Research

Impact on diabetes management of General Practice Management Plans, Team Care Arrangements and reviews

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Abstract

Objectives: To investigate whether General Practice Management Plans (GPMPs), Team Care Arrangements (TCAs) and reviews of these improve the management and outcomes of patients with diabetes when supported by cdmNet, a web-based chronic disease management system; and to investigate adherence to the annual cycle of care (ACOC), as recommended in diabetes guidelines.

Design, participants and setting: A before-and-after study to analyse prospectively collected data on 577 patients with type 1 or 2 diabetes mellitus who were managed with a GPMP created using cdmNet between June 2008 and November 2012.

Main outcome measures: Completion of the clinical tests in the ACOC (process outcome) and values of six of these clinical measurements (clinical outcomes).

Results: Significant improvements were seen after creation of a GPMP in the proportion of ACOC clinical tests completed (57.9% v 74.8%, $P < 0.001$), total cholesterol level ($P < 0.01$), low-density lipoprotein (LDL) cholesterol level ($P < 0.001$) and body mass index (BMI) ($P < 0.01$). Patients using GPMPs and TCAs also improved their glycated haemoglobin (HbA_{1c}) level ($P < 0.05$). Patients followed up with irregular reviews had significant improvements in the proportion of ACOC clinical tests completed (59.2% v 77.6%, $P < 0.001$), total cholesterol level ($P < 0.05$), and BMI ($P < 0.01$), but patients with regular reviews had greater improvements in the proportion of ACOC clinical tests completed (58.9% v 85.0%, $P < 0.001$), HbA_{1c} level (57.7 v 53.0 mmol/mol, $P < 0.05$), total cholesterol level (4.8 v 4.5 mmol/L, $P < 0.05$), LDL cholesterol level (2.8 v 2.4 mmol/L, $P < 0.01$) and diastolic blood pressure (76.0 v 74.0 mmHg, $P < 0.05$).

Conclusion: There were significant improvements in process and clinical outcomes for patients on a GPMP or a GPMP and TCA, particularly when these were followed up by regular reviews. Patients using cdmNet were four times more likely to have their GPMP or TCA followed up through regular reviews than the national average.

The prevalence of diabetes is increasing worldwide, placing a major burden on individuals, communities and health services. In meeting this challenge, evidence suggests that the Chronic Care Model (CCM)[1] leads to improved patient care and better health outcomes.[2] The importance of the CCM delivery system — longitudinal planned care, regular follow-up and review, and multidisciplinary team care — is well established.[3] Studies have shown that delivery system interventions are associated with improvements in clinical processes and outcomes,[4] including glycated haemoglobin (HbA_{1c}) and low-density lipoprotein (LDL) cholesterol levels[5] and glycaemic control[6] in patients with diabetes.

In Australia, Chronic Disease Management Medicare items were introduced to increase support for the management of chronic illness.[7] These items provide rebates for General Practice Management Plans (GPMPs) to improve care planning, Team Care Arrangements (TCAs) to foster multidisciplinary care, and GPMP and TCA reviews to support ongoing care and regular follow-up.[8] Evidence indicates that TCAs are associated with improved outcomes for patients with diabetes,[9,10] but no detailed study on the impact of reviews for patients with diabetes has been done.

Web-based care management systems integrated with primary care are associated with improved glycaemic control,[11] while modest improvements have been found in the absence of full integration.[12-15] One such system, cdmNet (Precedence Health Care),[16,17] is used by Australian practices to improve systematic management of patients with chronic disease. cdmNet supports key CCM processes: it creates best-practice, personalised GPMPs and TCAs; shares these plans with the care team and patient; continuously monitors the plans; facilitates collaboration and regular review; and supports patient self-management. Initial studies suggest that cdmNet is associated with improved team collaboration and adherence to best-practice guidelines.[18]

We aimed to investigate whether GPMPs, TCAs and their reviews improve the management and outcomes of patients with diabetes when supported by cdmNet.

Methods

This was a before-and-after study of prospectively collected data from cdmNet. This web-based care management system was chosen because of its relatively broad adoption in Australia.[19] Patients with type 1 or 2 diabetes mellitus from across Australia (including metropolitan, rural and regional communities) who had been on a GPMP created using cdmNet for at least 14 months between June 2008 and November 2012 were selected for inclusion. cdmNet did not report comprehensive clinical data until 1 May 2011, so eligible patients had to still be actively involved in cdmNet after this date. Patients who sign up to use cdmNet agree to allow non-identifiable data collected in the system to be used for research purposes. The general practitioners in this study were those participating in

the cdmNet care plans of the included patients.

The Monash University Human Research Ethics Committee approved this study (CF11/1035: 2011000519, CF11/1699: 2011000947).

Outcomes

Quality of care was measured using process and clinical outcomes.

Process outcome

Process outcomes measure adherence to best-practice care according to some standard. In this study, we used a single process outcome based on the proportion of completed clinical tests in the annual cycle of care (ACOC), as recommended in Australian diabetes guidelines.[20] While the patients in the study were "available" to have multiple clinical tests done, not all patients had these done by their GPs. The process outcome was therefore defined as the percentage of ACOC clinical tests completed for the patient. The ACOC guidelines specify that seven clinical tests should be carried out within a 13-month period: one measurement each for HbA_{1c}, total cholesterol, triglycerides, high-density lipoprotein (HDL) cholesterol, and microalbuminuria; and two measurements 5 months apart of body mass index (BMI) and blood pressure (BP).[20] We calculated the process outcome by dividing the number of completed clinical tests (to a maximum of seven) by the recommended number of tests (seven). For each of BMI and BP, both tests needed to be done to count as completed. Tasks carried out by allied health personnel (eg, podiatrists, optometrists) were not included, as data on these before using cdmNet (ie, before a GPMP) were not available.

The process outcome was calculated for both the period of 1–14 months before the first cdmNet GPMP was created, and for the 13-month period after creation of the GPMP.

Clinical outcomes

In this study, clinical outcomes refer to six of the clinical measurements included in the ACOC: HbA_{1c} level, total cholesterol level, LDL cholesterol level (derived from the HDL cholesterol test), BMI, and systolic and diastolic BP.

Clinical outcomes before the first cdmNet GPMP was created were defined as the most recent value of each clinical measurement taken between 3 months before and 1 month after the creation of the GPMP. Measurements taken in this period represent the status of the patient before the intervention, even if they were measured after creation of the GPMP. Clinical outcomes after the GPMP were defined as the most recent value of each clinical measurement taken 13–18 months after the creation of the GPMP.

Data analysis

The analysis was carried out in three parts. First, we investigated the effect of creating a GPMP on process and clinical outcomes, irrespective of whether or not a TCA was also created. Second, we investigated the effect of creating both a GPMP and TCA. Third, we analysed the effect of reviews of GPMPs or GPMPs and TCAs, for which patients were divided into three groups based on the regularity of review:

- No reviews: no GPMP or TCA reviews were performed within 13 months from creation of the GPMP.
- Irregular reviews: at least one GPMP or TCA review was performed within 13 months from creation of the GPMP, but the conditions for regular reviews were not met.
- Regular reviews: two or more GPMP or TCA reviews were performed within 13 months from creation of the GPMP, with the first performed at least 3 months after the GPMP, and with at least two performed more than 3 months apart.

Given the importance of glycaemic management in preventing or delaying complications of diabetes,[21,22] a further analysis was carried out to compare HbA_{1c} levels before and after a GPMP for patients whose HbA_{1c} level before the GPMP was greater than the recommended Australian target of 53 mmol/mol.

The paired-samples *t* test[23] was used to compare process and clinical outcomes before and after the GPMP. In analysing the effect of reviews, an additional analysis was carried out using one-way between-groups analysis of variance[23] to compare outcomes among the three groups. Adjustment for multiple comparisons was made using the Tukey honestly significant difference test.[24] For each test, effect size was determined by calculating eta-squared and interpreted using the guidelines proposed by Cohen (0.01 is considered a small effect, 0.06 is moderate and 0.14 is large).[25] We used SPSS version 20 (SPSS Inc) for statistical analysis.

Results

A total of 577 patients managed by 36 GPs satisfied the inclusion criteria. Characteristics of the patients are shown in the Appendix (online at mja.com.au). There were 271 patients

1 Process and clinical outcomes before and after creation of a General Practice Management Plan (GPMP)

Outcome	Patients*	Mean (SD)		Mean improvement (95% CI)	*P*	Effect size†
		Before GPMP	After GPMP			
Proportion of ACOC tests completed	577	57.9% (31.9%)	74.8% (28.9%)	16.9% (13.4% to 20.3%)	< 0.001	large
HbA_{1c} level (mmol/mol)	221	55.2 (15.5)	53.4 (10.6)	1.8 (– 0.1 to 3.8)	0.06	na
Total cholesterol level (mmol/L)	123	4.6 (1.2)	4.3 (1.0)	0.3 (0.1 to 0.4)	< 0.01	moderate
LDL cholesterol level (mmol/L)	112	2.6 (1.0)	2.3 (0.9)	0.3 (0.1 to 0.4)	< 0.001	moderate
Body mass index (kg/m^2)	236	32.1 (6.3)	31.7 (6.2)	0.4 (0.2 to 0.7)	< 0.01	small
Systolic BP (mmHg)	312	137.3 (16.3)	136.6 (16.0)	0.7 (– 1.4 to 2.9)	0.50	na
Diastolic BP (mmHg)	312	75.1 (10.2)	74.0 (9.6)	1.1 (– 0.1 to 2.3)	0.08	na

ACOC = annual cycle of care. HbA_{1c} = glycated haemoglobin. LDL = low-density lipoprotein. BP = blood pressure. na = not applicable. * Number of patients differs for clinical outcomes as not all patients had all clinical tests completed. † Determined by calculating eta-squared, where 0.01 is considered a small effect, 0.06 is moderate and 0.14 is large.[25] ◆

2 Process and clinical outcomes before and after creation of a General Practice Management Plan (GPMP) for patients with a GPMP and Team Care Arrangement

Outcome	Patients*	Mean (SD)		Mean improvement (95% CI)	*P*	Effect size†
		Before GPMP	After GPMP			
Proportion of ACOC tests completed	507	58.9% (31.8%)	73.9% (30.0%)	15.0% (11.2% to 18.8%)	< 0.001	moderate
HbA_{1c} level (mmol/mol)	198	55.8 (16.1)	53.4 (10.4)	2.4. (0.3 to 4.5)	< 0.05	small
Total cholesterol level (mmol/L)	110	4.6 (1.2)	4.3 (1.0)	0.3 (0.1 to 0.4)	< 0.01	moderate
LDL cholesterol level (mmol/L)	100	2.6 (1.0)	2.3 (0.9)	0.3 (0.1 to 0.4)	< 0.01	moderate
Body mass index (kg/m^2)	205	32.2 (6.4)	31.8 (6.2)	0.4 (0.2 to 0.7)	< 0.01	small
Systolic BP (mmHg)	274	138.1 (16.7)	136.7 (15.8)	1.4 (– 0.9 to 3.6)	0.25	na
Diastolic BP (mmHg)	274	75.2 (10.3)	73.9 (9.6)	1.3 (0.0 to 2.6)	0.05	na

ACOC = annual cycle of care. HbA_{1c} = glycated haemoglobin. LDL = low-density lipoprotein. BP = blood pressure. na = not applicable. * Number of patients differs for clinical outcomes as not all patients had all clinical tests completed. † Determined by calculating eta-squared, where 0.01 is considered a small effect, 0.06 is moderate and 0.14 is large.[25] ◆

diagnosed with more than one chronic illness. The length of time since diagnosis of diabetes was unknown.

Effect of a GPMP on outcomes

Patients with a GPMP had significant improvements in the proportion of ACOC tests completed and in total cholesterol level, LDL cholesterol level and BMI (Box 1).

For 89 patients whose HbA_{1c} level was > 53 mmol/mol before the GPMP, there was a significant decrease in HbA_{1c} level after the GPMP, with a large effect (mean [SD], 68.2 [16.9] v 58.8 [11.7]; $t(88) = 4.7$, $P < 0.001$). The mean decrease in HbA_{1c} level in this group was 9.4 mmol/mol (95% CI, 5.5–13.3 mmol/mol).

Effect of a GPMP and TCA on outcomes

For the 507 patients (87.9%) with both a GPMP and TCA, significant improvements were seen in the proportion of ACOC tests completed and in HbA_{1c}, total cholesterol and LDL cholesterol levels and BMI (Box 2).

For 84 patients whose HbA_{1c} level was > 53 mmol/mol before the GPMP, there was a significant decrease in HbA_{1c} level after the GPMP, with a large effect (mean [SD], 68.7 [17.2] v 58.3 [11.5]; $t(83) = 5.2$, $P < 0.001$). The mean decrease in HbA_{1c} level in this group was 10.4 mmol/mol (95% CI, 6.5–14.4 mmol/mol).

Effect of reviews on outcomes

Of the 577 patients, 116 (20.1%) had no reviews, 270 (46.8%) had irregular reviews and 191 (33.1%) had regular reviews. Overall, 461 patients (79.9%) had their GPMP and/or TCA reviewed.

There were no significant improvements for patients with no reviews (Box 3). Patients having irregular reviews had significant improvements in the proportion of ACOC tests completed, total cholesterol level and BMI. Patients having regular reviews had significant improvements in the proportion of ACOC tests completed, HbA_{1c} level, total and LDL cholesterol levels, and diastolic BP. The mean increase in the process outcome was 1.4 times higher for patients having regular reviews than for those having irregular reviews.

Improvements in the process outcome showed a significant difference ($P < 0.05$) among the three groups ($F[2, 574] = 17.2$, moderate effect [0.06]). Post-hoc comparisons indicated the mean change in process outcome for no reviews was significantly different from irregular reviews and regular reviews (Box 3). Improvements in HbA_{1c} level also showed a significant difference ($P < 0.05$) among the three groups ($F[2, 218] = 3.5$, small effect [0.03]). The mean change in HbA_{1c} level for regular reviews was significantly different from irregular reviews.

Discussion

This study found improvements in process and clinical outcomes for patients for whom GPMPs or GPMPs and TCAs were created, particularly when these were followed up by GPMP or TCA reviews.

For managing diabetes, the proportion of ACOC tests completed gives an indication of quality of care.[26] This measure increased by over 15% in magnitude for patients on a GPMP or GPMP and TCA. One explanation is that placing patients on a GPMP or TCA helps the GP implement best-practice guidelines and encourages the patient to adhere to these. cdmNet also reminds patients to make and attend appointments. As almost 90% of the patients in our study had both a GPMP and TCA, it was not possible to determine the effect of creating a TCA in addition to a GPMP.

Patients with a GPMP or GPMP and TCA also showed significant improvement in the clinical outcomes of HbA_{1c}, total cholesterol and LDL cholesterol levels, and BMI, although the HbA_{1c} measure was not significant for the GPMP group. This suggests that a GPMP alone may be insufficient to affect HbA_{1c} levels. These improvements could be associated with the additional support, such as education on nutrition and weight management, that multidisciplinary teams provide.

GPMP and TCA reviews had a significant effect on the process outcome, with the proportion of ACOC tests completed increasing in magnitude by over 18% for patients receiving irregular reviews and 26% for those receiving regular reviews. In contrast, there was no improvement for patients who had no reviews. This important finding demonstrates how critical the follow-up and review process is for improving quality of care.

While both regular and irregular reviews were associated with improvements in clinical outcomes, improvements in key diabetes measures such as HbA_{1c} and LDL cholesterol levels were only found in patients who had regular reviews. The improvement in HbA_{1c} levels was statistically significantly different between patients who

3 Comparison of process and clinical outcomes before and after creation of a General Practice Management Plan (GPMP), by regularity of review

Outcome by review group	Patients*	Mean (SD)		Mean improvement (95% CI)	*P*	Effect size†
		Before GPMP	After GPMP			
Proportion of ACOC tests completed						
No reviews	116	53.4% (31.7%)	51.6% (34.7%)	− 1.8% (− 10.5% to 6.8%)	0.67	na
Irregular reviews	270	59.2% (32.1%)	77.6% (24.8%)	18.4% (13.7% to 23.0%)	< 0.001	large
Regular reviews	191	58.9% (31.6%)	85.0% (22.2%)	26.1% (20.5% to 31.8%)	< 0.001	large
HbA_{1c} level (mmol/mol)						
No reviews	31	56.3 (12.9)	53.1 (10.5)	3.2 (− 0.7 to 7.1)	0.12	na
Irregular reviews	109	53.0 (12.5)	53.7 (11.4)	− 0.7 (− 3.1 to 1.7)	0.57	na
Regular reviews	81	57.7 (19.3)	53.0 (9.6)	4.8 (1.0 to 8.5)	< 0.05	moderate
Total cholesterol level (mmol/L)						
No reviews	21	4.6 (1.0)	4.5 (1.1)	0.1 (− 0.3 to 0.4)	0.67	na
Irregular reviews	60	4.4 (1.1)	4.1 (0.9)	0.3 (0.0 to 0.5)	< 0.05	moderate
Regular reviews	42	4.8 (1.4)	4.5 (1.1)	0.3 (0.1 to 0.6)	< 0.05	moderate
LDL cholesterol level (mmol/L)						
No reviews	20	2.7 (1.0)	2.6 (1.1)	0.1 (− 0.2 to 0.5)	0.38	na
Irregular reviews	53	2.4 (0.8)	2.2 (0.8)	0.2 (0.0 to 0.3)	0.05	na
Regular reviews	39	2.8 (1.1)	2.4 (0.9)	0.4 (0.1 to 0.7)	< 0.01	large
Body mass index (kg/m^2)						
No reviews	28	31.8 (5.5)	31.6 (5.6)	0.2 (− 0.8 to 1.2)	0.68	na
Irregular reviews	108	32.5 (6.7)	31.9 (6.7)	0.6 (0.2 to 0.8)	< 0.01	moderate
Regular reviews	100	31.8 (6.1)	31.4 (5.8)	0.4 (0.0 to 0.8)	0.05	small
Systolic BP (mmHg)						
No reviews	42	137.4 (18.8)	138.1 (20.5)	− 0.7 (− 6.9 to 5.3)	0.80	na
Irregular reviews	149	139.3 (16.1)	137.1 (14.8)	2.2 (− 1.1 to 5.4)	0.20	na
Regular reviews	121	135.0 (15.5)	135.4 (15.6)	− 0.4 (− 3.7 to 2.7)	0.76	na
Diastolic BP (mmHg)						
No reviews	42	74.6 (9.7)	74.6 (10.8)	0.0 (− 3.2 to 3.1)	0.99	na
Irregular reviews	149	74.5 (10.1)	73.9 (9.3)	0.6 (− 1.1 to 2.4)	0.48	na
Regular reviews	121	76.0 (10.4)	74.0 (9.5)	2.0 (0.0 to 4.0)	< 0.05	small

ACOC = annual cycle of care. HbA_{1c} = glycated haemoglobin. LDL = low-density lipoprotein. BP = blood pressure. na = not applicable. * Number of patients differs for clinical outcomes as not all patients had all clinical tests completed. † Determined by calculating eta-squared, where 0.01 is considered a small effect, 0.06 is moderate and 0.14 is large.[25] ◆

received irregular and regular reviews, and the magnitude of improvement was less for patients who received no reviews than for those with regular reviews. These findings reinforce the importance of GPMP and TCA reviews, especially when carried out regularly.

Another finding was the possible importance of the web-based management tool, cdmNet, in improving adherence to best-practice guidelines for chronic disease management. Patients using cdmNet were four times more likely to have their GPMP or TCA followed up through regular reviews than the national average (80% v 20%, respectively, within a 13-month period, based on the recommended frequency of three reviews for every GPMP or TCA).[27]

For patients with diabetes, demonstrating improvement in clinical measures of diabetes control, obesity, BP and lipid levels demonstrates not just a stabilisation of their diabetes but a reduction in their disease burden. For a single patient, small changes are not generally clinically meaningful, but in this study the averaged results of the group showed a significant and meaningful improvement.

Our study has some limitations. The patients were not randomly chosen but were prospectively assessed from among users of cdmNet. There was no control group, and possible bias and confounders could affect the outcomes. In addition, because the ACOC guidelines were not followed for all patients, data for each of the clinical outcomes were available for only about 20%–60% of participants. Therefore, the conclusions regarding clinical outcomes relate only to the subset of patients who had measurements available from both before and after the GPMP for analysis. The fact that data were not collected for many patients because of this divergence from the guidelines is an important finding and points to the need for future research to investigate the reasons for this.

This study provides an evidence base to support creating GPMPs and TCAs and conducting formal reviews at regular intervals. It indicates that the use of web-based tools for supporting collaborative care management for patients with diabetes has the potential for transformative change in best-practice care. Further analysis with a longer follow-up period would be beneficial in confirming these results. In the future, longitudinal data from cdmNet will allow extensive analyses that take patients' disease and behavioural complexities into consideration, as well as analyses into health provider behaviour.

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Competing interests: Michael Georgeff is the CEO and Marienne Hibbert is the clinical integration manager of Precedence Health Care, which developed cdmNet.

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