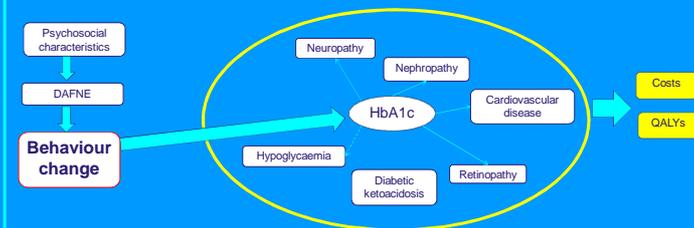
Figure 3. A conceptual example of possible factors affecting HbA1c



Results

The literature reviews and psychosocial modelling have been used to develop a framework to incorporate psychosocial and behavioural characteristics into our cost-effectiveness simulation model. Treatment effects will be incorporated via change in psychosocial characteristics and behaviour. The behaviour-focused model will allow estimation of change in patients' self-care behaviours following DAFNE and prediction of the effect this behaviour change has on HbA1c values. As HbA1c is a key driver of long-term complication incidence in the model, this approach will permit direct estimation of the cost-effectiveness of post-DAFNE behaviour change (Fig. 4).

Figure 4. A framework for incorporating psychosocial characteristics in a cost-effectiveness model of Type 1 diabetes



Next steps

It is expected that this framework will have the flexibility to aid clinical decision making by predicting individual patients' expected long-term costs and outcomes of DAFNE from their baseline psychosocial and demographic characteristics. This will offer the potential to improve the cost-effectiveness of DAFNE as the intervention can be targeted to those patients that are most likely to receive improved metabolic control. The framework will also aid prediction of the types of patients likely to need follow-up support after taking the DAFNE course and could inform the type of support required.

Conclusions

We have developed a new framework for incorporating psychosocial characteristics and behavioural treatment effects into a cost-effectiveness model of Type 1 diabetes. The integration of psychosocial and economic modelling demonstrates potential for informing clinical decision making by identifying those patients likely to have positive outcomes from interventions and the types of patients that might require follow-up support. Although the approach is demonstrated here by way of the DAFNE case study, the framework may plausibly be applied to any intervention for which patients' psychosocial characteristics and behavioural responses are expected to affect clinical outcomes.

Acknowledgements

We would like to thank our collaborators Dr Debbie Cooke and Dr Marie Clark at University College London and Dr Rod Bond at University of Sussex for sharing their preliminary research findings from the NIHR DAFNE Research Programme.

References

1. DAFNE Study Group. 2002. 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*, 325, pp.746-749.
2. Shearer, A. et al., 2004. Effectiveness of flexible intensive insulin management to enable dietary freedom in people with type 1 diabetes in the UK. *Diabetic Medicine*, 21, pp.460-467.