

Effect of a chronic disease management service for patients with diabetes on hospitalisation and acute care costs

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Abstract

Objective. To evaluate the effect of a diabetes-management program for patients with type 2 diabetes and related comorbidities on acute healthcare utilisation and costs.

Methods. This was a retrospective administrative dataset analysis using data for patients enrolled from 2007 to 2008. Inpatient admissions for diabetes-related conditions were compared before, during and following enrolment. Costs per episode were estimated from Weighted Inlier Equivalent Separations (WIES) funding. A cost model was then developed based on admission rates per 100 patients.

Results. Data were retrieved for 357 patients; 49% males, mean age 62 years. The mean per-patient cost of the program was AU\$524 (s.d. \$213). The mean cost of an inpatient admission was \$4357 (95% CI 2743–5971) pre-enrolment and \$4396 (95% CI 2888–5904) post-enrolment. Following program completion the annual costs (per 100 patients) for managing ‘diabetes with multiple complications’ and hypoglycaemia decreased from \$10 181 to \$1710 and \$9947 to \$7800. In contrast, the annual cost of cardiovascular disorders increased from \$14 485 to \$40 071 per 100 patients.

Conclusions. In the short-term diabetes-management programs for patients with comorbid vascular disease may reduce hospital utilisation for diabetes but not for cardiovascular disease. Longer-term follow-up is needed to determine whether intensive management of vascular complications can reduce costs.

What is known about the topic? Type 2 diabetes is now recognised as the fastest growing chronic disease in Australia and other western countries. In developed countries, diabetes is a leading cause of cardiovascular disease and renal failure, and, in the over 60 age group, is a leading cause of blindness and non-traumatic lower limb amputations. Glycated haemoglobin (HbA1c) is a measure of diabetes control, with set target levels for the prevention or delay of development of macrovascular and microvascular complications of diabetes. Epidemiological studies have demonstrated that a 1% reduction in HbA1c can lead to a 15–21% reduction in diabetes-related deaths and 33–41% reduction in microvascular complications over a 10-year period. Indicating that improvements in glycaemic control may have the potential to decrease acute healthcare costs associated with management of complications over the long term.

What does this paper add? There are limited data available on the short to medium term effect of disease-management programs for patients with already established complications on acute healthcare utilisation. This study evaluated the cost of providing the Northern Alliance Hospital Admission Risk Program for diabetes disease management and its effect on acute healthcare utilisation at Northern Health. In contrast, the overall inpatient costs for the management of diabetes and related conditions were high and did not decrease significantly following program completion. The major acute care cost drivers were surgical interventions for advanced peripheral vascular disease and the management of cardiovascular events.

What are the implications for practitioners? These findings demonstrate that in this population with a high prevalence of established cardiovascular and peripheral vascular complications that diabetes-management programs need to be equipped and resourced to manage these complications if potential savings in acute care costs are to be realised.

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Background

Diabetes is among the top ten leading chronic diseases in Australia and imposes a substantial burden on the healthcare system. It is anticipated that the demand for diabetes services will grow, a report by the Australian Institute of Health and Welfare in 2008 found that the prevalence of diabetes in Australia has more than doubled in the past 20 years.¹ The direct healthcare costs for diabetes amounted to nearly \$289 million in 2000–01, of which, 37% were hospital care expenses.² The indirect costs of diabetes are more difficult to quantify; however, in developed countries diabetes is a leading cause of cardiovascular disease³ and renal failure, and in the over 60s of blindness and non-traumatic lower limb amputations.^{4,5}

In Australia, Commonwealth and State and Territory government initiatives have focussed on improving models of service delivery to decrease fragmentation of care and to improve access to diabetes services for high-risk groups. The 'Diabetes Cycle of Care' aims to improve the monitoring and follow-up of patients in primary care to increase the early identification of diabetes-related complications (in particular microvascular and macrovascular disease) and potentially to decrease the severity and progression of these vascular complications.⁶ In response to increasing hospital demand for management of chronic medical condition, the Department of Health Victoria (DOHVIC), Australia, introduced the Hospital Admission Risk Program-Chronic Disease Management (HARP-CDM).⁷ These programs are designed for patients with severe disease with complex co morbidities who are at high risk of hospitalisation.

The outer northern metropolitan region of Melbourne is a major suburban growth corridor in which there is a high unmet demand for both primary and secondary healthcare services (www.health.vic.gov.au/regions/northwestern/about.htm, accessed 8 February 2012). In recognition of the high prevalence of diabetes in this area, the Northern Alliance Hospital Admission Risk Program (NA-HARP) established a chronic disease management program for patients with poorly controlled diabetes. Patients eligible for this service were defined as patients with: either an HbA1c >8.0%, or the presence of diabetes-related complications or hospitalisation for diabetes management in the past 12 months. The majority (90%) of clients enrolled in NA-HARP diabetes management have type 2 diabetes and an estimated 10% have type 1 diabetes.⁸ Accepted patients undergo a comprehensive, multidisciplinary assessment and an individualised care plan is developed in consultation with the patient. Patients are provided with expert care from endocrinologists and allied health professionals, including individualised education from diabetes educators and dietitians. The service has integrated a self-management coaching approach into its model of care to assist clients in making the psycho-behavioural changes necessary to improve the control and management of their diabetes.

Reduction in acute care utilisation and the cost of acute care service provision are important outcomes of the Victorian Hospital Admission Risk programs.^{9–12} This study evaluated the cost of providing the NA-HARP for diabetes disease management and its effect on acute healthcare utilisation at Northern Health. A cost model was then developed (based on admission rates per 100 patients) to determine the short-term effect (12 months post-program completion) of the program on acute healthcare demand and costs.

Methods

Population and design

The evaluation used retrospective administrative data from 357 patients with diabetes who attended the NA-HARP for diabetes management between 1 September 2007 and 31 May 2008. The majority of patients who enrol in the program access the Northern Hospital for acute hospital services (emergency and inpatient admissions). Hospital utilisation by the cohort was compared in the 12 months pre-enrolment, during program enrolment and in the 12 months post-completion of the diabetes program.

The study timelines were defined as follows: the pre-enrolment period was the 12 months from 1 September 2006 to 31 August 2007; the intervention period was the 9 months from 1 September 2007 to 31 May 2008; and the follow-up period (post-completion of the program) was the 12 months from 1 June 2008 to 31 May 2009.

The characteristics of the study population were obtained from the diabetes disease program administrative database. A random sample of 123 (34%) patients' clinical files was audited to estimate the point prevalence of diabetes-related complications at enrolment into the program.

Service costs for NA-HARP-CDM for diabetes

The cost of providing the diabetes service predominantly relates to staffing costs. Cost data (staff annual salaries or hourly rates (salary plus 15% on-costs) for each staff member working in the diabetes service were obtained from administrative data. The data were used to calculate the cost per patient of service provision. Each recorded session with a clinician from the diabetes program was allowed an average of 1 h. The total cost for each clinical discipline was calculated as the product of the hourly rate and the number of occasions of service. Overheads, administration support, staff support services and patient consumables costs were provided as annual figures. The cost of the latter items over the 9-month intervention period was calculated as three-quarters of the annual costs. Averages were calculated and added to each individual patient's total clinical service costs to give the total service costs. The cost of diagnostic tests and medications were excluded from this cost analysis, as these services are funded independently of the services provided by the program.

Acute hospital utilisation indicators and costs

Reasons for acute hospital utilisation were limited to those related to primary diabetes and associated complications, as these episodes of care were more likely to be directly influenced by intervention from the diabetes program. The study was largely reliant on locally available administrative data and resource constraints limited the evaluation to the catchment's healthcare provider (The Northern Hospital), excluding across-catchment broader hospital utilisation and private healthcare facilities. Acute care utilisation was summarised as the total number of inpatient admission episodes and the number of individual patients requiring admission. Inpatient admission costs per episode of care were estimated from Weighted Inlier Equivalent Separations (WIES) funding. WIES is a hospital funding system based on

Table 1. Discharge ICD codes for attributing given inpatient admission discharge diagnoses to diabetes

ICD-10 Code	Description
E10–E14 (excluding E12)	Diabetes mellitus
G59.0	Diabetic mononeuropathy
G63.2	Diabetic polyneuropathy
G73.0	Diabetic amyotrophy
G99.0	Diabetic autonomic neuropathy
H28.0	Diabetic cataract
H36.0	Diabetic retinopathy
I10–I69	Diseases of the circulatory system
I70–I70.9	Atherosclerosis
I79.2	Diabetic peripheral angiopathy
M14.2	Diabetic arthropathy
M14.6	Diabetic neuropathic arthropathy
N08.3	Glomerular disorders in diabetes mellitus

Diagnosis Related Groups (DRGs) and time a patient spends in hospital.¹³ DRGs are believed to be a clinically meaningful way of relating the types of patients treated in a hospital to the resources required by the hospital.¹⁴ DRGs data were obtained from the hospital's inpatient administrative dataset. WIES takes into account inflation and funding is accordingly revised annually. Primary discharge diagnostic reasons for acute care admissions were defined using the International Classification of Diseases (ICD) version 10 classification codes.¹⁵ The ICD codes that were included are listed in Table 1; all other acute care episodes were excluded from this analysis.

Data analysis

Inpatient admissions were summarised as the total number of discharge episodes, and total number per discharge diagnostic group (cardiovascular, hypoglycaemia, ketoacidosis, multiple complications, unstable diabetes without complications, ophthalmic, peripheral circulatory and renal). Total and median cost, means with 95% confidence interval and range of costs per admission were then computed. Kruskal–Wallis tests were performed to compare costs over the intervention phases overall and at discharge diagnoses level. As the cost data were not normally distributed and the sample size was small, cost estimates were validated using bootstrapping techniques. Bootstrap analysis of overall costs was performed with pre- and post-intervention phases acting as controls for the intervention phase; 100 samples were drawn for 1000 bootstrap trials. All costs are reported in Australian dollars.

Cost modelling

In order to determine the potential future effect of the program on acute healthcare utilisation, a prediction model was developed based on the acute healthcare utilisation rates of participants in this study ($n = 357$). Admission rates and acute care costs before and after program enrolment were standardised as admission rates and costs per 100 enrolled patients. The effect of the program on inpatient admission costs were contrasted with the additional costs of providing the program.

Table 2. Patient characteristics

Age (years), mean (s.d.)	62 (13)
Males	175 (49%)
Program service contacts, median (range)	3 (1–20)
Duration (months) of enrolment, median (range)	7 (3–9)
Residence within the Northern Health catchment	98%
Admitted to hospital	22%
Referral source:	
General practice	60%
Hospital	26%
Other NA-HARP services	2%
Other	12%
Prevalence of complications (95% CI)	
Cardiovascular	43% (26.3–60.6)
Renal	6% (0.7–19.2)
Ophthalmic	6% (0.7–19.2)
Peripheral circulatory	11% (3.2–26.7)
Multiple complications	6% (0.7–19.2)

Results

The diabetes service provided care to 357 patients with a mean age at enrolment of 62 years (Table 2). HbA1c results were available for 262 (73%) patients, the mean HbA1c at enrolment into the program was 9.11% (SE 0.13). The estimated point prevalence of cardiovascular disease at enrolment was 43% and peripheral circulatory conditions 11%. A total of 6% of patients had multiple diabetes related complications.

HARP diabetes occasions of service and costs

NA-HARP for diabetes management delivered 1474 h of occasions of service with diabetes nurse educators providing the largest proportion (38%) of service contacts (Fig. 1). The total cost for providing the NA-HARP for diabetes service over a 9-month period was AU\$187 167 with a median cost per patient of \$463 (range \$463–\$2484) and a mean cost of \$524 (s.d. \$213).

Inpatient admissions and costs

The number of admissions pre-enrolment in the diabetes program was 35 ($n = 25$ patients), during the intervention period there were 70 admissions ($n = 49$ patients) and post-enrolment there were 44 admissions ($n = 33$ patients) (Table 3). These equate to annual admission rates of 9.8 per 100 patients in the pre-enrolment period, 19.6 per 100 patients during the intervention period and 12.3 per 100 patients in the post-enrolment period. The median length of stay in the pre-enrolment period was 2 days (range 1–62 days), during the service intervention was 4 days (range 1–77 days), and in the post-enrolment period was 1.5 days (range 1–20 days). Total hospital admission costs were \$152 500 in the pre-intervention period, \$372 300 during intervention and \$193 000 in the post-intervention period. Mean costs break down by discharge diagnosis are presented in Table 3.

There was a trend towards escalating costs overall, peaking during the intervention phase and declining post-intervention. This increase in total acute care costs related to an increase in the number of inpatient episodes rather than an increase in the cost per episode of care. The observed mean costs per episode were not statistically different ($P > 0.05$) across the different time periods.

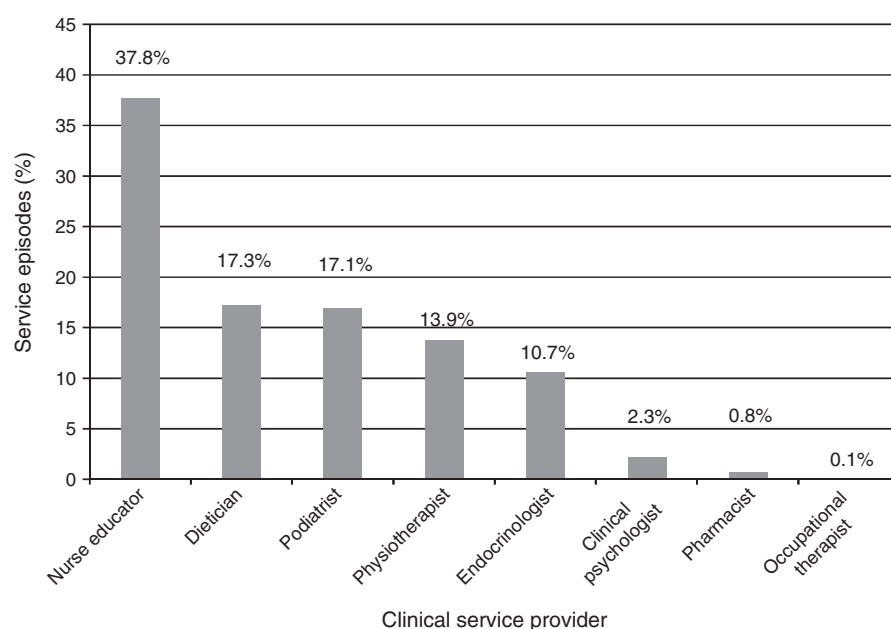


Fig. 1. Proportions of occasions of service hours by clinical discipline.

Table 3. Inpatient admission costs

Admission time-period	Diagnosis	Episodes	Total	Median	Minimum	Maximum
12 months pre-HARP diabetes intervention	Cardiovascular	15	\$56 189.00	\$3245.00	\$1139.00	\$25515.00
	Hypoglycaemia	8	\$37 701.00	\$2703.00	\$2441.00	\$17300.00
	Ketoacidosis without coma	1	\$2703.00	\$2703.00	\$2703.00	\$2703.00
	Multiple complications	2	\$45 068.00	\$22 534.00	\$15 781.00	\$29287.00
	Neuropathy	0				
	Unstable diabetes without complications	1	\$2441.00	\$2441.00	\$2441.00	\$2 441.00
	Ophthalmic	2	\$3602.00	\$3602.00	\$3602.00	\$3602.00
	Peripheral circulatory	4	\$36 049.00	\$18 024.50	\$6762.00	\$29287.00
	Renal	2	\$5171.00	\$2585.50	\$2016.00	\$3155.00
	All diagnoses	35	\$188 924.00	\$3245.00	\$1139.00	\$29287.00
During HARP intervention	Cardiovascular	37	\$183 240.00	\$3900.00	\$878.00	\$32096.00
	Hypoglycaemia	10	\$73 894.00	\$4802.00	\$2703.00	\$25265.00
	Ketoacidosis without coma	4	\$10 812.00	\$2703.00	\$2703.00	\$2703.00
	Multiple complications	8	\$125 638.00	\$6403.00	\$2703.00	\$98275.00
	Neuropathy	1	\$32 096.00	\$32 096.00	\$32 096.00	\$32096.00
	Unstable diabetes without complications	3	\$11 330.00	\$2703.00	\$2703.00	\$5924.00
	Ophthalmic	2	\$3646.00	\$1823.00	\$1823.00	\$1823.00
	peripheral circulatory	3	\$129 464.00	\$25 265.00	\$5924.00	\$98 275.00
	Renal	2	\$4483.00	\$2241.50	\$2140.00	\$2343.00
	All diagnoses	70	\$574 603.00	\$2864.00	\$878.00	\$98 275.00
12 months post-HARP diabetes intervention	Cardiovascular	29	\$145 374.00	\$3811.50	\$1144.00	\$29 674.00
	Hypoglycaemia	6	\$30 563.00	\$4630.00	\$2850.00	\$8768.00
	Ketoacidosis without coma	1	\$2850.00	\$2850.00	\$2850.00	\$2850.00
	Multiple complications	2	\$5700.00	\$2850.00	\$2850.00	\$2850.00
	Neuropathy	0				
	Unstable diabetes without complications	1	\$6064.00	\$6064.00	\$6064.00	\$6064.00
	Ophthalmic	2	\$11 167.00	\$5583.50	\$1911.00	\$9256.00
	Peripheral circulatory	0				
	Renal	3	\$7029.00	\$2343.00	\$2343.00	\$2343.00
	All diagnoses	44	\$208 747.00	\$3196.00	\$1144.00	\$29 674.00

Bootstrapping results showed pre- v. during intervention mean difference of \$970 (95% CI: -\$516-\$2550) compared to raw data difference of \$962 (95% CI: -\$1167-\$3091), difference

for pre v. post \$79 (95% CI: -\$1111-\$1337) (raw data mean difference \$39 (95% CI: -\$2100-\$2177)) and post v. during intervention \$952 (95% CI: -\$483-\$2397) (raw data mean

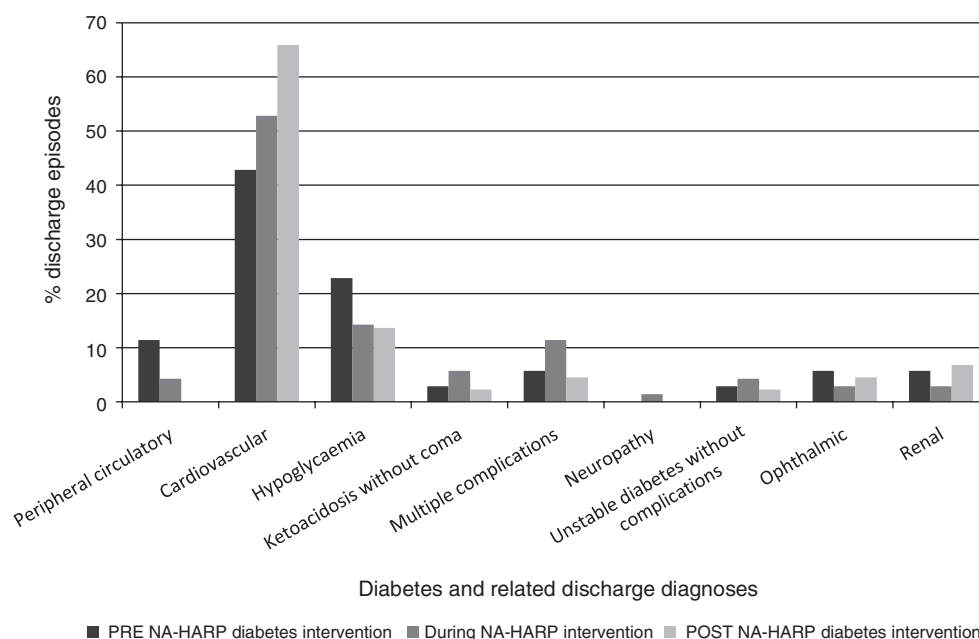


Fig. 2. Proportion of discharge episodes in each period.

difference \$924 (95% CI: -\$1140–\$2987)). Following completion of the program there was a decrease in the cost of admissions for the management of multiple diabetic complications (\$17 000 v. \$2900). Inpatient episodes for cardiovascular problems increased by 23% in the post-enrolment period, due to increases in episodes for chest pain, congestive heart failure, atherosclerotic heart disease, left ventricular failure and haemorrhagic stroke (Fig. 2).

The highest admission costs were for the management of peripheral vascular disease and its complications; in the pre-enrolment period these accounted for 11% of all admissions and involved complex peripheral vascular problems, amputation and reconstructive procedures (DRG codes F13Z, F13C and F65A) (Fig. 2). During the program enrolment period the number of admissions for surgical management of peripheral vascular disease increased. While enrolled in the diabetes program two patients had prolonged admissions following vascular reconstructive procedures; one required major reconstructive

procedures with a length of stay (LOS) of 55 days, costing \$98 000, the other required a toe amputation with a LOS of 18 days costing \$29 000.

Cost model

Hospital admission rates and associated acute care costs were modelled as admissions per 100 patients (Table 4). There was a small decrease in the number of admission episodes for management of hypoglycaemia following enrolment in the program (2.2 pre- v. 1.7 post-admission), this was associated with a decrease in total annual bed-days (22.4 per 100 patients pre-enrolment v. 11.5 per 100 patients post-enrolment in the program). In contrast this model demonstrated a substantial increase in admission rates and associated costs over time for the management of cardiovascular disease in patients with diabetes. In the pre-enrolment period the admission rate for cardiovascular disease was 4.2 (95% CI, 2.4–6.8) admissions per 100 patients per year. Following

Table 4. Costs modelled on admission rates per 100 patients
Rates and bed days are summarised as mean and 95% confidence interval

Discharge diagnoses	Pre-HARP diabetes intervention			Post-HARP diabetes intervention		
	Admission rate per 100 patients	Bed days per 100 patients	Cost (median cost × admission rate)	Admission rate per 100 patients	Bed days per 100 patients	Cost (median cost × admission rate)
Cardiovascular	4.2 (2.4–6.8)	21.0 (16.9–25.6)	\$8117.65	8.1 (5.5–11.5)	34.2 (29.3–39.3)	\$27 684.03
Hypoglycaemia	2.2 (1.0–4.4)	22.4 (18.2–27.1)	\$5763.59	1.7 (0.6–3.6)	11.5 (8.4–15.3)	\$5233.61
Ketoacidosis without coma	0.3 (0–1.6)	1.1 (0.3–2.8)	\$757.14	0.3 (0–1.6)	0.3 (0–1.6)	\$798.32
Multiple complications	0.6 (0.1–2.0)	24.4 (20.0–29.2)	\$9506.44	0.6 (0.1–2.0)	1.4 (0.5–3.2)	\$1596.64
Unstable diabetes without complications	0.3 (0–1.6)	0.3 (0–1.6)	\$683.75	0.3 (0–1.6)	0.3 (0–1.6)	\$849.30
Ophthalmic	0.6 (0.1–2.0)	0.6 (0.1–2.0)	\$1008.96	0.6 (0.1–2.0)	0.6 (0.1–2.0)	\$1070.59
Renal	0.6 (0.1–2.0)	2.0 (0.8–4.0)	\$1129.41	0.8 (0.2–2.4)	0.8 (0.2–2.4)	\$1968.91

completion of the program this increased to an admission rate of 8.1 (95% CI, 5.5–11.5) admissions per 100 patients per year. This was associated with an increase in costs for the management of cardiovascular disease from \$8118 per year for 100 patients to \$27 684 per year for 100 patients.

Discussion

This study evaluates the effect of a diabetes disease management service for patients with type 2 diabetes on acute care admission costs. The program's service delivery of 1474 h over 9 months (4 h per patient) delivered a low per-patient cost (\$463.00 per patient). In contrast, the overall inpatient costs for the management of diabetes and related conditions were high and did not decrease significantly following program completion. The major acute care cost drivers were surgical interventions for advanced peripheral vascular disease and the management of cardiovascular events. These findings demonstrate that in this population with a high prevalence of established cardiovascular and peripheral vascular complications that diabetes management programs need to be equipped and resourced to manage these complications if potential savings in acute care costs are to be realised.

The number of admissions for peripheral vascular disease (PVD, e.g. leg ulcers, amputations or reconstructive procedures) increased following program enrolment. This was probably because some of the patients had advanced peripheral vascular disease requiring surgical intervention at the time of program enrolment. Previous program evaluation found that at enrolment that 29% had a pre-existing diagnosis of PVD and 39% cardiovascular disease.^{8,16} At this late stage it would have been difficult for the specialist diabetes service to have had a direct effect on these individuals' need for surgical intervention. It is noteworthy that the number of admissions for peripheral vascular complications was very low in the 12 months following program completion, indicating that the diabetes program may be having a medium-term effect on acute healthcare utilisation. A longer duration of follow-up is needed to ascertain whether the preventative interventions provided to high-risk individuals had an effect on amputation rates in the medium to longer-term (3–5 years).

In line with national costing data, vascular and surgical reconstructive procedures incurred the highest cost per episode of care for patients in this study. Throughout Australia, amputations and ulcers rank second and third after renal failure for diabetes-related conditions that require the most days in hospital.¹⁷ Data from the US indicate that 33% of the US\$116 billion of direct-care costs for diabetes and complication in 2007 was attributed to foot ulcers and treatment costs for high grade ulcers are 8 times higher than low grade ulcers.¹⁸ Previous studies have reported that intensive management of high-risk patients can result in increased costs in the short term,^{18,19} which is offset by future cost reductions emanating from reduced complications or an increase in complication-free time.^{18–20} 'High-risk foot' programs for patients with diabetic foot ulcers have also been demonstrated to reduce amputation rates.²¹ Clarke *et al.*¹⁷ estimated the cost of amputation were AU\$20 416 and for chronic leg ulcers was AU\$15 413 in the first year they occur, with both reducing to almost \$3300 in subsequent years. In programs such

as this one (whose target population is patients with diabetes-related complications), it would be appropriate for more resources to be allocated to the high-risk foot component of the program. If the program reduced the need for vascular reconstructive procedures and amputations the potential for cost savings in the medium term would be high.

A total of 43% of the study participants had diagnosed cardiovascular disease at enrolment into the program. In contrast to previous studies,^{22–24} a reduction in cardiovascular events was not seen in the 12 months following program completion. These findings confirm more recent reports that have found that the benefits of intensive glucose control decline with age, duration of diabetes and the level of comorbid illness.²⁵ The outcomes of this evaluation demonstrate that it is difficult to have a short-term effect on presentation rates and the costs of managing cardiovascular disease in this patient population with established cardiovascular comorbidity. Longer-term follow-up of patients enrolled in the HARP-funded diabetes program will give a better indication of whether programs are able to achieve the benefits reported by the DCCT and UKPDS studies.^{26,27} Although recent reports indicated that tight glycaemic control of older adults may be associated with increased risk of cardiovascular mortality,²⁸ there was no evidence that hypoglycaemia contributed to the number of presentations for cardiac management by patients in this program.

It is acknowledged there are several factors that may affect cost per admitted patient over time. Governments and funding bodies revise and index funding in accordance with the increasing costs of healthcare. WIES costs involved funding over different periods and this meant the same DRG attracted different levels of WIES funding across the different time periods considered in this study (e.g. discharge DRG K60B with LOS of 1 day had a WIES cost of \$2441 in December 2006, whereas a similar diagnosis had a WIES of \$2701 in August 2007).²⁹ Although the exact effect of WIES variation was not delineated in our study, the results of our costing analysis demonstrated that there was not a statistically significant variation in cost per episode over the short time period covered by this study. Other factors that are taken into account by the WEIS funding algorithm are length of stay in acute care and the number and severity of patient complications. The amount of funding received per episode will therefore be influenced by the accuracy of the clinical coding for each episode which may vary over time. The use of WIES for cost estimation is a controversial approach; it is linked to funding and anecdotes suggest it may be exploited to attract additional income.^{30,31} Changes to diagnostic labelling as a result of coding revisions,¹⁵ inter-personnel factors³² and changes in the patterns of discharge diagnoses used can all influence funding based on DRGs. Despite these limitations WEIS funding has the advantage that it accurately reflects the funding that a particular institution actually received to manage their patient population and it reflects actual funds disbursed from the public purse.

There were other limitations in the evaluation. The cohort size used in the study was small and only a small fraction of the cohort was admitted to hospital, which may in part explain why although the program focussed on improving diabetes control this was not reflected by a change in readmission rates for

unstable diabetes. The focus of hospital utilisation to a single health service to the exclusion of admissions to other may underestimate acute care costs. Despite this limitation this study does provide pertinent information relating to the effect of the program at the local health service level. The cost modelling indicates that if diabetes management programs are able to decrease admissions for vascular complications of diabetes the potential for cost savings can be realised.

Conclusion

Disease management programs for patients with diabetes and related complications have the potential to reduce inpatient hospital utilisation costs. Self-management coaching and lifestyle modification programs should be targeted to people with poorly controlled diabetes who are at risk of admission in the medium term. In contrast intensive community-based disease management and service coordination interventions should be developed to improve outcomes for individuals with advanced cardiovascular or peripheral vascular complications of diabetes. Further program development and evaluation is needed to determine the best model of care for individuals with cardiovascular complications both in terms of improving clinical outcomes and decreasing costs.

Competing interests

The authors declare that no conflicts of interest exist.

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