any people with type 1 diabetes mellitus (T1DM) struggle with the everyday challenge of attempting to achieve near-normal glycaemia while avoiding hypoglycaemia. The Dose Adjustment for Normal Eating (DAFNE) program of structured education for people with T1DM,1 developed in the United Kingdom by adapting a German diabetes teaching and treatment program,2 offers one potential approach to managing this problem. Reported benefits of DAFNE training include improved overall glycaemic control, reduced hypoglycaemia and improved quality of life.1,2

DAFNE courses have been offered in Australia since February 2005. These involve a 5-day (Monday to Friday over 1 week) outpatient program of structured education in diabetes self-management for groups of six to eight people with T1DM, with an emphasis on insulin dose adjustment using a flexible dietary intake and detailed estimation of dietary carbohydrate intake. Insulin-to-carbohydrate ratios and corrective insulin doses form the basis of prandial insulin titration.

A national “OzDAFNE” collaborative coordinates training and accreditation of centres and ensures standardised, high-quality delivery of the DAFNE course in Australia. The dietary elements of DAFNE have been adapted to Australian food choices and nutritional analysis, but the core curriculum is consistent with the UK program. Collection of audit data (before and 1 year after DAFNE training) from participants is an agreed condition of membership of the OzDAFNE collaborative. This is funded through each centre’s existing resources.

This report presents outcome data for the cohort of people with T1DM who participated in DAFNE courses in Australia between February 2005 and March 2007.

METHODS
Clinical data collection
Pre-specified inclusion criteria for DAFNE training included confirmation of T1DM at least 12 months previously; being in the post-“honeymoon phase”", glycated haemoglobin (HbA1c) level < 12%; age over 17 years; and ability to understand written and spoken English. To be included in this study, we required participants to have HbA1c levels recorded both before and after DAFNE training. De-identified clinical data from people undergoing DAFNE training were collected at seven specialist (secondary/tertiary) diabetes centres and community diabetes organisations and entered into a secure web-based database. The OzDAFNE database was locked on 31 March 2008.

Participants agreed to the use of their de-identified collective data for quality assurance purposes, but no formal consent form was used. The data collection and reporting process was reviewed by the Mater Health Services Human Research Ethics Committee and the study was exempted as a quality assurance activity, consistent with National Health and Medical Research Council guidelines.3

Data items included participants’ demographics, anthropometric data, history of diabetes and its complications, biochemical variables and scores from two measures of quality of life — the Hospital Anxiety and Depression Scale (HADS)4 and the Problem Areas in Diabetes (PAID) Scale5 — which have been validated in people with diabetes. The HADS is used to assess both anxiety and depressive symptoms. From a possible total score of 21 over both domains, scores < 7 are considered normal, 8–10 suggestive of anxiety or depression, and ≥ 11 indicative of a probable mood disorder. The PAID score covers a range of emotional states frequently reported in diabetes. These data were collected within 1 month of beginning and 1 year after participation in the DAFNE program. Biochemical variables were analysed using routine methods at each local DAFNE centre, without standardisation across centres.

ABSTRACT
Objective: To audit and describe the effects of participation in the Dose Adjustment for Normal Eating (DAFNE) course on clinical outcomes in people with type 1 diabetes mellitus (T1DM).

Design, setting and participants: Audit of clinical outcomes before and 1 year after DAFNE training for 145 people with T1DM who participated in courses at seven Australian diabetes centres between February 2005 and March 2007. Participants had been diagnosed with T1DM at least 1 year before and were beyond the “honeymoon phase”, with glycated haemoglobin (HbA1c) < 12% and no severe diabetes complications. They were aged over 17 years and able to understand written and spoken English.

Intervention: A 5-day structured education program covering T1DM management with an emphasis on unrestricted diet, precise carbohydrate estimation and prandial insulin dosing using insulin-to-carbohydrate ratios.

Main outcome measures: Glycaemic control (HbA1c levels), weight, severe hypoglycaemia, and quality of life scores on general (Hospital Anxiety and Depression) and diabetes-specific (Problem Areas in Diabetes) scales.

Results: Mean HbA1c fell from 8.2% to 7.8% (95% CI for change, −0.5% to −0.2%; P < 0.0001) and weight from 75.1 to 74.2 kg (95% CI for change, −1.6 to −0.2 kg; P = 0.012). Severe hypoglycaemia was less frequent after DAFNE training (P = 0.0001). Quality of life improved (P < 0.0001 for both scales).

Conclusions: One year after participation in the DAFNE program of structured education, people with T1DM showed improved glycaemic control, reduced incidence of severe hypoglycaemia, slightly reduced weight and improved quality of life. The DAFNE course offers one means of improving clinical outcomes in T1DM.

MJA 2010; 192: 637–640
Statistical analysis

Data items were tested for normality of distribution using the Shapiro–Wilks test and results verified by examining Q-Q plots. Normally distributed data were analysed primarily using paired t tests and are reported as mean ± SD or mean difference (95% confidence interval). Non-normally distributed data were analysed using the Wilcoxon signed rank test and are reported as median (interquartile range). Statistical comparisons were by unpaired t tests for continuous variables. Categorical results are reported as frequencies (%) and were analysed using the χ² test or Fisher exact test. Exact P values are noted unless P is less than 0.0001. Statistica, version 8.0 (StatSoft, Tulsa, Okla, USA) was used for all analyses.

RESULTS

Participants

Baseline data for 446 DAFNE course participants were recorded in the system. Of these, 272 had completed DAFNE training at least 1 year before the locking of the database and were eligible for inclusion. One-hundred and fifty-five people had at least some recorded data 1 year after training, and 145 (53%) had HbA₁c levels recorded both before and after DAFNE training. These 145 people form the cohort for this report. The number of participants with data recorded varies for different characteristics. Baseline characteristics of the people included and excluded from this study are presented in Box 1. Only the frequency of diabetic peripheral neuropathy varied significantly between these two groups. Nearly all of our final cohort (97%) were white. Participants’ mean body mass index (BMI) was in the overweight range. Twenty-eight per cent had known complications of diabetes.

Major clinical outcomes

Mean HbA₁c levels for the whole cohort fell from 8.2% to 7.8% (95% CI for change, −0.5% to −0.2%; P < 0.0001), and the change in HbA₁c varied according to baseline glycaemic control, being greater for participants with HbA₁c levels in the highest quartile before DAFNE training (Box 2).

DISCUSSION

Our audit of clinical outcomes suggests that the DAFNE program benefits people with...
T1DM in Australia. The results are broadly consistent with those reported in the UK DAFNE randomised controlled trial and in a large-scale German audit series. The UK trial reported a larger (about 1%) mean reduction in HbA1c levels, but it had recruited patients with poor glycaemic control and a mean HbA1c level of 9.3% at baseline. Consistent with our findings, the German audit described differences in HbA1c reduction according to baseline HbA1c quartile.

The landmark Diabetes Control and Complications Trial (DCCT) offered the first clear evidence that improved glycaemic control in T1DM improves clinical (in particular, microvascular) outcomes, but both the DCCT and a subsequent meta-analysis suggested that HbA1c reduction must inevitably be accompanied by an increase in severe hypoglycaemia. This, in addition to the weight gain associated with intensive therapy, has served to discourage many people with diabetes, and their treating doctors, from attempting more intensive glycaemic control.

However, both our data and the UK and German reports demonstrate that it is possible to lower HbA1c levels without these unwanted effects using the DAFNE structured education program. We suggest that these benefits may derive from the very detailed 5-day program of patient education that comprises the DAFNE course and from the less stringent glycaemic targets used in DAFNE. While the DCCT program was largely doctor-, dietitian- and nurse-driven, with prescription of dietary regimens, and insulin doses adjusted by clinicians, DAFNE promotes self-management with dietary flexibility and self-titration of insulin doses.

Type 1 diabetes is a profoundly vexatious chronic disease for many people, as it involves complex juggling of insulin doses according to food intake, glucose concentrations, exercise and other, often apparently random, factors on an unremitting daily basis. This clearly can impair quality of life. Although quality of life was not markedly abnormal in our cohort at baseline, all measures did improve after participation in the DAFNE course. The reasons for this may include reduced hypoglycaemia, improved self-management skills and confidence, and building a relationship with the health professional team, as well as the supportive environment and sharing of experiences of the “diabetic life” which, anecdotally, are always part of the DAFNE group dynamic.

Some limitations of our data should be noted. All data items were collected in a routine clinical environment, without standardised assays, dedicated staff or uniform data collection systems.

People with T1DM participating in DAFNE may not be representative of the population of people with T1DM as a whole. However, the mean baseline HbA1c level and BMI for our cohort were very similar to reported values for the cohort of T1DM patients who participated in the 2006 Australian National Diabetes Information Audit and Benchmarking survey of patients attending specialist diabetes clinics in Australia (HbA1c, 8.1% ± 1.6%; BMI, 26.2 ± 4.5 kg/m²). The distribution of HADS scores in our cohort at baseline was also similar to that reported in a UK cohort of adults with T1DM. The reasons why

### Change in participants’ HbA1c levels 1 year after DAFNE training

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Pre-DAFNE HbA1c (%)</th>
<th>Mean (SD)</th>
<th>95% CI</th>
<th>Post-DAFNE HbA1c (%)</th>
<th>Mean (SD)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>6.2%–7.4%</td>
<td>8.6% (1.2%)</td>
<td>8.1%–9.1%</td>
<td>7.8% (1.3%)</td>
<td>7.3% (0.9%)</td>
<td>6.8%–8.2%</td>
</tr>
<tr>
<td>Q2</td>
<td>7.5%–8.1%</td>
<td>8.2% (1.1%)</td>
<td>7.7%–8.7%</td>
<td>7.5% (1.2%)</td>
<td>7.0% (0.8%)</td>
<td>6.6%–7.9%</td>
</tr>
<tr>
<td>Q3</td>
<td>8.2%–9.1%</td>
<td>8.4% (1.3%)</td>
<td>7.9%–9.8%</td>
<td>7.8% (1.4%)</td>
<td>7.3% (1.0%)</td>
<td>6.8%–8.8%</td>
</tr>
<tr>
<td>Q4</td>
<td>9.1%–11.4%</td>
<td>9.0% (1.6%)</td>
<td>8.4%–9.6%</td>
<td>8.2% (1.4%)</td>
<td>7.7% (1.1%)</td>
<td>7.1%–9.0%</td>
</tr>
</tbody>
</table>

**DAFNE = dose adjustment for normal eating. HbA1c = glycated haemoglobin. *P < 0.0001.**

### Change in self-reported frequency* of severe hypoglycaemia among DAFNE participants (n = 137)

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Pre-DAFNE</th>
<th>Post-DAFNE</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe hypoglycaemic episodes previous year</td>
<td>0 (0–1)</td>
<td>0 (0–0)</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-glucose tests/week</td>
<td>28 (20–35)</td>
<td>30 (25–38)</td>
<td>0.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HADS — anxiety score</td>
<td>5 (3–9)</td>
<td>4 (2–6)</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HADS — depression score</td>
<td>5 (2–8)</td>
<td>3 (1–6)</td>
<td>0.0003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAID — total score</td>
<td>25 (15–45)</td>
<td>16.25 (10–30)</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DAFNE = dose adjustment for normal eating. HbA1c = glycated haemoglobin. IQR = interquartile range. PAID = Problem Areas in Diabetes Scale. *P < 0.0001.**

### Major clinical outcomes for participants 1 year after DAFNE training (n = 145)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before DAFNE training</th>
<th>1 year after DAFNE training</th>
<th>Mean difference (95% CI)*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (%)</td>
<td>8.2% (1.2%)</td>
<td>7.8% (1.3%)</td>
<td>−0.4% (−0.5% to −0.2%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.1 (13.8)</td>
<td>74.2 (13.4)</td>
<td>−0.9 (−1.6 to −0.2)</td>
<td>0.012</td>
</tr>
</tbody>
</table>

**DAFNE = dose adjustment for normal eating. HbA1c = glycated haemoglobin. IQR = interquartile range. PAID = Problem Areas in Diabetes Scale. *P < 0.0001.**

---

**MJA • Volume 192 Number 11 • 7 June 2010**
some participants did not attend for data collection 1 year after DAFNE training are not known, but these participants do not appear to differ in terms of baseline clinical characteristics from those who did attend. This audit reports outcomes on a pre- and post-intervention basis, with no control group to assess changes over time without the intervention. However, such data are available from the UK DAFNE study and our results are consistent with other published reports.

Structured patient education has been endorsed as a routine part of diabetes management by the National Institute for Clinical Excellence in the UK, with DAFNE being recognised as one program suitable for people with TIDM. Cost modelling in the UK has suggested that DAFNE is cost-saving, due to reduced diabetic complications, rather than just cost-effective. Other structured education courses, such as the Empowerment program developed and conducted in Newcastle, Australia, and flexible insulin therapy teaching courses in Basel, Switzerland, have also shown benefits, including reduced hypoglycaemia and improved quality of life, although reductions in HbA1c levels have not always been shown, perhaps due to differing participant populations.

Despite the positive outcomes of DAFNE in Australia, funding for this type of intensive, structured education program remains difficult to secure. Limited support for group education is available to people with type 2 diabetes. However, the current Medicare Benefits Schedule rebate of $16.00 per group service (Item 81105) is clearly inadequate to fund an intensive education program, and TIDM is excluded. Many OzDAFNE centres have been charging no or minimal fees for the DAFNE course. This allows some people with TIDM to access the program, but limits the number of courses that centres are able to provide.

In summary, our audit of people with TIDM undergoing the DAFNE course demonstrates clinical benefits similar to those reported in other health care settings. DAFNE provides one potential means of improving glycaemic control and other important health outcomes in people with TIDM. We believe that OzDAFNE merits consideration for more widespread availability, predicated on more systematic funding.

REFERENCES


Medical Journal of Australia

ISSN: 0025-729X

Title: Medical Journal of Australia

Country: Australia
Status: Active
Start Year: 1914
Frequency: Semi-monthly (23/yr.)
Document Type: Journal; Academic/Scholarly
Refereed: Yes
Abstracted/Indexed: Yes
Media: Print

Alternate Edition ISSN: 1326-5377

Price: AUD 368.50 subscription per year domestic to individuals
AUD 474 subscription per year foreign to individuals
AUD 420 subscription per year domestic to institutions
AUD 530 subscription per year foreign to institutions
AUD 60 subscription per year domestic to students (effective 2008)

Subject: MEDICAL SCIENCES
Dewey #: 610
LC#: R99
CODEN: MJAUAJ
Circulation: 28500 unspecified, Audited by: Circulations Audit Board

Special Features: Includes Advertising, Abstracts, Bibliographies, Illustrations, Book Reviews

Article Index: S-a. index
Editor(s): Martin Van Der Weyden
E-Mail: medjaust@ampco.com.au
URL: http://www.mja.com.au
Description: Covers medical practice and clinical research papers, editorials, original research papers and case reports.

ADDITIONAL TITLE INFORMATION

Alternate Title: Medline Abbreviated title: Med J Aust; Variant title: M J A
Title History: Formed by the merger of (1881-1914): Australasian Medical Gazette (Australia) (0314-5158); (1910-1914): Australian Medical Journal (Australia) (0314-514X); Which was formerly (until 1909): Intercolonial Medical Journal of Australasia (Australia) (1033-3487); Which was formed by the merger of (1895-1896): Intercolonial Quarterly Journal.