

Management of Care through Computerised Protocol-Based Care Plans

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Abstract: Health care for Aboriginal people in the Kimberley region of Western Australia is based on a pro-active, community-level and protocol based approach supported by a web-based clinical information system called MMEEx. In MMEEx, protocols are encoded as structured care plans that prompt health professionals to perform specified activities according to a specified schedule. Use of the care plans means that care for patients, who exhibit a high incidence of chronic disease in this population is more effective and efficient. Performance of the health services can be measured easily with meaningful measures of benefit to the patients they serve. This paper describes the basis for this system and how it was implemented in this remote region of Australia.

Key words: Health Informatics, Population Health, Aboriginal Health.

Unlike acute or reactive care for the majority of patients in Australia, the care for Australian Aboriginal patients focuses on a proactive, community-based approach that emphasises active monitoring of the community's health status with systematic management of discovered conditions or illnesses (CARPA, 2003). This reflects the US Chronic Care Model which is made up of six major elements: community resources, the health care system surrounding the provider organization, patient self-management, decision support, health care delivery system redesign, and clinical information systems (BODENHEIMER, 2003).

The Kimberley region of Western Australia is approximately the same size as the US state of California and has a total population of 41,200 people (KDC, 2011) of which an estimated 15,000 are Aborigines (ATKINSON *et al.*, 1999). The majority of the Kimberley is unpopulated but the Aboriginal communities are spread throughout the area in small communities or town sites. The primary health care needs of the Aboriginal communities are provided by Aboriginal Community Controlled Health Services (ACCHS) and

the Western Australian Country Health Services (WACHS). The Kimberley Aboriginal Medical Services Council (KAMSC) also provides renal services including satellite haemodialysis services, and WACHS are responsible for the operation of some of the remote clinics and 6 hospitals in the region. The Kimberley region attracts a large number of visitors with an average of 346,600 visitors coming into the region over the years 2005-2007 (KDC, 2009).

Aboriginal health services in the region faces a number of challenges including the remoteness of the communities, the harsh conditions which include flooding, cyclones and extreme heat and the challenges of meeting the need for growth of a skilled and stable workforce in this environment. There is a very high burden of ill-health and early death in the region. This is reflective of the overall life-expectancy of Aboriginal people in WA which is 65 compared to 79 in the non-Aboriginal population (AIHW, 2011 [6]). The major causes of death in Aboriginal men and women is circulatory disease (26% for men and 27% for women). The ill-health and early death is in part reflecting the impact of underlying determinants of health including low socio-economic status, overcrowding, poor school retention and high levels of unemployment. The underlying prevalence of chronic disease in the population is significantly greater in the Aboriginal population than the non-Aboriginal population in Australia (AIHW, 2011 [7]). For example, the annual incidence rate of end stage kidney disease in the Kimberley is the highest recorded in Australia, at 1249 per million population (MARLEY *et al.*, 2010), over ten times the overall Australian incident rate.

The burden of chronic disease in Aboriginal populations is much greater than in the non-Aboriginal Australian population. For example, type 2 diabetes occurs at a younger age and reaches a prevalence of up to five times that of non-Aboriginal populations; further, rates in remote Aboriginal populations are reported to be up to twice the rates of non-remote counterparts (ABS, 2011).

Central to the systematic management of primary health care in the Kimberley has been Patient Information Recall Systems (PIRS), which are able to prompt health professionals when scheduled health checks, medications, assessments, reviews and other interventions come due (SI *et al.*, 2008; FRAME *et al.* 1994; BAILIE *et al.*, 2003). Coupled with this has been the use of evidence-based protocols that cover the detection, management and follow-up of not only disease and illness conditions, but also provide for preventative care and regular or opportunistic health assessments (BAILIE *et al.*, 2003). Health information systems are critical in

providing for this mode of care and arguably it would not be possible to track patients against implementation of protocols without these information systems. There are a variety of clinical systems employed in Aboriginal Health Services in Australia. These include systems that support patient information recall such as Communicare (Communicare Systems Pty Ltd) and Ferret (Pen Computing Systems) and the more traditional GP systems such as Medical Director (Health Communication Network) and Best Practice (Best Practice Pty Ltd). Each of these systems has their advantages and disadvantages. None are systematic in their implementation of health care protocols.

Protocols are usually written in document form, occasionally with graphical decision-based flowcharts for general guidance (KAMSC, 2011). Implementations of health care protocols in GP systems also take a text-based approach with guidance being provided in the form of the use of templates (RACGP, 2008). Whilst being convenient for the GP and possibly understandable for the patient, there is a burden on the GP in producing this form of care plan and GPs in Australia are not sufficiently incentivised to spend time on implementing these types of care plans or following them up. One study (SCOTT, 2008) showed that only 2% of attendances at GPs in Australia resulted in claims for this type of work. This is despite the prevalence of chronic disease in the Australian population with between 21% and 32% of over 25 year-old Australians suffering from at least one chronic disease.

In order to tackle the high incidence of chronic disease in Aboriginal communities, Aboriginal Community Controlled Health Services in the Kimberley region of Western Australia have used computerised structured care plans that implement specific models of care for detection, management and follow-up of their patients. These models of care have been implemented as care plans that provide a schedule of activities over a period of time. Care plans are specific to the age, gender and ethnicity of the patient and standardised across services.

This paper describes the development of a web and mobile-based system called MMEx that implements structured, electronic care plans as a core component of an electronic health record and clinical information system. MMEx has been developed at The Centre for Software Practice (CSP) at The University of Western Australia (UWA) as part of the biomedical engineering initiative. Funded by the Department of Health and Ageing through their e-Health program, the UWA CSP partnered with the

Great Southern GP Network in 2007 to provide a secure network connecting GPs, Specialists, Hospitals, Aged Care Facilities and allied health providers.

MMEEx care plans prompt clinicians when assessments and treatments are due and provide facilities for reporting and auditing performance of the health service in carrying out the protocols of care and reporting on patients' outcomes compliance with care protocols and their clinical outcomes. Although the care plans have been constructed to be used in the context of health care in Aboriginal communities, the applicability of this approach to health care in all primary care settings is made apparent.

■ The Kimberley protocols

The Kimberley Aboriginal Medical Services Council (KAMSC) along with the Western Australian Country Health Services (WACHS) have developed a series of clinical protocols (KAMSC, 2011) that cover maternal and child health, chronic disease and other conditions, and are, specifically targeted at the aboriginal population of the Kimberley region of Western Australia. The protocols cover the diagnosis, management, therapeutic protocols and follow up for conditions such as Acute Rheumatic Fever (ARF), Coronary Artery Disease, Diabetes Type II, Renal Disease and others. The protocols are evidence-based and incorporate the knowledge and expertise of local multidisciplinary service providers to ensure practical and contextual application of available evidence. The protocols are adjusted for the Aboriginal and Non-Aboriginal population, although certain conditions such as ARF are rarely encountered in Non-Aboriginal people. Table 1 shows an example of a Case Definition for Chronic Kidney Disease (CKD).

The protocol recommends the measurement of a number of pathology and physiology measures and sets targets for management. The therapeutic protocol recommends lifestyle changes, drug treatments and immunisations with reviews and assessments by specialists and allied health professionals.

Table 1 - Case definition for chronic kidney disease

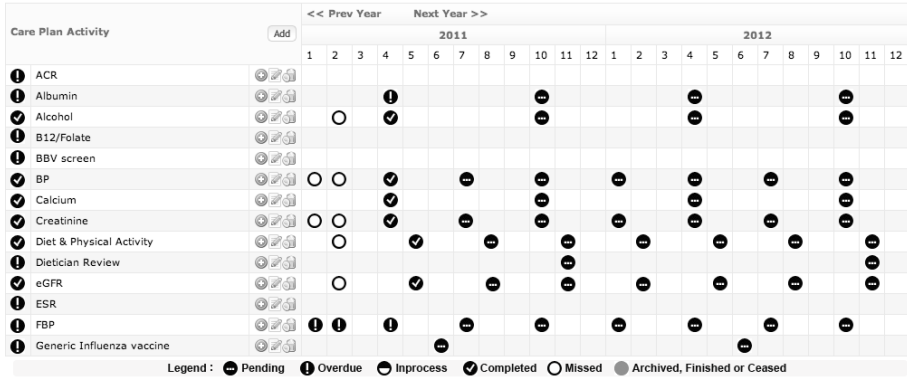
<i>Case Definition</i>		
Chronic kidney disease is defined as an eGFR < 60ml/min on 2 separate occasions at least 1 week apart and not explained by an acute insult (illness, urinary infection or medications especially NSAIDs, ACEi and ARBs). eGFR results above 60 are currently reported by Pathwest only as ">60" rather than as actual values. However, eGFRs > 60 may include patients with early kidney disease – see table below. To determine the exact value for patients with a lab report of "eGFR >60", an eGFR calculator is available at http://www.kidney.org.au . Note that eGFR values >90 may be unreliable.		
<i>Stage</i>	<i>eGFR</i>	<i>Significance</i>
1	> 90 with evidence of kidney damage	May be normal but regular monitoring recommended – declining eGFR indicates CKD. Refer to PROTEINURIA WITH EGFR > 60 protocol.
2	60 - 89 +/- 2 additional evidence	
3	30 - 59	eGFR declines with age. If eGFR STABLE and > 70 years old, may be normal for age if there are no other signs of kidney disease. Usually asymptomatic.
4	15 - 29	Usually mild symptoms. Need referral for predialysis education.
5	< 15	Usually marked symptoms. Imminent need for renal replacement therapy to support life.

■ Care plans in MMEx

Care plans in MMEx are created as a template of activities that are of a particular type and have an associated schedule. The care plan is associated with criteria for the allocation of the care plan to a patient. In the case of the CKD protocol, the care plans are split into three sections, depending on the stage of renal disease. An example of a care plan activity is a blood pressure measurement that is recorded every month. Another activity would be a Full Blood Picture pathology test that is also carried out every month.

Once allocated to a patient, MMEx constructs a visual representation of a care plan (Figure 1). The image has been altered for black and white presentation. On the live system, the activities are colour coded with blue squares representing pending activities, red, overdue activities and green squares, completed activities.

Figure 1 - Visual representation of a CKD care plan showing scheduled activities



Patients may have multiple care plans and so it is important that they are not over or under-assessed. This may result from multiple care plans all prompting the same activities but at different times. MME_x can aggregate all of the care plan activities and makes decisions on an optimal frequency of assessment for each activity. Activities that are linked to pathology tests are updated automatically from electronic pathology results that are imported into the electronic patient record. Likewise, data are linked to other parts of the record and so if a blood pressure measurement is entered for the patient in any part of the system it will update all relevant activities.

■ Lifetime care plans

A Lifetime Care Plan is a special type of care plan that is automatically allocated to all individuals from birth. It schedules activities such as immunisations, health checks, screenings such as mammograms, pap smears and bowel cancer tests, dental, hearing, eye checks over the patient's lifetime and forms the foundation of organised patient care.

The care plans differ depending on gender and aboriginality. They are developed according to the health profiles associated with the population base to which the patient belongs, and can be tailored to deal with familial health traits, such as a genetic predisposition to particular diseases. The lifetime care plan can also be used for scheduling *ad hoc* activities such as health professional reviews that are not part of a separate condition care plan. This makes scheduling and monitoring activities on behalf of patients a relatively straightforward task.

■ Opportunistic care

Experience within Aboriginal community controlled health services in the Kimberley has shown the use of an integrated care plan schedule provides an effective platform to inform health staff of overdue and pending patient care. All members of the health team are prompted by the MMEX integrated schedule to provide evidence based population screening and care as the patient attends the clinic for other reasons, which over time supports widespread population coverage even with limited resources.

■ Reporting

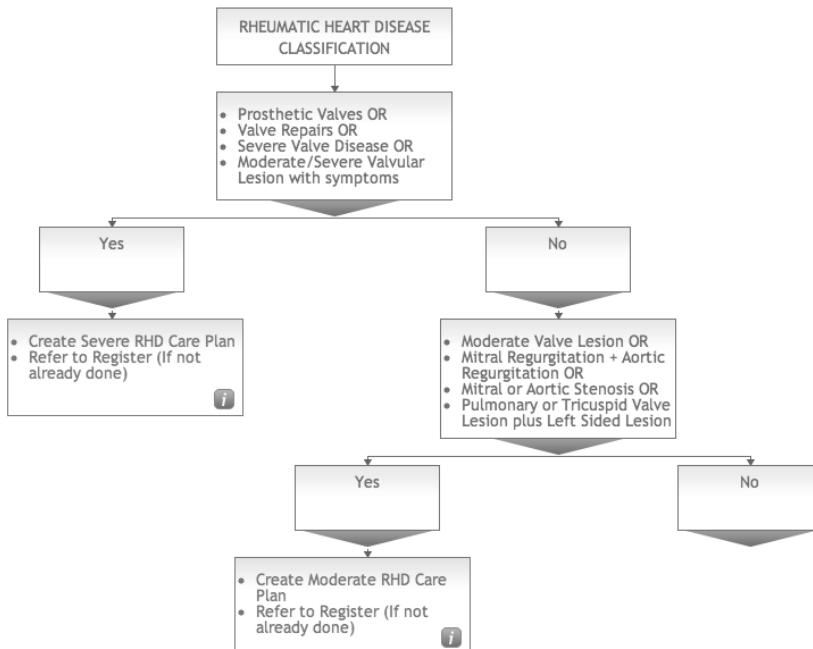
A reporting function in MMEx allows a clinic or health professional to provide lists of all patients that have been allocated specific care plans. The reporting can also query all patients who have a particular activity that is due, or overdue. This is used to generate recalls to the clinic, targeting those patients most in need of care and allowing managers to apportion resources for the most benefit. It can also be used to provide population health level statistics on any parameter measured by the system. For example, in the case of Diabetes Type II, it is trivial to monitor the levels of blood sugar (through measurements of blood sugar level, BSL or through HbA1c levels) in a population of diabetics as a percentage of the general population and to assess how effective the service is in reducing the overall levels through their interventions. Measures such as these are a key in establishing meaningful use of clinical information systems in addition to measuring the effectiveness of care. They are also essential in any development of effective public health policy, such as limiting access to cigarettes or alcohol, or designing alternative distributions of food supplies.

As the system is web-based and supports the ability to share data across organisations with appropriate consent, it is also possible to aggregate de-identified data across multiple services. A challenge for population health reporting is that the data for any one patient may be stored in multiple distinct locations across the variety of service providers encountered by the patient, and aggregation of data is misleading. MMEx is able to assess the data across all services utilising the application, increasing accuracy of the population denominator and reducing duplicate reporting against individuals.

■ Decision support

The allocation of care plans to patients is based on the criteria that are associated with that care plan. In the example of the CKD care plan, this would be abnormal measures of kidney function on separate occasions that are not explained by a number of other attributable factors. In other cases, the allocation of a care plan may be quite a complicated decision. This is especially the case when the health provider allocating the plan may be unfamiliar with the particular disease or illness whose prevalence varies geographically because of its relative rareness. In these cases, decision support tools have been built to aid clinicians in allocating the correct care plans. The decision tools come in a number of different formats but one tool that has been developed is a clickable decision pathway diagram that allows clinicians to answer particular questions and then allocate the correct care plan. An example of this is illustrated in Figure 2:

Figure 2 - Decision support for creating rheumatic heart Disease care plans



This pathway allows for the classification of Rheumatic Heart Disease by severity. A feature of the pathway is that it can record the decisions made by clinicians for future analysis. This will allow modifications implemented in

light of the decisions made and the care plans that are allocated. An additional feature of this particular pathway is that it also has the capacity to send a secure electronic message to refer the patient with consent to the state-based Rheumatic Heart Disease Register where the patient can be monitored by a special team.

■ **Sharing patient information: A single health record**

The benefits of the care plans in MMEEx become even more apparent when coupled with the capability of sharing the care plans along with the patient record with the entire health care team. MMEEx provides an access control mechanism that allows organisations to permit other providers with full or limited access to a patient record after obtaining patient consent, and the permission for access may be time-limited. This means that any changes to the record made by any member of the health care team are reflected in the same record that everyone in that team is viewing. Given that members of the health care team may belong to different organisations, the ability to share information in this way becomes extremely useful. Current application of this functionality in the Kimberley is being defined through the establishment of formalised agreements between organisations clarifying responsibilities in the sharing arrangement.

■ **MMEEx mobile platform**

A particular problem encountered with the use of even a web-based system in some remote areas of the Kimberley has been access to reliable and fast Internet connectivity. A number of clinic sites in the Kimberley have either no Internet access or only satellite access. The satellite access is subject to issues with weather in addition to generally being low-bandwidth. For this reason, offline access to client records, has been developed using an iPad version of MMEEx that is capable of operating in disconnected mode with a synchronisation feature, and will be expanded for future use to ensure reliable access to MMEEx care plan functionality and decision support tools.

■ Use of the system

MMEEx is currently used in a wider setting than the Kimberley region of WA and is used by a broad range of health services. Consequently, care plans cover additional functionality in areas such as aged care, allied health and cancer care.

MMEEx features currently 139 different care plan templates with 855 different activities (MMEEx, 2011). There are on average 10 activities per care plan template.

There are currently 65,797 patients in the system with 93,844 care plans. This equates to 1.4 care plans per patient. The care plans have 1 307 725 recorded activities illustrating a large number of care plans in which there are no activities being directly recorded.

Of active care plans, there were 969,901 activities that have been marked as completed and these related to 23,947 care plans (40.5 activities completed per care plan) allocated to 12,373 patients (1.94 care plans per patient). These care plans reflected the most active use of the system, which is still in the Kimberley.

■ Conclusions and future directions

MMEEx has implemented an innovative approach to health care in the Aboriginal community controlled health setting based on health protocols and processes developed by the Kimberley Aboriginal Medical Services Council. The care plans are allocated to patients based on specific criteria, the application of which can be selected through decision support tools. Once allocated, the care plans will prompt for appropriate activities to ensure that patients are receiving the correct level of monitoring and treatment and ultimately follow up. Reporting mechanisms can be used to manage this process for groups of patients at the community level. Reporting can also be used to provide population health analysis that assists in monitoring the care provided and optimises this care for the resources available.

None of this would be possible without a clinical information system and having one that is web-based with a mobile version has proved highly suitable for the health service environment in the Kimberley region of Western Australia.

Future enhancements will include providing patients with access to their care plans and the ability for them to view their progress through a variety of visual means - such as those utilised on NHS.info (NHS.info, 2011). Adapting this to accommodate varying levels of health and technological literacy will also be an area of research interest.

Whilst the approach to health care outlined in this paper has been focussed on Aboriginal health, there is clear application for use in non-Aboriginal populations as chronic disease and old age increase in prevalence.

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