Point-of-Care Testing in Aboriginal Hands—A Model for Chronic Disease Prevention and Management in Indigenous Australia

Mark D. S. Shephard, MSc, MAACB,* Beryl C. Mazzachi, MSc,* Anne K. Shephard, BSc,* Tony Burgoyne,† Angela Dufek,† Jacquie Ah Kit,† David Mills, FRACGP, MD,‡ and David Dunn, BMBS, DRACOG, FRACGP§

Abstract: Point-of-care testing (POCT) has a critical niche in rural and remote indigenous Australia where geographic isolation from laboratory services is common, the resultant turnaround of laboratory results is often slow, and the burden of chronic disease is very high. This paper describes a POCT program called Point-of-Care in Aboriginal Hands, which delivers POCT services for chronic disease prevention and management to 4 rural and remote Aboriginal medical services in Australia. Aboriginal health workers were trained as POCT operators of the DCA 2000 (Bayer Diagnostics, Tarrytown, NY) and the Cholestech LDX lipid analyzer (Cholestech, Hayward, Calif). Prevalence rates in the general community for diabetes (17%), microalbuminuria (20%), and obesity (48%) were between 2 to 3 times the national average. Statistically significant reductions in hemoglobin A1c (HbA1c) of 0.7% and 1.2% (paired t test, P < 0.05) in type 2 diabetes patients (n = 45 and 24) after the introduction of POCT at 2 services confirmed that POCT had been an effective tool in improving clinical outcomes. Community acceptance of POCT was extremely high among key stakeholder groups (doctors, Aboriginal POCT operators and diabetes patients) interviewed and surveyed in the program. The percentage of patients who were satisfied with their diabetes service after the introduction of POCT rose significantly from 64% to 88%, whereas the percentage unsatisfied or unsure about their diabetes service fell from 8% to 3% and 28% to 9% after POCT (Fisher exact test, χ² = 9.7; P = 0.03). The POCT proves versatile and adaptable in the varied mix of participating communities, which came from widely divergent geographical locations.

Key Words: Aboriginal health, chronic disease, point-of-care testing, prevention and management

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A ustralia has a total population of 20 million people, 30% of whom live in rural and remote Australia.1 In these areas, there is greater geographic isolation and an increasingly larger indigenous component of the population. A total of 38% of Aboriginal people live in rural and remote Australia, with the remainder making up only 1% of the urban population.2 The generally poorer health status of people living in rural and remote Australia is particularly exacerbated in the indigenous community sector.3–4 In relation to chronic disease, Aboriginal people have approximately 15 times higher mortality rates due to diabetes than non-Aboriginal people, escalating rates of end-stage renal disease in the range 770 to 1300 per million have been recorded in the desert regions of Australia, and rates of cardiovascular mortality in the younger adult Aboriginal population between 25 and 44 years of age are 10 times higher than the national average.5–9

During the past 8 years, the Community Point-of-Care Services (CPS) unit within the Flinders University Rural Clinical School has developed and implemented several point-of-care testing (POCT) models for chronic disease in the Australian Aboriginal health sector. The national Quality Assurance for Aboriginal medical services program (QAAMS) focuses on diabetes management, whereas the Umoona Kidney Project investigated the use of POCT for risk assessment and management of renal disease.10–14 This paper describes a further POCT model for chronic disease called Point-of-Care Testing in Aboriginal Hands. This program is a partnership between the Flinders CPS unit and 4 Aboriginal medical services (AMS) from Port Lincoln, the Riverland, and Meningie in South Australia and Kalgoorlie in Western Australia. Three of the participating AMS are rural, and one is remote according to the Australian government’s classification system for rurality (rural remote metropolitan area).15

The program has a broad chronic disease focus, with both risk assessment and management arms. There is wider
use of POCT technology in this program than in our other models, with Aboriginal health workers trained as POCT operators in the use of both the DCA 2000 (Bayer Diagnostics, Tarrytown, NY) and the Cholestech LDX lipid analyzer (Cholestech, Hayward, Calif). There is a strong local community focus, involving teams of health professionals from each service and engaging community members to foster a strong sense of community ownership.

This paper describes the unique features of this model and attempts to answer the following research questions. Can POCT work effectively across Aboriginal medical services with differing sizes and levels of staff? What were the overall chronic disease risk profiles in these Aboriginal communities? Could POCT be integrated into the clinical management of patients with chronic diseases? How well was POCT accepted by doctors, POCT operators, and patients with chronic disease?

**METHODS**

**Participating Communities**

Each of the 4 participating Aboriginal medical services was located between 150 and 650 km by road from the nearest capital city. Two were situated in coastal areas, one on a major inland waterway, and the other on the fringe of a large desert region. One site was very small with 1 health worker and 2 doctors servicing a small community. Two sites were well-resourced, servicing communities of several hundred people. The remaining site had a very large infrastructure, delivering health care not only to a large “town” population but also providing outreach services to a number of remote locations. This varied mix of communities provided a challenging environment for POCT.

**Ethics Approval**

Ethics approval to conduct the program was obtained from the Aboriginal Health Research Ethics Committee of South Australia and the Flinders Medical Centre’s Committee on Clinical Investigation.

**Community Consultation**

Before commencing the program, a series of meetings were held with members of each local Aboriginal community and with each participating medical service to discuss and formulate the aims and objectives of the program. A culturally appropriate information sheet about the program was also developed for each community and disseminated widely to community members.

**Organization and Management of POCT Services**

Clinical governance for POCT resided with the senior medical officer at each service. The program manager (first author) was responsible for overall supervision and management of POCT services, notably education and training of Aboriginal POCT operators and ensuring compliance with quality management procedures. Where possible, a POCT working group was established comprising the medical officer, program manager, supporting CPS scientist, and practice staff including, for example, the nurse-in-charge, senior Aboriginal health worker, nutritionist, diabetes educator, and information technology personnel. In this way, as many allied health professional staff as possible were aware of the POCT program and could support and encourage the health worker(s) as the on-site POCT operator(s).

With the program manager based at Flinders University, regular on-site visits were critical to maintain rapport with the health professional teams and the broader communities. During field visits, training was delivered, quality management results reviewed, reagent audits conducted, and summaries of results presented to the health team and the service’s board of directors. Presentations were also made to the local community, and community functions and health promotion activities were attended. Community posters were also prepared to promote local ownership.

**Training for Aboriginal Health Workers in the Use of POCT Instruments**

Aboriginal health workers from each health service participated in a series of continuing education and training sessions delivered by the program manager and scientists from the Flinders’ CPS unit. Health workers were provided with a culturally appropriate understanding of chronic disease, its burden on Aboriginal Australians, a description of the pathology tests that can be measured by POCT to detect and manage chronic diseases, and basic interpretation of patient POCT results.

Systematic hands-on training and practical instruction in how to conduct patient POCT and quality management testing procedures (internal quality control and, where available, external quality assurance testing) was also provided to health workers from participating services in an on-going sense. A series of color posters providing step-by-step guides to the operation of each POCT instrument and the performance of patient and quality management testing were also produced for each service.

**POCT Technology**

The 2 POCT instruments used in this program were the Bayer DCA 2000 (Bayer Diagnostics, Tarrytown, NY) and the Cholestech LDX lipid analyzer (Cholestech, Hayward, Calif). The Bayer DCA 2000 measured hemoglobin A1c (HbA1c) on a capillary whole blood sample in 6 minutes and urine albumin:creatinine ratio (ACR) on 40 μL of first morning urine in 7 minutes. HbA1c is an established marker of long-term diabetes control in patients with diabetes. Urine ACR is not only a sensitive marker for early renal disease that can be used for risk assessment and management but also predicts cardiovascular disease. The Cholestech lipid analyzer measures a full lipid profile (total cholesterol, triglyceride, high-density lipoprotein [HDL] cholesterol, and calculated low-density lipoprotein [LDL] cholesterol) and glucose on 35 μL of whole blood in approximately 5 minutes. The analytical performance of both these POCT instruments has been previously validated by the Flinders CPS unit.

**Community Risk Assessment**

Chronic disease risk assessment was conducted on a voluntary basis for adult community members, after their
prior informed consent. A risk assessment algorithm was developed, based on current best practice guidelines, and included urine ACR, lipid and glucose measurements by POCT as well as blood pressure, age, body mass index, personal and family history, smoking status, and alcohol consumption. With specific regard to POCT measurements, each patient was asked to provide a first morning urine sample to be tested by an Aboriginal health worker for urinalysis (by dipstick) and urine ACR (on the DCA 2000). The Aboriginal health worker also took a capillary (finger-prick) whole blood sample for measurement of HbA1c (on the DCA 2000) and fasting lipids and glucose (on the Cholestech). All risk assessment results were recorded by the health worker on a single-page pro forma, which the patient then took to the doctor. Results were also entered into the service’s patient management system and fixed to the CPS unit where subsequent community risk profiling was conducted.

Whereas most risk assessments were conducted in the service’s clinic, the opportunity was taken wherever possible to conduct POCT in the community setting.

Management of Chronic Disease

Patients identified at risk for chronic disease were managed locally, with POCT being an integral component of their management strategy and conducted at a frequency consistent with best practice management guidelines. With the permission of 2 services, the Flinders CPS unit tracked the management of selected patients with type 2 diabetes to assess the impact of POCT on clinical outcomes among individuals and groups of patients with chronic disease. At the first service, HbA1c POCT results were recorded on type 2 diabetes patients who attended their clinic across a 12-month period from 2003 to 2004. At the second service, POCT was linked to chronic condition self-management care planning, and selected POCT results were monitored on these patients from 2003 to 2005, as they entered the care planning process. Care planning provided a structured program for the patient to set personal, behavioral, lifestyle, and medication goals in conjunction with the doctor and health workers.

Community Acceptance of POCT

Community acceptance was assessed by 3 stakeholder groups, namely doctors, Aboriginal health workers (as POCT operators), and patients with chronic disease (specifically those with type 2 diabetes). The principal doctor and Aboriginal POCT operator from each participating service were interviewed during the production of a CD-ROM for the program. More broadly, all stakeholder groups were invited to complete separate questionnaires developed by the program manager, in conjunction with the Flinders University Centre for Biostatistics and Epidemiology. The questionnaires, which were also part of a larger survey for the national QAAMS HbA1c program, contained a series of short statements or questions, based on the 5-point Likert scale. Respondents were asked to rate their level of agreement or disagreement with the statement or question posed. The results of the questionnaires were analyzed by the program manager and an epidemiologist from the Flinders University Centre for Biostatistics and Epidemiology using the Epidata software (www.epidata.dk).

Quality Management for POCT

To oversee the analytical performance of POCT in the field and to ensure the highest standards of methodological rigor were maintained, POCT operators were required to conduct both internal quality control testing (on both the DCA 2000 and Cholestech) and participate in external quality assurance testing (on the DCA 2000) as part of the national QAAMS Program for HbA1c and urine ACR testing. All 4 services had been active members of the QAAMS Program since 2001. A quality assurance program for POCT lipid testing in Aboriginal medical services is not currently available.

RESULTS

Community Risk Assessment

Six hundred and twenty-six risk assessments were carried out across the 4 AMSs from 2002 to 2004. The overall prevalence of individual risk factors found in the general adult population in 3 of the communities, together with age and sex profiles, is shown in Table 1. Risk assessments at service 4 (n = 246) were conducted on persons specifically referred to the service’s chronic disease clinic. Prevalence rates at this service were thus overestimated in this more selected population and have been excluded from this table.

The prevalence of type 2 diabetes (self-reported and/or capillary glucose, >11 mmol/L) in communities 1 to 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Community 1</th>
<th>Community 2</th>
<th>Community 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean ± SE</td>
<td>Range</td>
<td>Aged 15–29, %</td>
</tr>
<tr>
<td>Mean</td>
<td>41 ± 1.1</td>
<td>16–80</td>
<td>37</td>
</tr>
<tr>
<td>Range</td>
<td>43 ± 1.3</td>
<td>15–83</td>
<td>20</td>
</tr>
<tr>
<td>Aged older than 45, %</td>
<td>43 ± 1.4</td>
<td>17–74</td>
<td>24</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male:Female ratio, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 30–44, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged older than 45, %</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Risk assessments at service 4 (n = 246) were conducted on persons who were specifically referred to the service’s chronic disease clinic, and therefore, prevalence rates do not reflect those of the general community. They were therefore excluded from this table.

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ranged from 15% to 18%. Microalbuminuria (urine ACR between 3.4 and 34 mg/mmol measured by POCT) was detected in approximately 20% of people assessed. Abnormal lipids (total cholesterol, >5.5 mmol/L measured by POCT) were found in over one third of people, whereas rates of hypertension (blood pressure, >140/90 mm Hg or >130/85 mm Hg for diabetic patients) were approximately 30%. Almost half of all persons assessed were obese (body mass index, >30 kg/m²). More than 50% were current smokers. Significant sex differences in prevalence rates were observed at 2 services for cholesterol (service 1, men 45% and women 28%; service 2, men 59% and women 32%) and obesity (service 1, men 30% and women 49%; service 2, men 19% and women 53%) (χ² test, P < 0.05 in each case).

Community risk assessments were carried out at a range of different locations outside the main service clinic, including at a local ecotourism center, an adult education college, an adult women’s center (as part of a nutrition health promotion activity), the local community fair and home visits. At 1 service, a bus was renovated to accommodate the POCT instruments and provide a mobile POCT testing service for community members throughout the region. An eye check for diabetes patients was also available on the bus. The local Aboriginal POCT operator and doctor traveled on the bus to provide this mobile service.

### Management of Chronic Disease

At service 1, a group of 45 Aboriginal patients with type 2 diabetes had POCT performed at baseline (when POCT commenced) and at 12 months after the introduction of POCT. There was a statistically significant reduction in HbA1c across this period (Table 2). Categorization of patients into those who achieved target or controlled glycemia (HbA1c, <7% and <8%, respectively) and those exhibiting poor diabetes control (HbA1c, >10%) also revealed a trend toward better glycemic control after POCT, although these trends did not reach statistical significance due to small patient sample size (χ² test, P > 0.05).

At the second service, 36 patients with type 2 diabetes participated in chronic condition self-management care planning. Twenty-four patients were clinically assessed by the service’s doctor and chronic disease coordinator as “self-managing well” (SMW); that is, they attended their clinic appointments, had regular POCT, and were compliant in taking medication. They were managed on care plans for a median of 18 months (up to a maximum of 33 months). The remaining 12 patients were classed as “having difficulties with self-management” (SMD) because they were unable to regularly attend the clinic and have POCT, they were generally noncompliant in taking medication or they had other associated illnesses or social and emotional issues that impinged negatively on their ability to participate in care planning. This group had been on care plans for a median of 15 months (up to a maximum of 30 months). Selected clinical outcome measures in the SMW and SMD groups are compared in Table 3. The mean HbA1c of the SMW group fell significantly by 1.2% (P = 0.0001; paired t test), whereas the mean of the SMD group rose by 0.9% (P = 0.097; paired t test). The renal profiles of the 2 groups, as assessed by their urine ACR status, were very different with the high rate of macroalbuminuria in the SMD patients of particular concern. There was a statistically significant reduction in mean total and LDL cholesterol (as measured by POCT) of 1.0 and 0.7 mol/L (P = 0.02 and 0.03, paired t test),

### TABLE 2. Improvement in Glycemic Control in a Group of 45 Type 2 Diabetes Patients After the Introduction of POCT in Service 1

<table>
<thead>
<tr>
<th>Observation</th>
<th>Baseline POCT (n = 45)</th>
<th>12 Months After POCT (n = 45)</th>
<th>Paired Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in HbA1c (mean ± SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>9.5% ± 2.1%</td>
<td>8.8% ± 1.9%</td>
<td>0.7%*</td>
</tr>
<tr>
<td>Achieving target glycemia (HbA1c, &lt;7%)</td>
<td>18</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Achieving controlled glycemia (HbA1c, &lt;8%)</td>
<td>24</td>
<td>42</td>
<td>18</td>
</tr>
<tr>
<td>Exhbiting poor glycemic control (HbA1c, &gt;10%)</td>
<td>40</td>
<td>27</td>
<td>-13</td>
</tr>
</tbody>
</table>

*Statistically significant change (P = 0.02, paired t test).

### TABLE 3. Comparison of Clinical Outcome Measures in the Group of Type 2 Diabetes Patients Who Were SMW (n = 24) or SMD (n = 12)

<table>
<thead>
<tr>
<th>Test</th>
<th>Units</th>
<th>SMW</th>
<th>SMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c</td>
<td>%</td>
<td>Baseline POCT 8.7 ± 2.0</td>
<td>Baseline POCT 9.4 ± 1.9</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>mmol/L</td>
<td>Most Recent POCT 7.5 ± 1.5*</td>
<td>Most Recent POCT 10.3 ± 1.2</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>mmol/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuminuria (ACR)</td>
<td>% Normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% Microalbuminuria</td>
<td>37</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>% Macroalbuminuria</td>
<td>4</td>
<td>43</td>
</tr>
</tbody>
</table>

*Statistically significant change (P < 0.05, paired t test).
respectively, in the SMW group. In contrast, the mean of these lipid fractions were slightly higher (by 0.2 and 0.4 mmol/L) in the SMD group. Although the changes in the SMD group did not reach statistical significance due to the small sample size, the contrasting trends in the 2 patient groups are apparent. Patients who self-managed well benefited from care planning and regular POCT, whereas those patients unable to take advantage of these services exhibited poorer health and were at higher risk of developing diabetic complications.

The clinical usefulness of POCT is also illustrated in the following brief case studies.

The first case describes a middle-aged man with type 2 diabetes, obesity, and ischemic heart disease. He had not visited the health service clinic for more than 2 years but had become aware of the availability of the new POCT service. His initial POCT results were HbA1c 10.5%, urine ACR 2.8 mg/mmol, blood pressure 150/90 mm Hg, and weight 124 kg. His poor glycemic control was immediately treated. During the next year, the patient had regular POCT, with his HbA1c falling to 9.7%, 8.8%, and 8.4%. Across this period, he received on-going dietary, podiatry, and retinopathy review. He commented that regular POCT has helped motivate him to achieve improved diabetes control. He also began undertaking bush trips and consuming more traditional bush foods.

The second case describes a young man from a remote Aboriginal community who presented at the local health service complaining of severe headaches. His POCT results were HbA1c 10.6%, urine ACR 22.7 mg/mmol, cholesterol 12.0 mmol/L, nonfasting triglyceride more than 7.3 mmol/L, and blood pressure 156/115 mm Hg. The patient’s blood sample was also left standing on the bench, allowing the red blood cells to settle and revealing a plasma that was milky in color. Opportunistic POCT led to the patient being identified as diabetic with poor glycemic control, microalbuminuria and severe hyperlipidemia (as well as hypertension). Treatment was initiated immediately, and the patient is now managed in his own community by the visiting Royal Flying Doctor Air Service. Visualization of the milky plasma led to valuable education for Aboriginal health workers about blood fats.

The third case describes a grossly overweight middle-aged woman whose initial POCT results were urine ACR 8.7 mg/mmol, HbA1c 5.0%, blood glucose 6.1 mmol/L, blood pressure 135/85 mm Hg, and weight 97 kg. Medications were commenced to treat microalbuminuria and assist weight loss. A visiting renal specialist, podiatrist, and dietician subsequently reviewed the client. Follow-up urine ACR measurements performed by POCT over the next year (7.5 and 3.5 mg/mmol) indicated an improvement in microalbuminuria. The patient also showed increased motivation to lose weight, exercise, and adhere to medication. This case describes how opportunistic POCT helped identify and improve obesity-related microalbuminuria in a patient who did not have diabetes or hypertension.

The final case describes an elderly woman with cardiovascular disease who was placed on a care plan. Her initial lipids by POCT were extremely high (total cholesterol, 11.1 mmol/L and triglyceride, 7.3 mmol/L). She was placed on lipid lowering medication, and her lipid profile improved significantly (cholesterol 5.0 mmol/L and triglyceride 3.3 mmol/L). However, severe muscular pain developed, and the patient could no longer tolerate this medication. Her lipid profile subsequently worsened necessitating a further change in medication. Her most recent POCT lipids were total cholesterol, 4.7 mmol/L, triglyceride, 2.1 mmol/L; HDL cholesterol, 1.1 mmol/L; and LDL cholesterol, 2.7 mmol/L. Close monitoring through care planning and POCT during the past 18 months have now stabilized her cardiovascular risk.

Community Acceptance of POCT

The 12 clinical staff responsible for managing patients with diabetes across the 4 participating AMSs unanimously agreed that the availability of the POCT results at the time of consultation was convenient for them, the opportunity to discuss the POCT results immediately with the patient was advantageous, and they had confidence in the accuracy and reliability of the POCT result. More than 90% believed POCT was an acceptable alternative to the laboratory, contributed positively to overall patient care and management and provided a more clinically and culturally effective service for patients with diabetes than the laboratory.

Specific comments by doctors during interview included the following:

“The program has been very successful so far and the ability to perform analyses opportunistically by point-of-care has been critical. Being able to give results to people immediately is a powerful tool in recruiting and retaining patients on disease registers. Local acceptance of point-of-care testing has been good so far. The ability for Aboriginal health workers to perform the testing has however proven its greatest success. Lastly, the doctors have not had to change their practice very much and have found immediate discussion of results very helpful. It may mean that treatment is not delayed, or patients lost in uncertain follow-up.”

“POC testing has greatly improved the efficiency and effectiveness of the chronic disease services we provide. We are now able to offer a full range of risk assessment and monitoring tests for common chronic diseases with instant results. This means doctors and health workers are able to make management decisions for our diabetic and renal clients on the spot instead of having them come back for results. Clients get quick feedback on how they are progressing.”

There was unanimous agreement among the 13 Aboriginal POCT operators across all participating services that they were confident in the accuracy and reliability of the POCT result, were satisfied with the level of support services provided by the Flinders’ team, and believed that the patients with diabetes were pleased to have POCT as part of their management. More than 90% of health workers felt confident in discussing the POCT result with the patient and agreed that the training methods used by the Flinders’ team were instructive and culturally appropriate.
Specific comments from Aboriginal health workers during interview included the following:

“All the health workers at our service think the program is good because it empowers us to do the testing and to have an important role in chronic disease management. We’ve already picked up a lot of people with problems. All the clients are now really keen on the program. The availability of the program is now spreading rapidly by word-of-mouth through the community. People want to come and get tested. They are asking questions about the machines and what they can tell us about chronic diseases.”

“The program has been received well by the community. Clients are interested to know what their results mean. Those with diabetes are keen to see how their control is. They know if they’re not looking after themselves that we can help them. From my perspective as a health worker, the program has been very educational.”

“We all feel confident in using the machines. The program is well worth it and great for the community. The program has good health promotional benefits because the program has shown people that they must take greater responsibility for their own health.”

Fifty-eight Aboriginal patients with type 2 diabetes across the 4 services completed the patient questionnaire. They were unanimous that regular POCT encouraged them to “look after their health better” and that obtaining their POCT result while they waited was more convenient than having to come back for a follow-up visit. More than 90% understood the purpose of using POCT instruments and believed that the doctor was better able to manage their chronic condition by having their POCT results available at the time of consultation. Fingerprick testing was considered less stressful than venipuncture by 98% of respondents.

Patients were specifically asked to rate how satisfied they were with their diabetes service before and after the introduction of POCT (Fig. 1). The percentage of patients who were satisfied with their diabetes service after the introduction of POCT rose significantly from 64% to 88%, whereas the percentage who were either unsatisfied or unsure about their diabetes service fell from 8% to 3% and 28% to 9% after POCT had commenced for their management (Fisher exact test, $\chi^2 = 9.7; P = 0.02$).

**Quality Management for POCT**

The average within-site imprecision (coefficient of variation, CV%) achieved for external quality assurance HbA1c and urine ACR POCT in the national QAAMS program by all 4 participating services for each 6-month testing cycle over the past 3 years is shown in Figure 2. The performance for urine ACR quality assurance testing continued to improve across time. Apart from one time point (HbA1c, first cycle in 2004), the level of imprecision readily met the minimum precision goals of 4% and 12% recommended for these 2 analytes by the Australian Government’s Interim Standards for Point-of-Care Testing.

For POCT lipid testing on the Cholestech, an external quality assurance program for lipids was not available. In addition lot numbers of commercial quality control material changed between and within participating services every...
3 to 6 months, making detailed analysis of imprecision difficult. However, the average imprecision for quality control testing across participating services has been calculated using control lot numbers for which the highest number of quality control results have been documented (n = 36 and 33 for low and high controls, respectively). Imprecision averaged 4.2% and 4.0% for total cholesterol, 4.7% and 4.7% for triglyceride, and 6.9% and 4.1% for HDL cholesterol (for low and high controls, respectively). This level of imprecision meets the minimum precision goals of 5.0% for cholesterol, 7.5% for triglyceride and 6.0% for HDL cholesterol recommended for these analytes by the Australian Government’s Interim Standards for Point-of-Care Testing, except for the low HDL cholesterol control.24

**DISCUSSION**

In rural and remote Australia, many Aboriginal medical services (AMS) are often hundreds of kilometers from their local laboratory service provider and the turnaround of laboratory results can take several days often weeks in some areas. It can also be very difficult for Aboriginal people to attend a follow-up clinical appointment to discuss their pathology results with the doctor due to other family and cultural priorities. POCT, where results are immediately available for both the doctor and the patient, offers a practical and more efficient solution to the delivery of pathology services in the rural and remote environment. With appropriate training, Aboriginal health workers (Aboriginal people living and working in the community and trained in primary health care) can perform POCT on-site, empowering them to have a significant role in the care of their community members with chronic disease and ensuring ownership and control of patient information is retained within the medical service. Both these factors are crucial advantages of POCT in the cultural context.

This paper describes the results from a POCT model for chronic disease risk assessment and management conducted in the challenging environment of rural and remote indigenous Australia, where poor accessibility to goods and services, limited employment opportunities, low income and poor access to housing and education all contribute to excessively high morbidity and mortality rates for chronic disease in this health sector. 3

The paper reports the results of community risk assessments for chronic disease, which used POCT as its centerpiece. Chronic disease risk profiles between communities were generally similar. However, comparisons with national averages, as reported in the recent Australian Diabetes, Obesity and Lifestyle study, show disturbing trends.23 The prevalence of diabetes found in Aboriginal communities participating in the POCT in Aboriginal Hands program was between 2 to 3 times the national average and consistent with rates reported in other indigenous studies.5 Rates of microalbuminuria of the order of 20% were 3 times the national average.26 As for diabetes, these high rates of early renal disease were consistent with those found in previous studies by our group and other independent studies in Aboriginal Australia.14,27–29 Rates of hypertension were approximately the same as the national average of 29%, whereas prevalence of abnormal lipids (cholesterol, >5.5 mmol/L) were lower than the national average of 51%. Rates of smoking and obesity were 3 to 4 times and 2 to 3 times the national averages, respectively.25 In May 2004, the Australian Government introduced the Adult Health Check for all Aboriginal people aged between 15 and 54 years of age.30 The aim of this national initiative was to encourage early detection, diagnosis and intervention for common chronic conditions (such as diabetes, renal and heart disease) that cause significant morbidity and early mortality. POCT dovetails neatly into this initiative, which should result in the wider use and uptake of POCT across Aboriginal Australia.

For management of chronic disease, POCT has a crucial role in reducing the burden of diabetes and end-stage renal disease in Aboriginal Australia. Glucose meters have not been accepted well by Aboriginal people with diabetes for a number of cultural and financial reasons, and alternative programs have been needed. Regular monitoring of HbA1c concentrations (to track glycemic control) and urine ACR levels (to target albuminuria and reduce renal complications from diabetes) are now becoming an integral component of the national QAAMS POCT program to assist diabetes management. Increased testing of lipids by POCT should further enhance management for both diabetes and cardiovascular patients. Data presented in this paper confirm that POCT can be effectively integrated into the management of patients with chronic disease and assist in improving clinical outcomes. However, the high mean HbA1c concentrations found in Aboriginal patients with diabetes when POCT was first introduced at the 2 services studied (approximately 9%–9.5%) indicates the extent of poorly controlled diabetes in indigenous Australians and highlights the magnitude of the task ahead for clinical and allied health professional staff managing these patients.

Community acceptance of POCT was extremely high in all stakeholder groups surveyed in the POCT in Aboriginal Hands program. POCT played a vital role in improving patient self-motivation due its convenience, the immediacy of result and a belief by patients that the doctor was better able to manage their diabetes by having their results available at the time of consultation. POCT proved clinically and culturally effective across the diverse mix of participating Aboriginal medical services with small, medium, and large infrastructures and widely divergent geographical locations. In addition, the versatility and adaptability of POCT in the rural and remote Aboriginal community setting was confirmed by the variety of different locations and community contexts in which POCT was used during this program.

Many challenges nonetheless remain for POCT in the indigenous rural and remote environment. In this program, a government-funded medical rebate was available for POCT HbA1c testing conducted for managing patients with established diabetes. This rebate for POCT HbA1c testing is available to all services who are members of the national QAAMS Program. For risk assessment, the costs of selected POCT were absorbed as part of the rebate available for the
adult health check. The remainder of the costs for reagent and consumable supplies were borne by the goodwill of the participating POCT diagnostic companies. Cost effectiveness of POCT will continue to be an important element for sustainability of POCT programs in rural and remote Australia.

The POCT in Aboriginal Hands program has been successful because there has been excellent commitment to this program from the management and clinical staff of participating services. Furthermore, each service has provided strong support and encouragement for the Aboriginal health worker teams in their role as POCT operators, and there have been minimal health worker staff changes across the lifetime of the program. However, it should be noted that many Aboriginal medical services continue to have excessive rates of staff turnover that make health programs, including POCT, difficult to sustain. Innovative means to maintain “by distance” education and training for POCT operators in the face of ever-changing staff patterns will be a crucial factor for POCT programs as the use and application of POCT continues to expand and evolve in rural and remote Australia.

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