

Evidence for improved patient management through electronic patient records at a Central Australian Aboriginal Health Service

Wendy E. Hoy,¹ Cheryl E. Swanson,¹ Alex Hope,² Jo Smith,^{1,2} Chris Masters²

Chronic diseases (CDs) such as hypertension, kidney disease and diabetes, exist at high rates in remote Aboriginal communities.¹⁻⁴ Increasing use of electronic patient records in Aboriginal Health Services through systems such as Communicare⁵ offers the prospect of developing community-based health profiles in addition to increased efficiency for monitoring patients with chronic conditions.^{6,7}

Despite advances in electronic records and thereby the potential for health service data analysis, few profiles of individual Aboriginal communities for health status and chronic disease rates have been described in the medical literature to date.^{3,4} Our previous work seems to offer notable exceptions.^{3,4} Health profiles of more Aboriginal communities could add considerably to knowledge of the distribution of CDs rates in other communities as well as to devising strategies to tackle these serious health problems. Community profiles of CDs have been suggested as a basis for informed, needs-based health services planning, leading to developing a strategic framework for CD services.⁴

In this manuscript, we describe clinic processes and activities, patient clinical profiles and prevalence of morbidities in a community using electronic patient records from a remote Aboriginal Health Service in Central Australia. Until recently, CD management in this community, as well as others in remote areas of Australia, had been essentially opportunistic when people

Abstract

Aim: To examine chronic disease (CD)-related clinical activity and outcomes associated with introduction of a more systematic approach to chronic disease care in a remote Aboriginal community, using data from Communicare patient record management system.

Methods: We examined CD process measures, outcomes and clinical profiles in adults age 15+ years from Communicare data and compared results for two intervals. Process measures were clinic visits and proportions of eligible patients with recorded CD-related procedures or diagnostic tests. Outcome measures were results of CD care items and CD morbidities. Data in the interval 2007-2009 were compared with data from 2009 to 2011, in which an intensified CD program was conducted in the clinic by its own staff.

Results: About one-third of adult visits were related to CD care; CD-cycle of care encounters increased significantly in the second interval, from 3.2% to 9.1%, and proportions of adults having CD-related procedures or tests were also higher. For already commonly performed items, like blood pressure, weight and lipids, proportions of adults tested were 30-50% higher in the second interval, while proportions tested for more recently emphasised items, like waist, HbA1C, urine ACR, rose by more than 200%. Levels of SBP, DBP, HbA1c and HDL-C significantly improved in the second interval. Proportions of adults with clinical values outside normal ranges decreased for at least half of observations.

Conclusions: Parameters of CD care activities and outcomes have increased significantly over the last four years in this setting, accompanied by stabilisation of or improvement in outcomes.

Key words: chronic disease, Indigenous health, electronic patient records, Communicare

presented to the clinic for other reasons. More recently, an initiative to improve CD service delivery was instigated by the community itself, its health board and its clinic, resulting in an intensified CD program conducted within the clinic by its own staff. Comparison of the results for the two time periods encompassing introduction of that program allows evaluations based on a whole of adult community approach as distinct from an audit-based approach utilised in other health service surveys.⁶⁻⁸

Subjects and methods

This report was based on clinical records from a single Aboriginal Health Service (AHS) in central Australia. Aboriginal individuals aged 15 years and older who had visited the AHS for any reason between July 2007 and June 2011 were included. For reporting purposes, the first value recorded for an individual for each CD-related observation in 2007-2009 and the last value recorded for an individual for each CD-related observation in 2009-2011

1. Centre for Chronic Disease, University of Queensland

2. Central Australian Aboriginal Congress, Northern Territory

Correspondence to: Dr Cheryl Swanson, Centre for Chronic Disease, University of Queensland, Health Sciences Building, Level 8, Royal Brisbane and Women's Hospital, Herston, QLD 4029; e-mail: c.swanson@uq.edu.au

Submitted: March 2013; Revision requested: April 2013; Accepted: November 2013

The authors have stated they have no conflict of interest.

were used to compile the profile for those periods. Data for analysis were downloaded remotely from Communicare (v11.2), which is an electronic patient information, reminder and recall system used predominantly in Indigenous health services. The electronic patient record system became operational in mid-2007, therefore the analysis periods were defined by financial years, e.g. first period: July 2007 through June 2009 (2007-2009) and second period: July 2009 through June 2011 (2009-2011).

Data were obtained to determine numbers of patients seen, patient visits, service delivery and CD-related observations. Data were also obtained on medications prescribed. Service delivery was defined as the proportion of eligible patients who had received a service as indicated by available observations or diagnostic test results. CD-related observations were the investigations, assessments or test results indicating each service and comprised: risk behaviours – smoking status, alcohol consumption; body habitus measures – height, weight, waist circumference, body mass index (BMI); clinical parameters – systolic blood pressure (SBP), diastolic blood pressure (DBP); laboratory-based measures – haemoglobin (Hb), HbA1C, random blood glucose (RBG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglycerides, serum creatinine (sCreat), estimated MDRD glomerular filtration rate (eGFR), urine albumin creatinine ratio (uACR), haematuria and proteinuria by urine dipstick. Hypertension, kidney disease, diabetes, cardiovascular disease, asthma or chronic obstructive airway or pulmonary disease (COAD) were defined as chronic morbidities using standard criteria (see supplementary table) applied to any relevant observation recorded for an individual during each interval.

Frequencies were determined for clinic processes, service delivery variables, outcome measures and CD morbidities, including individuals with any CD morbidity, and those with multiple CD morbidities. Descriptive statistics were used to compare results for 2009-2011 with 2007-2009 as a measure of the intensified CD initiative. T-tests, Wilcoxon rank sums tests or z-tests of proportions were used as appropriate for the distribution of the variables to test the differences between 2007-2009 and 2009-2011. Two-tailed tests of significance were used and the 0.05 level of significance was used throughout. All

analyses were performed with Stata version 11.2 statistical software.⁹

The clinic programs

During the first period, CD management was accomplished through opportunistic checks and screening by Aboriginal Health Workers and nurses, the services of one GP three days per week and one remote area nurse with a specific CD portfolio.

The intensified CD program introduced in mid-2009 expanded staffing by the addition of a CD educator four days per week providing one-on-one education sessions and family group education in the community; an exercise physiologist three days per week; a nutritionist providing healthy eating information and cook ups two days per month; implementation of a part-time SEWB (Social, Emotional Well-Being) team; introduction of a Quit Smoking Program; regular visits by a podiatrist once or twice per month; regular visits by a physiotherapist/acupuncturist for 2-3 weeks twice yearly.

A policy was introduced and followed for opportunistic health checks to be performed on patients presenting to the clinic for any reason, taking the form of full adult health checks when time permitted or mini-CD checks if the clinic was busy. Patient management was enhanced by the development of a chronic disease data entry screen in the Communicare database to provide for three-monthly and 12-monthly CD cycle of care health checks, with the 12-monthly health check including all items needed for the MBS 715 Adult Health Check. Recalls for follow-up or referrals were generated through the data entry form and recalls or reminders were issued for those patients with overdue CD checks using letters, appointment cards, and personal contact. In addition, a concerted team effort by clinic staff was conducted once or twice a year in the form of Healthy Men's Check or Healthy Women's Check to maximise CD-screening and management within the community.

Results

Clinic/Process measures

Service population: In the first period, 558 people visited the clinic, while 693 visited the clinic in the second period. In both intervals, the largest number of both sexes was in the 25-29 year age group followed by the 5-9 year, 10-14 year and 30-34 year age groups. In both intervals, the overall age structure of the service populations was similar to that of the 2006 census data for this community (2007-2009 $\chi^2 = 1.58, p=0.21$; 2009-2011: $\chi^2 = 2.02, p=0.16$), as well as for those aged 15 years and older (2007-2009: $\chi^2 = 0.43, p=0.51$; 2009-2011: $\chi^2 = 1.62, p=0.20$).¹⁰

Clinic activities: A total of 8,609 visits were made to the clinic in 2007-2009 and 9,836 visits in 2009-2011, an increase of 14%. The number of visits by females increased by 22% in 2009-2011, while visits by males remained constant. Visits for reasons related to CD increased by 3% among females in 2009-2011 and decreased by 9% among males. In the second interval compared to the first interval, CD cycles of care encounters increased significantly from 3.2% to 9.1% of all encounters recorded for adult patients ($p<0.0001$).

Service providers: As shown in Table 1 in 2007-2009, nurses were the most frequent service providers for females followed by GPs then Aboriginal health workers (AHWs), whereas the most frequent service providers for males were AHWs followed by GPs then nurses. There was no change in frequency of service providers for females between the two time periods, however there was for males. In 2009-11 the most frequent service providers for males were AHWs followed by nurses followed by GPs.

Service delivery: As shown in Table 2, service delivery frequencies for CD-related observations for females were higher than for males in both periods. Service delivery frequencies of all CD-related observations increased for both sexes in 2009-2011, with

Table 1: Service providers as a proportion of encounters: 2007-9 vs 2009-11.

	2007-9 (n=16,103)			2009-11 (n= 16,626)		
	All %	Females %	Males %	All %	Females %	Males %
GPs	27.3	26.7	28.3	21.2	21.1	21.3
Nurse	43.5	58.6	16.2	41.6	51.6	24.7
AHW	23.9	8.3	52.2	17.0	4.8	37.4
Other*	5.3	6.4	3.4	20.2	16.9	16.6

* includes various medical specialists, allied health personnel, exercise physiologist, etc

some CD-related observations (e.g. waist circumference in females and urine ACR in males) showing as much as a two-fold increase, and all increases reaching statistical significance or near statistical significance.

Outcome measures

In the second interval compared with the first interval, as shown in Table 3, significant or near significant decreases were evident in SBP for both sexes and in DBP for males, a significant improvement in HbA1C and HDL-C for males and a significant increase in serum creatinine for females. In other respects, overall results for means and SDs showed general stability for both sexes.

In the second interval compared with the first interval, as shown in Table 4, 50% of the observations for both sexes showed lower proportions of patients with results beyond the normal range for CD-related observations and risk behaviours. Significant or near significant improvements were evident for SBP in both females (22.4% vs 10.8%, $p=0.006$) and males (28.8% vs 18.4%, $p=0.059$), while significant improvements were evident for Hb for females (23.2% vs 9.8%, $p=0.002$) and HbA1c (22.9% vs 9.2%, $p=0.028$) for males. Lower proportions of patients with results outside the normal range were found for DBP, ACR and proteinuria for both sexes in the second interval. In addition, lower proportions of females with results outside the normal range for LDL-C, HbA1c and smoking and of males for HDL-C and RBG were found in the second interval.

Compared with the first interval, the numbers of patients in the second interval receiving prescriptions for CD-related conditions increased from 113 to 135. The proportions of patients with prescriptions for BP-lowering agents, anti-coagulants, lipid-lowering agents and hypoglycaemic agents, the most frequently prescribed medications, did not change except for hypoglycaemic agents, which increased from 36.3% to 44.4% of patients with prescriptions.

Chronic Disease: Overall, 65.4% of the adult clinic population had at least one and 31.9% had more than one CD morbidity. As shown in Figure 1, the most frequently defined CDs in females in 2007-2009 were, in descending order, hypertension, kidney disease and diabetes; however, in 2009-2011, kidney disease was most frequent followed by hypertension and diabetes. The most

frequently defined CDs in males in both 2007-2009 and 2009-2011, were hypertension, kidney disease and diabetes. In both sexes, rates of CDs were higher in older than younger age groups, except for diabetes in females and kidney disease in males, where the rates were lower in the 55 and over age group in 2009-2011.

Discussion

This study shows that the application of protocols for CD management, in this instance, the intensified clinic-conducted CD program, combined with a system of electronic patient records provide a means for documenting clinic processes and

Table 2a: Service delivery* for CD-related observations by period: Females.

Rank	Service item	2007-2009 % (n=263)	2009-2011 % (n=193)	P**
1	Smoking	58.6	65.8 (10)	0.075
2	Alcohol	58.2	66.8 (8)	0.062
3	DBP	57.8	81.9 (2)	<0.0001
4	SBP	57.8	81.9 (1)	<0.0001
5	Weight	57.7	78.8 (3)	0.0001
6	Height	55.6	72.5 (7)	0.0002
7	Hb	55.5	74.1 (5)	<0.0001
8	RBG	54.8	77.2 (4)	<0.0001
9	BMI	52.9	73.6 (6)	<0.0001
10	Proteinuria	52.5	66.3 (9)	0.003
11	eGFR	44.1	60.0 (15)	0.0008
12	sCreat	44.1	60.0 (14)	0.0008
13	uACR	43.0	60.1 (13)	0.0003
14	Haematuria	40.3	63.7 (12)	<0.0001
15	Trigs	38.0	59.1 (16)	<0.0001
16	HDL-C	37.6	56.0 (19)	0.0001
17	LDL-C	36.9	57.0 (18)	<0.0001
18	HbA1C	36.5	65.3 (11)	<0.0001
19	Waist circumference	30.8	58.0 (17)	<0.0001

Table 2b: Service item delivery* for CD-related observations by period: Males.

Rank	Service item	2007-2009 % (n=205)	2009-2011 % (n=171)	P**
1	DBP	54.1	73.1 (1)	0.0001
2	SBP	54.1	73.1 (2)	0.0001
3	Weight	52.2	69.0 (3)	0.0009
4	Alcohol	52.2	59.6 (6)	0.15
5	Smoking	51.7	59.1 (7)	0.15
6	Hb	49.8	58.5 (8)	0.09
7	eGFR	48.3	57.3 (11)	0.08
8	sCreat	48.3	57.3 (10)	0.08
9	RBG	48.3	65.5 (4)	0.0008
10	Height	46.2	57.9 (9)	0.02
11	BMI	45.2	63.2 (5)	0.0005
12	uACR	36.1	53.8 (12)	0.0006
13	Trigs	34.1	53.2 (13)	0.0002
14	HDL-C	34.1	53.2 (14)	0.0002
15	LDL-C	31.2	49.1 (16)	0.0004
16	HbA1C	23.4	50.9 (15)	<0.0001
17	Proteinuria	21.5	38.6 (18)	0.0003
18	Waist circumference	21.0	42.1 (17)	<0.0001
19	Haematuria	10.7	28.7 (19)	<0.0001

* expressed as proportion of eligible adults with data available in descending order for the 2007-2009 period. Rankings for 2009-2011 shown in brackets for each item.

** z-test of two proportions. P-values less than 0.05 in bold.

health profiles in this health service and community. This CD community-based health initiative provided a pivotal element around which clinic processes and health profiles could be compared over time, as the clinic moved from an opportunistic approach to CD management to a systematic format of scheduled visits and recall, clinical investigations and feedback to patients. The intensified activity is reflected in the increase in service provider episodes, as well as in the significant increases in both service delivery of all CD-related observation types and in CD cycles of care recorded in the second interval.

Profiles of baseline CD-related observations for both sexes in the second interval using first observations recorded (data not presented) showed little difference to profiles for both sexes for the first interval. Those significant and near significant profiles changes in the second interval for SBP for both sexes and for HbA1c and HDL-C in males (based on last observation data), coupled with the decrease in proportions of individuals with values outside the normal range for half of the observations, indicate that general results were not getting worse and in specific areas were getting better. Both kidney disease and hypertension were present from young ages onward while diabetes was generally diagnosed at older ages. Females had higher rates of kidney disease and diabetes than males in this community, while males had higher rates of hypertension. These profiles are consistent with and exceed those published for other remote Aboriginal communities.^{3,4,11,12}

Given the similar baseline profiles for each interval and the determination of CD diagnoses on the basis of any recorded observation for an individual meeting the

Table 3 a & b: Descriptive statistics for CD-related observations by sex and time period.

Variable	a) Females: 2007-2009 (n=263)			2009-2011 (n=193)			
	N	Mean (SD)	[95% C.I.]	n	Mean (SD)	[95% C.I.]	P**
Height cm	141	161.2 (5.9)	160.2 - 162.2	140	161.5 (5.8)	160.5 - 162.5	0.67
Weight kg	152	78.6 (19.4)	75.5 - 81.7	152	81.9 (19.7)	78.7 - 85.0	0.14
Waist cm	81	104.2 (15.1)	100.9 - 107.6	112	105.3 (15.1)	102.5 - 108.1	0.62
BMI kg/m ²	136	30.4 (6.6)	29.3 - 31.6	142	31.5 (7.7)	30.2 - 32.7	0.21
SBP mmHg	152	123.8 (20.4)	120.5 - 127.0	158	118.9 (15.6)	116.4 - 121.4	0.02
DBP mmHg	152	77.2 (10.9)	75.5 - 79.0	158	76.5 (9.9)	75.0 - 78.1	0.55
Hb g/dL	146	12.8 (1.5)	12.6 - 13.0	143	13.0 (1.3)	12.8 - 13.2	0.23
HbA1C %	96	6.6*	6.3 - 7.0	126	6.5*	6.3 - 6.8	0.53
RBG mmol/L	145	7.5 (4.3)	6.8 - 8.2	149	7.9 (4.6)	7.2 - 8.6	0.45
HDLc mmol/L	99	1.0 (0.2)	1.0 - 1.1	110	1.0 (0.2)	1.0 - 1.1	1.0
LDLc mmol/L	97	2.6 (0.8)	2.4 - 2.7	108	2.5 (0.7)	2.4 - 2.6	0.35
Trigs mmol/L	100	1.7 (0.9)	1.5 - 1.9	114	1.7 (1.0)	1.5 - 1.9	1.0
sCreat µmol/L	116	58.1 (13.6)	55.6 - 60.6	115	63.1 (20.5)	59.3 - 67.0	0.03
eGFR	116	115.5 (35.2)	109.0 - 122.0	115	109.1 (35.7)	102.5 - 115.7	0.17
uACR mg/mmol	113	3.9*	2.8 - 5.4	116	3.2*	2.3 - 4.5	0.69

* geometric mean

** t-test of difference between the two time periods

Variable	b) Males: 2007-2009 (n=205)			2009-2011 (n=171)			
	N	Mean (SD)	[95% C.I.]	n	Mean (SD)	[95% C.I.]	P**
Height (cm)	141	173.5 (6.1)	172.3 - 174.7	99	172.6 (10.8)	170.4 - 174.8	0.41
Weight (kg)	107	83.3 (19.7)	79.5 - 87.0	118	85.0 (21.0)	81.2 - 88.8	0.53
Waist (cm)	43	103.9 (13.7)	99.7 - 108.1	72	103.1 (15.7)	99.5 - 106.8	0.78
BMI	90	28.0 (5.7)	26.8 - 29.1	108	28.0 (6.1)	26.8 - 29.2	1.00
SBP	111	131.9 (17.5)	128.6 - 135.2	125	128.1 (16.9)	125.1 - 131.1	0.09
DBP	111	81.7 (11.0)	79.6 - 83.7	125	79.6 (10.6)	77.7 - 81.4	0.14
Hb	102	15.2 (1.4)	14.9 - 15.4	100	15.0 (1.7)	14.6 - 15.3	0.36
HbA1C	48	6.8*	6.4 - 7.4	87	6.1*	5.9 - 6.4	0.01
RBG	99	7.2 (3.1)	6.6 - 7.8	112	6.8 (3.1)	6.2 - 7.4	0.35
HDLc	70	0.9 (0.2)	0.9 - 1.0	91	1.0 (0.3)	0.9 - 1.0	0.01
LDLc	64	2.7 (0.8)	2.5 - 2.9	84	2.7 (1.0)	2.5 - 2.9	1.00
Trigs	70	2.5 (2.1)	2.0 - 3.0	91	2.2 (1.6)	1.9 - 2.5	0.29
sCreat	99	89.3 (63.1)	75.7 - 80.8	98	81.4 (20.0)	77.5 - 85.3	0.24
eGFR	99	107.6 (29.2)	101.7 - 113.4	98	105.0 (37.2)	97.5 - 112.4	0.59
uACR	99	3.9*	2.4 - 6.1	92	3.2*	2.1 - 4.9	0.76

* geometric mean

** t-test of difference between the two time periods

Figure 1a: Rates of chronic diseases as percentage of population by age group and sex by period: Females.

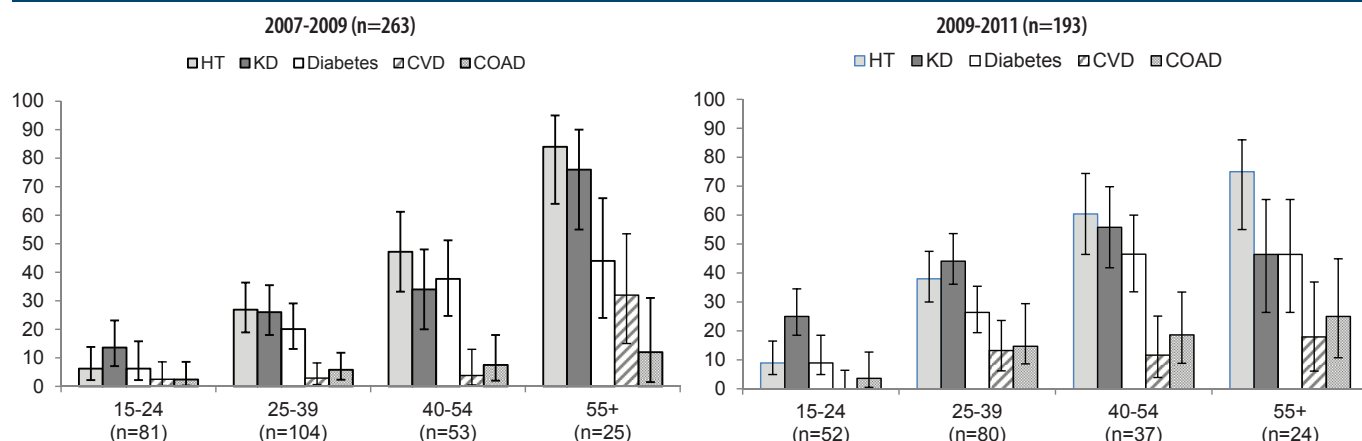
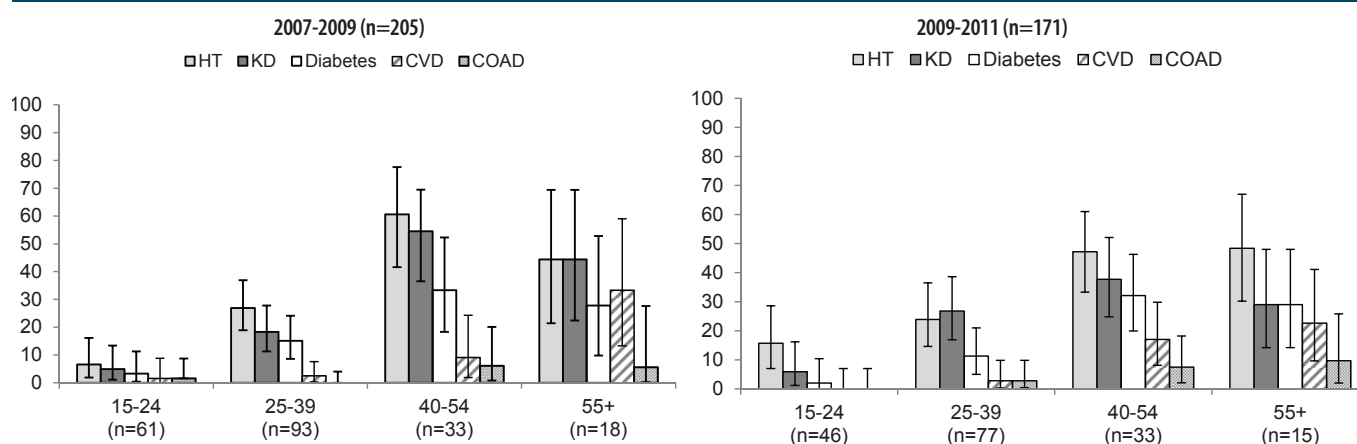


Figure 1b: Rates of chronic diseases as percentage of population by age group and sex by period: Males.



diagnostic criteria during each interval, the higher CD rates in the second interval may, in some instances, reflect some transient states that have not been examined in this study. The higher rates may also reflect a range of beneficial outcomes from the intensified program. Increased CD awareness and management amongst clinic staff are evidenced by increased CD cycles of care, increased testing of risk factors and increased numbers of prescriptions related to CD conditions. This increased awareness of staff may have resulted in better recording of observations of all types in general and possibly CD-related observations in particular. It may also have resulted in patients feeling more willing to attend the clinic, more comfortable about being at the clinic, and having an increased willingness to visit the clinic when feeling unwell which, in turn, could result in an increased likelihood of CD-relevant observations, e.g. elevated BP or elevated RBG or breathing difficulties, being recorded.

Issues of data quality may be another factor in the differences seen. The Communicare system was implemented in 2007, and data entry presented an additional task for staff that competed with other necessary clinical activities. Maintaining accurate and comprehensive data collection is an ongoing challenge for remote health services faced with frequent staff turnover and the need for new staff to quickly learn the existing system. Systematic scheduling of appointments and recalls, regular testing for CDs and associated risk factors with treatment for such, as well as education for patients, staff and community contribute to an increased patient participation in the health process and increased sense of the commitment by the

Table 4 a & b: Proportion of CD-related observations (as per Table 3) at risk or outside the normal range by period by sex: (Bold indicates items with improved proportions of affected individuals in 2009-11)

a. Females	2007-2009 % (number tested)	2009-2011 % (number tested)	P*
Waist > 89 cm	87.1 (81)	88.0 (125)	0.85
BMI > 25 kg/m ²	78.4; 54.7 (136)	83.8; 55.5 (146)	0.25; 0.75
SBP > 140 mmHg	22.4 (152)	10.8 (158)	0.006
DBP > 90 mmHg	13.8 (152)	8.8 (158)	0.16
Hb < 11.5 g/dL	23.2 (146)	9.8 (143)	0.002
HbA1C > 8.0%	21.9 (96)	16.3 (129)	0.29
RBG > 8.0 mmol/L	24.1 (145)	29.5 (149)	0.30
HDLc < 1.2 mmol/L	68.7 (99)	73.6 (110)	0.43
LDLc > 3.4 mmol/L	14.4 (97)	8.3 (108)	0.17
Trigs > 2.0 mmol/L	25.0 (100)	23.7 (114)	0.82
sCreat > 90 µmol/L	4.3 (116)	7.8 (115)	0.26
eGFR < 60 mL/min/1.73m ²	4.4 (116)	7.8 (115)	0.26
uACR > 2.8 mg/mmol	50.4 (113)	42.7 (117)	0.24
Proteinuria (+ve)*	27.7 (202)	27.3 (128)	0.94
Haematuria (+ve)*	23.6 (106)	22.8 (123)	0.88
Smoking (any current)*	38.3 (154)	32.3 (127)	0.30
Alcohol (current; unsafe)*	34.6; 10.4 (153)	35.7; 10.1 (129)	0.85; 0.93
* z-test of two proportions			
b. Males	2007-2009 % (number tested)	2009-2011 % (number tested)	P*
Waist > 102 cm	55.8 (43)	55.7 (79)	0.99
BMI > 25 kg/m ² ; > 30 kg/m ²	65.8; 31.9 (94)	63.0; 38.9 (108)	0.68; 0.31
SBP > 140 mmHg	28.8 (111)	18.4 (125)	0.059
DBP > 90 mmHg	21.6 (111)	17.6 (125)	0.44
Hb < 12 g/dL	4.9 (102)	7.0 (100)	0.53
HbA1C > 8.0%	22.9 (48)	9.2 (87)	0.028
RBG > 8.0 mmol/L	25.2 (99)	18.8 (112)	0.26
HDLc < 1.0 mmol/L	58.6 (70)	48.4 (91)	0.20
LDLc > 3.4 mmol/L	21.9 (64)	25.0 (84)	0.66
Trigs > 2.0 mmol/L	42.9 (70)	40.7 (91)	0.78
sCreat > 100 µmol/L	8.1 (99)	10.2 (98)	0.61
eGFR < 60 mL/min/1.73m ²	6.1 (99)	6.1 (98)	1.00
uACR > 2.8 mg/mmol	51.4 (74)	43.4 (49)	0.17
Haematuria (+ve)*	9.1 (22)	28.9 (49)	0.066
Proteinuria (+ve)*	36.4 (44)	28.8 (66)	0.40
Smoking (any current)*	49.1 (106)	57.4 (101)	0.23
Alcohol (current; unsafe)*	64.5; 28.0 (107)	67.6; 27.9 (102)	0.64; 0.46
* z-test of two proportions			

clinic and its staff to the health status of the community. Related anecdotal reports from patients have been included in the electronic patient records, providing a potential source of qualitative evidence.

As shown in this work, monitoring primary care performance in chronic disease management and prevention can be effectively achieved through examining key aspects of clinical activity and outcomes from electronic patient records. Although the complexity of the Indigenous health service sector presents a challenging environment for improving systems and service delivery, focus on an individual health service allows opportunities to identify particular gains that could be overlooked in more general audits.

Conclusion

Parameters of activity of CD care have increased significantly over the past four years in this setting and electronic patient records are particularly useful for monitoring this activity. Better disease ascertainment accompanied by stabilisation of or improvement in service variables suggest that the possibility of improved outcomes has already begun to be realised, but requires continued support to ensure the future of such improvements.

Acknowledgements

Data were collected with the approval of the community councils and approval from the Central Australian Human Research Ethics Committee and the University of Queensland Human Research Ethics Committee. Support for this work came from the communities, community councils, health services, their executives, staff and clients. Funding support came from the Colonial Foundation. Heidi Tudehope and Steve White from Communicare and David Murtagh and Phil Craig from the Aboriginal Medical Services Alliance Northern Territory (AMSANT) provided generous support in matters related to remotely accessing and working within the Communicare system.

References

1. Hoy WE, Kondalsamy-Chennakesavan S, McDonald SP, Cass A, Singh GR, Bertram JF, et al. Chronic Kidney Disease in Aboriginal Australians. In: Nahas MEL, editor. *Kidney Diseases in the Developing World and Ethnic Minorities*. New York (NY): Taylor & Francis; 2005.
2. Hoy WE, Norman RJ, Hayhurst BH, Pugsley DJ. A health profile of adults in a Northern Territory Aboriginal community, with an emphasis on preventable morbidities. *Aust N Z J Public Health*. 1997;21(2):121-6.
3. Hoy W, Kondalsamy-Chennakesavan S, Scheppingen J, Sharma S, McKendry K. *Final Report on the NT Aboriginal Chronic Disease Outreach Program*. Brisbane (AUST): University of Queensland Centre for Chronic Disease; 2004.
4. Hoy WE, Davey RL, Sharma S, Hoy P, Smith JM, Kondalsamy-Chennakesavan S. Chronic disease profiles in remote Aboriginal settings and implications for health services planning. *Aust N Z J Public Health*. 2010;34(1):11-18.
5. Communicare eHealth Solutions. *Aboriginal Health Records, Support and Training, Electronic Health Record*. O'Connor (AUST): Communicare Systems; 2013.
6. Gardner K, Bailie R, Si D, O'Donoghue L, Kennedy C, Liddle H, et al. Reorienting primary health care for addressing chronic conditions in remote Australia and the South Pacific: Review of evidence and lessons from an innovative quality improvement process. *Aust J Rural Health*. 2011;19:111-17.
7. Spurling GKP, Hayman NE, Cooney AL. Adult health checks for Indigenous Australian: The first year's experience from the Inala Indigenous Health Service. *Med J Aust*. 2009;190(10):562-4.
8. Bailie RS, Si D, Connors DM, Kwedza R, O'Donoghue L, Kennedy C, et al. Variation in quality of preventive care for well adults in Indigenous community health centres in Australia. *BMC Health Serv Res*. 2011;11:139.
9. STATA: statistical software. Version 11. College Station (TX): StataCorp; 2011.
10. Australian Bureau of Statistics. *2068.0 - 2006 Census Tables*. Canberra (AUST): ABS; 2007.
11. Hoy WE, Kondalsamy-Chennakesavan S, Scheppingen J, Sharma S, Katz I. A chronic disease outreach program for Aboriginal communities. *Kidney Int Suppl*. 2005;98:S76-82.
12. Katz IJ, Hoy WE, Kondalsamy-Chennakesavan S, Gerntoltz T, Scheppingen J, Sharma S, et al. Chronic kidney disease management--what can we learn from South African and Australian efforts? *Blood Purif*. 2006;24(1):115-22.

Supporting Information

Additional supporting information may be found in the online version of this article:

Appendix A: Diagnoses and their definitions used in this analysis.