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Improving GP diabetes management

A PDSA audit cycle in Western Australia

Background
Tight glucose, blood pressure and lipid control in patients with diabetes can reduce morbidity and mortality from macro- and micro-vascular complications. However, treatment targets are not being met in a large proportion of patients. Clinical audit involves cycles of evaluation of current activity against standards. It allows problems to be identified and action to be taken to address them.

Methods
Annual retrospective audits over 3 years of random samples of up to 20 patient medical records from 13 general practitioners in the midwest region of Western Australia (n=807). Statistical tests compared the second and third audits with the first in regard to completeness of screening, health indicators, and the proportion of patients within The Royal Australian College of General Practitioners and Diabetes Australia guidelines targets.

Results
While there was a significant improvement in lipid monitoring over the study period ($p<0.001$), monitoring of HbA1c and blood pressure (BP) remained unchanged. Between the first and third audits, a reduction in mean HbA1c ($p<0.001$), mean total cholesterol ($p=0.017$), mean LDL cholesterol ($p=0.014$) and mean systolic BP ($p=0.002$) was seen. There was an improvement in the proportion of patients achieving cholesterol goals (measured by LDL and reaching a target of HbA1c <7%) between the first and third audits; however the proportion with BP within target declined. In the third audit, 11% of patients on diet alone, 36% on an oral hypoglycaemic agent, 90% on three oral hypoglycaemic agents and 84% of those on insulin were outside the target HbA1c. In the same audit, of those outside target BP, 53% were on no treatment and 65% were only on one type of medication. Eighty-seven percent of patients outside target cholesterol levels had not been prescribed a statin.

Discussion
Many of the audited GPs in our study undertreated BP, HbA1c and cholesterol. Improvement in some areas was seen over the study period, which may have been due to the quality assurance activities undertaken. These results reveal a therapeutic opportunity for reducing cardiovascular events in patients with diabetes. More aggressive management of BP and lipids by GPs may see rewards in terms of reducing cardiovascular events in patients with diabetes.

In the management of type 1 and 2 diabetes, it is clear that tight glucose, blood pressure (BP) and lipid control can reduce morbidity and mortality from macro- and micro-vascular complications.[1–6] Best practice recommended biological targets are constantly under re-evaluation and change. Current consensus guidelines suggest the following:[7]

- **glycated haemoglobin (HbA1c <7%)**
- **BP (<130/80 mmHg), and**
- **total cholesterol (<4.0 mmol/L).**

Despite the known benefits of managing these parameters appropriately, targets are not being met in a large proportion of patients with type 2 diabetes mellitus (T2DM).[8,9] Better screening alone does not improve health outcomes;[10] however there is evidence of improved lipid levels with active clinical management.[6]

General practitioners are encouraged to participate in continuing professional development and quality assurance programs to enhance knowledge and change behaviour in order to improve quality of care. Clinical audit involves cycles of evaluation of current activity against standards, allowing problems to be identified and action taken to address them.[11] Based on this principle, our study involved three repeated audits of management of diabetes by 15 GPs. General practitioners had the opportunity to provide feedback and reflect on the experience (not reported in this article). The aim was to evaluate the impact of a 'plan, do, study, act' (PDSA) cycle on GP diabetes management relating to screening for complications, health outcomes for patients, and GP prescribing patterns to control blood sugar, BP and cholesterol. The audit process was performed annually on three occasions from 2005–2007; the results of the first audit were published in 2007.[12] This article describes changes in GP behaviour and patient outcomes over the 3 years as a result of these PDSA cycles and examines patterns of medicine prescription in 2007 in the context of these outcomes.

Methods

Study design and setting

Three cross sectional retrospective audits were conducted using a cluster sample design. The target region for the study was the midwest region of Western Australia, where 42 GPs currently practise. Power calculation indicated that 15 GPs were required to generate statistically significant results. Starting in 2005, a random sample of 15 of the 42 GPs were selected for the audit; the GPs agreed to participate as part of a registered continuous professional development activity.

The audit was excluded from formal ethics approval by the University of Western Australia Ethics Committee as it was a quality assurance activity.

Data collection

Each GP provided a list of all their patients with type 1 or type 2 diabetes who had been under their care for a minimum of 2 years. From this list, a random sample of up to 20 patients was selected. An audit of the medical records of these patients (either manual or electronic, or a combination of both) was conducted by a credentialed diabetes educator for the period spanning January to December 2004. The cycle was repeated in 2006 and 2007, covering the periods from January to December 2005 and January to December 2006.

Patient notes were audited using the GP subset of the current Australian National Dataset for Diabetes (NDOQRIN).[13] All three audits recorded the specific medications but only the third audit included drug dosages used to control blood glucose, BP and lipid levels. Quality of care and clinical health outcome targets were based on the 2004–2005 Royal Australian College of General Practitioners (RACGP)/Diabetes Australia guidelines.[14]

Owing to poor documentation of body mass index, and referrals to podiatry and ophthalmology, analysis of change in these areas was not possible and have been omitted from the results.

Statistical analysis

Statistical tests compared the second and third audits with the first in regards to completeness of screening, health indicators and the proportion of patients within RACGP/Diabetes Australia targets. Logistic regression was used to test for changes in proportions screened and proportions within targets. The equations controlled for the age and gender of patients and included a set of dichotomous variables representing the 13 GPs to control for possible effects of clustering. Differences in mean health indicators were tested using linear mixed models with GPs treated as a random effect and age, gender and audit number as fixed effects. Statistical analysis was performed using SPSS for Windows (version 17.0).[15]

Results

GP profile

All 15 randomly selected GPs participated in the audit. Two participating GPs subsequently left the region, and their patients have been removed from the analysis. Seventy percent of the participating GPs were located within the city of Geraldton, with a predominance (60%) working within a group practice. All the doctors working outside the city were solo practitioners. The majority of practices used both electronic and paper based medical records (60%), employed a practice nurse (60%), used care plans (80%) and claimed enhanced primary care (EPC) items for treatment (73%). The first audit[12] found no correlation between quality of care and patient outcomes with practice type (solo or group), GP location, involvement of practice nurses or evidence of care plans.[12] This was confirmed in subsequent analysis of the next two audits.

Table 1. Demographic and health information for patients included in the audits

Measure	First audit (2005) (n=253)	Second audit (2006) (n=293)	Third audit (2007) (n=261)
Location			
Rural	30%	27%	30%
Geraldton	70%	73%	70%
Practice			
Solo	59%	60%	46%
Group	41%	40%	54%
Gender			
Male	54%	55%	54%
Female	46%	45%	46%
Aboriginal			
Yes	7%	7%	7%
No	7%	7%	9%
Not stated	86%	86%	84%
Diabetes			
Type 1	7%	8%	3%
Type 2	93%	91%	96%
Not stated	0%	1%	1%
Treatment			
Diet only	25%	22%	21%
OHA	56%	58%	65%
Insulin	9%	11%	6%
Insulin and OHA	10%	8%	8%
Not stated	0%	1%	0%
Smoker			
Yes	13%	13%	15%
No	44%	48%	52%
Not stated	43%	39%	33%
Care plan			
Yes	43%	46%	66%
No	57%	54%	34%
Age			
Mean (years)	62	62	63
Range (years)	10–93	9–93	20–94

Table 2. Changes in the proportion of patients screened within the 2004–2005 RACGP/Diabetes Australia recommended guidelines (n=755)

	Percentage of patients screened within the recommended interval		
	First audit	**Second audit**	**Third audit**
HbA1c	70%	56%	67%
Odds ratio (*p* value)		0.491 (<0.001)	0.806 (0.292)
Blood pressure	77%	63%	71%
Odds ratio (*p* value)		0.472 (<0.011)	0.681 (0.076)
Lipids	64%	67%	86%
Odds ratio (*p* value)		1.230 (0.318)	4.404 (<0.001)

NB: Age and gender of patient included in the model. To reflect the clustering of patients within general practices, a set of dichotomous variables for the 13 GPs was also included

Table 3. Mean health outcomes over the three audits

	n	**First audit**	**Second audit**	**Third audit**
HbA1c	691	7.5 (7.3–7.7)	7.3 (7.1–7.5)	6.9 (6.7–7.1)
Estimated change (*p* value)			0.196 (0.139)	0.579 (<0.001)
BP systolic	714	135 (132–137)	134 (132–136)	133 (131–135)
Estimated change (*p* value)			1.589 (0.102)	3.001 (0.002)
BP diastolic	714	78 (76–79)	77 (75–78)	75 (74–77)
Estimated change (*p* value)			0.405 (0.800)	1.421 (0.377)
Cholesterol	646	4.92 (4.8–5.1)	4.82 (4.7–5.0)	4.66 (4.5–4.8)
Estimated change (*p* value)			0.082 (0.424)	0.244 (0.017)
Triglycerides	641	1.96 (1.77–2.16)	1.85 (1.66–2.04)	1.91 (1.73–2.10)
Estimated change (*p* value)			0.098 (0.460)	0.045 (0.730)
HDL cholesterol	581	1.22 (1.13–1.32)	1.21 (1.16–1.26)	1.22 (1.15–1.27)
Estimated change (*p* value)			0.016 (0.747)	0.006 (0.897)
LDL cholesterol	562	2.87 (2.73–3.00)	2.87 (2.73–3.01)	2.64 (2.51–2.76)
Estimated change (*p* value)			–0.005 (0.958)	0.227 (0.014)

NB: The estimate is of the fixed effects in a linear mixed model. Age and gender were included as other fixed effects and the GP as a random effect to control for effects of clustering

Table 4. Patients within RACGP/Diabetes Australia targets for health outcomes at each audit and adjusted odds ratios of changes in interval between audits

			Percentage of patients within targets		
	2005–2006 targets	**n**	**First audit**	**Second audit**	**Third audit**
HbA1c	≤7%	691	46%	51%	65%
OR (*p* value)				1.202 (0.353)	2.296 (<0.001)
BP	<130/85 mmHg	714	45%	49%	37%
OR (*p* value)				1.155 (0.444)	0.686 (0.051)
Cholesterol	<4.0 mmol/L	646	18%	23%	26%
OR (*p* value)				1.338 (0.246)	1.578 (0.061)
Triglyceride	<2.0 mmol/L	641	64%	65%	68%
OR (*p* value)				1.005 (0.981)	1.188 (0.416)
HDL cholesterol	≥1.0 mmol/L	581	75%	80%	74%
OR (*p* value)				1.290 (0.332)	1.055 (0.828)
LDL cholesterol	<2.5 mmol/L	562	38%	40%	49%
OR (*p* value)				1.108 (0.650)	1.631 (0.027)

Patient profile

A total of 807 medical records of patients with diabetes were audited over the three audit periods, with 253 records audited in 2005, 293 in 2006, and 261 in 2007 (*Table 1*). There was no significant difference in the demographic profile of the selected patients in each of the three audits. The mean age was 62 years, 96% had T2DM and 7% were Indigenous Australians. Care plans were operational for 66%, with 18% receiving a home medication review.

Patient screening

The percentage of patients screened according to the 2004–2005 RACGP/Diabetes Australia guidelines[14] in each audit cycle for HbA1c, BP and lipids is shown in *Table 2*. The proportion of patients with timely screening for HbA1c and BP declined in the second audit but returned to year 1 rates in year 3. For each instance of HbA1c screening, 67% of patients were being screened appropriately in the third audit. This shows improvement since the second audit and is comparable with screening levels in the first. There was a significant improvement in the monitoring of lipid profiles over the 3 years ($p<0.001$).

Patient outcomes

Between the first and third audits a reduction in mean HbA1c ($p<0.001$), mean total cholesterol ($p=0.017$), mean LDL cholesterol ($p=0.014$) and mean systolic BP ($p=0.002$) was seen. There were no significant declines between audits one and two (*Table 3*). Similarly, after adjusting for possible confounders, there was improvement in the proportion of patients achieving cholesterol goals (as measured by LDL and reaching a target of HbA1c <7%) by the third audit (*Table 4*). The proportion with BP within target declined during the audit cycles.

Medications

Only the third audit included drug dosages. *Figure 1* shows the percentage of patients in the third audit with T2DM within and outside target for each hypoglycaemic treatment mode. *Figure 2* compares patients on diet alone with those on one, two or three oral hypoglycaemic agents (OHAs). Sixty-five percent of patients in the third audit were on a combination of different OHAs, with only 8% on an OHA with insulin. Also in the third audit, 11% percent of patients on diet alone, 36% of patients on an OHA, 90% of those on three OHAs and 84% on insulin were outside the target HbA1c.

Seventy-two percent of people were on an angiotensin converting enzyme inhibitor or angiotensin receptor blocker with or without a diuretic. There was no increase in prescribing of these drugs over the period of study. In the third audit, of those outside targets, 53% were on no antihypertensive agent and 65% were only on one type of medication (*Figure 3*).

Eighty-seven percent of patients outside target cholesterol levels had not been prescribed a statin. In the third audit, of those that were on a statin and outside target, 67% were on 10 mg and 62%, 20 mg (*Figure 4*).

Figure 1. Percentage of patients with T2DM in the third audit inside and outside target HbA1c for each hypoglycaemic treatment mode (n=223)

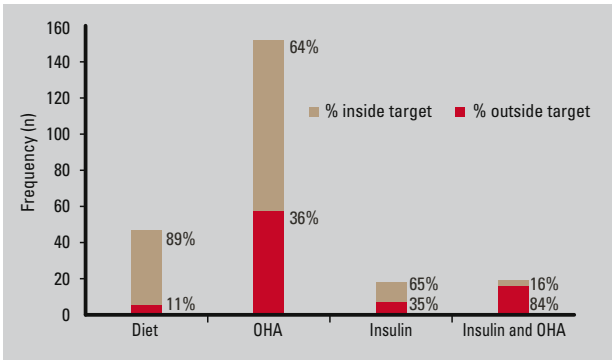


Figure 2. Type 2 diabetes patients in the third audit inside and outside target HbA1c for each OHA treatment mode (n=215)

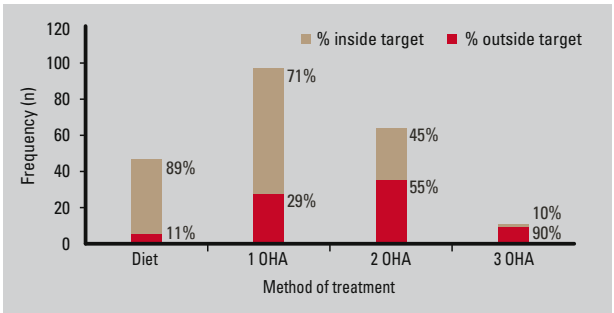


Figure 3. Patients in the third audit inside and outside target BP by number of antihypertensive agents (n=241)

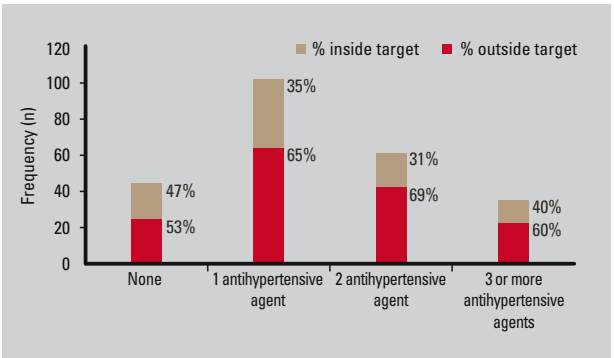
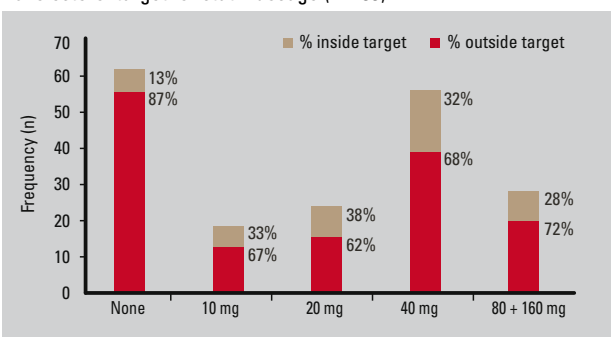


Figure 4. Patients in the third audit inside and outside LDL cholesterol target for statin dosage (n=233)



Discussion

Our study aimed to document changes to diabetes management and health outcomes following a PDSA quality assurance cycle. The study design enabled us to focus on GP management and avoid the confounding factors that would have been presented by a longitudinal design, including the natural process of aging and development of diabetic complications. However, the cross sectional design meant that we were unable to analyse individual patient factors that may have been behind what we observed, such as changes in medication or static or changing patient factors (eg. socioeconomic circumstance). These factors may have influenced the clinical outcomes and may be a source of bias and/or error in our results. Another limitation of this study is that it was restricted to rural GPs and may not be representative of the national GP population. However, our results may be reflective of other rural areas in Australia.

Over the study period there was a significant improvement in the level of screening for lipids and a significant reduction in HbA1c, systolic BP, LDL cholesterol and triglyceride levels. There was also improvement in the proportion of patients who achieved target LDL and HDL cholesterol goals. There was a 100% re-response rate for GPs over each of the 3 years of the audit. Other similar studies have shown improvements in quality of care, but no improvements in HbA1c.[9,10,16] Health outcome improvements seen in this study were equal if not better than those found in other studies, including those done in metropolitan areas around Australia[9] and internationally.[16] This occurred despite the fact that there are limited tertiary endocrinological facilities available in our rural study area. While this study is not a longitudinal study, some GPs had less than 20 patients and all were audited for the 3 year audit periods. Where there were more than 20 patients for a GP, patients were randomly selected but may still represent the same cohort for the three audits.

Despite these encouraging results, analysis of treatment for control of blood sugar revealed that 55% of patients treated with two oral agents and 90% of those on three oral agents were outside target. However, we did not find that those on diet alone were particularly poorly managed, as suggested by a United Kingdom study[17] in which one out of 6 patients had an HbA1c above 7.5%. In this study, those on diet alone had better control than those on medication, with only 11% outside target (HbA1c >7%). Contrary to present recommendations to start insulin early before beta cell failure occurs,[7] we found only a small number of patients were prescribed insulin, in spite of 90% of patients on three OHAs being outside target. This result is not surprising as there is a reluctance in doctors and patients in general to start insulin. Data from the National Prescribing Service[18] demonstrates similar prescribing practices to those seen in our study.

Intensive blood pressure and LDL reduction have a powerfully beneficial effect on cardiovascular disease risk reduction.[1,2,6] Adequate hypertensive treatment often requires at least two antihypertensive agents to achieve accepted targets.[2,19] In spite of this evidence, the majority of hypertensive patients in our study were outside target (53% of those on no antihypertensive agent and 65% of those on one antihypertensive agent) and 87% had high cholesterol levels but were not on cholesterol medication. When treatment did occur it was still minimal, with 18% on only small doses of statins of 10–20 mg/day. The most common dosage was 40 mg, and 68% of patients on this dosage were not within target. A recent US National Health Survey showed similar undertreatment of BP, with only 37% of patients being treated for hypertension achieving target BP levels.[20]

Despite improvement over the study period, 35% of patients in our study were not within the RACGP/Diabetes Australia target range for HbA1c. A reluctance to increase medication or treat has been noted in other papers.[21,22] Poor health outcomes are also often attributed to patient factors.[9,23] However, this study suggests that encouraging GPs to treat to target may also result in improved outcomes. Clinical uncertainty[21] may underlie the reluctance to implement adequate treatment strategies; this suggests that further education and quality assurance activities may improve outcomes. The adoption of a harm reduction model may also provide a further strategy for delivering the best care that is also compatible with each patient's chosen lifestyle.[24]

Lifestyle and patient self management are key ingredients in diabetes control;[25] however the focus of this paper is on GP management. Many of the audited GPs in our study undertreated blood pressure, HbA1c and cholesterol. Improvement was seen over the study period, which may have been due to the quality assurance activities undertaken. These results reveal a therapeutic opportunity for reducing cardiovascular events in patients with diabetes. Intensive multiple risk factor interventions have been shown to result in an overall 20% absolute reduction in the risk of death from any cause compared to normal therapy.[26] More aggressive management of BP and lipids by GPs may see rewards in terms of reducing cardiovascular events in patients with diabetes.

Conflict of interest: none declared.

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