Quality indicators of diabetes care: an example of remote-area Aboriginal primary health care over 10 years

Abstract

Objectives: To describe service characteristics of Derby Aboriginal Health Service (DAHS) and document diabetes management activities and intermediate clinical outcomes for Aboriginal patients with type 2 diabetes.

Design, setting and patients: Retrospective audit of records for patients > 15 years old who had a confirmed diagnosis of type 2 diabetes, received primary health care from DAHS for at least 6 continuous months between 1 July 1999 and 30 June 2009, resided in the Derby area and were not on renal replacement therapy.

Main outcome measures: Electronic records of blood pressure (BP), glycated haemoglobin (HbA1c) level, weight, albumin–creatinine ratio, creatinine level or estimated glomerular filtration rate, lipid levels and smoking status during each audit year; and proportions of patients who met clinical targets for HbA1c, BP and cholesterol.

Results: Over the 10 years, the proportion of clinical care activities undertaken according to regional protocols increased significantly, with very high levels recorded in the last 3 years (at least 70% of patients had each activity recorded). There were significant improvements in systolic BP, diastolic BP and cholesterol levels over the 10 years (P < 0.001 for all). In the final year, 69% of patients had at least half their BP measurements < 130/80 mmHg and 83% had median annual cholesterol levels of < 5.5 mmol/L. There were small improvements in HbA1c levels that approached statistical significance (P = 0.05). In the final year, 34% of patients had median annual HbA1c levels of < 7.0%.

Conclusions: This study shows that diabetes monitoring and outcomes can be improved and maintained over a 10-year period in a well supported remote Aboriginal community-controlled health service setting.

Methods

This study covers 10 audit years, from 1 July 1999 to 30 June 2009. It includes Aboriginal and Torres Strait Islander patients seen at DAHS who had type 2 diabetes mellitus, were > 15 years old, received primary care from DAHS for at least 6 continuous months, lived in or near Derby, and were not on renal replacement therapy.

The final study population was determined by carrying out a comprehensive retrospective review of paper and electronic records. During review of these records, the date of diagnosis of diabetes for each patient was confirmed as far as possible.

Data extraction and cleaning

In 2007, DAHS staff checked the accuracy of patients’ electronic records against paper records. Results incorrectly recorded or not entered into Project Ferret (Pen Computer Systems), a patient information and recall system, were corrected. From 2007, data entry was monitored more closely. At the end of 2009, data were extracted from Project Ferret and transferred into Excel 2003 (Microsoft). Outliers were identified and data entry errors were corrected. Fewer electronic creatinine results than expected were observed during the audit years 2005–06 and 2006–07 and further corrections, based on paper records, were made. The data were then imported into Stata, version 11 (StatCorp).

Service characteristics

The major activities and factors likely to have had a direct impact on the quality of care provided to patients with diabetes at DAHS are listed in Box 1.

Quality indicators of diabetes care

The occurrence of activities relating to diabetes management was assessed over the 10 audit years. Measures...
expected to be recorded at least 6 monthly (blood pressure [BP], glycated haemoglobin [HbA1c] level, weight) were assessed over the last 6 months of each audit year (1 January to 30 June). Measures expected to be recorded annually (albumin–creatinine ratio [ACR], creatinine level or estimated glomerular filtration rate [eGFR], lipid levels, smoking status) were assessed over the full audit year.

Clinical outcome measures
Clinical outcome measures were assessed each audit year. Overall median HbA1c and cholesterol levels were determined using medians for individual patients during each audit year. Also, the proportions of patients with median HbA1c and cholesterol levels meeting recommended targets were determined for each audit year. As the recommended target for BP includes meeting the target for both systolic (≤ 130 mmHg) and diastolic (≤ 80 mmHg) measurements, the proportions of patients with at least half their electronic measurements meeting both targets were determined for each audit year.

Patients were classified as having proteinuria and/or kidney disease if they had at least two ACR results > 3.6 mg/mmol without obvious infection, creatinine or eGFR results suggestive of chronic kidney disease, and/or were assigned to a proteinuria or chronic kidney disease care plan.

Statistical analysis
A non-parametric test for trend across ordered groups was used to assess trend over time. Analyses were performed using Stata, version 12 (StataCorp). \( P < 0.05 \) was considered statistically significant.

Ethics approval
Ethics approval was obtained from the Western Australian Aboriginal Health Information and Ethics Committee and exemption from ethics review was obtained from the Human Research Ethics Committee of the University of Western Australia.

Results
After identifying 517 patients with results suggestive of diabetes, 263 were excluded for not meeting the selection criteria (Box 2). Participants who commenced renal replacement therapy, stopped receiving primary care from DAHS or died were not included after these events occurred.

The final study population of 254 patients contributed a total of 1502 patient-years of care. Of this patient population, 107 (42%) were diagnosed after becoming a regular patient at DAHS, 195 (77%) regularly attended DAHS (as determined by the clinic) from when they entered the study until they were included or the study finished, 166 (65%) were included in at least 5 audit years, 35 (14%) were included in all 10 years and 45 (18%) were included in both the first and last years. The median age of patients at the time of entering the study was 46 years (range, 15–84 years); 159 patients (63%) were female, 185 (73%) had or developed proteinuria and/or kidney disease, 12 (5%) commenced renal replacement therapy and 41 (16%) died.

Service activity for BP, HbA1c, weight, ACR, creatinine level or eGFR, lipid levels and smoking status increased significantly over time \( (P < 0.002 \text{ for trend over 10 years}; \text{Box 4}) \). Median annual systolic and diastolic BP values and cholesterol levels decreased significantly over time \( (P < 0.001 \text{ for trend over 10 years}; \text{Box 4}) \). The proportion of patients who met currently recommended targets for median annual cholesterol and who had at least half their recorded results for BP ≤ 130/80 mmHg also significantly increased over time \( (P < 0.001 \text{ for trend over 10 years}; \text{Box 4}) \). Improvements in glycaemic control over time approached statistical significance \( (P = 0.05 \text{ for trend over 10 years}; \text{Box 4}) \).

In the last year of the study, the proportions of patients who met the old targets of HbA1c < 7.0% and BP < 130/80 mmHg were 33% and 53%, respectively. Previously reported data on care quality indicators and clinical outcome measures relating to diabetes care in other Australian populations are included in Box 3 and Box 4, respectively.
2 Selection process used to determine DAHS study population

517 patients ≥15 years old who had attended DAHS from 1 July 1999 to 30 June 2009 were identified as having results suggestive of diabetes, indicated by one or more of the following:

- on a diabetes care plan
- diagnosis of diabetes on paper records
- taking hypoglycaemic medication
- fasting plasma glucose level ≥7.0 mmol/L
- random plasma glucose level ≥11.1 mmol/L

100 patients did not have confirmed type 2 diabetes
- 31 did not have diabetes
- 67 had only one abnormal test result relating to diabetes and had not been formally diagnosed
- 2 had type 1 diabetes

417 patients had confirmed type 2 diabetes

143 patients did not receive regular care
- 78 received primary care elsewhere
- 57 were visitors and not Derby area residents
- 8 received < 6 months care from DAHS after being diagnosed with diabetes

274 patients had confirmed type 2 diabetes and were regular DAHS patients

20 patients were excluded from the study for other reasons
- 17 were not Indigenous Australians
- 3 commenced RRT before being diagnosed with diabetes

254 patients were included in the study

DAHS = Derby Aboriginal Health Service. RRT = renal replacement therapy.

Discussion

To our knowledge, this is the first published Australian study looking at 10 years of diabetes management in primary care at an individual health service. We showed significant and sustained improvements in health monitoring and intermediate outcomes at DAHS.

Improved care processes, improved control of BP and prevention of complications that result in hospitalisation have previously been demonstrated in Aboriginal community-controlled health services over short periods when adequate clinical support and appropriate management structures have been provided.\(^5\,\text{a},\text{f}\)

The main strength of our study is that we used all recorded results for patients over a 10-year period and analysed clinical outcomes according to clinical targets from current guidelines.\(^11\) Comparisons can be made with other studies, but caution is required because of the different methods and clinical targets used. The Australian Primary Care Collaboratives program operates through “waves” of 20–200 practices working together over 18 months,\(^8\) while the Audit and Best Practice for Chronic Disease project randomly selected 30 patients with diabetes from each of 62 services and used the most recent value for each patient within 12 months of the audit.\(^9\) The currently recommended target for BP is ≤130/80 mmHg,\(^11\) but previously it was <130/80 mmHg. In our study, this meant that the proportion of patients with BP complying with target values changed from 53% to 69% in the final year. Similar changes occurred in the Australian National Diabetes Audit and Benchmarking project (54% of patients with BP ≤130/80 mmHg in 2009, compared with 38% of patients with BP <130/80 mmHg in 2006).\(^17,20\) The change in HbA1c target (<7.0% to ≤7.0%) made less difference in our study (33% v 34% of patients meeting the respective targets in the final year).

Limitations of this study included underreporting. In the earlier years, this may have contributed to the trend of improvements over time. As part of the CQI processes at DAHS, staff checked the accuracy of the measures reported in this article and updated electronic records, but some bias due to underreporting in the earlier years is likely. Our data on the duration of diabetes may also be biased because of difficulties in determining when diabetes was diagnosed in patients who were diagnosed at other health services. This study was also limited to data that were available: important outcomes, such as hospital admissions and medication usage, were not recorded electronically and more sophisticated measures relating to quality of life were not collected.

Our results compare well with those of other Australian studies of patients with diabetes. In terms of the intermediate outcome measures that we examined, BP was better controlled than in other Australian studies, including mainstream general practice studies (69% v 28%–54%\(^8\text{a},\text{f},\text{H}\)) and cholesterol levels were similar or better (83% v 53%–86%\(^9\text{a},\text{f},\text{H}\)). Glycaemic control was near the best reported in Indigenous Australian studies (34% v 22%–32%\(^1,\text{a},\text{f},\text{H}\)) but not as good as has been reported in studies of mainstream general practice (37%–57%\(^8\text{a},\text{f},\text{H}\)).

Despite the improvements we have shown, there is substantial room for further improvements in clinical outcomes. The focus on preventing or delaying kidney failure in the Kimberley may partly explain why BP control was particularly good in this study. Glycaemic control is considered more difficult to achieve compared with other measures\(^6\) and only small improvements in glycaemic control were evident in this study, although even small improvements can be clinically useful. Further investigation is planned to model HbA1c measurements over time for individuals and determine factors that are likely to

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3 Proportions of DAHS study population for whom diabetes management activities were recorded in the electronic patient and information recall system during the 10 audit years, and corresponding values from the final years of other studies

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<tbody>
<tr>
<td>Total no. of patients</td>
<td>582</td>
<td>816</td>
<td>603</td>
<td>699</td>
<td>808</td>
<td>982</td>
<td>943</td>
<td>1232</td>
<td>1349</td>
<td>1227</td>
<td>&lt;0.001</td>
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<tr>
<td>No. of patients included in study</td>
<td>80</td>
<td>129</td>
<td>136</td>
<td>136</td>
<td>164</td>
<td>176</td>
<td>172</td>
<td>172</td>
<td>177</td>
<td>173</td>
<td>&lt;0.001</td>
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<tr>
<td>Median time since diagnosis, at 30 June (years)</td>
<td>1.3</td>
<td>2.2</td>
<td>3.0</td>
<td>4.0</td>
<td>4.4</td>
<td>5.4</td>
<td>6.0</td>
<td>6.8</td>
<td>7.5</td>
<td>8.5</td>
<td>&lt;0.001</td>
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Proportion of patients for whom activity was recorded

| Blood pressure | 74% | 77% | 64% | 71% | 75% | 74% | 74% | 81% | 82% | 80% | <0.001 |
| HbA1c | 53% | 60% | 68% | 66% | 69% | 66% | 66% | 72% | 75% | 70% | <0.001 |
| Weight | 53% | 58% | 49% | 45% | 64% | 61% | 66% | 75% | 75% | 79% | <0.001 |
| Albumin–creatinine ratio | 45% | 47% | 51% | 54% | 77% | 67% | 65% | 77% | 79% | 81% | <0.001 |
| Creatinine level or eGFR | 68% | 74% | 72% | 85% | 83% | 80% | 75% | 87% | 89% | 94% | <0.001 |
| Lipid levels | 56% | 62% | 53% | 67% | 72% | 68% | 70% | 80% | 79% | 91% | <0.001 |
| Smoking status | 11% | 45% | 14% | 48% | 60% | 49% | 38% | 70% | 80% | 85% | <0.001 |
| All seven activities | 0 | 19% | 6% | 14% | 29% | 22% | 18% | 47% | 47% | 50% | <0.001 |

Proportion of patients for whom activity was recorded

| Mean no. of activities recorded | 2.9 | 4.2 | 3.6 | 4.1 | 4.9 | 4.3 | 4.3 | 5.3 | 5.4 | 5.5 | <0.001 |

4 Clinical outcome measures of DAHS study population and proportions of those with outcome values that met currently recommended targets during the 10 audit years, and corresponding values from the final years of other studies

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<tbody>
<tr>
<td>Systolic BP (mmHg)</td>
<td>135</td>
<td>134</td>
<td>130</td>
<td>128</td>
<td>124</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>85</td>
<td>80</td>
<td>81</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>78</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>8.2, 66</td>
<td>8.7, 72</td>
<td>8.2, 66</td>
<td>77, 61</td>
<td>81, 65</td>
<td>83, 67</td>
<td>81, 65</td>
<td>80, 64</td>
<td>76, 60</td>
<td>80, 64</td>
<td>0.05</td>
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<tr>
<td>Cholesterol (mmol/L)</td>
<td>5.0</td>
<td>5.0</td>
<td>5.1</td>
<td>4.9</td>
<td>5.0</td>
<td>4.9</td>
<td>4.6</td>
<td>4.7</td>
<td>4.6</td>
<td>4.7</td>
<td>&lt;0.001</td>
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Proportion of study population with median values that met targets

| BP ≤ 130/80 mmHg | 38% | 46% | 44% | 53% | 66% | 66% | 67% | 75% | 70% | 69% | <0.001 |
| HbA1c ≤ 7.0% (≤ 53 mmol/mol) | 26% | 28% | 34% | 34% | 31% | 24% | 32% | 36% | 39% | 34% | 0.05 |
| Cholesterol < 4.0 mmol/L | 4% | 12% | 8% | 22% | 16% | 18% | 16% | 21% | 24% | 25% | <0.001 |
| Cholesterol < 5.5 mmol/L | 64% | 63% | 71% | 76% | 72% | 76% | 75% | 83% | 83% | 0.001 |

Contribute to individuals attaining and maintaining good glycaemic control.

From 2012, reporting of national key performance indicators (nKPIs) is a requirement for Aboriginal community-controlled health services under the National Indigenous Reform Agreement. The nKPIs include the HbA1c and BP measures for patients with diabetes that we included in our study. It is hoped that the use of nKPIs will result in comparable data from Aboriginal health services being produced.

Over the decade covered by our study, a number of policy changes were introduced at a national level which may have had an enabling role for DAHS in chronic disease care for its patients. These include the introduction of Medicare reimbursement for comprehensive Aboriginal and Torres Strait Islander preventive health checks and for chronic disease management planning and follow-up, and access to medications at low or no cost for Aboriginal people in remote areas (section 100 of the National Health Act 1953 [Cwlth]).

DAHS had regular changes in health staff and management, but it also had significant consistency in senior staff over the decade we studied. The service also had improving resources over the study period, although resourcing started from a low base. DAHS maintained its community connections with a consistent board of directors, long-term employment of Aboriginal health workers and nurses, and a focus on genuine comprehensive primary health care for its patients.

Sustainability of chronic disease programs has previously been reported to be a major challenge in remote Aboriginal and Torres Strait Islander health settings. This study shows that diabetes monitoring and outcomes can be improved and maintained over a 10-year period in a remote Aboriginal community-controlled health service setting.

DAHS = Derby Aboriginal Health Service. PHC = primary health care. HbA1c = glycated haemoglobin. eGFR = estimated glomerular filtration rate. * For trend over 10 years. † Australian Aboriginal and Torres Strait Islander patients treated in PHC settings. ‡ General Australian population treated in secondary care settings. § General Australian population treated in primary health care settings. ¶ Process recorded from 1 January to 30 June during each audit year. ◆ Process recorded from 1 July to 30 June during each audit year.
Acknowledgements: This study was initiated and funded by DAHS as part of their CQI program, with in-kind contributions including independent analysis by the Rural Clinical School of WA, at the University of Western Australia, and the Kimberley Aboriginal Medical Services Council. We had full access to all the data (including statistical reports and tables) in the study. We thank staff at DAHS for their efforts in cleaning up the database used in this study. We thank Max Bulsara and Sharon Evans for expert statistical advice and Sophie Couzos and Ian Ring for critical reading of this article.

Competing interests: Carmel Nelson was the Senior Medical Officer (from 1999 to 2005) at DAHS. Vicki O’Donnell is the Chief Executive Officer (from 2002 to present) of DAHS.

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