An audit of structured diabetes care in a rural general practice

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ABSTRACT

Objective: To assess the impact of structured diabetes care in a rural general practice.

Design and setting: A cohort study of structured diabetes care (care plans, multidisciplinary involvement and regular patient recall) in a large general practice in a medium-sized Australian rural town. Medical care followed each doctor's usual practice.

Participants: The first 404 consecutive patients with type 2 diabetes who consented to take part in the program were evaluated 24 months after enrolment in July 2002 to December 2003.

Main outcome measures: Change in cardiovascular disease risk factors (waist circumference, body mass index, serum lipid levels, blood pressure); change in indicators of risks associated with poorly controlled diabetes (glycated haemoglobin [HbA_{1c}] concentration, foot lesions, clinically significant hypoglycaemia); change in 5-year cardiovascular disease risk.

Results: Women had a lower 5-year risk of a cardiovascular event at enrolment than men. Structured care was associated with statistically significant reductions in mean cardiovascular disease risk factors (waist circumference, –2.6 cm; blood pressure [systolic, –3 mmHg; diastolic –7 mmHg]; and serum lipid levels [total cholesterol, –0.5 mmol/L; HDL cholesterol, 0.02 mmol/L; LDL cholesterol, –0.4 mmol/L; triglycerides, –0.3 mmol/L]); and improvements in indicators of diabetic control (proportion with severe hypoglycaemic events, –2.2%; proportion with foot lesions, –14%). The greatest improvements in risk factors occurred in patients with the highest calculated cardiovascular risk. There was a statistically significant increase in the proportion of patients with "ideal" blood pressure (systolic, < 130 mmHg; diastolic, < 80 mmHg) and LDL cholesterol level (< 2.5 mmol/L) of 6.4% and 20.5%, respectively.

Conclusions: Implementing structured care in this rural general practice coincided with improved risk factor management, and may have contributed to the improvement. The greatest benefits were in patients with high cardiovascular risk.

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Diabetes has been described as a modern epidemic within Australia and the developing world. General practice is at the coalface of diabetes management, yet little is known about its impact on this disease.

In 1999, the Australian Government introduced the Enhanced Primary Care (EPC) Program, designed to encourage general practitioners to participate in multidisciplinary care.[1] The program enabled funding of structured care and coordinated multidisciplinary support for patients with chronic or complex conditions. While there has been evidence of population-based improvements in health outcomes through a region-wide coordinated care approach,[2] there have been no reports on the effect of a structured practice-based intervention.

Warwick is a rural town in south-east Queensland. The Condamine Medical Centre, servicing a local population of 12 000 and a district population of about 25 000 people, provides about 60% of the town's primary care services. There are over 700 patients with diabetes (90% type 2) on the practice register. The centre has 10 GPs and five nurses; a part-time diabetic educator and a dietitian are funded by the local Division of General Practice.

In 2002, the Condamine Medical Centre moved to formalise diabetic management by adopting a program of structured care for patients with diabetes. This involved care planning, regular recall, and multidisciplinary review. We report a quality-of-care audit to determine the clinical impact of this change.

METHODS

Any patient with type 2 diabetes who consented to be involved in the multidisciplinary care process could participate in the program. Enrolments occurred via self-presentation to the practice. The records of patients enrolled from July 2002 to December 2003 were used in the audit.

A pre-formatted care plan was generated using an electronic patient management system (Medical Director, Health Communication Network, Sydney, NSW) containing the required Health Insurance Commission administrative details, a clinical section with parameters set by the National Diabetes Goals,[3] and an area for individual clinical notes.

All the GPs continued to manage patients with diabetes according to their own therapeutic frameworks, including optional referral to the dietitian and diabetic educator. All care by the doctor, nurse, dietitian and diabetes educator was provided in one centre using one medical record. Patients were recalled every 3 months for assessment and, if necessary, management change.

Two practice nurses attended to all patients and were responsible for managing the recall system, ensuring pathology tests were ordered (serum lipid levels, glycated haemoglobin [HbA_{1c}] concentration, and annual urinary microalbumin estimation), measuring and recording the patient's weight, waist circumference, blood pressure, and visual acuity, and for performing foot screening before every general practice visit.

A retrospective audit of the electronic records was performed to evaluate the clinical impact of the program on the patients. The program was funded by payments for a combination of Enhanced Primary Care item numbers and normal consultation item numbers.

Performance indicators

The impact of the program was measured by:

- Change in known cardiovascular disease (CVD) risk factors: weight, waist circumference, body mass index (BMI), serum lipid levels, systolic and diastolic blood pressure.
- Change in indicators of risks associated with poor control of diabetes: HbA_{1c} concentration, presence of foot lesions, clinically significant hypoglycaemia in the past 12 months.
- Analysis by CVD risk groups: 5-year CVD risk was calculated using the United Kingdom Prospective Diabetes Study (UKPDS) risk formulas for coronary heart disease[4] and stroke[5] for each patient. Risk allocations were low (5-year CVD risk, < 10%), moderate (5-year CVD risk, 10%–15%) or high (5-year CVD risk, > 15%).

- Analysis of 5-year CVD risk: controlling for non-modifiable risk factors of age, sex and duration of diabetes, again using the UKPDS risk formulas for coronary heart disease and stroke at both time points.
  - the risk for each patient was calculated at 2 years assuming that the level of modifiable risk factors at baseline remained unchanged.
  - the "ideal" 5-year risk for each patient was calculated assuming all modifiable risk factors achieved optimal levels (HbA_{1c} concentration, 7%; systolic blood pressure, 130 mmHg; non-smoker; and ratio of total cholesterol level : high-density lipoprotein [HDL] cholesterol level, 3.5).

Both measures were compared against the results actually achieved at 2 years.

- Comparing our results against international benchmark data — the intensive treatment arm of the UKPDS,[4,5] and the Steno 2 trial for patients with microalbuminuria.[6,7]

Statistical analysis

Analysis was by intention to treat. For patients who withdrew, the last complete set of data from an intermediate check was carried forward to complete the 2-year dataset. Significance was calculated using McNemar's test for paired categorical variables, and two-tailed paired sample *t* tests for continuous variables. The χ^2 test was used to test for correlation of categorical variables at one time point, and analysis of variance was used as a test of correlation of continuous variables at one time point. Significance was set at $P < 0.05$. Calculations were performed using SPSS, version 11 (SPSS Inc, Chicago, Ill, USA).

RESULTS

Four hundred and four consecutive patients with type 2 diabetes were enrolled (70% of the patients with type 2 diabetes attending the practice at the time). During the study period, 67 people (16.6% of 404) withdrew from the program or died: 26 patients (39% of 67) left the practice when a nearby town's general practice re-opened; 30 patients (45%) left the program voluntarily (16 [24%] because their newly diagnosed diabetes was well controlled by diet modification; and 14 patients [21%] for other reasons); and there were 11 deaths (16%).

There were equal numbers of men and women in the program, with similar age distributions (mean, 64 years) and duration of diabetes (mean, 6 years; 5.4 years for women and 6.5 years for men). Pensioners comprised 71% of the patients with type 2 diabetes. Forty per cent of the patients in the program had a calculated risk of an adverse CVD event within 5 years of < 10% (53% of women, 22% of men) and 29% had a risk of ⩾ 15% (25% of women, 58% of men) ($P < 0.001$ for both comparisons).

Cardiovascular disease risk factors

Box 1 presents changes in CVD risk factors from enrolment to audit at 2 years. There was a significant decrease in mean waist circumference, and a non-significant mean weight reduction. Significant improvements occurred in systolic and diastolic blood pressure and in all serum lipid levels except HDL cholesterol.

There was a non-significant reduction in mean HbA_{1c} concentration over the study period. The proportion of patients with an HbA_{1c} concentration < 7% worsened; however, the proportion of those with an HbA_{1c} concentration > 10% declined significantly. Severe hypoglycaemic events declined significantly.

1 Changes in cardiovascular disease risk factors after structured diabetes care

Risk factor	Baseline value	Audit value	Absolute change	*P*
Central obesity (mean waist circumference in cm)	106.5	103.9	–2.6	< 0.001
Mean weight (kg)	89.8	89.4	–0.5	0.057
Mean body mass index (kg/m²)	32.0	32.0	0.0	0.64
Males	30.9	30.5	–0.4	0.62
Females	33.2	33.4	0.2	0.25
Proportion smoking	12.6%	10.4%	–2.2%	0.057
Blood pressure (BP) (mmHg)				
Mean systolic BP	140.5	137.4	–3.1	< 0.001
Mean diastolic BP	78.1	71.1	–7.0	< 0.001
Proportion with systolic BP ⩾ 160	19.3%	10.9%	–8.4%	< 0.001
Proportion with systolic BP < 130 and diastolic BP < 80	15.3%	21.8%	6.4%	0.002
Cholesterol level (mmol/L)				
Mean total cholesterol	5.2	4.7	–0.5	< 0.001
Mean HDL cholesterol	1.23	1.25	0.02	0.04
Mean triglycerides	2.3	2.0	–0.3	< 0.001
Mean LDL cholesterol	3.0	2.5	–0.4	< 0.001
Proportion with LDL cholesterol < 2.5	23.8%	44.3%	20.5%	< 0.001
Proportion with total cholesterol < 4	10.3%	23.0%	12.7%	< 0.001
Glycaemic control				
Mean HbA_{1c} concentration (%)	7.4%	7.3%	–0.1%	0.23
Proportion with:				
HbA_{1c} < 7%	52.0%	46.8%	–5.2%	0.024
HbA_{1c} 7%–< 8%	15.8%	26.5%	10.7%	< 0.001
HbA_{1c} > 10%	7.7%	5.0%	–2.7%	0.048
Proportion with severe hypoglycaemia in past 12 months	2.7%	0.5%	–2.2%	< 0.001
Foot care				
Proportion with any foot lesion	18.3%	3.7%	–14.6%	< 0.001
Proportion with a foot ulcer	1.2%	1.5%	0.3%	1.00

HDL = high-density lipoprotein; LDL = low-density lipoprotein; HbA_{1c} = glycated haemoglobin. Some minor discrepancies in absolute change values are a result of rounding. ◆

The prevalence of foot lesions declined, but there was no improvement in the prevalence of foot ulcers.

Cardiovascular disease risk analysis

CVD risk analysis by risk group (Box 2) revealed that the greatest falls in systolic blood pressure occurred in the high-risk group. All risk groups experienced falls in diastolic blood pressure of around 7 mmHg. The high-risk group achieved higher absolute reductions in mean total cholesterol and low-density lipoprotein (LDL) cholesterol levels than those in the moderate- and low-risk groups. Prescribing of statins increased across all risk groups within the cohort.

The calculated mean 5-year CVD risk for the patient group at baseline was 16.5%. This did not change over the 2 years. However, the 5-year CVD risk calculated on the assumption of no change in modifiable risk factors over the 2 years rose to 20.5% (difference –3.9%; 95% CI, –4.5% to –3.3%); $P < 0.001$). Furthermore, the proportion of patients who were at or below "ideal risk" of an adverse 5-year CVD event increased from 17.9% to 35.9% ($P < 0.001$)

Comparing with benchmark data

The mean HbA_{1c} concentration remained almost identical over the 2 years (7.4%, 7.3%), while that of the UKPDS intervention group, with the same average duration of diabetes (6–8 years), rose from 7.1% to 7.5%.

The proportion of patients tested for microalbuminuria in the previous 12 months rose from 19.8% of the population to 75.2%. Patients with microalbuminuria who were the same age as those in the Steno 2 trial showed similar improvements in risk factors at 2 years to those seen at 4 years in the Steno trial (the first reported endpoint in that trial) (Box 3). The results for patients with microalbuminuria of all ages showed similar changes.

2 Changes in lipid levels and blood pressure (BP) control after structured diabetes care, by 5-year cardiovascular disease (CVD) risk at enrolment

5-year CVD risk	Baseline value	Audit value	Absolute change	*P*
Low (> 10%) (*n* = 155)				
Cholesterol level (mmol/L)				
Mean total cholesterol	5.4	4.9	–0.5	< 0.001
Mean LDL cholesterol	3.1	2.7	–0.4	< 0.001
Proportion with LDL cholesterol < 2.5	20.6%	41.9%	21.3%	< 0.001
Proportion with total cholesterol < 4	5.8%	14.2%	8.4%	0.002
Proportion taking a statin	22.6%	47.1%	24.5%	< 0.001
Blood pressure (mmHg)				
Mean systolic BP	134.7	133.1	–1.6	0.18
Mean diastolic BP	78.5	71.5	–6.9	< 0.001
Proportion with systolic BP < 130 and diastolic BP < 80	20.6%	27.7%	7.1%	0.08
Proportion with systolic BP ≥ 160	8.4%	3.2%	–5.2%	0.03
Medium (10%–15%) (*n* = 79)				
Cholesterol level (mmol/L)				
Mean total cholesterol	5.1	4.7	–0.4	< 0.001
Mean LDL cholesterol	2.8	2.5	–0.3	< 0.001
Proportion with LDL cholesterol < 2.5	30.4%	51.9%	21.5%	< 0.001
Proportion with total cholesterol < 4	13.9%	29.1%	15.2%	0.001
Proportion taking a statin	35.4%	64.6%	29.1%	< 0.001
Blood pressure (mmHg)				
Mean systolic BP	138.7	139.6	0.9	0.24
Mean diastolic BP	79.5	71.9	–7.5	< 0.001
Proportion with systolic BP < 130 and diastolic BP < 80	16.5%	22.8%	6.3%	0.23
Proportion with systolic BP ≥ 160	19.0%	17.7%	–1.3%	0.81
High (> 15%) (*n* = 170)				
Cholesterol level (mmol/L)				
Mean total cholesterol	5.1	4.5	–0.6	< 0.001
Mean LDL cholesterol	2.9	2.4	–0.5	< 0.001
Proportion with LDL cholesterol < 2.5	29.4%	50.6%	21.2%	< 0.001
Proportion with total cholesterol < 4	12.9%	28.2%	15.3%	< 0.001
Proportion taking a statin	35.9%	60.6%	24.7%	< 0.001
Blood pressure (mmHg)				
Mean systolic BP	146.7	140.3	–6.4	< 0.001
Mean diastolic BP	76.7	69.9	–6.8	< 0.001
Proportion with systolic BP < 130 and diastolic BP < 80	10.0%	15.9%	5.9%	0.07
Proportion with systolic BP ≥ 160	29.4%	14.7%	–14.7%	< 0.001

LDL = low-density lipoprotein. Some minor discrepancies in absolute change values are a result of rounding. ◆

DISCUSSION

Our audit revealed improvements in known CVD risk factors, and in outcomes indicative of control of diabetes. While direct comparisons are not possible, benchmarking against internationally published best practice intensive treatment suggests that structured diabetes care produced broadly similar results to those achieved by intensive therapy. This simple intervention may have been effective in reducing CVD risk in patients with diabetes.

Management priorities in the care of patients with type 2 diabetes have undergone a substantial change in the past decade. Optimal care places increased emphasis on reducing cardiovascular risk, in addition to the processes of care and glycaemic control.[8]

Care systems that provide one or more of the elements of chronic disease management: delivery system design (ie, team care, coordination and recall systems), decision support, patient self-management, clinical

3 Changes in CVD risk factors in our patients with microalbuminuria (40–65 years), compared with those in patients in the intervention arm of the Steno 2 trial[6,7]

	Mean baseline values		Mean change in risk factor	
	Our patients	Steno 2 patients	At 2 years (our patients)	At 4 years (Steno 2 patients)
Age (years)	55.1	54.9		
Duration of diabetes (years)	7.4	5.5		
HbA_{1c} concentration (%)	8.1%	8.4%	–0.7%	–0.6%
Systolic BP (mmHg)	143.5	146	–8.5	–8.0
Diastolic BP (mmHg)	81.0	85	–10.0	–7.0
Total cholesterol : HDL cholesterol ratio	5.2	5.2	–0.6	–0.7
Total cholesterol level (mmol/L)	5.5	5.4	–0.6	–0.8

CVD = cardiovascular disease; HbA_{1c} = glycated haemoglobin; BP = blood pressure; HDL = high-density lipoprotein. ◆

information systems, and use of community resources, have been shown to improve health outcomes.[9] These elements are at the heart of current general practice incentives and the Enhanced Primary Care program.

Our program introduced routine recall of patients with type 2 diabetes, multidisciplinary review, and structured measurement of known risk factors by the practice nurses before the patient saw the doctor. There was no attempt to introduce standardised medical management.

There was no improvement in HbA_{1c} concentrations or in the 5-year CVD risk. However, HbA_{1c} concentrations and CVD risk in a population are influenced by non-modifiable factors.[10] Adjusting for non-modifiable risk factors showed more accurately the probable effect of the intervention. We believe that controlling for non-modifiable risk should be more widely used in assessing the value of interventions.

The increased prescribing of statins in patients at low risk, and in particular in women at low risk, suggests that current lipid management guidelines may be too inclusive.[11] These guidelines refer to all patients with diabetes as being "high" risk and requiring treatment, whereas individual risk calculations in our patients show that this may not be the case.

To provide structured care, the practice developed several support systems to manage processes and to integrate allied health professionals into the workplace appropriately. These were difficult to initiate and required continued support and attention. The task was not insurmountable, and has given us the experience to develop care systems for other chronic diseases. The challenge now is finding the rooms and nursing staff to manage the workload appropriately.

Our study used baseline data as a control device, and hence does not have the strength of evidence of a randomised controlled trial. A multisite randomised controlled trial of integrated care will be required to confirm what appear to be effective changes in known risk factors for CVD in diabetic patients.

This audit is an example of a general practice which has evaluated and monitored its care outcomes. The key to being able to implement such programs is financing systems and infrastructure support. We hope this report encourages GPs to utilise the abundance of health data they have stored electronically on their desktop.

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COMPETING INTERESTS

None identified.

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