CDM-Net

A Broadband Health Network for Transforming Chronic Disease Management

Final Report
March 2010

precedence healthcare

Barwon Health

Australian Government
Clever Networks

State Government Victoria AUSTRALIA

CDM-Net:

A Broadband Health Network for Transforming Chronic Disease Management

FINAL REPORT

Period of project	5 July 2007 to 19 December 2009
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List of consortium partners	Barwon Health Cisco Systems CSIRO Australian e-Health Research Centre Deakin University Diabetes Australia – Vic Global Health GP Association of Geelong IBM Intel Monash University Victoria University Centre for Strategic Economic Studies
Geographical area covered by the project	Barwon South Western Region of Victoria and Eastern Goldfields Region of Western Australia

This work was supported by funding from the Australian Government under the Clever Networks program and by the Victorian Department of Innovation, Industry and Regional Development, Department of Human Services, and Multi Media Victoria.

EXECUTIVE SUMMARY

1. The need

The World Health Organisation (WHO) predicts by the year 2020 chronic disease will account for almost three quarters of all deaths. In Australia, chronic diseases are estimated to be responsible for more than 80% of the burden of disease and injury and account for over 60% of healthcare costs ($60 billion per annum). Chronic disease significantly impacts on workforce productivity ($8 billion per annum) and threatens the sustainability of the healthcare system as we know it. Over 30% of the Australian population has a major chronic disease but less than 5% of these people receive best-practice care.

If this drag on the nation is to be overcome, new models of collaborative care are needed that involve planned and continuous management by a team of care providers and the patient themselves, in contrast to conventional episodic, siloed care delivered by a single health care professional or organisation. However, without supporting information and communication technologies, these new models of care cannot be cost effectively or equitably delivered to those suffering chronic illness.

The aim of the CDM-Net project was to establish a broadband network of secure, scalable, and sustainable services, called CDM-Net, to support the management of chronic disease and collaboration among a patient’s care team and with the patient themselves. Such a network of services could lead to safer and higher quality care, greater efficiency in delivering that care, reduced costs of health care, more equitable access to care, and higher participation and productivity of the workforce.

CDM-Net could also help position Australia to take a leading position in the emerging worldwide market for technology-based collaborative care services and products. This could become a significant domestic and export industry opportunity for Australian businesses. For example, Forrester Research estimates the market for such collaborative care solutions will grow to over US$34 billion in the US alone by 2015.

2. Project partners and funding

The project was undertaken by a collaboration of twelve Australian and international organisations led by Precedence Health Care. The collaborating partners were: Barwon Health, Cisco Systems, CSIRO Australian e-Health Research Centre, Deakin University, Diabetes Australia – Vic, Global Health, the GP Association of Geelong, IBM, Intel, Monash University, Precedence Health Care, and Victoria University Centre for Strategic Economic Studies.

The project received a total of over $9.6 million cash and in-kind funding. This included $2.0 million from the Australian Government Department of Broadband, Communications and Digital Economy (DBCDE) under the Clever Networks program, $1.0 million from the Victorian Government Department of Innovation Industry and Regional Development (DIIRD), $0.5 million from Multi Media Victoria, $0.5 million from the Victorian Department of Human Services, and over $5.6 million from the collaborating organisations.

3. The project outputs

The primary output of the project was the CDM-Net network of computing services and infrastructure for supporting chronic disease management. CDM-Net includes the following components:

- a broadband-based (or ‘cloud’) service, called Chronic Disease Management Service (CDMS), for supporting the general practitioner (GP), care team, and patient in achieving best-practice care,
- a Health Services Bus, which provides an open, service-oriented infrastructure that allows different broadband-based services and other systems to ‘plug in’ to CDM-Net and communicate and interact with one another, and
- connectivity infrastructure, which provides gateways, data extractors, and encryption mechanisms that allow applications and existing systems (such as Clinical Desktops and hospital systems) to securely connect to CDMS and the Health Services Bus.

The core application service, CDMS, enables doctors to develop and track personalised care management plans and to share the real time status of these plans and the patient’s health record with the care team and the patient. In particular, CDMS supports GPs, care teams, and patients to better manage chronic disease by:

- creating a registry of patients with chronic disease
- creating a shared health record for these patients
- creating best practice, personalised care plans and distributing these to the patient’s care team and to the patient
- tracking the care plan, medication renewals, and appointments to enable timely follow up and review
- facilitating collaboration by sharing the health record, care plan, and progress against the care plan among the care team and with the patient
- supporting patient self-management by sending alerts, reminders, and notifications to assist with adherence to care plans and the achievement of wellness goals, and
- removing the administrative burden associated with care planning and management by automating the administrative processes and documentation necessary to meet Medicare and best-practice guidelines.

CDM-Net is a world-first chronic disease management network and has overcome the major challenges of security, privacy, reliability, and stakeholder uptake that typically frustrate many e-Health initiatives.

4. The CDM-Net trials

The project was conducted initially in the Barwon South Western Region (BSWR) of Victoria. This region extends from Geelong to the South Australian border. Approximately 85,000 people in this region have a major chronic disease and over 18,000 have diabetes.

The project was later extended to the Eastern Goldfields Region (EGR) of Western Australia, an area covering almost one third of the land mass of the state and with a population of 54,000 people.

The project involved 97 GPs in these regions and over 1,000 care providers and their patients. Of these, 12 GPs and 99 patients in the BSWR participated in a research evaluation undertaken by Monash and Deakin Universities.

The outcomes of the project were evaluated in three ways:

- analysis of service use over the population of participating GPs, other healthcare providers and patients in both the BSWR and the EGR,
- analysis of demographic data, service use, and health outcome measures for the GPs and patients participating in the research evaluation, and
- collection of information from surveys and expert panels on the use of broadband-based services to assist in collaborative care.

5. Key Performance Indicators

A number of Key Performance Indicators (KPIs) were identified prior to commencement of the project. The project met or exceeded most of these KPIs.

For KPI 1 (measuring increased broadband take-up), 97 GPs and 268 other healthcare providers (including practice nurses) used CDMS broadband services. This provided access to CDMS for approximately 30,000 patients with chronic disease, of whom about 6,000 have diabetes. During the period of the trial, 733 patients with diabetes were registered users of CDMS. The number of patients using CDMS is expected to reach 3,000 over the next 12 months.

For KPI 2 (measuring increased range and use of broadband applications, content and services), in the 16 months over which users progressively enrolled in CDM-Net there were over 90,000 page downloads from the CDMS web site. This represents an average of about 200 care provider interactions with CDMS per patient per year. Of these, 26,336 (or approximately 30%) involved care team members outside the GP practice, including allied health, specialists, and pharmacists.

For KPI 3 (measuring increased use of broadband in the health sector), from a baseline of zero, CDMS broadband services generated 725 new care plans and 186 care plan reviews. CDMS also collected over 30,000 health measurements, recorded over 2,000 appointments, and facilitated over 550 collaborative interactions between care providers. CDMS sent 322 SMS reminders and 385 email reminders to patients. These services were provided to patients and healthcare providers covering 71 postcodes across regional, rural and remote areas of Victoria and Western Australia.

6. Estimates of care planning activity

The primary measure of the efficacy of CDM-Net is the degree to which the use of CDMS increased care planning activity. This was measured by the level of provision of Medical Benefits Scheme (MBS) Chronic Disease Management (CDM) items: GP Management Plans (GPMPs), Team Care Arrangements (TCAs), and the subsequent reviews of GPMPs and TCAs after a recommended period of six months.

Analysis of data pre and post the adoption of CDMS for a sample of eight GPs in the BSWR research evaluation showed increases of:

- 205% in GPMPs (compared with a regional change of 21% over the same period)
- 201% in TCAs (compared with 45% regionally)
- 385% in GPMP first (6 month) reviews (compared with 10% regionally)

- 224% in TCA first (6 month) reviews (compared with 49% regionally)

For a sample of five GPs in the EGR for which pre and post data was available, the data showed increases of:

- 88% in GPMPs (compared with a regional decrease of 12% over the same period)
- 80% in TCAs (compared with a decrease of 10% regionally)
- 310% in GPMP first (6 month) reviews (compared with a decrease of 14% regionally)
- 220% in TCA first (6 month) reviews (compared with an increase of 32% regionally)

As the practices did not change their work processes to accommodate the use of CDMS, it can reasonably be assumed that these gains resulted in large part from improved productivity of the GP and/or the practice nurse through the use of CDMS.

Caution should be exercised in extrapolating the above results, given the relatively small sample sizes and the pre/post study design.

7. Estimates of planned service use

Important measures of both the quality of care plans and whether or not these plans are acted upon is the degree to which patients are provided with the services recommended by best practice guidelines, such as HbA_{1c} (blood glucose) tests and podiatrist services.

Analysis of Medicare claims data for the BSWR research cohort of 99 patients over a 10 month period shows that patients using CDMS receive a greater proportion of these services than patients on care plans prior to the use of CDMS. The proportion of patients on a care plan who received the recommended services increased by:

- 25% in HbA_{1c} tests
- 5% in microalbumin tests
- 0% in HDL (high density lipoprotein) tests
- 707% in dietician services
- 68% in podiatry services, and
- 185% in Home Medicines Review (HMR) services.

These changes indicate that either many of the care plans created prior to CDMS did not include these recommended healthcare services or that patients were not followed up to ensure that they received these services.

The actual change in the number of patients provided the recommended services is further multiplied by the increase in the number of patients on care plans resulting from the use of CDMS. This results in the following overall increases in service use on a population basis:

- 82% in HbA_{1c} tests (compared with 4% regionally)
- 75% in microalbumin tests (12%)
- 66% in HDL tests (-4%)
- 1645% in dietician services (26%)
- 151% in podiatry services (53%), and
- 498% in HMR services (23%).

8. Clinical evaluation

The design used for the clinical study of the 99 patients in the BSWR was a single cohort before and after study with the intervention period being between seven and fourteen months (depending on when the patient was placed on a CDMS care plan). Data was collected at four times during the intervention, including baseline. The sources included a questionnaire, data provided by CDMS, semi-structured interviews with health professionals and patients, and field notes. Data collected included demographic data, psychological and behavioural information, medicines profile, physical status, patient attitudes, health professional attitudes, service use, and process data. Completion rates of the questionnaire were high: 99 at Time 1, 93 at Time 2 and 80 at Time 3.

Following the use of CDMS, patients reported increases in allied health attendances consistent with recommended team care for diabetes management.

During the study, eight metabolic parameters were recorded in CDMS care plans. When the mean values were compared, seven out of the eight metabolic parameters show an improved reading, though not statistically significant. The moderate changes are not unexpected given the short duration of the trial and the fact that most patients had only just reached the first review stage of the care plan.

Prescribed medicines were recorded for 96 of the 99 participating patients No significant relationship was found between the number of prescribed medicines and gender or income. Duration of diabetes was longer for patients prescribed one or more diabetes medicines than patients who were not prescribed one of these medicines. There were no changes to recorded prescribed medications or dose regimens throughout the study, but this was not unexpected because these patients indicated that their use of medications was already excellent.

9. Users’ perspectives

Interviews with professionals and patients reflected a positive view of their involvement in the CDM-Net project and their experience with CDMS. All indicated they had experienced both positive and challenging aspects of CDMS.

Approximately two thirds of the participants reported having Internet connected, of which 70% were using email and 70% were conducting Internet searches. Approximately 75% of the patient participants owned mobile phones and, of these, about 40% were using SMS. Hence CDM-Net interactions with patients, especially reminders for tests and appointments via email or SMS, could be sent to around half of this population.

Questions were also asked about beliefs and attitudes to, and satisfaction with, CDMS. Sixty one percent of patients agreed that they believed the care plan developed through CDMS improved their control of diabetes and helped them comply with their care plans, with 29% unsure. Of the 50% of respondents that used email or received SMS, approximately 80% found CDMS reminders and alerts helpful. Of importance to this study, two thirds of respondents agreed they would recommend that CDMS be made available to others with diabetes, with 9% unsure.

Attitudes to and beliefs about web-based care plans were sought from health professionals who attended either one of three focus groups or two face-to-face interviews. One clear message was that neither a web-based plan nor electronic communication can be separated from other aspects of chronic disease management. A second message was that planning cannot be divorced from the understanding that patients do or do not have about

GPMPs and TCAs. The concept of a care plan, the nature of inter-professional engagement, the time and financial pressures in clinical practice, and most importantly, the need to have the patient at the centre of the process, all add layers of complexity to chronic disease management.

10. Medico-legal studies

It is likely that shared electronic care plans will become more prevalent in Australia which raises new legal and ethical issues that need to be understood and addressed if GPs and other care team members are to use such services with confidence.

Interviews were conducted with eight professionals (four GPs, one diabetes educator, and three practice nurses) and ten patients between March 2009 and October 2009 and a second interview conducted with the four GPs approximately six months later.

Seven of the eight health professionals felt that sharing patients' health information electronically with other health professionals was a positive thing to do. Six of the eight professionals felt sharing health information electronically had made a difference to the care they provided for the patients. Significantly, all ten patients' responses supported the professionals' views.

The eight professionals indicated they take patient privacy seriously. All ten patients felt that the use of CDM-Net did not make any difference to their sense of privacy.

An expert panel was convened to address two key legal issues of privacy and professional negligence. On the first issue, the consensus stressed the difficulties in ensuring appropriate informed consent on the part of patients and the privacy dangers inherent in creating a shared record accessible by multiple treating professionals and a private sector intermediary IT service provider.

On the issue of professional negligence, the panel concluded that there was some legal uncertainty regarding the potential additional risks associated with failure to follow up specific aspects of patient treatment as they appear in the care plan.

Many of the medico-legal concerns could be addressed by ensuring privacy receives appropriate protection in a context of informed consent, that care plans reflect best practice, and that the mutual rights and responsibilities of participants are clearly documented.

11. Health economic impact

The hypothesised health economic impact from the CDM-Net trial is difficult to establish, because of the short trial period, the small number of participants, and the limits of a before/after trial design. However, the program logic of the intervention is sound, reflecting the literature on chronic disease management and current barriers to high quality care. CDM-Net is designed to encourage GPs to prepare and review care plans, to promote multi-disciplinary team care and management that follows care protocols. The expectation is that this will result in higher quality care and better outcomes for patients.

Trial participants achieved a high rate of care plan preparation and review compared with rates prior to the use of CDMS. Observations suggest multi-disciplinary team care is being encouraged by CDMS. Patients also report greater use of dietician, podiatry and diabetes educator services during than before the trial; based on self-report and also as suggested from Medicare data. The care plan process also demonstrates considerable dialogue between GPs and other members of a patient's care team. It is not possible at this stage to know whether the initiative has or will result in better patient outcomes, in terms of health and wellbeing, or a reduction (or increase) in use and cost of other health services.

As yet, any benefits are not translating into quality of life improvements, as measured by the AQoL (Assessment of Quality of Life), which shows no change between base-line and follow up. However, the capacity to observe any change in quality of life was compromised by the short follow-up period and lack of a control group.

CDMS provides for the GP a potentially more efficient approach to care planning, in terms of GP time. However, the increase in care planning activity and the greater utilisation of related health care services will result in an increase in cost to government.

12. Economic and social benefits of wider implementation of CDM-Net

The CDM-Net initiative is consistent with the Government's announced National e-Health Strategy and a good example of the benefits arising to patients and doctors of innovative, networked approaches in contrast to high cost, centralised solutions.

There are good theoretical reasons for believing that there is serious under investment in IT systems that provide critical tools and services to doctors and patients. This theoretical view is supported by a range of empirical evidence showing that expenditure on health IT is a fraction of that spent by many other industry sectors. A recent review undertaken by the National Academies in the US highlighted the failure to provide computer-based tools and systems for clinicians and patients as the key shortcoming of IT development in the health sector. This evidence argues for government support for individual firms to build IT-based tools and services in response to the particular demands of doctors and patients.

An economic assessment was made of the economic and social benefits that could result from the wider implementation of CDM-Net if implemented for diabetes patients across Victoria. The expected benefits from a full scale rollout over a ten year period with a 50% take-up of the service by GPs were determined as follows:

- GPs would gain $156.8 million from MBS CDM items and $9.8 million from practice incentive payments; allied health professionals would gain $144.1 million; giving a total of $310.6 million over ten years.
- Victorian public hospitals would save $148.8 million over ten years due to a reduction in diabetes related separations.
- The benefit to patients from better chronic disease management would be $19.7 million in 2010 rising to $229.3 million in 2019 for a total of $1.22 billion over the ten year period.

The cost to the Commonwealth Government of supplying these patients with chronic disease management plans would be $310.6 million derived by health professionals from MBS items and $569.3 million for PBS medicines over the ten year period. This would be compensated for by the improved health of individuals and their consequential higher workforce participation rate which could result in additional tax revenue of $733.1 million. In addition, the Commonwealth would receive a further $93.2 million from taxes on the increased payments to healthcare professionals.

The analysis only considered diabetes patients and the costs and benefits to Victoria of a wider rollout of CDM-Net. Including all major chronic diseases covered by CDM-Net and a national rollout would multiply these benefits and costs proportionately.

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Acronyms and terminology

Acronym	Definition
ACRRM	Australian College of Rural and Remote Medicine
AHP	Allied Health Professional
AQOL	Assessment of Quality of Life
BH	Barwon Health
BMI	Body Mass Index
BG	Blood Glucose
BP	Best Practice
BP	Blood Pressure
BR	Barwon Region
BSWR	Barwon South Western Region
CDE	Certified Diabetes Educator
CDM-Net	Chronic Disease Management Network
CDMS	Chronic Disease Management Service
CHF	Chronic Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
DAV	Diabetes Australia Victoria
DBP	Diastolic Blood Pressure
DHS	Department of Human Services
ED	Emergency Department
EGR	Eastern Goldfields Region
EHR	Electronic Health Record
FTE	Full Time Equivalent
GEGPN	Goldfields Esperance General Practice Network
GP	General Practitioner

GPAG	General Practice Association of Geelong
GPMP	General Practitioner Management Plan
HbA_{1c}	Glycosylated Haemoglobin
HDL	High Density Lipoprotein
HMR	Home Medicines Review
ICD	International Classification of Diseases
IQR	Inter-Quartile Range
IT	Information Technology
LDL	Low Density Lipoprotein
MBS	Medicare Benefits Schedule
MD3	Medical Director 3
NDSS	National Diabetes Service Scheme
NHS	National Health Service
OHA	Oral Hypoglycaemic Agent
OOS	Occasions Of Service
Precedence	Precedence Health Care
RACGP	Royal Australian College of General Practice
SBP	Systolic Blood Pressure
SMS	Short Message Service
SPSS	Statistical Package for the Social Sciences
TCA	Team Care Arrangement
TZD	Thiazolidinedione

1 The CDM-Net Project

1.1 Project objectives and approach

Author: Professor Michael Georgeff

The prevalence and burden of chronic disease has a major impact on healthcare worldwide and will increase with ageing of the population. The WHO predicts by the year 2020 that chronic disease will account for almost three quarters of all deaths [1]. In Australia, chronic diseases are estimated to be responsible for more than 80% of the burden of disease and injury [2]. Chronic disease is responsible for 87% of recurring and some 60% of all healthcare costs in Australia [3], or about $60 billion per annum. In addition, chronic disease has a major effect on workforce participation rates and productivity, estimated to cost the Australian economy over $8 billion per year [4].

Over 30% of the Australian population have a major chronic disease [3]. Currently less than 5% of these people receive best practice care. A broadband-based solution, called CDM-Net, was proposed as a cost effective way to deliver chronic disease management (CDM) services equitably to the very large numbers of people with chronic disease across Australia, as well as their care providers.

CDM-Net also provides the opportunity for Australia to take a leading position in the emerging global market for collaborative care products and services. Forrester Research [5] estimates the US market for such products and services to skyrocket to over US$34 billion by 2015.

1.1.1 The Outputs of the project

The intended outputs of the CDM-Net project were to:

- establish a network, called CDM-Net, which will connect 3000 people with type 2 diabetes in the Barwon South Western Region (BSWR) of Victoria with their general practitioner (GP), health service, and diabetes nurse educators to improve compliance with best practice management of their condition
- ensure CDM-Net is a secure, scalable, sustainable and extensible broadband-based network of chronic disease management services for the use of registered care providers and consumers (patients) in the BSWR of Victoria, and
- ensure CDM-Net includes the following three components:
    - A Health Services Bus
    - Connectivity Infrastructure, and
    - Intelligent Application Services.

The Health Services Bus aimed to provide an open, service-oriented infrastructure to allow different application service providers providing a variety of healthcare services to ‘plug in’ to CDM-Net and communicate and interact with one another.

The Connectivity Infrastructure aimed to provide gateways, data extractors, and encryption mechanisms to allow applications and existing systems (such as clinical desktops and hospital systems) to securely connect to and exchange data with the Health Services Bus.

The Intelligent Application Services, called collectively the Chronic Disease Management

Service (CDMS), aimed to include services for:

- the creation of evidence-based care plans detailing medications, treatments, tests, and referrals tailored to the specific circumstances of the individual consumer
- real-time tracking against care plans to determine adherence to the care plan
- the issuing of reminders, notifications and alerts to support users in their adherence to the care plan
- remote monitoring of key wellness parameters, such as blood glucose and body weight, providing feedback to consumers and care providers, and ensuring that interventions and changes in the care plan are effected in a timely way
- care coordination, including sharing of care plans, shared health information, and electronic referrals and/or discharge summaries, and
- provider feedback, presenting care providers with population-based performance indicators and comparisons against regional means.

1.1.2 Project plan

The outputs were to be achieved through:

- development of a detailed project plan and requirements specifications
- rollout and implementation of Phase 1:
    - developing and implementing CDM-Net, and
    - rolling out, operating and supporting CDM-Net in the Barwon South Western Region (BSWR) of Victoria for selected persons with chronic disease (type 2 diabetes), as well as their primary GP and care team and the Geelong Hospital.
- evaluation of Phase 1:
    - evaluating CDM-Net over an eleven month period with a cohort of 600 persons with chronic disease (diabetes) in the BR of Victoria, together with their primary GP, care team, and the Geelong Hospital to determine the benefits realised by CDM-Net.
- extension of the system to Phase 2:
    - extending CDM-Net to:
        i. cover the BSWR of Victoria
        ii. provide further communications management components and capabilities to allow a wider range of users and application services to ‘plug in’ to the network, and
        iii. include other chronic diseases and disease co-morbidities
    - rolling out, operating and supporting CDM-Net for a further 2,400 persons with chronic disease, and
- final evaluation to determine benefits realised by CDM-Net
    - analysing the benefits of CDM-Net and the extent to which CDM- Net can be scaled across Victoria, nationally, and potentially internationally.

The project also planned to include:

- research and analysis to determine appropriate models of care and appropriate best-practice and/or evidence-based care plans for people with chronic disease, including co-morbidities, and
- research and analysis to determine appropriate technologies and methods for creating and tracking care plans.

1.1.3 Expected benefits

The outputs of the project were expected to lead to the following benefits and outcomes, as measured by a number of KPIs:

- help drive participation and use of broadband networks by providing a range of high value broadband-based services to a wide range of users, including people with chronic disease, health care providers, and selected other stakeholders in health care, and
- improve health outcomes and provide social and economic benefits to the nation, including:
    - improved access to chronic disease management services for urban, regional, rural, and remote residents in the BSWR
    - increased quality of life for residents in the region arising from improved delivery of chronic disease management services
    - increased uptake of care plans for people suffering from chronic disease
    - increased adherence to care plans by people suffering from chronic disease
    - increased uptake by GPs of extended primary care items associated with chronic disease, and
    - improvement in the control of key health parameters, such as blood glucose levels.

1.2 The challenge of chronic disease management

Authors: Associate Professor Peter Schattner, Professor Michael Georgeff

Conventional approaches to health care are not well suited for the prevention and treatment of chronic disease. According to the American College of Physicians, “meeting the complex needs of patients with chronic illness or impairment is the single greatest challenge facing organised medical practice” [6].

Doctors often do not know what medications and tests have been given to patients by other doctors, even when they are members of the same care team. It is even more difficult to bring relevant medical knowledge to the point of care, to create integrated care plans, to monitor a patient’s progress against the care plan, or to alert care providers when a patient’s condition requires intervention. Over 50% of doctors do not follow best practice guidelines [7] and 30-50% of patients with chronic disease are hospitalised because of inadequate care management [8].

People with chronic disease also have difficulty managing their own care. For example, diabetes management—even without complications—requires self-management training, regular and timely laboratory evaluations, clinical nutrition therapy, compliance with medication regimes, regular self-monitoring of blood glucose levels, and regular podiatric and ophthalmic examinations. Evidence indicates that more proactive disease management, better utilization of knowledge, care-coordination, and remote monitoring of a patient's medical condition can make a significant difference to health outcomes and health care costs.

In Australia, it is estimated that improved knowledge sharing and care plan management for patients with chronic disease would produce productivity savings of over $4.5 billion per year [9]. Better coordination of care, including sharing of information on medication, allergy and pathology tests, would save a further $2 billion per year [10].

Numerous pilot studies show that home monitoring of persons with chronic disease can reduce emergency room visits by up to 40%, hospital admissions by 30-60%, and length of stay for those hospitalised by up to 60%, as well as providing significant improvements in quality of life [11, 12]. Other studies have suggested that physicians who receive electronic clinical reminders follow medical evidence more frequently than physicians who do not receive these reminders [13].

In the United States of America (USA), chronic disease management (CDM) programs that focus on proactive patient interaction have also produced significant improvements in healthcare processes and outcomes. A recent study [12] of over 16,000 titles and review of 102 rigorous studies published between 1987 and 2001 concluded that disease management programs were associated with marked improvements in many different processes and outcomes of care. Of the outcomes studied, disease management appeared most commonly to improve patient satisfaction (71%), followed by patient adherence (47%) and disease control (45%).

CDM-Net aims to address these challenges by providing broadband-based infrastructure and services for assisting health care providers and their patients better manage chronic illness. It aims to transform the manner of collaboration among health care providers and their patients, to assist the care team in the ongoing management and processes of care, to monitor the provision of care and support compliance, and to assist patients in managing their own care.

1.3 Project implementation

Authors: Professor Michael Georgeff, Professor Trisha Dunning AM, Dr Kay Jones

1.3.1 Project scope

The CDM-Net Project was a two and a half year funded project that developed, implemented and evaluated a broadband-based network of health services, CDM-Net, for managing chronic disease using type 2 diabetes as the test disease.

The project was conducted initially in the Barwon South Western Region (BSWR) of Victoria (Figure 1-1 on page 25). This region includes regional, rural and remote health care providers and consumers. It extends from Geelong to the South Australian border, covering 29,637 square kilometres. The region has a population of approximately 340,000. Approximately 85,000 people have a major chronic disease; over 18,000 have diabetes.

The region includes over 300 GPs, organised into two divisions of general practice. It supports four major hospitals, plus a number of smaller hospitals and community health services. The majority of people living in the area are serviced by Barwon Health, which includes Geelong Hospital. A large number of other health care providers, including specialists, allied health professionals, pharmacies, and pathology and radiology labs provide services to the region.

The hospitals and community services in the region are linked via SWARH Net, a high speed broadband network. A small number of GPs are also connected to SWARH Net. Approximately 80% of the population has access to other broadband services.

The project scope was subsequently extended to include the Eastern Goldfields Region (EGR) of Western Australia, covering an area one-third that of Western Australia. This area is serviced by the Goldfields Esperance General Practice Network. It includes the city of Kalgoorlie-Boulder and the surrounding region, from the coastal town of Esperance in the South, to the inland town of Wiluna in the North. There are 52 GPs in the region, a number of specialists, pharmacists, practice nurses, regional and district hospitals and two Aboriginal medical services. Kalgoorlie-Boulder has a large hospital and a base for the Royal Flying Doctor Service of Australia, which serves the entire area.

The CDM-Net project was initially planned to run for two years from 1 July 2007 to 30 June 2009. Time extensions were sought in September/October 2008 and July 2009 and were granted from the Victorian DIIRD and the Commonwealth DBCDE to account for unanticipated delays beyond the control of project management. The completion date was extended to 16 December, 2009.

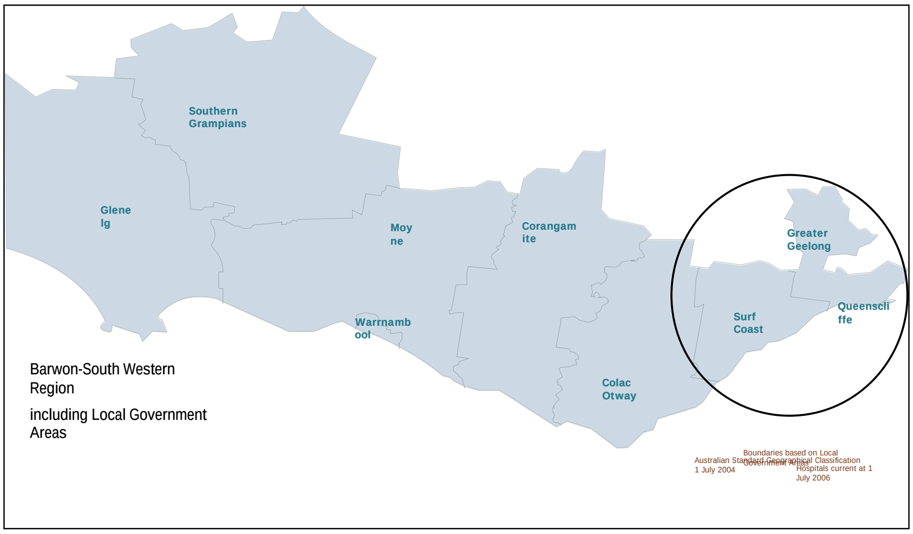

Figure 1-1: Map of the Barwon South-Western region depicting the local government areas. The Barwon region is circled.

1.3.2 Participating organisations and funding

The CDM-Net Project was undertaken by a collaboration of twelve Australian and international organisations led by Precedence Health Care. The collaborating partners and their roles were:

- Precedence Health Care: Project lead and direction, system and services development, including Intelligent Applications Services, Health Services Bus, and Connectivity Infrastructure, technology and integration, adoption, and change management
- CSIRO Australian e-Health Research Centre: project management
- Barwon Health: Integration with healthcare services, including Connectivity Infrastructure, health services expertise, and CDMS adoption
- Diabetes Australia - Victoria: expertise in clinical models of care and call centre facilities
- GP Association of Geelong: CDMS adoption and change management
- Global Health: technology expertise
- Cisco Systems: technology expertise
- IBM: technology expertise, development of the Health Services Bus and Connectivity Infrastructure

- Intel: technology expertise
- Monash University: clinical models of care, IT research, and clinical and health services evaluation
- Deakin University: clinical evaluation and CDMS adoption, and
- Victoria University Centre for Strategic Economic Studies: economic evaluation.

The project received a total of over $9.6 million cash and in-kind funding. This included $2.0 million from the Australian Government Department of Broadband, Communications and Digital Economy (DBCDE) under the *Clever Networks* program, $1.0 million from the Victorian Government Department of Innovation Industry and Regional Development (DIIRD), $0.5 million from Multi Media Victoria (MMV), $0.5 million from the Victorian Department of Human Services (DHS), and over $5.6 million from the collaborating organisations.

1.3.3 Project management structure

The CDM-Net management structure is shown in Figure 1-2 below.

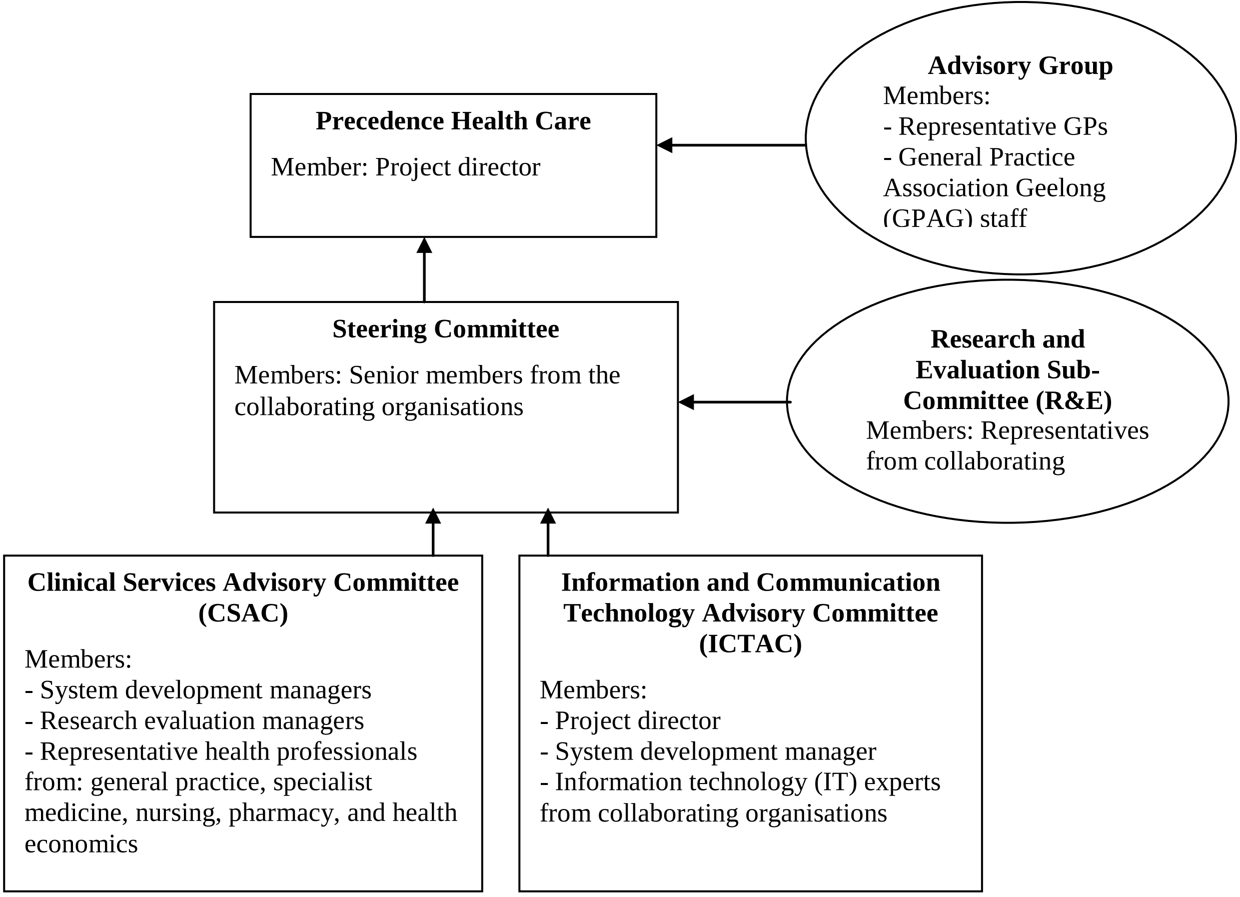

Figure 1-2: Overview of the Chronic Disease Management Network (CDM-Net) management structure and committee membership

The primary function of the Steering Committee was to oversee the conduct of the project, review the financial statements and performance against the project plans, agreements, and contracts.

The ICT Advisory Committee (ICTAC) was responsible for providing advice about planning and implementing Information and Communication Technology (ICT), setting objectives to meet the ICT requirements of the project, overseeing ICT activities, and reporting progress to the steering committee.

The Clinical Services Advisory Committee (CSAC) was responsible for providing advice about planning and implementing the clinical components of the project including evaluating the outcomes of the project.

The Research and Evaluation (RE) sub-committee provided advice about the conduct of the research component including the study design, obtained ethics approval from Monash University and Barwon Health, ensured research activities were conducted according to the ethics requirements, and monitored the progress of the research.

The CDM-Net Advisory group provided advice to Precedence about liaising with GPs.

1.3.4 CDM-Net evaluation

The evaluation of CDM-Net involved two components:

- the evaluation of healthcare service use across all users of CDM-Net services, including measurement of the KPIs, and
- a research evaluation of a selected cohort of GPs and their patients from the BSWR of Victoria.

An overview of the research evaluation and a timeline for completing the tasks associated with each research activity is presented in Table 1-1 on page 28.

Deakin, Monash, and Victoria Universities collaboratively undertook the research evaluation.

Deakin University:

- undertook the clinical evaluation.

Monash University:

- Department of General Practice
    - determined health professional use, and health professional and patient acceptability of CDMS GPMPs and TCAs and the central support service, and
    - explored the interprofessional and organisational psychodynamics resulting from the introduction of a novel system for sharing clinical information
- Faculty of Law undertook legal and policy research and analysed privacy issues
- Faculty of Pharmacy managed the integrated medication management component
- Faculty of Business and Economics was responsible for the health economic evaluation.

Victoria University:

- examined the overall public benefit of CDMS, and
- undertook the business realisation and development evaluation component.

Table 1-1: Timeline for the CDM-Net research and evaluation activities

ACTIVITY	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Jun 08	Jul 08	Aug 08	Sep 08	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct – Dec 09
Development of care plan templates	Requirements				Evaluation				Co-morbidities															Report
Care Plan Support Services for general practitioners (GPs) and patients	Requirements				Evaluation				Co-morbidities															Report
Predicting Absolute Risk with a care plan									Select Risk Calculator							Trial								Report
Use and Acceptability of Care Plan Support Service									Evaluation of stage 1 rollout															Report
Data mining techniques to determine the efficacy of care plans									Design							Pilot								Report
Legal and Policy research and analysis of privacy issues	Requirements				Review				Evaluation															Report
Integrated medication management	Planning				Documentation				Evaluation															Report
Clinical evaluation of the CDM-Net	Planning				GP recruit		Training		Patient enrolment		GP Workshops and data collection													Analysis & report
Health economic evaluation of CDM-Net	Data Requirements				Modelling								Data collection											Analysis and report
Estimation of the overall public benefit of CDM-Net	Data Requirements				Collect external data				Develop evaluation model							Data collection using model								Analysis and report
Business realisation and development evaluation	Requirements				Business model documentation				Assess alliance/partnership model							Model overall impact								Report
CDM-Net milestones	System design complete					Stage 1 system rollout			Stage 2 system rollout															Final report

1.4 Report overview

This report describes the benefits and outcomes of the CDM-Net project as a whole, specifically in relation to the outputs described in Section 2.1 and the Key Performance Indicators for the project.

The report also provides:

- an examination of how the project provided new and improved services to the health services sector in regional, rural and remote Australia
- an explanation of the need that prompted the project and an assessment of how well this has been addressed, in terms of sector geographical area and service offered
- a description of the project in terms of activities, outputs, and outcomes, including the technical solution adopted with an emphasis on innovation and enablement
- an analysis, supported by quantitative and qualitative data, of how the selected regions benefited from the these services, including the difference made to recipient communities and the increases in service demand
- the cost savings and efficiencies in the way the new chronic disease management services have been delivered, and
- a discussion on the future of CDM-Net, including its sustainability and the barriers to adoption of CDM-Net nationally.

1.5 References

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2 Product Definition and Development

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2.1 The Chronic Disease Management Network

2.1.1 Introduction

The Chronic Disease Management Network (CDM-Net) is a network of computing services, computer middleware, and connecting end-points (for example, clinical desktops and hospital systems) for supporting chronic disease management.

In particular, CDM-Net is a secure, scalable and sustainable broadband-based network that includes the following components:

- an Intelligent Application Service, called Chronic Disease Management Service (CDMS) for supporting the GP, care team, and patient in achieving best-practice care
- a Health Services Bus, which provides an open, service-oriented infrastructure that allows different broadband-based services and other systems to ‘plug in’ to CDM-Net and communicate and interact with one another, and
- Connectivity Infrastructure, which provides gateways, data extractors, and encryption mechanisms that allow applications and existing systems (such as Clinical Desktops and hospital systems) to securely connect to the Health Services Bus and exchange data with the Bus.

2.1.2 The Chronic Disease Management Service (CDMS)

The Chronic Disease Management Service (CDMS) is the primary computing service provided by CDM-Net. CDMS is a ‘cloud’ (Internet) service that aims to support general practitioners, care teams, and patients to better manage chronic disease by:

- creating a registry of patients with chronic disease
- creating a shared health record for these patients
- creating best-practice, personalised care plans and distributing these to the patients’ care teams and to the patients
- tracking the care plans, medication renewals, and appointments to enable timely follow up and review
- facilitating collaboration by sharing the health record, care plan, and progress against the care plan among the care team and with the patient
- supporting patient self-management by sending alerts, reminders, and notifications to assist with adherence to care plans and the achievement of wellness goals, and
- removing the administrative burden associated with care planning and management.

CDMS uses innovative decision support and monitoring software connected to a broadband network such as the Internet, to collect health information and monitor health events across the continuum of care, including GPs, allied health professionals, specialists, hospitals, pharmacies, community centres, and pathology labs. The communication between healthcare providers, patients and CDMS occurs via the user’s preferred communication channel, including phone, SMS, email and web-based portals.

CDMS aims to save GP time spent on administration and increases the amount of time available to the patient. It ensures that best practice care plans are made available to the GP at the point of care. CDMS improves collaboration among the care team both by sharing clinical information and by improving the efficiency of the collaboration and management processes. By tracking the care plan, CDMS simplifies and improves review and follow up.

CDMS addresses some of the key barriers to uptake of care plans and collaboration among the care team. In particular, CDMS

- improves the efficiency with which GPs and practice nurses can create and administer care plans by automating key aspects of care plan creation and distribution, including the creation and distribution of all documentation required to support the care plan; and
- facilitates collaboration between the care team and the GP and streamlines care plan reviews by allowing the GP to base reviews on information such as appointment attendances and reports contributed by the entire care team.

2.1.3 How the Chronic Disease Management Service works

In its simplest form, CDMS works as follows. A GP identifies a patient with chronic disease who consents to being managed with the assistance of CDMS and to share health information among the care team. Once the patient is registered, the GP sends any relevant health information to CDMS through an e-referral system, using their existing clinical software in the same way they would send a referral to a specialist – in this case, electronically.

CDMS uses this information (and information received from other providers) to create a shared electronic health record for the patient. It then employs best practice rules for chronic disease management to automatically create a personalised care plan for the patient. This care plan is returned electronically to the GP’s clinical desktop for authorisation or amendment and, through a coordinated electronic process, is then distributed and agreed to by the full care team. The care plan is also made available to the patient.

CDMS then tracks health events against the care plan. For example, members of the care team and the patient can enter clinical measurements and other data at any time. They can also enter appointments, whether or not these are attended, and progress notes that are shared among them.

At any time, the GP can modify or update the care plan in response to the patient’s condition and information provided by CDMS. For example, the GP may become aware of an additional comorbidity and request that CDMS create a revised care plan, or alter medications based on the progress notes shared by CDMS. In this way, the care plan becomes a ‘live’ object that continually reflects the status of the patient and actions that need to be taken to deliver continuous best-practice care.

CDMS also supports adherence to the care plan by sending reminders and alerts to patients and the care team. For example, if the care plan requires the patient to visit a podiatrist in the next month, a notification is sent to the patient, for example, as an SMS, advising that an appointment needs to be made, with whom, and when. Similar reminders and alerts are sent for generic items such as medication renewals, pathology tests, and GP visits. The care team is similarly reminded of upcoming tasks, reviews, and appointments. At the same time, CDMS also continuously monitors key biomedical parameters such as blood glucose levels entered either by the care team or the patient. Measurements outside the desired range can trigger an alert, which is then escalated to the patient, their GP, or other healthcare provider.

2.1.4 The Connectivity Infrastructure

The Connectivity Infrastructure, where possible using existing state-wide and national standards, includes connectors to data sources, such as clinical desktops, remote monitoring units, hospital systems and community health services. The Connectivity Infrastructure includes system gateways, which provide a secure connection between data sources, provider systems and consumer systems to the network. A data extractor is used to extract key consumer data (as authorised by the consumer) from the source application (for example, Medical Director), passing this to the system gateway. A PID (Patient Identification) mapping agent is used to assign an appropriate subject identifier to the data to uniquely identify the consumer. The system gateway converts encrypts the health data prior to transmission. The gateway is exposed as a web service or other service interface as appropriate.

2.1.5 The Health Services Bus

The Health Services Bus facilitates the communication among Application Service Providers, Local Application Services, and system gateways. Its key features are:

- Location and identity: participants need not know the location or identity of other participants; for example, service requesters don't need to be aware that a request could be serviced by any of several service providers. Service providers can be added or removed without disruption
- Interaction protocol: participants need not share the same communication protocol or interaction style.
- Interface: requesters and providers don't need to agree on a common interface. The Health Services Bus reconciles differences by transforming request messages into a form expected by the provider.

The Health Services Bus supports a variety of interaction types, including one-way, request/response, asynchronous, synchronous, and publish/subscribe communication.

The Health Services Bus also includes consumer and provider directories that allow applications to identify and communicate with consumers and providers. For CDM-Net, the content of these directories is relatively simple, sufficient for registering the consumers and providers involved in the project. However, they have been designed with web services and other interfaces complying, where appropriate, with National E-Health Transition Authority (NeHTA) standards and guidelines. This allows the implemented directories to be easily replaced with other, more extensive directory services developed on a state or national level.

The Health Services Bus includes:

- A consumer health log that contains a set of notified consumer encounters with the health system, including GP visits, pathology tests, home monitoring information, referrals traffic and this information is communicated to CDM-Net.
- Identity management, authentication and authorisation services.
- Mediation services for transforming message formats and terminologies between standards.

- Message management services for managing messaging protocols.

CDM-Net operates over secure broadband, which is achieved using the Internet with SSL (Secure Socket Layer) security and the South West Alliance of Rural Health Network (SWARHNet). SWARHNet provides a secure, high bandwidth broadband network established across the BSWR and connects regional healthcare provider organisations.

2.2 CDM-Net capabilities

2.2.1 Functionality

The CDM-Net infrastructure and the CDMS application service met and exceeded all the functionality requirements as described by the project outputs and the project plan. Precedence receives continuous feedback from users and regularly upgrades CDM-Net. Surveys of users clearly demonstrate that CDM-Net meets user expectations. The Commonwealth's Professional Services Review has also stated that CDM-Net exceeds Medicare requirements for the management of chronic disease.

2.2.2 Technology

The CDM-Net web portal supports secure access to services for all users and uses existing secure electronic referral mechanisms to receive demographic and clinical information from GP practices. CDM-Net provides web service interfaces to electronic health records, e-referral and messaging services, and hospitals.

Decision support is provided by sophisticated and patent pending rule-based technologies using XML-based knowledge representation models. This approach facilitates the extension of CDM-Net to new chronic diseases and to support for other healthcare processes such as hospital discharge planning. The CDM-Net technology components have been thoroughly tested, proven and well-established in the operational environment.

The communications infrastructure required by CDM-Net is provided by existing public broadband networks and, in future, the National Broadband Network.

2.2.3 Scalability

CDM-Net is designed to reliably manage services for tens of millions of users, using proven and scalable component technologies to support rapid adoption of the service. It uses technologies such as database clustering over multiple virtual machines for redundancy and scalability.

Practically, scaling across Australia is limited by the lack of an Individual Health Identifier (IHI), comprehensive provider directories, and healthcare authentication services. These are planned to be available from NeHTA during 2010 and will be incorporated into CDM-Net as soon as practicable.

2.2.4 Adherence to standards

The CDM-Net technology elements conform to all relevant national and international technical standards. CDM-Net supports the creation and tracking of care plans that embody clinical guidelines and standards for best practice.

CDM-Net is strongly aligned with the National e-Health Strategy and the standards being progressively developed by NeHTA.

The modular, service-oriented architecture of CDM-Net will ensure that any new standards will be readily incorporated. Such standards include:

- privacy, consistent with National Privacy Principles and consent models
- clinical best practice guidelines, models of care and healthcare workflow support
- the National Health Data Dictionary and Snomed terminology
- messaging and communications, such as NeHTA Messaging Guidelines and Web Services Architecture
- security, authorisation and authentication including PKI, SSL, NeHTA Foundation e-Health components, Health eSignature Authority, and
- message content, such as HL7 and CCR.

2.2.5 Access conditions and protocols

CDM-Net is accessible on a transparent and equivalent basis to all authorised stakeholders across the full continuum of care.

Authorised stakeholders are currently all Australian and include the following categories:

- healthcare providers, including GPs, specialists, pharmacists, allied health professionals, pathology and radiology labs, hospitals and community services
- patients/consumers with chronic disease and their nominated carers, and
- researchers.

Fees are payable for access to the services provided by CDM-Net. The current fee is a charge of approximately 15% of the Medicare rebates a GP receives for MBS CDM Items. Note that no fee was charged for participants in the current project.

Users must agree to use standards-based interfaces for linking to CDM-Net and must agree to standard terms regarding proper use of the network. Healthcare providers are authenticated prior to registration. Businesses and other organisations providing services that link to the network will be required to register as a trusted organisation and agree to meet minimum standards for privacy, security and quality of service.

2.2.6 Interoperability

CDM-Net uses an open, services-oriented architecture designed to maximize interoperability with other systems and services. Interfaces are based on web services standards where appropriate. Other interfaces, for example, email gateways, are provided to maximise interoperability with existing systems. CDM-Net has been designed to comply with NeHTA’s interoperability framework.

2.2.7 Privacy

CDM-NET manages information and access consistent with privacy legislation, including the Health Records Act and the Health Privacy Principles. The approach to privacy in CDM-NET is to gain informed consent from the patient for sharing clinical data and optionally, for use of de-identified data for research purposes. Surveys of patients and providers indicate that users of CDM-Net are satisfied with the level of privacy protection. The project team also worked closely with NeHTA to help promote changes to national privacy regulations to remove legal barriers to the wider adoption of e-Health initiatives.

2.2.8 Security

CDM-Net provides meets all security requirements for the provision and storing of health information. All user access with the system is via SSL connections, with username and password. Strict password management rules are enforced by CDM-Net. PKI encryption is used for sending patient clinical information via secure email from the GP practice to CDM-Net. CDM-Net will use the National Authentication Service for Health when it becomes available.

2.2.9 Reliability

CDM-Net is hosted at SWARH-Net, a high speed, secure, broadband network connecting hospitals and community services across the Barwon South Western region of Victoria. SWARH-Net provides highly redundant server and networking infrastructure to protect against loss of data and to support continuous operation 24/7/365. SWARH is a ‘qualified provider’ under DoHA’s Broadband for Health scheme.

2.2.10 Maintenance strategy

CDM-Net is provided as a web-based (‘cloud’) service. Maintenance requirements are thereby minimised and largely independent of scale. The open services-oriented architecture ensures:

- reduced total cost of ownership, as functionality can easily be re-used
- ‘future proof’, as superseded component services can be easily swapped for newer technologies
- customisable to the needs of particular regions or stakeholders
- adaptable, as the ‘loosely coupled’ services can be easily modified to better suit the changing needs of health care, and
- extensible, as increasingly extensive CDM and other services can be added at minimal cost.

2.3 End-User demand

Based on extensive discussions with the key stakeholders over four years, analysis of the evidence and validation by Deloitte and Cisco, the value propositions for potential users of CDM-Net that should drive and sustain demand have been identified as follows:

- Patient/consumer and their carers: better health outcomes, support for self-management, improved quality of life. There are over 7 million people nationally with a chronic illness.
- GPs, allied health professionals, specialists, pharmacists: higher quality, safer care; greater efficiency; increased productivity; and higher financial returns. Nationally, there are over 25,000 potential GP users, 230,000 allied health, and approximately 6,000 practice nurses.
- Hospitals, community services, day clinics: better coordination with primary care; reduced adverse events; fewer admissions and shorter length of stay. Each of the regions supports one or more hospitals/community services.

- Payers: more efficient care; lower costs; improved health outcomes; broader accessibility; and comprehensive evidence base for new models of care. Includes all state and territory governments, private health insurers, and indemnity insurers.
- Employers: reduced sick days, improved workforce productivity and participation rates. Includes large and small companies and corporate health services organisations.
- Healthcare industries: access to the primary care provider market; paths to large global market.
- Research and health policy organisations: access to previously unavailable primary healthcare data for developing policy and models of care, education and training.

CDM-Net is a world-first, broadband-based collaborative care management service that enables doctors, the care team, and the patient to collaborate in the development and tracking of best-practice care plans and facilitates adherence to these plans using electronic reminders and alerts.

CDM-Net uses innovative decision support and rule-based technologies to create and track care plans including—for the first time—care plans for multiple co morbidities; employs innovative mechanisms for collecting primary healthcare data and managing the collaboration processes involved in CDM; and uses the web as a collaborative space and to link to other web-based services.

Our research to date, confirmed by Cisco, IBM, and Intel, indicates that there is no known equivalent of CDM-Net worldwide with comparable collaborative and care planning capabilities. CDM-Net has filed patents on its technologies, which have been accepted by the international examiner. The uniqueness of CDM-Net is also validated by the success of Cisco and Precedence in winning a major contract in Oman to provide CDM services using CDM-Net and Cisco's Unified Communications solution.

2.4 Alignment with National and State priorities

CDM-Net is strongly aligned with the National e-Health Strategy and the standards being progressively developed by NeHTA. CDM-Net is based on NeHTA's recommended service-oriented approach to the design of the National E-Health Infrastructure (NEHI) and the applications that use it. CDM-Net will comply with the standards and requirements for foundation e-health components, including healthcare provider directories and authentication services as these are developed.

CDM-Net is aligned with the National E-Health Roadmap and incorporates some of the major High Priority Solutions and Infrastructure identified in the National E-Health Strategy, including chronic disease management and electronic information sharing. It also serves as a driver for the use of key E-Health Foundations, including Unique Healthcare Identification and the National Authentication Service for Health.

CDM-Net also addresses the major national priorities in healthcare and human capital reform, including:

- The Key Priority areas identified in the National Primary Health Care Strategy:
    - better management of chronic conditions,
    - improving quality, safety, performance and accountability, and
    - improving access and reducing inequity.
- The key reforms of the Health and Hospitals Reform Commission:

    - improved shared care and team collaboration for people with chronic conditions
    - improved accessibility of care, and
    - implementation of a national ehealth system.
- The priorities identified in the COAG Human Capital Reform:
    - increasing labour force participation by reducing the impact of chronic disease, and
    - increasing the effectiveness of the health system through more integrated care delivery.

CDM-Net-Australia also directly addresses the priorities established for the Divisions of General Practice, the Australian Primary Care Collaboratives Program, and the chronic disease guidelines developed by the Royal Australian College of General Practitioners.

2.5 Sustainability

CDMS is now being rolled out more widely across Australia. The sustainability of the service is currently based on end-user payments of 15% of transaction value associated with the MBS incentive payments and rebates that are delivered by CDMS. Acceptance of these fees by general practitioners is based on the value proposition that CDMS offers to the GP and other healthcare providers:

- saves time
- improves quality of care
- reduces administrative burden
- increases practice revenues
- increases health services referrals within best practice guidelines
- improves patient outcomes
- provides more accessible care.

The sustainability of CDM-Net and other interoperable high priority solutions is further driven by the external impetus created through Commonwealth and State Government policies and initiatives as well as healthcare industry collaboration. NeHTA, the National eHealth Strategy, the National Primary Health Care Strategy and the Report of the Health and Hospitals Reform Commission all establish the urgent need for the solutions being provided by CDM-Net. These are long-term programs and define a clear market need.

- The Australian Government is focused on reform, innovation, and major infrastructure projects, including the NBN and key infrastructure that will enable CDM-Net scalability across Australia, for example, healthcare provider directory, unique patient identifier, referrals and interoperability standards.
- Internationally, many governments, including in particular the UK and US, have similarly identified e-Health and chronic disease management as key to their healthcare reform, opening up substantial export opportunities for Precedence and its partner organizations.

There still remain some barriers to wide scalability of CDM-Net, particularly to regional, rural and remote Australia. These include:

- lack of high speed, secure, reliable broadband to all users
- lack of National Unique Health Identifiers for all patients

- a comprehensive national Healthcare Provider Directory, including service and communication details for GPs, specialists, allied health, pharmacists, and other healthcare organisations and services, and
- failure of vendors to provide open interfaces to existing medical software and applications, particularly clinical desktop applications and other primary care software systems.

The first barrier will be greatly reduced by the rollout of the National Broadband Network. The second and third barriers should be overcome as the National eHealth Transition Authority completes implementation of the infrastructure components of its e-Health strategy. User pressure, together with government incentives and requirements, could eventually help overcome the last of these barriers.

3 CDM-Net usage and Key Performance Indicators

Authors: Professor Michael Georgeff, Mr Jon Hilton

3.1 Evaluation design

The evaluation involved two cohorts of service users with measures of service use taken over the period from 1 August, 2008 to 15 December, 2009. A subgroup in each of these cohorts provided both before and after measures. Key Performance Indicators (KPIs) were taken throughout the project and at the conclusion of the project.

3.2 Sampling population

The evaluation was undertaken in the Barwon South Western Region (BSWR) of Victoria and the Eastern Goldfields Region (EGR) of Western Australia. Participants included GPs, practice nurses, allied health, specialists, pharmacists, hospitals and the patients (consumers) enrolled by GPs on CDMS care plans. The initial target was to involve 3,000 patients in the evaluation together with their associated care providers, estimated to involve approximately 100 GPs and 200 other care providers. The target number of GPs and care providers was achieved. However, not all the enrolled GPs were active users. In addition, the rate at which GPs placed their chronically ill patients on care plans was lower than expected and outside the project control, in part because of the swine flu pandemic. This resulted in 733 patients being enrolled by end of project with the remainder expected to be enrolled progressively over the next year, including regions beyond BSWR and EGR.

3.3 Key Performance Indicators

3.3.1 Key Performance Indicator 1: Measuring increased broadband take-up

Table KPI-1 on page 187 reports the achievements on KPI 1 as at the conclusion of the project on 15 December, 2009.

As is seen from the table, 97 GPs and 268 other healthcare providers (including practice nurses) used CDMS broadband services. This provided access to CDMS for all chronically ill patients treated by these GPs (approximately 30,000 patients, of whom about 6,000 have diabetes). The GPs and/or their practice nurses began progressively registering these patients with CDMS during the trial. By the end of the project, 733 patients with diabetes were registered users of CDMS. Over the next 12 months, the number of patients using CDMS is expected to reach 3,000.

3.3.2 Key Performance Indicator 2: Measuring increased range and use of broadband applications, content and services

Table KPI-2 on page 188 and Figure 3-1 below summarise the achievements on KPI 2 as at the conclusion of the project.

As can be seen, the number of page downloads from the CDMS website was very high, particularly in comparison with other e-Health initiatives and services (see, for example, reference [1]). Over the approximately 16 months over which users progressively enrolled in CDM-Net, there were over 90,000 page downloads. Of these, 26,336 (or approximately 30%) involved care team members outside the GP practice, including allied health professionals, specialists, and pharmacists. This is an impressive number taking into consideration that most of the care planning and management is carried out by the GP and practice nurse and typical care planning without CDM-Net involves very limited collaboration among the care team.

Given that patients (consumers) were enrolled progressively over the 16 month period, the data represents an average of about 200 care provider interactions per consumer per year.

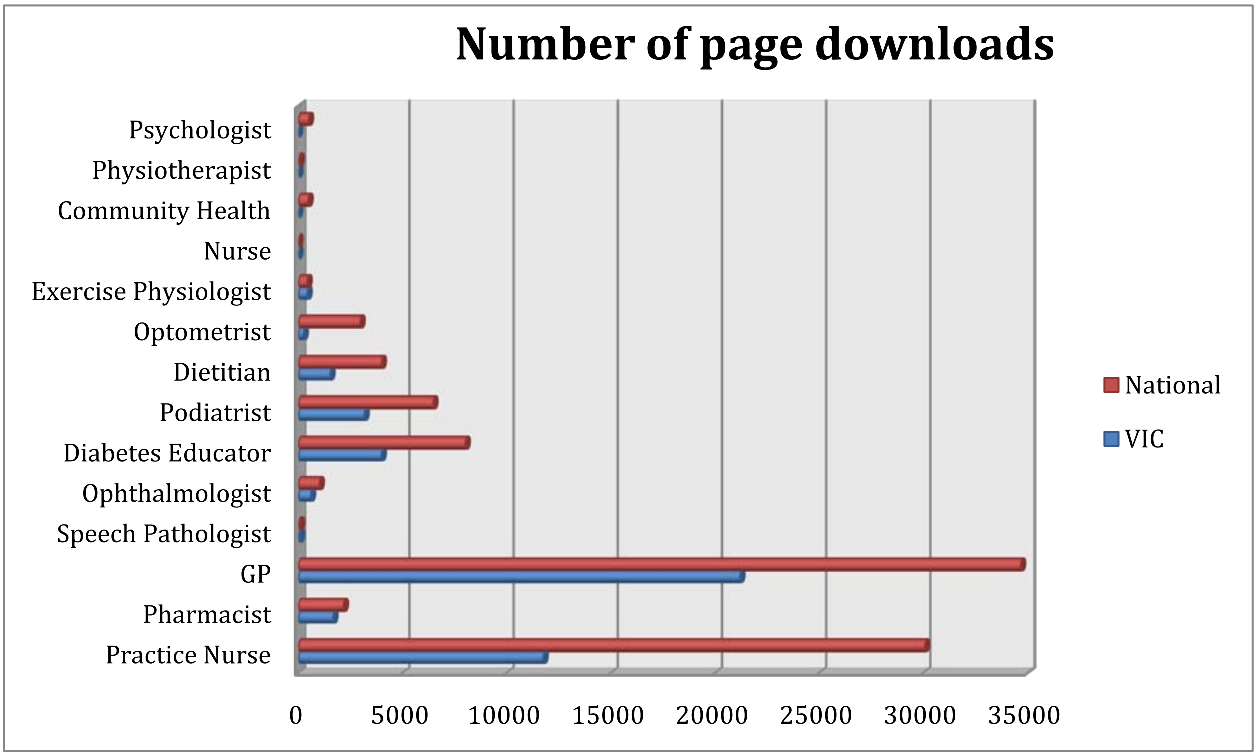

Figure 3-1:Frequency of Interactions by User Group

3.3.3 Key Performance Indicator 3: Measuring increased use of broadband in the health sector

Table KPI-3 on page 190 summarises the achievements on KPI 3 as at the conclusion of the project. The measures show that, from a base of zero, CDMS broadband services:

- generated 725 new care plans and 186 care plan reviews,
- collected over 30,000 health measurements,
- recorded over 2,000 appointments with healthcare providers,
- facilitated over 550 collaborative interactions between care providers, and
- sent 322 SMS reminders and 385 email reminders to patients.

These services were provided to patients and healthcare providers covering 71 postcodes across regional, rural and remote areas of Victoria and Western Australia.

3.4 Analysis of MBS Item use (Barwon Region)

A subgroup of the 12 GPs involved in the BSWR research trial were able to provide data on the use of MBS chronic disease management (CDM) items both prior to and post the use of CDMS. This section provides an analysis of that data, together with data collected by the CDMS system itself.

3.4.1 Data analysis and validation

Twelve GPs were involved in the BSWR research trial. All of these GPs were male; four worked part-time and eight worked full-time. The workload of GPs ranged from 0.2 full-time equivalent (FTE) to 1.0 FTE.

Each participating GP was asked for the number of patients with type 2 diabetes he managed and the number of MBS CDM items claimed for managing these patients in the two years prior to using CDMS and the period since using CDMS to 31 August 2009. The MBS CDM items are:

- GP Management Plan (GPMP Item 721)
- Team Care Arrangement (TCA Item 723)
- GPMP Review (Item 725), and
- TCA Review (Item 727).

The recommended frequency of these CDM items is every two years for GPMPs and TCAs and every six months for reviews of these care plans. As reviews cannot be claimed at the same time as a GPMP or TCA, one would expect three times the number of Item 725s compared to Item 721s on average over a given period, and similarly for Item 727s compared to Item 723s, should the recommended frequencies be applied in practice.

Methods of data collection included:

- estimation
- Best Practice clinical software
- Mediflex practice software
- PEN Clinical Audit Tool
- manual searching.

Data were collected by GPs in two practices, by practice receptionists in two, by a practice nurse in one, and was assisted by members of the research team in one practice.

The data is summarized in Table 3-1 on page 45, including the estimated number of diabetes patients in the practice, the start date for using CDMS, and the method of data collection.

There are some apparent inconsistencies in the data provided by the practices in comparison with Medicare rules for claiming these MBS items. In particular, under Medicare rules it would be expected that the number of Item 723 claims would not exceed the number of Item 721 claims in a given period, and similarly the number of Item 727 claims would not exceed the number of Item 725 claims in a given period. However, as observed in the data, there are some small departures from this rule, most likely resulting from delays in claiming these items. In addition, for GP #9, the number of Item 727 claims in the period prior to the use of CDMS greatly exceeds the number of Item 725 claims in the same period. This variation possibly results from a large number of Item 727 claims being made in that period for services provided in earlier periods. To account for this, in the following analysis, the number of Item 727 claims for GP #9 has been adjusted to equal the number of MBS 725 items in the same period.

In addition, three of the GPs did not provide any data regarding MBS item claims and GP #12 only used CDMS to redo some existing care plans, rather than use it to create new care plans for his patients. These GPs have therefore been excluded from the analysis.

Table 3-2 on page 46 shows the number of MBS CDM services generated with the use of CDMS for the period over which GPs started using CDMS to 31 August 2009. The table also shows the proportion of these services that were claimed in the same period, based on the claims data in Table 3-1 on page 45. It is observed that about 70% of the CDM Items 721 and 723 claimed in the period were generated with the assistance of CDMS.

With respect to the reviews of care plans (CDM Items 725 and 727), only about 30% of these were created with CDMS. This is to be expected, as approximately two thirds of the reviews can be expected to relate to care plans created prior to the use of CDMS. Section 3.4.3 provides further analysis of these CDM review items.

Table 3-1 Number of patients diagnosed with type 2 diabetes and the number of MBS CDM items for managing type 2 diabetes claimed in the two years prior to and after implementing CDMS to 31 Aug 2009 (n = 12)

GP	Full-Time Equivalent workload	N patients diagnosed with type 2 diabetes	Data extraction method	CDMS start date	Pre CDMS (two years prior to CDMS)				Post CDMS (CDMS start date to 31 Aug 2009)			
					721s claimed	723s claimed	725s claimed	727s claimed	721s claimed	723s claimed	725s claimed	727s claimed
1	20%	12	Mediflex* and Best Practice*	22-Jul-08	7	7	0	0	9	9	5	4
2	100%											
3	100%	92	BP* search and Mediflex	5-Sep-08	25	25	8	0	21	22	3	0
4	100%	92	BP search and Mediflex	5-Sep-08	17	17	19	17	28	28	36	35
5	100%	50	Best Practice, manual search	29-Oct-08	14	7	2	3	16	19	3	5
6	100%	13	Best Practice	7-Nov-08	6	4	3	0	19	7	15	0
7	60%			5-Sep-08								
8	40%	30	Best Practice, manual search	17-Jul-08	9	7	5	1	0	17	4	1
9	100%	143	MediFlex, manual search	13-Oct-08	24	22	35	54	26	26	29	20
10	100%			10-Feb-09								
11	100%	74	MediFlex, manual search	3-Dec-08	3	7	10	8	10	7	9	8
12	100%	100	PEN CAT**; Best Practice	18-Dec-08	63	3	45	7	26	0	23	14

Source: Practice data for patients diagnosed with diabetes

* Best Practice (BP) and MediFlex are software systems used by practices for clinical and billing functions

** PEN CAT is a clinical audit too

Table 3-2:The number of MBS CDM services generated by CDMS for managing type 2 diabetes and CDMS services as percentage of CDM items claimed (n = 8)

GP	Number of CDM services by CDMS				CDMS services as % of CDM claims			
	721	723	725	727	721	723	725	727
1	9	9	0	0	100%	100%	0%	0%
3	14	13	4	0	67%	59%	133%	NA
4	18	18	9	8	64%	64%	25%	23%
5	10	9	1	0	63%	47%	33%	0%
6	8	6	2	0	42%	86%	13%	NA
8	15	14	4	3	79%	82%	100%	300%
9	24	23	11	9	92%	88%	38%	45%
11	6	5	3	3	60%	71%	33%	38%
Total	104	97	34	23	70%	72%	33%	32%

Source: CDMS system data

3.4.2 Analysis of claims for MBS Items 721 and 723

To analyse the impact of CDMS on the number of GPMP and TCA claims (MBS Items 721 and 723, respectively), the data in Table 3-2 needs to be normalised to take into account the different time intervals to which the data relates. To do this, the data is converted to the number of claims per annum. The number of annualised claims post the use of CDMS is then compared with the number of annualised claims pre CDMS, in which the difference is expressed as a percentage of the annualised claims pre CDMS (see Table 3-3 on page 47).

All GPs show a large increase in claims made after the introduction of CDMS. The increase in claims for GPMPs (Item 721) range from 70% to 800% and for TCAs (Item 723) from 80% to 550%. The increase over all eight GPs for both GPMPs and TCAs is over 200%, or three times the number of claims in the period post CDMS as compared to the period prior to CDMS.

The mean number of annualised GPMPs per FTE GP prior to CDMS was 8.0 compared to 24.3 post CDMS. This difference was significant (paired t-test, $p < 0.001$). The means for annualised TCAs per FTE GP was 7.3 pre CDMS and 21.9 post CDMS; this difference was also significant (paired t-test, $p < 0.001$). As on average there are approximately 60 patients with diagnosed diabetes per FTE GP, the proportion of diabetes patients on care plans is still very low—even after using CDMS—indicating considerable opportunity for further improvement.

As the practices did not change their work processes to accommodate the use of CDMS, it can reasonably be assumed that these gains resulted in large part from improved productivity of the GP and/or practice nurse through the use of CDMS.

For comparison, for the BSWR covered by the GP Association of Geelong, the average increase in GPMPs and TCAs in the same period for all chronic diseases was 21% and 45%, respectively, after subtracting out the effect of the research cohort on the totals for the region. No data was available for diabetes patients alone, and therefore a direct comparison with regional data is not possible.

The mean number of annualised GPMPs per FTE over all chronic diseases in the region was 42 for the period prior to the trial and the mean number of annualised TCAs per FTE was 24. As a large proportion, if not most, care plans in the region are for diabetes patients, it is therefore likely that the eight GPs in the research cohort are coming from a low base of care planning compared to the region. For this reason, as well as the relatively small number of GPs involved, the large increases in care planning observed with the use of CDMS should be treated with caution.

Table 3-3: Annualised number of MBS CDM items for managing type 2 diabetes claimed prior to and after implementing CDMS (n = 8)

GP	CDM Claims Pre-CDMS		CDM Claims Post-CDMS		Change (Post-Pre)/Pre	
	721	723	721	723	721	723
1	3.5	3.5	8.1	8.1	132%	132%
3	12.5	12.5	21.3	22.3	71%	79%
4	8.5	8.5	28.4	28.4	235%	235%
5	7.0	3.5	19.1	22.7	173%	549%
6	3.0	2.0	23.4	8.6	679%	331%
8	4.5	3.5	16.9	15.2	276%	333%
9	12.0	11.0	29.5	29.5	146%	168%
11	1.5	3.5	13.5	9.4	800%	170%
Total	52.5	48.0	160.3	144.3	205%	201%

Source: Practice data for patients diagnosed with diabetes

3.4.3 Analysis of claims for MBS Items 725 and 727

Calculating any change in the reviewing of care plans is more complicated as it is necessary to take into account the following two considerations:

1. The first review of a care plan (Item 725 and possibly 727) does not usually take place, according to Medicare guidelines, until six months after creation of the care plan (i.e., six months after the services for Items 721 and 723, respectively, have been completed).
2. Following the creation of a care plan (i.e., completing Item 721 and possibly 723), three reviews (Item 725 and 727, respectively) should be completed, according to Medicare guidelines, at six monthly intervals.

As a consequence, during the trial (post the implementation of CDMS), only the first of the three reviews could be completed by a GP in the time period and this could only be done for those patients who had completed a care plan (Item 721 and possibly 723) at least six months prior to the end of the trial period. Therefore, it is not possible to directly compare the number of Item 725s and 727s claimed pre CDMS with those claimed post CDMS in the period to 31 August 2009.

However, using the data obtained from the CDMS system, it is possible to determine the proportion of GPMPs for which a GPMP review was completed. This “follow up” ratio for the first GPMP review can then be compared with the claims data prior to the use of CDMS.

Table 3-4 on page 48 shows the number of MBS CDM services generated by CDMS to 31 December 2009 restricted to those patients where the GPMP (Item 721) was generated prior to 30 June 2009. From this data, the follow-up ratio for the GPMP review can then be determined as the ratio of the number of Item 725 services provided in the period to 31 December 2009 to the number of Item 721 services in the prior period to 30 June 2009.

Similarly, the follow-up ratio for the TCA review is calculated as the ratio of the number of Item 727 services to the number of Item 723 services over the same periods, respectively. These ratios are shown in Table 3-5 on page 49.

Table 3-4: Number of MBS CDM services generated by CDMS to 31 December 2009 for patients where the GPMP (Item 721) was generated prior to 30 June 2009 (n = 8)

GP	CDM services generated by CDMS			
	721	723	725 (1st)	727 (1st)
1	9	8	4	0
3	14	13	4	0
4	18	18	11	5
5	9	8	1	0
6	7	5	7	1
8	14	12	9	7
9	24	23	22	16
11	6	5	2	2
Total	101	92	60	31

Source: CDMS system data

The follow up ratios generated with the use of CDMS can be compared with the follow up ratios prior to CDMS by comparing the MBS CDM claims data in the period prior to the use of CDMS. In doing so, it is necessary to take into account that the claims data includes not only the “first” GPMP review, but also the second and third reviews from previously created care plans. To determine the number of “first” GPMP reviews in this set, it is assumed that the first, second, and third GPMP reviews are equally dispersed across the period. The number of first reviews can therefore be taken to be one third of the total number of GPMP reviews claimed. The same assumption is made regarding TCA reviews claimed.

The follow up ratios for GPMPs (Item 725: Item 721) and TCAs (Item 727: Item 723) based on claims data in the period prior to the use of CDMS is shown in Table 3-5 on page 49, where it is compared with the follow up ratios obtained when using of CDMS. The data shows that the follow up ratios for GPMPs increased for all GPs except GP #11. The follow up ratio for TCAs was less consistent, decreasing for two GPs and increasing for four, with two GPs not creating any TCA reviews in either period. However, those GPs who create most care plans have the higher follow up ratios, so that the increase in the follow up ratio over all GPs is 128% for GPMPs and 52% for TCAs. Of note, for those GPs using CDMS, on average almost 60% of GPMPs and almost a third of TCAs are being followed up.

To determine the overall increase in the “first” reviews for GPMPs and TCAs resulting from the use of CDMS, it is necessary to multiply the above follow up ratios by the number of GPMPs and TCAs created by CDMS. This calculation results in an expected increase in the number of GPMP “first” reviews by 385% and the number of TCA “first” reviews by over 224%.

For comparison, for the Barwon Region covered by the GP Association of Geelong, the average follow up ratios for GPMPs and TCAs are 0.15 and 0.08 respectively, with almost no change in the period prior to the trial and during the trial (in fact, there was a small decrease in follow up ratio for GPMPs in the region).

It should be noted that the review functionality of CDMS during the trial period was still under development and that GPs and practice nurses received little training on how to use

CDMS for carrying out the reviews. It is therefore likely that the improvements determined above will increase with further development and use of CDMS.

While the trial did not cover a period involving the second and third reviews, there is no reason to expect that the improvements observed above would not also be realised with these subsequent reviews.

Table 3-5: The Follow-Up Ratios of GPs for GPMPs (725:721) and TCAs (727:723) prior to and after implementing CDMS (n = 8)

GP	Follow-up Ratio Pre-CDMS		Follow-up Ratio Post-CDMS		Change (Post-Pre)/Pre	
	725:721	727:723	725:721	727:723	725:721	727:723
1	0.00	0.00	0.44	0.00	NA	NA
3	0.11	0.00	0.29	0.00	168%	NA
4	0.37	0.33	0.61	0.28	64%	-17%
5	0.05	0.14	0.11	0.00	133%	-100%
6	0.17	0.00	1.00	0.20	500%	NA
8	0.19	0.05	0.64	0.58	247%	1125%
9	0.49	0.53	0.92	0.70	89%	31%
11	1.11	0.38	0.33	0.40	-70%	5%
Total	0.26	0.22	0.59	0.34	128%	52%

3.4.4 Pattern of Use of MBS Items post CDMS Implementation

The pattern of follow up ratios for the research GPs is shown graphically in Figure 3-2 on page 49. Also included in the graph is the ratio of TCAs (Item 725) to GPMPs (Item 723). For diabetes, best practice guidelines recommend that all these ratios should all be close to 100%; that is, each patient on a GPMP should also be provided a TCA and be followed up with a review of both these plans after six months.

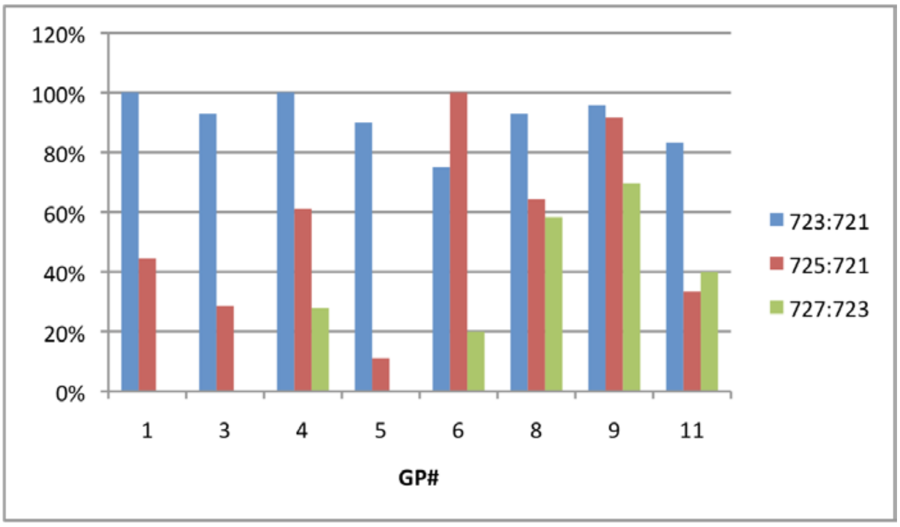

Figure 3-2: Pattern of usage of MBS CDM Items for managing type 2 diabetes after implementing CDMS (expressed as ratios relative to MBS CDM Items 721 and 723).

It is seen that the ratio of TCAs to GPMPs is good across all the GPs and that two of the GPs mostly follow up both GPMP and TCA services with appropriate reviews. However, while the use of CDMS has had a strong influence on increasing the follow up ratios for GPMPs and TCAs, there is still room for considerable improvement for most GPs.

3.5 WA Eastern Goldfields Region

The same analysis as above was carried out with GPs using CDMS in the West Australian Eastern Goldfields Region (EGR). The results of that analysis are reported from Table 3-6 to Table 3-10 starting on page 51. As can be seen from the tables, the same trends are observed in the EGR trial as in the BSWR trial.

In Table 3-6 the claims data recorded by the practices includes all chronic diseases, whereas the data recorded by the CDMS system is for diabetes only. However, for the practices involved, almost all their MBS CDM claims are for diabetes patients. Table 3-7 on page 51 shows the proportion of MBS CDM claims in the trial period that have been generated by CDMS. Interestingly, in many cases, this proportion exceeds 100%. The reason for this apparent anomaly is that the claiming for the MBS CDM items in these practices appears to lag considerably behind the provision of the CDM services, so that a number of services generated by CDMS were unclaimed in the period of analysis (in total, some 30 Item 721 services were unclaimed in the period). As for the BSWR trial, the lower proportion of Items 725 and 727 reflect the fact that many of the claimed reviews relate to care plans created in prior periods.

Because of the lag in claims for services rendered during the trial, the data recorded by the CDMS system for measuring the use of MBS Items 721 and 723 is used for comparison with the claims data for these items prior to the implementation of CDMS. This data is shown in Table 3-8 on page 51. As can be seen from the table, the increase in GPMPs resulting from the use of CDMS across the five GPs is 88% and the increase in TCAs is 80%, with all GPs showing an increase in both items. Note that if claims data is used for the period post CDMS instead of the data reported by the CDMS system, the increase in annualised GPMP claims is 52% and in TCAs is 82%.

The difference in mean number of GPMPs per FTE GP was 30 pre CDMS compared to 55 post CDMS. The difference was significant at the 0.1 level (paired t-test, $p < 0.09$). The difference in means for TCAs per FTE GP was 23 pre CDMS compared with 42 post CDMS. This difference was significant (paired t-test, $p < 0.01$).

Note that as the data prior to CDMS included all chronic diseases, but post CDMS data included only diabetes, the above analysis likely underestimates the increases achieved.

As for the BSWR trial, the EGR data shows a large increase in the follow up ratio for GPMPs and TCAs (see Table 3-10 on page 52), with more consistent uptake for TCA reviews than observed for the GPs in the BSWR trials. Taken together with the increase in GPMPs and TCAs resulting from the use of CDMS, the overall increase in “first” reviews for GPMPs and TCAs would be expected to be about 310% and 220%, respectively, or roughly four and three times the number prior to CDMS.

The average number of annualised GPMPs and TCAs per FTE GP for the region prior to the trial was 25 and 11.5, respectively. The follow up ratio was 0.08 for GPMPs and 0.02 for TCAs. The comparison indicates that, unlike the GPs in the BSWR trial, those in the EGR trial started from a considerably higher base than the average for the region.

Excluding the five GPs involved in the trial who provided baseline data, the number of Items 721, 723, 725 *decreased* in the same period by 12%, 10%, and 14%, respectively, in the region. The number of claims for MBS Item 727 increased by an average of 32%. The follow up ratio for the region did not change for GPMPs during the trial but the TCA follow up ratio increased from 0.02 to 0.04.

The pattern of usage of MBS Item numbers in the EGR trial is shown Figure 3-3 on page 52. The pattern is more uniform than in the Barwon South Western trial and most of the GPs conform more closely to best practice guidelines in both GPMP and TCA reviews.

Table 3-6: The number of MBS CDM Items for all chronic diseases claimed by GPs in the period prior to and after implementing CDMS to 1 Aug 2009 (n = 5)

GP	CDM Claims Pre CDMS					CDM Claims Post CDMS				
	Period months	721	723	725	727	CDMS Start Date	721	723	725	727
1	10	11	12	6	5	8-Oct-08	20	19	21	16
2	20	43	36	21	19	1-Oct-08	16	16	20	19
3	20	36	15	11	8	14-Oct-08	22	20	14	13
4	20	28	17	12	6	20-Oct-08	16	13	11	10
5	12	26	27	20	0	25-Aug-08	61	61	6	0

Source: Practice data for all patients diagnosed with chronic disease

Table 3-7: The number of MBS CDM services generated by CDMS for managing type 2 diabetes and CDMS services as percentage of CDM items claimed (n = 5)

GP	Number of CDM services by CDMS				CDMS services as % of CDM claims			
	721	723	725	727	721	723	725	727
1	26	25	10	5	130%	132%	48%	31%
2	26	22	5	4	163%	138%	25%	21%
3	19	14	5	3	86%	70%	36%	23%
4	26	23	3	3	163%	177%	27%	30%
5	69	41	6	3	113%	67%	100%	NA
Total	166	125	29	18	123%	97%	40%	31%

Source: CDMS system data

Table 3-8: Annualised number of MBS CDM claims for all chronic diseases prior to CDMS and for type 2 diabetes patients CDM services provided after implementing CDMS (n = 5)

GP	CDM Claims prior to CDMS (from claims data)		CDM Services post CDMS (from CDMS)		Change (Post-Pre)/Pre	
	721	723	721	723	721	723
0	13	14	32	31	142%	113%
1	26	22	31	26	21%	23%
2	22	9	24	18	10%	95%
3	17	10	33	29	98%	189%
4	26	27	74	44	184%	63%
Total	103	82	194	148	88%	80%

Source: Practice data (claims) for all patients diagnosed with chronic disease and CDMS system data (services) for all type 2 diabetes patients

Table 3-9: Number of MBS CDM services generated by CDMS to 31 December 2009 for patients where the GPMP (Item 721) was generated prior to 30 June 2009 (n = 5)

GP	CDM services generated by CDMS			
	721	723	725 (1st)	727 (1st)
1	23	22	15	8
2	26	22	8	5
3	17	11	6	3
4	24	22	6	5
5	54	37	16	3
Total	144	114	51	24

Source: CDMS system data

Table 3-10: The Follow-Up Ratios of GPs for GPMPs (725:721) and TCAs (727:723) prior to and after implementing CDMS (n = 5)

GP	Follow-up Ratio Pre-CDMS		Follow-up Ratio Post-CDMS		Change (Post-Pre)/Pre	
	725:721	727:723	725:721	727:723	725:721	727:723
1	0.18	0.14	0.65	0.36	259%	162%
2	0.16	0.18	0.31	0.23	89%	29%
3	0.10	0.18	0.35	0.27	247%	53%
4	0.14	0.12	0.25	0.23	75%	93%
5	0.26	0.00	0.30	0.08	16%	NA
Total	0.16	0.12	0.35	0.21	119%	78%

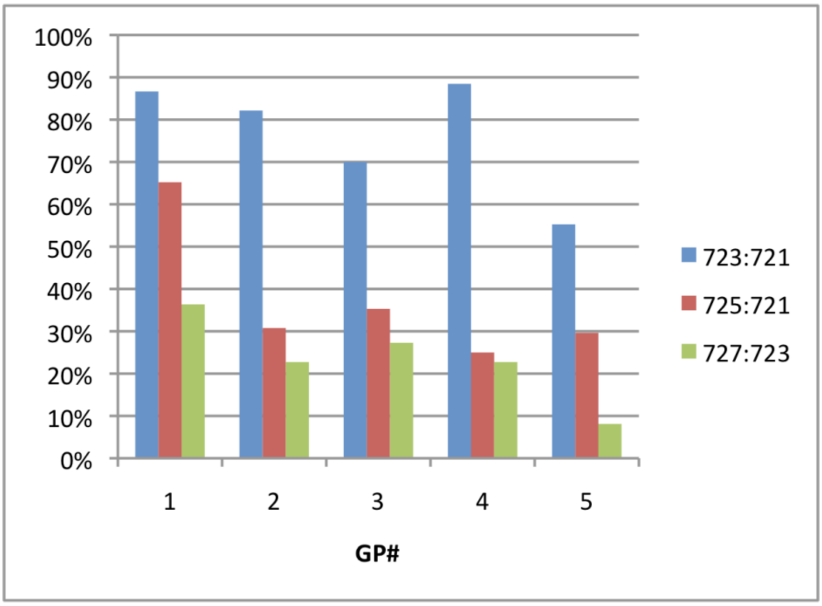

Figure 3-3: Pattern of usage in the Eastern Goldfields trial of MBS CDM Items for managing type 2 diabetes after implementing CDMS (expressed as ratios relative to MBS CDM Items 721 and 723).

3.6 Medicare MBS Data

Permission was sought from patients involved in the BSWR trial and with that permission MBS and PBS claims data were purchased from Medicare. The data included the 99 patients in the research cohort covering the period from 1 March, 2006 to 1 June, 2009.

The aim of examining this data is to determine if CDMS brought about any change in the use of services associated with care plans and in patient compliance with the care plans (see also Section 5 for self-reported service use data).

The data examined included the following services:

Chronic Disease Management (CDM) services:

- General Practice Management Plan (GPMP) Item 721
- Team Care Arrangement (TCA) Item 723
- GPMP review Item 725
- TCA review Item 727

Metabolic Testing Services:

- HDL (as a representative for a wider range of lipid tests) Item 66536
- HbA_{1c} Item 66551
- microalbumin Item 66560

Provider Services:

- Dietician Item 10954
- Podiatrist Item 10962

Medicines Management Services:

- Home Medicines Review (HMR) Item 900

This data was compared over the following two time periods:

Prior to CDMS: claims data in the 10 months prior to the beginning of CDMS rollout (taken to be 1 October, 2007 to 31 July, 2008) and

Post CDMS: claims data in the 10 months post that period (1 August, 2008 to 31 May, 2009).

While the period over which the post CDMS Medicare data was collected is ten months, it is important to note that the research GPs joined the research trial progressively; that is, each started using CDMS at a different time. The average period over which GPs used CDMS was 7.8 months, or 7.5 months weighted for FTE, as of 1 June 2009 (the end date of the Medicare MBS data set), rather than the full ten months. Also, the patients themselves were progressively placed on CDMS care plans with an average time on care plans of 6.5 months up to 1 June 2009.

Medicare MBS data prior to 1 October 2007 was used to determine the number of patients who were on a care plan in the ten-month period prior to using CDMS, even though they may not have made a claim for MBS CDM services during that ten-month window.

Table 3-11 on page 54 shows the number of services provided in both the prior and post periods, together with the percentage change in these services between the two time periods. Table 3-12 on page 54 shows the number of patients receiving these services in both the prior and post periods, together with the percentage change.

Table 3-11: Number of Medicare MBS healthcare services claimed by patients both prior to and post CDMS (n = 99)

Number of Services	Service (Item number)	Prior to CDMS	Post CDMS	Change %
CDM Services				
	GPMP (721)	13	82	531%
	TCA (723)	9	72	700%
	GPMP Review (725)	20	28	40%
	TCA Review (727)	20	18	-10%
Metabolic Testing Services				
	HDL (66536)	33	46	39%
	HbA_{1c} (66561)	103	146	42%
	Microalbumin (66560)	45	59	31%
Provider Services				
	Dietician (10954)	2	35	1650%
	Podiatry (10962)	29	73	152%
	Home Medication Review (900)	2	12	500%
GP Services				
	Level B Consultation (23)	498	605	21%
	Level C Consultation (36)	93	122	31%

Table 3-12: Number of patients claiming Medicare MBS healthcare services both prior to and post CDMS (n = 99)

Number of Patients Claiming	Service	Prior to CDMS	Post CDMS	Change %
Metabolic Testing Services				
	HDL	25	38	52%
	HbA_{1c} >= 2 tests	30	50	67%
	Microalbumin >= 1 test	44	53	20%
	HbA_{1c} >=2 & HDL	17	25	47%
	HbA_{1c} >=2 & Microalbumin	18	33	83%
	HDL & Microalbumin	10	17	70%
	All three	8	14	75%
Provider Services				
	Dietician	1	17	1600%
	Podiatry	11	39	255%
	Home Medication Review	2	12	500%

Care needs to be exercised in interpreting this data. The changes in the MBS CDM items do not reflect the actual change in care planning activity, as not all care plans in the prior period are included in the sample cohort. In particular, most patients who have care plans created in the prior period cannot be included in the sample of 99 because Medicare guidelines exclude claims for GPMPs that are made within a year of a prior GPMP, other than in exceptional circumstances. The actual increase in these MBS CDM items for the research GPs is discussed in Sections 3.4.

Similarly, as the care-plan-related services—for example, HbA_{1c} tests—are likely correlated with whether or not a patient is on a care plan, the changes in these parameters could to some extent reflect changes in the number of care plans between the prior and post periods. It is therefore not possible to directly use these observed changes to determine the effect of CDMS on MBS service usage.

To determine the actual effect of CDMS on these parameters, it is necessary to determine the extent to which these parameters depend on care planning. These measures of dependency, expressed as conditional probabilities, can then be used together with data on the change in the number of care plans created by the research GPs to estimate the changes in these parameters resulting from the use of CDMS.

3.6.1 Effect of CDMS on service usage for patients on care plans

The first issue is whether or not CDMS itself has an effect on the provision of healthcare services to patients on care plans, that is, does a patient on a care plan created by CDMS have a higher probability of service use or receive a higher mean number of services, for items in the care plan, than a patient on a care plan prior to the use of CDMS?

Table 3-13 on page 55 shows the mean number of services provided for patients who are on a GPMP both prior to the use of CDMS and post the use of CDMS. Table 3-14 on page 56 shows the probability of receiving a specified service for patients on care plans both pre and post the use of CDMS, based on the sample proportions of patients in the research cohort.

Table 3-13: Mean number of services received per patient with a care plan prior to CDMS (n = 47) and post CDMS (n = 99)

Services Provided	Mean number per GPMP (prior)	Mean number per GPMP (post)	Change per GPMP
HDL (66536)	0.51	0.46	-9%
HbA_{1c} (Item 66551)	1.30	1.47	14%
Microalbumin (66560)	0.53	0.60	12%
Dietician (10954)	0.04	0.35	731%
Podiatry (10962)	0.62	0.74	20%
Home Medication Review (900)	0.04	0.12	185%

Table 3-14: Probability of service provision for patients with a care plan prior to CDMS (n = 47) and post CDMS (n = 99)

Patients Receiving Services	Prob|GPMP (prior)	Prob|GPMP (post)	Change per GPMP
HDL >= 1 test	0.38	0.38	0%
HbA_{1c} >= 2 tests	0.40	0.51	25%
Microalbumin >= 1 test	0.51	0.54	5%
HbA_{1c} and Microalbumin	0.21	0.33	57%
HbA_{1c} and HDL	0.28	0.25	-9%
HDL and Microalbumin	0.15	0.17	15%
HbA_{1c}, HDL and Microalbumin	0.13	0.14	11%
Dietician (10954)	0.02	0.17	707%
Podiatry (10962)	0.23	0.39	68%
Home Medication Review (900)	0.04	0.12	185%

For the metabolic parameters, CDMS appears to have a small positive effect on these dependencies, that is, CDMS increases the probability that the service will be provided as planned, except possibly for HDL testing. However, the use of CDMS greatly increases the probability of patients receiving dietician, podiatry, and HMR services compared with those patients on a GPMP in the prior period.

3.6.2 Effect of CDMS on overall service usage

The information of most interest is how service usage is affected by CDMS across the total diabetes population of the research GPs; that is, what is the total increase in these services for all patients, including those both on care plans and not on care plans prior to the use of CDMS. As mentioned above, this question cannot be answered by simply considering the 99 patients in the research cohort, but needs to consider the full set of diabetes patients being treated by the research GPs.

Based on the increase in care planning activity resulting from the use of CDMS (Section 3.4), together with information on the proportion of services provided to patients who are not on care plans, it is possible to estimate the effect of CDMS on overall service usage. Table 3-15 and Table 3-16 on page 57 show the change in number of care plan services provided (or number of patients receiving these services) that could be obtained with the adoption of CDMS across the population of diabetes patients of the participating GPs. The increase in all cases is substantial, particularly so for provider and medication review services.

Table 3-15: Estimated change in the number of healthcare services provided for diagnosed diabetes patients of the GPs in the BSWR trial prior to and post CDMS

Services Provided	Change (BSWR trial)	Change (Victoria)
HDL (66536)	66%	-4%
HbA1c (Item 66551)	82%	4%
Microalbumin (66560)	75%	12%
Dietician (10954)	1645%	26%
Podiatry (10962)	151%	53%
Home Medication Review (900)	498%	23%

Table 3-16: Estimated change in the number of diagnosed diabetes patients of the GPs in the BSWR trial receiving healthcare services prior to and post CDMS

Patients Tested	Change (BSWR trial)
HbA1c >= 2 tests	103%
Microalbumin >= 1 test	66%
HDL >= 1 test	80%
HbA1c and Microalbumin	127%
HbA1c and HDL	70%
HDL and Microalbumin	99%
HbA1c, HDL and Microalbumin	99%
Dietician (10954)	1595%
Podiatry (10962)	253%
Home Medication Review (900)	498%

3.7 Discussion

The data indicates higher service follow-through post CDMS than pre CDMS, with the probability and mean of the patients on care plans receiving services increasing in all cases except for HDL testing. This is particularly strong with provider services, including dietician and podiatrist visits, as well as home medication reviews. Note that MBS Items 10954 and 10962 do not include services provided by community services, so that the actual compliance rate can be expected to be higher than that based on MBS claims data alone. (See Section 5 for patient reports of service use.)

These changes in service use for patients on care plans prior to CDMS compared to patients on CDMS care plans (post CDMS) indicate that either many of the care plans created prior to CDMS did not include recommended healthcare services or that patients were not followed up to ensure that they received these services. This is a key finding and indicates the potential of CDMS to provide higher quality care both through best practice care plans and through follow up to ensure that the planned healthcare services are delivered to the patient.

On a population basis, the results show that GPs using CDMS achieve a consistent improvement in service usage as recommended by best practice guidelines. For the HbA_{1c} tests, the data show an increase in number of tests by 82%. In comparison, the Australian Primary Care Collaboratives (March 2009) show an average increase in HbA_{1c} testing of 48% over periods varying from 5 to 10 months. For HDL tests, the improvement is 66%, compared with APCC data, which show an average increase in cholesterol testing of

51%; there is no data available for HDL tests alone. The estimated number of provider services increased by even greater amounts: dietician services by over ten-fold, podiatry services by over twofold, and HMRs by almost sixfold.

The above data needs to be compared with possible trends in testing observed more widely, to determine if CDMS can be reasonably proposed as the cause for the change rather than other external factors. Examination of data for Victoria (see Table 3-15 on page 57) shows that the changes resulting from the use of CDMS exceed these trends by two to five times; HDL being reversed from a negative to a positive trend, with very large changes observed in the key provider services used in the GPMP.

Caution should be exercised in interpreting the above results, given the relatively small sample sizes and the pre/post study design. See also Section 5.2.3 for a discussion of the limitations of the evaluation.

3.8 References

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4 Clinical evaluations: methodology and study population

Authors: Professor Trisha Dunning AM, Dr Kay Jones, Dr Beth Costa, Ms Kristine Fitzgerald

4.1 Significance and aims

4.1.1 Significance of the clinical evaluation

Chronic disease care management plans, provided in Australia as GP Management Plans (GPMPs) and Team Care Arrangements (TCAs), are two key aspects of effective diabetes management and can enhance communication among health care providers and people with diabetes. GPMPs and TCAs enable management to be proactive and timely and thus increase the likelihood that management targets and optimal management outcomes will be achieved [1].

4.1.2 Hypothesis

CDM-Net (and in particular CDMS) will increase the efficiency and effectiveness of care and improve metabolic control, general health and quality of life outcomes of people with type 2 diabetes and, consequently, reduce health costs.

4.1.3 Research aims

The clinical evaluation aimed to:

- assess the impact of the Chronic Disease Management Service (CDMS) by measuring the uptake of and adherence to CDMS GPMPs and TCAs and clinical health and quality of life indicators
- test CDMS in ‘real life’ general practice clinical care settings within the Barwon Region
- assess provider and patient adherence to GPMPs and TCAs generated through CDMS, and
- undertake a formative evaluation of CDMS in a series of three GP workshops during the project.

4.2 Study design

The design was a single cohort before and after study with the intervention period being nine to fourteen months, depending on when patients were first put on CDMS care plans. Data were collected at four times; baseline (Time 1), at three to six months after care plan creation (Time 2), at nine months after care plan creation (Time 3), and on 30 September 2009 (Time 4).

4.3 Sampling population

The study was undertaken in the Barwon South Western Region (BSWR) of Victoria, Australia. Participants included two groups: GPs, and patients diagnosed with type 2 diabetes. The initial target was to recruit 40 GPs and 300 patients into the study, however due to reasons including time constraints and the degree of change management required for introducing new models of collaborative care and e-health into general practice, the final numbers were lower than this.

4.3.1 The Barwon South Western Region

The BSWR is one of eight Department of Human Services (DHS) administrative regions in Victoria, Australia.

The BSWR supports four major hospitals, two public and two private, in addition to a number of smaller hospitals and community health services. The majority of people living in the region are serviced by Barwon Health (BH), which includes the Geelong Hospital and a large number of health care providers including endocrinologists, ophthalmologists, diabetes educators, dieticians, podiatrists, optometrists, pharmacists, and pathology and radiology laboratories.

In June 2009, 19 diabetes educators (DEs) were practising within the BSWR, but not all were employed ‘full time’. Four DEs practised in multiple locations within the region. DEs worked within eight general practices. Eleven DEs worked in BH. Of these, five were located in the community and six were hospital-based. During the study, the average waiting time for a DE appointment was two weeks with a range from ‘no’ waiting time to ‘six weeks’ (personal communication).

The BSWR also supports a number of research and education institutions, the largest being Deakin University. Deakin University has four campuses, two of which are located in Geelong; Waurn Ponds and the Waterfront. A new medical school within the Faculty of Health, Medicine, Nursing and Behavioural Sciences was established in 2008. The Faculty has a major focus on chronic disease, which encompasses basic science, clinical and behavioural research.

4.3.2 Social and health profile of the Barwon South Western Region

The demographic profile of the BSWR population is shown in Table 4-1 on page 61.

According to the Victorian Population Health Survey 2007 [3], the majority (84%) of adults within the BSWR reported their health as excellent, very good, or good, while 16% reported their health as fair or poor. The prevalence of five diabetes lifestyle risk factors in the BSWR adult population is shown in Table 4-2 on page 61.

The prevalence of diagnosed diabetes mellitus within the BSWR is shown in Table 4-3 on page 62. Between 2001 and 2006 there was a 68% increase in the prevalence of diagnosed diabetes within the BSWR [4]. These figures do not include the rate of undiagnosed diabetes within the population, which is thought to be double the known diagnosed diabetes prevalence [4].

HbA_{1c} is a main indicator of glycaemic control and achieving $HbA_{1c} < 7\%$ is a diabetes management goal [6]. Table 4-4 on page 62 shows the proportion of individuals within the BSWR with HbA_{1c} values above and below 7%, based on laboratory test results ordered by GPs within the GP Association of Geelong (GPAG) during 2007 and prior to commencing the study.

Table 4-1: Demographic profile of the Barwon South Western Region*

Demographic Characteristics	% Total BSWR population (N = 334 836)
Male	49%
Female	51%
Indigenous Australian	0.8%
Born overseas	12%
Non-English speaking background	6.4%
Age	
18– 59	54.7%
60 – 84	18.5%
≥ 85	2.1%
Post-secondary qualifications	
No qualification	50.7%
Tertiary degree or diploma	18.8%
Vocational qualification	18.2%
Income	
Low income earner (≤ $399/wk)	45%
Middle income ($400/wk - $999/wk)	33%
High income earner (≥ $ 1, 000/wk)	14.4%

* Source: Australian Bureau of Statistics (ABS) 2006 national census [2].

Table 4-2: Prevalence of diabetes lifestyle risk factors in the Barwon South Western Region adult population*

Lifestyle risk factor	% of adult BSWR population (N=334,836)	
Overweight	38%	
Obese	16%	
	Males	**Females**
Current smoker	18%	14%
Insufficient physical activity	28%	34%
Consumed more than recommended number of drinks on one occasion on a weekly basis	18%	7%

* Source : Victorian Population Health Survey 2007 {Department of Human Services, 2008 #143}.

Table 4-3: Prevalence of diagnosed diabetes mellitus within three Victorian Local Government areas located in the Barwon South Western Region compared to the Victorian average*

Area	2006 census population	Number of persons diagnosed with diabetes	Proportion of people with type 2 diabetes	Number of persons prescribed insulin
Greater Geelong	197, 479	9, 265	85%	2, 717 (29%)
Surf Coast	21, 771	678	84%	185 (27%)
Queenscliff	3, 018	131	86%	39 (30%)
Victoria	4, 932, 422	199, 312	83%	62, 447 (31%)

* Source: National Diabetes Service Scheme (NDSS) AusDiabetes Map [5]

Table 4-4: The proportion of HbA_{1c} tests with values above and below the recommended target of 7% ordered by GPs within GPAG during 2007 (HbA_{1c} <7% at the time of the study)*

HbA_{1c} range	Proportion of tests ordered
< 7.0%	52.9%
7.1% - 8.0%	26.3%
8.1% - 9.0%	10.2%
> 9.0%	10.6%

*Source: Novo Nordisk Changing Diabetes Map [7]

4.3.3 General Practitioners

The majority of GPs practicing within the BSWR are members of GPAG. The boundaries of GPAG are presented in Figure 4-1 on page 63. As at June 2009, 260 GPs were members of the GPAG and were working in general practice, equating to a full-time equivalent (FTE) of 159.7 GPs (personal communication, GPAG). There were 64 GP practices located within the boundaries of the GPAG. Of these, 19 were solo practices, 24 practices had between two and five GPs, and 21 had six or more GPs. Of the 64 practices, 47 employed at least one practice nurse. A total of 119 practice nurses were working in general practices, most worked part time and/or job shared.

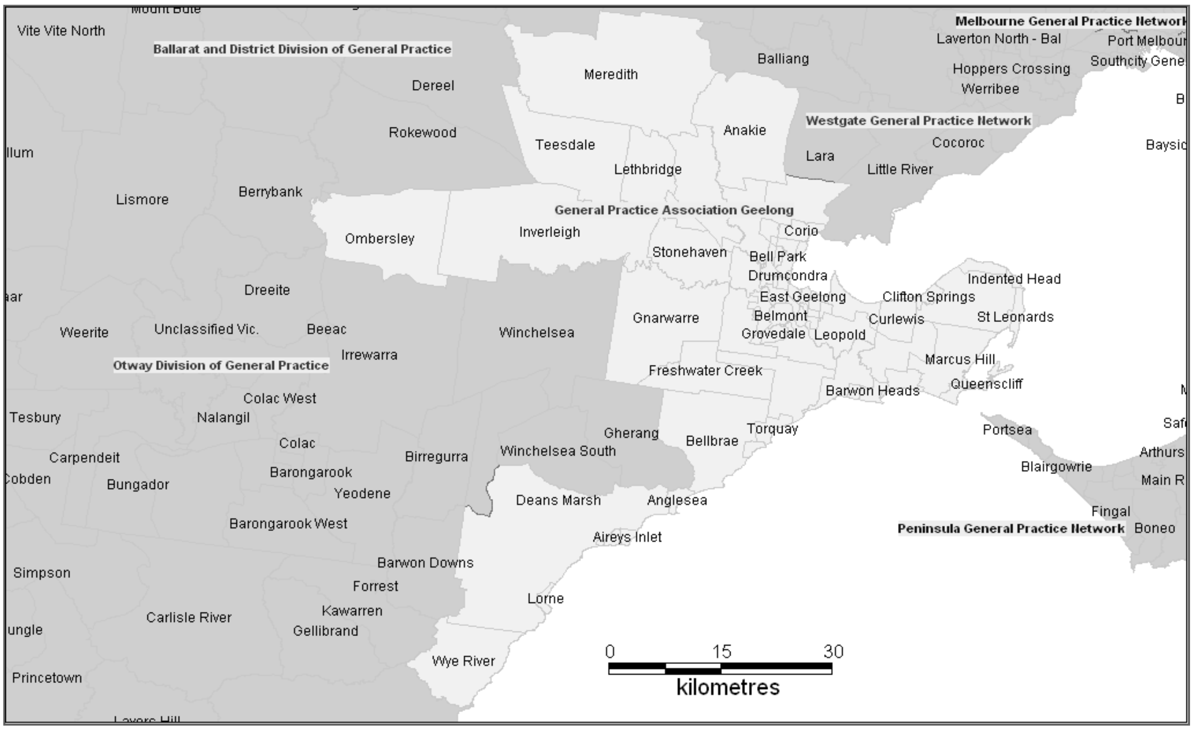

Figure 4-1: Map showing the GP Association of Geelong (GPAG) geographic boundaries highlighted

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4.4 Participants

There were two participant groups:

- general practitioners (GPs)
- patients with a diagnosis of type 2 diabetes.

4.4.1 General Practitioners

The aim was to enrol GPs from a range of practices including large and small practices situated in rural and urban locations with a range of patient socio-demographic profiles.

Inclusion criteria:

1. agreed to participate in and support the study and attend all three workshops, and
2. had either Medical Director 3 or Best Practice medical software installed in the practice.

Exclusion criteria:

1. engaged in another study such as the National Primary Care Collaborative (NPCC) or the Diabetes Australia Victoria (DAV) Life program, or another diabetes intervention trial, or
2. did not have Medical Director 3 or Best Practice medical software installed in the practice.

GPs/practices who agreed to participate were invited to commit to the study by:

1. providing informed consent
2. participating in an orientation workshop and two further information and formative evaluation workshops during the study period to assist the formative evaluation of CDMS and to maintain the study momentum
3. recruiting a minimum of 15 patients who met the inclusion criteria

4. seeking informed consent from all patients who agreed to participate
5. identifying one patient from their practice to take part in a face-to-face interview
6. collaborating with the research team to ensure all the relevant data were collected.

GPs were reimbursed for their time for participating in the project, and, if all the required criteria were met were eligible for one of the following:

1. Royal Australian College of General Practitioners (RACGP) Quality Assurance and Continuing Professional Development (QA&CPD) program points, or
2. Australian College of Rural and Remote Medicine (ACRRM) Professional Development Program (PDP) points.

4.4.2 Patients with a diagnosis of type 2 diabetes

Inclusion criteria:

- diagnosis of type 2 diabetes
- age range 18 – 75 years. Patients older than 75 years were included at the GP's discretion and the GP's estimation that the patient was able to provide informed consent
- access and ability to use a mobile phone, the Internet or a landline telephone
- living independently in the community
- able to give informed consent
- provided informed consent to share their health information electronically with Precedence Health Care (Precedence) and their care team.

Exclusion criteria:

- unable or unwilling to provide written informed consent in English
- pregnant women
- diagnosis of HIV/AIDS
- unable to access or use email, a landline or a mobile telephone.

4.5 Recruitment process

4.5.1 General Practitioners

Recruitment commenced in July 2008 and ceased at the end of January 2009. Practices using either Medical Director 3 or Best Practice clinical software were identified from the GPAG records. Members of the CDM-Net GP Advisory Group and Precedence staff contacted eligible GPs and practice staff informally between June and July 2008 and provided them with information about the CDM-Net project.

The research team then provided detailed information about the study by telephoning the practice staff. A project information sheet addressed to practice managers was faxed to all practices asking the managers to disseminate the information to the GPs. Follow up phone calls were made one week after the information was faxed.

The research team visited GPs/practices interested in participating in the study to:

- meet key practice staff
- provide detailed information about the study
- organise meetings with GPs
- demonstrate CDMS to GPs and other practice staff, and
- provide assistance to identify eligible patients on the practice patient databases.

A staff member from Precedence Health Care configured the GPs' clinical software (Medical Director or Best Practice) to operate with CDMS.

4.5.2 Patients

Between August 2008 and February 2009 GPs identified patients who met the inclusion criteria from their databases.

GPs discussed the study with eligible patients during routine patient consultations and sought informed consent. The research team assisted practice staff to recruit patients when GPs or practice staff requested it. The support included conducting a search of the practice databases, assisting staff to make appointments for relevant patients and attending the practice when the GPs developed a CDMS GPMP. Some practices nominated 'care plan days' for patients to attend. The research team assisted on these days to:

- inform patients with diabetes about the study
- invite eligible patients to participate
- obtain written informed consent from patients who agreed to participate
- ask patients to complete the Time 1 questionnaire, and
- answer study-related questions.

Throughout the recruitment and intervention period, the research team made weekly visits to all participating practices to collect completed patient consent forms and questionnaires and to support the GPs and practice staff to maintain the focus on the research and their commitment to the study.

4.6 Workshops

Three workshops were held during the study. The aim of the first workshop was to provide participating GPs with information about the study such as data collection and other study processes such as patient inclusion/exclusion criteria, and requirements regarding the questionnaire.

The aim of the second workshop was to provide GPs with information about the progress of the study, explain the different components of the project and describe how the data they were helping to collect would be used.

The aim of the third workshop was for GPs to report and discuss their experience using the CDMS system and participating in the study, for members of the Research and Evaluation Sub-Committee to provide feedback and respond to questions from attendees (GPs, nurses, practice staff, diabetes educators and podiatrists), and for the research team to provide an overview of the study results.

4.7 Data collection process

Data were collected at four time points (Table 4-5, page 66):

- Time 1 (baseline),
- Time 2 (3 – 6 months)
- Time 3 (6 – 9 months)
- Time 4 (30th September 2009), and
- Ongoing.

The data were collected from a number of sources:

- questionnaires (Time 1, Time 2, Time 3)
- CDMS collected data (Time 1, Time 2, Time 3, Time 4)
- semi-structured interviews with HPs, patients and stakeholders (ongoing)
- Barwon Health (ongoing)
- patient-nominated pharmacies (ongoing)
- research field notes (ongoing), and
- Medicare (ongoing).

Table 4-5: Data types, the measures used to collect each data type, data sources, and data collection time points (Table continues on following pages)

Types of data	Measure	Data Source	Data collection time point
Demographic data		Questionnaire	T1, T2
Psychological / behavioural	Assessment of Quality of Life (AQoL) Patient engagement in self-care Mental Health and Wellbeing	Questionnaire	T1, T2, T3
Medicine profile	Medication Adherence Reporting Scale (MARS)	Questionnaire	T1, T3
	Medication list, conventional complementary medicines, over the counter medicines	GPMP, Pharmacy	
	Number of prescriptions per patient	GPMP, Medicare	
	Home Medicines Review (HMR)	Pharmacy	
Physical status	Current health status Diabetes complication status Other co-morbidities Nutritional status Physical activity Alcohol consumption Smoking status Body weight, abdominal circumference BMI	GPMP	T1, T2, T3,T4
Measures	HbA_{1c} Lipid profile Albumin excretion rates eGFR Systolic BP Diastolic BP	GPMP	T1, T2, T3, T4
Patient attitudes	Satisfaction with care plans and diabetes management Satisfaction with CDMS Whether the system and care plans enhanced diabetes self-management and communication with health professionals Ability to navigate CDMS	Semi-structured interviews	T1, T3

Types of data	Measure	Data Source	Data collection time point
Health Professional attitudes	Satisfaction with care plans and CDMS Satisfaction with managing diabetes using CDMS care plans Ability to effectively navigate CDMS Ability to track management targets effectively Ability to recall patients for important assessments Whether CDMS enhanced or replaced existing processes Whether CDMS enhanced or improved communication among HCPs	Semi-structured interviews	Ongoing
Service Use	Hospital admissions/presentations to emergency Number of presentations overall and per patient Diagnosis using ICD codes AHP visits Medical imaging	Barwon Health	Ongoing
Additional Process data	Time spent on 'administrative processes' Occurrence of any unintended activities and/or processes (beneficial or harmful) Whether patients could access the services they required	Field notes	Ongoing

4.7.1 Diabetes management targets

The management targets for the CDMS GPMPs and TCAs were those defined in the Diabetes Management in General Practice 2007/08 [6], GPMP Medicare Item numbers 721 and 725, and TCA Medicare Item numbers 723 and 727 [8] (Table 4-6 on page 67).

Table 4-6: Goals for optimum diabetes management*

Measure	Target
BGL	4 – 6 mmol/L
HbA_{1c}	≤ 7%
$LDL\text{-}_C$	< 2.5 mmol/L
Total Cholesterol	< 4.0 mmol/L
$HDL\text{-}_C$	> 1.0 mmol/L
Triglycerides	< 1.5 mmol/L
Blood pressure	≤ 130/80 mm Hg
BMI	< 25 kg/m2 where practicable
Urinary albumin excretion rate	< 20 μg/min timed overnight collection or < 20 mg/L spot collection < 3.5 mg/mmol: women < 2.5 mg/mmol: men (albumin creatinine ratio)

Measure	Target
Smoking	Zero
Alcohol intake	≤ 4 standard drinks (40g) men ≤ 2 standard drinks (20g) women
Physical activity	at least 30 minutes walking (or equivalent) 5 or more days/week

*Source: Diabetes Management in General Practice 2007/08 [6]

4.7.2 Study questionnaires

Patient self-report data were obtained using a questionnaire developed specifically for the study from published literature, validated questionnaires and the extensive clinical experience of the researchers. Sections of the questionnaire were administered at the three time points.

The questionnaire contained a total of 102 questions (Table 4-7 on page 68).

Four formally validated scales were included in the questionnaire. Permission was sought and gained to use these questionnaires:

- Assessment of Quality of Life (AQoL) Scale [9]
- Medication Adherence Reporting Scale (MARS) [10]
- Control Preferences Scale [11]
- Kessler Psychological Distress Scale – 10 (K-10) [12].

For data management processes and to increase the accuracy of data coding, the questionnaires were formatted for electronic scanning.

Table 4-7: Questionnaire domains and administration times during the study

Domain	Time 1	Time 2	Time 3
1. Demographic data	*		* (not all questions)
2. Communication	*		*
3. Self-reported allied health service utilisation	*	*	*
4. Self-reported health during previous week	*		*
5. Self-reported health during previous four weeks	*	*	*
6. Beliefs and attitudes about and satisfaction with CDMS			*
7. Care plan history	*		
8. Home blood glucose and blood pressure monitoring	*		
9. Medication adherence	*		*
10. Medical decision-making preference style	*		*

Questionnaires were distributed at:

- Time 1 (T1) between July 2008 and January 2009
- Time 2 (T2) between February 2009 and May 2009
- Time 3 (T3) between April 2009 and October 2009.

Follow-up letters were mailed (as required) to patients one month and then two months after initial questionnaire mail-out. Questionnaire packages contained an explanatory letter, blank questionnaire and a return addressed, stamped envelope. GP practices where the patient was recruited addressed and mailed all packages and letters.

When the research team noted that a questionnaire had not been returned, the recruiting practice staff was asked to check their database to determine whether non-responders had died, changed address or changed GP.

4.7.3 Interviews

Face-to-face interviews were conducted with GPs, patients and allied health professionals (see Section 6).

4.8 Data analysis process

Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 17. Qualitative data analysis was conducted by the two senior members of the research team according to the Framework Method [13]. The researchers independently analysed the data and then met to reach a consensus. The Framework Method involves a five stage inductive and deductive process of becoming familiar with the data by reading the transcripts to recognise recurring words and themes. From this a content framework was developed and emerging themes were charted, mapped, and then interpreted. Illustrative quotations were used to highlight the main themes within the data in the findings section.

4.9 Ethical considerations

Ethics approval to conduct the study was obtained from Barwon Health Research Ethics Advisory Committee (REAC 08/09) and Monash University Standing Committee on Ethics in Research Involving Humans (SCERH 2008/0262), and subsequently noted by Deakin University Human Research Ethics Committee (HREC). Four minor amendments to the original ethics application and two extensions were approved during the project.

4.10 Literature search

During the project, literature searches concerning diabetes and chronic disease Information Technology (IT)-enabled management were undertaken to inform work carried out by the clinical evaluation team. Databases searched included the Medical Literature Analysis and Retrieval System Online (Medline), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the American Psychological Association Online Database (PsychINFO) and Informit. The search terms used within the Medical Subject Headings (MeSH) thesaurus were: diabetes mellitus AND chronic disease management AND informatics OR computerised medical record systems.

4.11 References

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5 Clinical evaluations: health impact

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5.1 Results

The quantitative findings are presented in this section and include the recruitment process, response rate, demographic data and changes over time. The qualitative findings, which include outcomes from interviews with GPs, patients, allied health professionals, nurses and other stakeholders are presented in Section 6.

5.1.1 Recruitment process and response rate

5.1.1.1 General Practitioners

The number of practices and GPs identified during the recruitment process are shown in Table 5-1 on page 71. A total of 121 telephone and email contacts were made to the eligible practices. In addition to telephone and email contact, the research team made 43 visits to 15 practices between July and December 2008 to recruit GPs. The duration of the visits ranged from 10 to 60 minutes; average 30 minutes.

Table 5-1: The number of general practices and GPs identified during recruitment

Recruitment stage	Number of Practices	Number of GPs
General Practitioner Association (GPAG) Geelong GP population	64	267
Met inclusion criteria	21	100
Attended CDMS demonstration*	15	45
Consented to participate in study	11	21
Final study sample	7	12

* CDMS was demonstrated 24 times to interested GPs and practice staff, including practice nurses (PN), practice managers (PM), medical registrars (MR) and diabetes educators (DE) between July and December 2008 (Table 5-2 on page 71).

Table 5-2: The number of CDMS demonstrations conducted at 15 general practices and the practice staff who attended the demonstrations

Practice code	Number of Demonstrations	Practice staff in attendance
1	2	GP, PN, PM
2	1	GP, PN
3	1	GP
4	1	GP, PN, PM
5	4	GP. PN, PM
6	1	GP, PN, PM, MR
7	4	GP, PN, PM
8	1	GP

Practice code	Number of Demonstrations	Practice staff in attendance
9	1	GP, PN, PM
10	1	GP, DE
11	3	GP, PM, DE
12	1	GP
13	1	PM
14	1	PN
15	1	GP

Twenty-one GPs from 11 practices initially agreed to participate; nine GPs from four practices withdrew. Reasons given for withdrawing from the study included unexpected staff shortages within the practice, inability to implement CDMS within the research time frame, and inability to recruit any patients before the end of the recruitment period.

The final GP sample included seven practices and 12 GPs, which represents 33% of the 21 eligible practices and 12% of the 100 eligible GPs. No GP dropped out of the study between Time 1 and Time 3, indicating a retention rate of 100%.

5.1.1.2 Patients

One hundred and thirteen patients with type 2 diabetes were recruited into the study and all completed the questionnaire at Time 1. Each GP recruited between two and 21 patients. Fourteen patients were not included in the final analysis: nine patients did not have an approved GPMP and identifying information was not available for five patients. Thus, the final number of patients was 99. The patient retention rate between Time 1, Time 2 and Time 3 is shown in Table 5-3 on page 72.

Table 5-3: The number of patients in the study at each time point, the number of patients included in the final analysis, and the percentage of participants retained from Time 1 to Time 3

	Time 1	Time 2	Time 3	% retained Time 1 to Time 2	% retained Time 1 to Time 3
Number of patients who completed the questionnaire	113	107	94	95%	83%
Number of patients included in the final analysis	99	93	80	94%	81%

5.1.2 Time 1 demographic characteristics

5.1.2.1 Practices

The seven participating practices were located in coastal, rural, suburban, and city areas in the BSWR (see Table 5-4 on page 73).

Table 5-4: Location type, practice composition, number of GPs (n = 12) and patients (n = 113) recruited into the CDM-Net clinical evaluation per practice

Practice Code	Location Type	n GPs in practice	Practice nurses in practice (Y/N)	n GPs in CDM-Net	n patients in CDM-Net
1	Suburb	7	Y	1	7
2	Suburb	3	Y	1	7
3	Suburb	6	Y	2	30
4	Coastal	8	Y	2	8
5	Coastal	3	Y	2	24
6	Rural	7	Y	3	35
7	Suburb	9	Y	1	2

Figure 5-1 on page 73 shows the distribution of practices within the GPAG boundaries. Four practices were located in Geelong, two were coastal practices, and one practice was rural. Locations of the seven practices that participated in the study are highlighted showing they include town and rural practices.

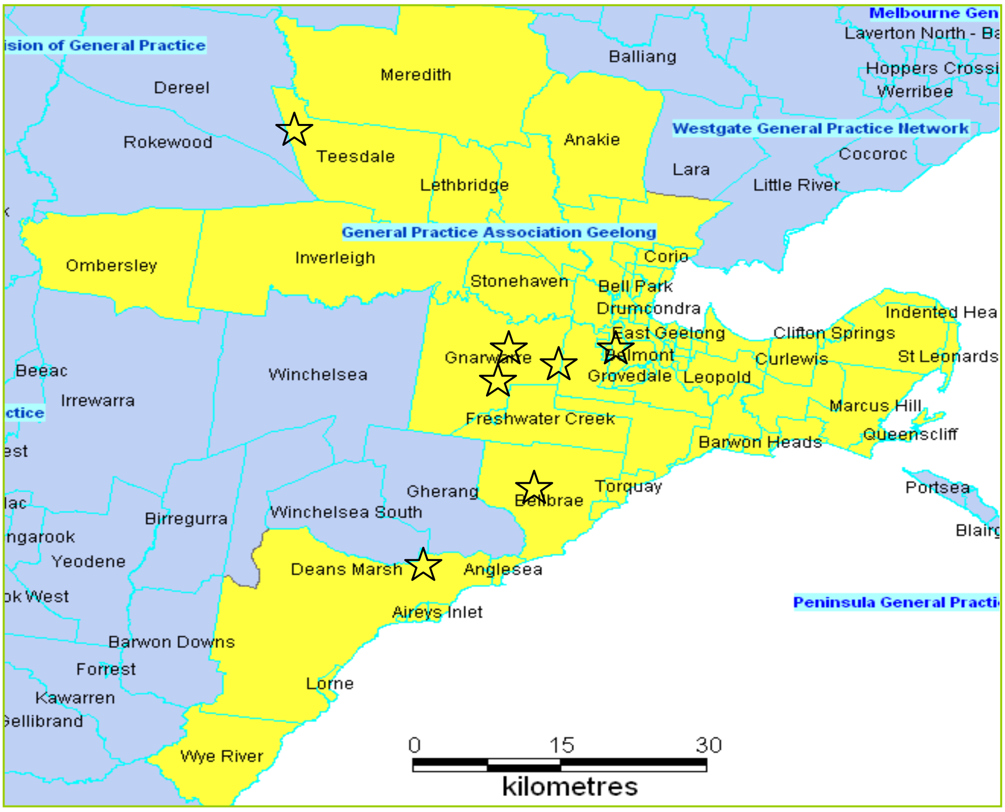

Figure 5-1: Map of the GP Association of Geelong.

5.1.2.2 General practitioners

Twelve GPs participated in this project, all of whom were male. Four worked part-time and eight worked full-time. The workload of GPs ranged from 0.2 full-time equivalent (FTE) to 1.0 FTE. Although all GPs were invited, no female GPs participated; the reason for this is unknown.

5.1.2.3 Patients

The final sample comprised 99 patients; 61 (62%) were men and 38 (38%) were women; age range from 31 to 91 years. Men were aged 31 to 83 years and women were aged 45 to 91 years.

For data analysis purposes, patients were divided into two age groups: ≤ 65 years (n = 52) and ≥ 66 years (n = 47). The grouping was chosen to reflect the current retirement age of 65 years and was used throughout the results for all age comparisons.

The majority of patients were Australian born (Table 5-5 on page 74). One participant indicated that she was an Aboriginal Australian. The 17 overseas born patients first arrived in Australia 11 to 60 years previously.

Table 5-5: Patients' country of birth (n = 99)

Place of birth	N	%
Australia	82	83
Europe	11	11
United Kingdom	3	3
New Zealand	2	2
United States	1	1

Seven of the overseas born patients indicated they spoke a language other than English at home including: German (three), Dutch (one), Italian (one), Hungarian (one) and Romanian/Hungarian (one).

Regarding living arrangements, the majority of participants lived with their spouse at home (Table 5-6 on page 74).

Table 5-6: Patients' living arrangements (n = 99)

Living Arrangements	N	%
With spouse at home	63	64
With family at home	10	10
By self at home	23	23
Share house with unrelated people	2	2
No response	1	1

Education level, including secondary school and any post-secondary qualifications; approximately half the sample indicated that they had either a trade or university qualification and half indicated that they had no post-secondary qualification (Table 5-7).

Table 5-7: Patients' educational level (n = 99)

Education Level	N	%
Secondary School		
Year 8 or below	13	13
Year 9	7	7

Education Level	N	%
Year 10	26	26
Year 11	15	15
Year 12	36	36
No response	2	2
Post-secondary		
Trade	24	24
University	27	27
No qualification	47	47
No response	1	1

Total annual income: approximately half of the patients who chose to answer this question had an annual income between $13,000 and $50,000 (Table 5-8).

Table 5-8: Self-reported total annual income (n = 99)

Annual income range ($)	N	%
No income	4	4
< 12, 999	11	11
13, 000 – 31, 199	23	23
31, 200 – 51, 999	22	22
52, 000 – 83, 199	9	9
> 83, 200	5	5
No response	25	25

The main source of income was paid work (n = 31), however if pensions and superannuation are grouped together they formed the largest group (n = 58) (Table 5-9).

Table 5-9: Main source of income (n = 99)

Source of income	n	%
Paid work	31	31
Age pension	23	23
Other pension	17	17
Superannuation	18	18
Investments	4	4
Family	4	4
No response	2	2

A higher proportion of males in the sample were in paid work, and a higher proportion of females received either a pension or superannuation payments (Table 5-10).

Table 5-10: Main source of income – Gender males (n = 61), females (n = 38)

Source of income	Males n (%)	Females n (%)
Paid work	24 (39)	7 (18)
Age pension	12 (20)	11 (29)
Other pension	9 (15)	8 (21)

Source of income	Males n (%)	Females n (%)
Superannuation	11 (18)	7 (18)
Investments	3 (5)	1 (3)
Family	0 (0)	4 (11)
No response	2 (3)	0 (0)

A higher proportion of people aged ≤65 were in paid work, and a higher proportion of those aged ≥ 66 received a pension or superannuation payments (Table 5-11 on page 76).

Table 5-11: Main source of income – Age, aged ≤ 65 years (n = 52), ≥ 66 years (n = 47)

Source of income	Patients aged ≤ 65 n (%)	Patients aged ≥ 66 n (%)
Paid work	(56)	2 (4)
Age pension	0 (0)	23 (49)
Other pension	12 (23)	5 (11)
Superannuation	6 (12)	12 (26)
Investments	1 (2)	3 (6)
Family	2 (4)	2 (4)
No response	2 (4)	0 (0)

The duration of diabetes ranged from 0 (new diagnosis) to 34 years. Six patients did not provide information about the duration of diabetes (Table 5-12 on page 76).

Table 5-12: Characteristics of patients diagnosed with diabetes within the previous five years, six to ten years, and more than ten years (n = 99)

Years since diagnosis	n	Mean age	% female	% with a disability
0 – 5 years	29	62	31	18
6 – 10 years	32	66	31	30
> 10 years	32	68	53	18
No response	6	64		

Seventy-seven patients (78%) were registered with the National Diabetes Services Scheme (NDSS). Patients registered with NDSS had diabetes for a significantly longer time than patients not registered with NDSS.

Of the 99 patients in the study, 34 (20 females and 14 males) reported they had a GPMP prior to participating in CDMS, 44 did not have a GPMP, 17 were not sure, and 4 patients did not respond to the question. Fifteen patients (9 females and 6 males) reported having a Team Care Arrangement (TCA) to manage their diabetes; 65 did not have a TCA prior to CDMS, 16 were unsure, and 3 did not respond to the question.

Females were significantly more likely to report they had a GPMP previously. Patients aged ≥ 66 years were more likely to report they had a TCA in the past (89%) than those aged ≤ 65 years (61.5%).

Patients were asked whether they self-monitored their blood glucose and blood pressure and whether they recorded the results (Table 5-13 on page 77).

Table 5-13: Self-reported blood glucose and blood pressure monitoring practices (n = 99)

Item (n patients who responded to each item)	Yes (%)	No (%)	Unsure (%)
Measure blood glucose with a glucose meter (n=99)	74 (75)	24 (24)	1 (1)
Measure blood pressure (n=98)	19 (19)	79 (80)	-
Record BG and BP test results in a record book (n=91)	39 (39)	52 (53)	-
Download BG test results to a personal computer (n=96)	3 (3)	92 (93)	1 (1)

The trend suggests that females were more likely than males to monitor their blood glucose and write their results in a record book.

There are a number of demographic and metabolic differences between patients who monitored their blood glucose at home and those who did not (Table 5-14 on page 77).

Table 5-14: Baseline characteristics of patients who do (n = 74) and do not (n = 25) regularly self-monitor blood glucose (n = 99)

Characteristic	Self-monitor blood glucose	Do not self-monitor blood glucose
Mean duration of diabetes (years)	8	3.5
Mean HbA_{1c} (%)	6.8	8.3
Mean age	67	56
Mean cholesterol	4.29	4.96
% who have had a GPMP prior to CDMS	39	21
% registered with National Diabetes Service Scheme	92	38

5.1.3 Allied health service utilisation

Patients were asked whether they had attended an appointment with a dietician, podiatrist, diabetes educator, optometrist, or pharmacist within the previous three months at the three time points. Patients reported a total of 477 allied health service attendances at Time 1, 480 at Time 2 and 460 at Time 3.

Table 5-15: Patients' attendances at five categories of health professionals within the last three months, including the range and duration of attendances reported at Time 1 (n = 99), Time 2 (n = 93), and Time 3 (n = 80)

	Patients who attended (%)			Range of attendances per patient			Median duration of visits in hours		
Health Professional	**Time 1**	**Time 2**	**Time 3**	**Time 1**	**Time 2**	**Time 3**	**Time 1**	**Time 2**	**Time 3**
Pharmacist	90 (91)	74 (80)	76 (95)	0 – 40	0 –12	0 – 24	0.5	0.5	0.5
Podiatrist	39 (39)	51 (55)	42 (53)	0 – 6	0 – 6	0 – 3	0.3	0.3	0.3
Optometrist	34 (34)	28 (30)	30 (38)	0 – 5	0 – 10	0 – 5	1	1	0.5
Diabetes Educator	18 (18)	31 (33)	17 (21)	0 – 5	0 – 12	0 – 2	1	1	1
Dietician	9 (9)	26 (28)	23 (29)	0 - 3	0 - 3	0 - 6	1	1	1

Table 5-15 on page 77 shows the number of patients who made these visits at each time point, as well as the range of attendance as per patient and the median duration of visits. Attendance at the five categories of health professionals tended to increase during the study.

5.1.4 Medicines profile

Prescribed medicines were recorded for 96 of the 99 participating patients: only three patients were not taking any prescribed medicines. Patients were prescribed between zero and 23 medicines at Time 1. Patients aged ≥ 66 years were prescribed a greater number of medicines (range 0 – 23 medicines) compared to patients aged ≤ 65 years (range 0 – 18 medicines). The relationship between the number of prescribed medicines and gender or income was not significant. Duration of diabetes was longer for patients prescribed one or more diabetes medicine (oral hypoglycaemic agent), insulin, lipid lowering agent, antihypertensive agent) than patients not prescribed one of these medicines.

There were no changes to recorded prescribed medications or dose regimens at Time 2, Time 3 or Time 4.

Seventy-one patients were prescribed Oral Hypoglycaemic Agents (OHAs) (Table 5-16 on page 78). Among the 66 patients with HbA_{1c} recorded at Time 4, those prescribed an OHA (n = 46) had significantly higher HbA_{1c} than patients not prescribed an OHA (n = 20).

Table 5-16: Classes of oral hypoglycaemic agent (OHAs) prescribed (n = 99)

Oral Hypoglycaemic Agent Class	n	%
Biguanides	60	61
Sulphonylureas	39	39
Thiazolidinediones (TZDs)	8	8
None	28	28

Note: n (%) do not add to 99(100%) because 27 patients were prescribed two and four patients were prescribed three OHAs: 23 patients were on a biguanide and a sulphonylurea; three were on a thiazolidinedione (TZD) and a biguanide; and one was on a TZD and a sulphonylurea.

Other prescribed medications recorded were the incretin enhancers sitagliptin (n=2) and exenatide (n=1).

Seven patients were prescribed an insulin preparation (Table 5-17 on page 78). Five of the seven patients who were prescribed insulin were also prescribed OHAs: two patients were prescribed a biguanide, one was prescribed a TZD and a biguanide, one was prescribed a sulphonylurea and a biguanide, and one was prescribed a TZD, a biguanide and a sulphonylurea.

Table 5-17: Insulin preparations prescribed (n = 99)

Insulin preparations	N	%
Lantus	4	4
Mixtard	2	2
NovoMix 30	1	1
None	92	93

Classes of Lipid lowering agents prescribed are shown in Table 5-18 on page 79.

Table 5-18: Classes of lipid lowering agent prescribed (n = 99)

Lipid lowering agent class	N	%
Statins	47	47
Fenofibrates	8	8
Ezetimibe	5	5
None	45	45

Note: n (%) do not add to 99(100%) because 6 patients were prescribed two lipid lowering agents.

Fifty-nine patients were prescribed an antihypertensive agent. Sixteen patients were prescribed two and one was prescribed three antihypertensive agents. Thirty-seven patients were prescribed aspirin and four were prescribed warfarin.

5.1.4.1 Self-reported medicine use

At Time 1 and Time 3, patients were asked complete the Medication Adherence Reporting scale (MARS) which indicates how often the patient forget to take their diabetes medicines (Table 5-19 on page 79)

Table 5-19: Patient responses at Time 1 (n = 99) and Time 3 (n = 80) to how often they forget to take their diabetes medicine

Frequency of forgetting	Time 1 n (%)	Time 3 n (%)
I never forget to take my diabetes medicine	53 (54)	40 (50)
I rarely forget to take my diabetes medicine	21 (21)	20 (25)
I sometimes forget to take my diabetes medicine	10 (10)	9 (11)
I very often forget to take my diabetes medicine	0 (0)	0 (0)
I always forget to take my diabetes medicine	0 (0)	0 (0)
No response	15 (15)	11 (14)

At Time 1 and Time 3 half the sample reported that they never forget to take their diabetes medicines. Patients reporting they never forget to take their diabetes medicines were significantly older than patients reporting they rarely forget. There was no significant relationship between patients forgetting to take their medicines and gender.

5.1.5 Participant physical status

5.1.5.1 Current health status

Twenty patients at Time 1 and 24 patients at Time 3 reported they had a disability that prevented them from working (Table 5-20 on page 80). Four patients at Time 1 and seven patients at Time 3 reported having more than one disability.

Table 5-20: Self-reported disabilities using patients' terminology at Time 1 (n = 99) and Time 3 (n = 80).

Disability	Time 1 n = 99 (%)	Time 3 n = 80(%)
Back injury	4 (4)	4 (5)
Diabetes	4 (4)	3 (4)
Old age	4 (4)	10 (13)
Stroke *	1 (1)	2 (3)
Cardiomyopathy *	1 (1)	1 (1)
Arthritis	1 (1)	1 (1)
Post-traumatic Stress Disorder	1 (1)	1 (1)
Advanced prostate cancer	1 (1)	
Chronic Heart Disease *	1 (1)	
Clotted arteries *	1 (1)	
Heart attack *	1 (1)	
Multiple Sclerosis	1 (1)	
Osteoporosis *	1 (1)	
Loss of eye	1 (1)	
Vision impairment		2 (3)
Knee replacement		1 (1)
Cancer		1 (1)
Heart condition		1 (1)
Irritable Bowel Syndrome		1 (1)
Intermittent claudication		1 (1)
No response	82 (83)	54 (68)

Note: *Long-term diabetes complications.

Thirty-six of the 99 patients had complications recorded by their GPs in their CDMS GPMPs; the number of complications ranged from one to 13 complications (Table 5-21on page 80).

Table 5-21: GP-recorded complications at Time 1 (n = 99)

Complication	N	%
Heart complications	38	38
Hypercholesterolaemia	19	19
Kidney complications	17	17
Psychosocial conditions	17	17
Eye complications	10	10
Peripheral neuropathy	5	5
Hypertriglyceridemia	4	4
None	63	64

Of the 99 patients (61 males and 38 females), a higher proportion of females than males reported following a diet at all three time points (Table 5-22 on page 81).

Table 5-22: The number of males and females who reported following a diet at Time 1 (n = 99), Time 2 (n = 93) and Time 3 (n = 80)

	Time 1	Time 2	Time 3
Males	22 of 61	30 of 57	23 of 48
%	36%	53%	48%
Females	26 of 38	22 of 36	21 of 32
%	68%	61%	66%

The number of females reporting diets remained consistent but the proportion of males following a diet increased over time. At Time 1, 15 patients reported following a structured diet program, 12 at Time 2 and eight at Time 3. Reported structured diet programs included Weight Watchers, Jenny Craig, Gloria Marshall, Sure Slim, Lite-n Easy, Slim Right, Town, Body Trim, CSIRO diet, Scarsdale Diet, low GI diet and 1200 calories a day diet. Only one patient reported following a diet devised by a dietician.

Of the 99 patients (61 males and 38 females), a higher proportion of females than males reported engaging in an exercise program at all three time points (Table 5-23 on page 81).

Table 5-23: The number of males and females who reported engaging in an exercise program at Time 1 (n = 99), Time 2 (n = 93) and Time 3 (n = 80)

	Time 1	Time 2	Time 3
Males	13 of 61	12 of 57	7 of 48
%	21	21	15
Females	18 of 38	14 of 36	14 of 32
%	47	39	44

There were no significant relationships between whether or not patients reported having taken part in an exercise program and age, duration of diabetes or income.

Of the 99 patients (61 males and 38 females), a higher proportion of males than females reported drinking alcohol at all three time points (Table 5-24 on page 81).

Table 5-24: The number of males and females who reported drinking alcohol at Time 1 (n = 99), Time 2 (n = 93) and Time 3 (n = 80)

	Time 1	Time 2	Time 3
Males	41 of 61	38 of 57	36 of 48
%	67	67	75
Females	16 of 38	14 of 36	12 of 32
%	42	39	38

Patients who reported drinking alcohol were asked how often they would consume six or more standard glasses per day. However, at all time points both genders rarely consumed alcohol. A greater proportion of females than males did not respond to this question.

Table 5-25 on page 82 shows the number of patients who indicated that they smoked at each time point. Notably, one patient who indicated that he smoked at Times 1 and 2 later indicated at Time 3 that he did not smoke. There were no significant differences in smoking habits according to gender or age. A higher proportion of males than females reported smoking in the past, and two patients had participated in smoking cessation programs including hypnotherapy and Smoke Enders

Table 5-25: The number of patients who reported smoking at each time point

	Time 1 (n = 99)	**Time 2 (n = 95)**	**Time 3 (n = 80)**
n	7	7	4

Body weight was recorded for 97 of the 99 patients at each time point. Males' weight ranged from 62kg to 170kg, and females' weight ranged from 44kg to 141kg. There were no changes in recorded weights between time points.

Abdominal circumference measurements were recorded at Time 1 and Time 4. Of the 99 patients, abdominal circumference was recorded for 81 patients at Time 1 and 83 patients at Time 4. At Time 4, males' abdominal circumference (n = 51) ranged from 83cm to 160cm and females' (n = 32) ranged from 77cm to 130cm.

Of the 99 patients, the research team calculated the BMI of 94 patients at Time 1 and 95 patients at Time 4 from weight and height values recorded. At Time 4, males' BMI (n = 58) ranged from 21.45 to 55.1 and females' (n = 37) ranged from 19.56 to 57.2. Table 5-26 on page 82 shows the number of patients classified into one of three BMI ranges (healthy, overweight and obese) at Time 4. More males were overweight while more females were obese.

Table 5-26: Males (n = 61) and females classified one of three Body Mass Index (BMI) ranges calculated from height and weight values recorded at Time 4

BMI Range	**Males n (%)**	**Females n (%)**
Healthy: 18.5 – 24.9	4 (7)	9 (24)
Overweight: 25 – 29.9	22 (36)	6 (16)
Obese: ≥ 30	32 (52)	22 (58)
Not recorded	3 (5)	1 (3)

5.1.5.2 Metabolic Parameters

Eight different metabolic parameters could be recorded in CDMS care plans. These measurements were recorded by GPs and entered into the care plan at various times during the study. In Table 5-27 on page 83, Time 1 shows the numbers of patients who had each metabolic parameter recorded in their care plan at the time that care plan was created, Time 2 shows the number of patients who had a measurement taken any time in the next four months, Time 3 shows the number of patients who had a measurement taken between Time 2 and the end of June 2009, and Time 4 shows the number of patients who had a measurement taken between the end of June 2009 and the end of September 2009.

At Time 1, blood pressure was recorded for every patient in the study, $HbA_{1c,}$ HDL, LDL, triglycerides and total cholesterol were recorded for more than half the sample and microalbumin was recorded for just under a third of the sample.

Table 5-27: The number of patients at each time point who had metabolic parameters recorded (n = 99)

Metabolic Parameter	Time 1 n (%)	Time 2 n (%)	Time 3 n (%)	Time 4 n (%)
HbA_{1c}	50 (51)	6 (6)	15 (15)	23 (23)
Microalbumin	31 (31)	2 (2)	3 (3)	13 (13)
Systolic Blood Pressure	99 (100)	13 (13)	15 (15)	35 (35)
Diastolic Blood Pressure	99 (100)	13 (13)	15 (15)	35 (35)
High Density Lipoprotein (HDL)	53 (54)	6 (6)	10 (10)	15 (15)
Low Density Lipoprotein (LDL)	52 (53)	5 (5)	10 (10)	15 (15)
Triglycerides	53 (54)	6 (6)	9 (9)	16 (16)
Total Cholesterol	55 (56)	6 (6)	10 (10)	16 (16)

Table 5-28 on page 83 shows the mean values of metabolic parameters for patients who had values recorded.

Table 5-28: Mean metabolic parameters recorded at Time 1, Time 2, Time 3 and Time 4 (n = 99)

Metabolic Parameter	Time 1	Time 2	Time 3	Time 4
HbA_{1c}	7.32	8.00	6.62	6.62
Microalbumin	6.74	18.15	3.07	14.68
Systolic Blood Pressure	139.38	144.77	140.73	137.11
Diastolic Blood Pressure	76.71	72.15	75.60	75.31
High Density Lipoprotein (HDL)	1.15	1.21	1.15	1.36
Low Density Lipoprotein (LDL)	2.47	1.56	2.06	2.21
Triglycerides	1.86	2.80	1.51	1.51
Total Cholesterol	4.41	3.82	3.94	4.26

Table 5-29 on page 84 shows the mean values of metabolic parameters taking into account only the first and last values recorded for each patient who had measurements taken on more than one occasion. For example, if a patient had microalbumin measured at Time 1, Time 2 and Time 4, his first reading would be the measurement taken at Time 1 and his last reading would be the measurement taken at Time 4. Comparing only these mean values, seven out of the eight metabolic parameters show an improved reading, suggesting a positive trend emerging in these parameters.

Table 5-29: Comparison of mean values of first and last readings of metabolic parameters for patients who had readings taken on more than one occasion

Metabolic Parameter	n	Mean of first reading	Mean of last reading
HbA_{1c}	23	7.41	7.05
Microalbumin	4	22.73	20.83
Systolic Blood Pressure	49	138.61	138.1
Diastolic Blood Pressure	49	74.36	75.31
High Density Lipoprotein (HDL)	17	1.25	1.31
Low Density Lipoprotein (LDL)	17	2.24	1.96
Triglycerides	19	2.21	1.89
Total Cholesterol	19	4.31	4.04

Twenty-three patients had HbA_{1c} recorded more than once and comparing each of these patients' earliest reading (usually Time 1) to the latest reading, the average overall change is a decrease of 0.36%. Eleven of these patients had a decrease in HbA_{1c}, nine had an increase and three had no change. By further restricting the analysis to include only those patients who had HbA_{1c} greater than or equal to 7% (the recommended national target) at least one time point, the average overall change is a decrease of 0.57%. This is calculated from the readings of 15 patients, eight of whom had a decrease, six had an increase and one had no change.

The number of patients with last recorded HbA_{1c} less than 7% was 30 at Time 1, increasing to 39 by Time 4. However, there was a similar increase in number of patients with last recorded HbA_{1c} greater than or equal to 7% (from 21 patients at Time 1 to 27 patients at Time 4). This data reflects the greater number of HbA_{1c} tests conducted post the introduction of CDMS.

5.1.6 Psychological status

The Kessler Psychological Distress Scale (K-10) measures non-specific psychological distress during the preceding four weeks. A score between 10 and 15 indicates low or no distress, between 16 and 29 indicates a medium level of distress and between 30 and 50 indicates a high level of distress. A scale score for each participant was computed at each time point by summing the scores of the ten items. Possible scale scores range from 10 to 50. There was very little change in total scale scores for patients according to time and gender, but those patients who reported having a disability (n = 20) had slightly higher distress scores at each time point than those who did not report a disability (n = 71). Overall, the sample reported low levels of distress (Table 5-30 on page 85).

Table 5-30: Median psychological distress score for the total sample, males and females, and patients who did and did not report a disability at Time 1 (n = 99), Time 2 (n = 93) and Time 3 (n=80)

	Time 1	Time 2	Time 3
Total sample	13	13	13
Males	13	14	13
Females	13	12	12
Reporting a disability	16	16	15
Not reporting a disability	13	13	12

Patients' preferred level of involvement in medical decision-making was measured using the Control Preferences Scale. Forty one patients (41%) at Time 1 and 31 patients (31%) at Time 3 indicated they preferred to share responsibility for decision-making with their GP. However, 17 patients (17%) at Time 1 and 21 patients (26%) at Time 3 indicated they preferred the doctor to make the final decision. There was no significant change in patients' self-reported medical decision-making preference style between Time 1 and Time 3 (Table 5-31on page 85).

Table 5-31: Patients' self-reported level of involvement in medical decision making reported at Time 1 (n = 99) and Time 3 (n = 80)

Preferred level of medical decision-making involvement	Time 1 n (%)	Time 3 n (%)
The patient makes the decision about which treatment they will receive	4 (4)	6 (8)
The patient makes the decision about treatment after considering their doctor's opinion.	9 (9)	12 (15)
The patient and their doctor share responsibility for deciding which treatment is best for the patient.	41 (41)	31 (39)
The doctor makes the final decision about which treatment will be used but considers the patient's opinion.	20 (20)	10 (13)
The doctor makes all decisions about the patient's treatment.	17 (17)	21 (26)
Did not respond	8 (8)	0 (0)

At Time 1 a greater proportion of females (n = 20, 53%) than males (n = 21, 34%) preferred to share responsibility for medical decision-making with their GP, and overall more males preferred the GP to make the decision, with or without patient consideration. There was an increase in the number of females who preferred to make the decision themselves after considering their doctor's opinion, from Time 1 (n = 1, 3%) to Time 3 (n = 6, 16%).

At Time 1 both age groups preferred to share responsibility for medical decision making: of those aged less than 66 years, 14 patients (27%) preferred the GP to make the final decision after considering the patient's opinion compared to only 6 (13%) of patients aged greater than 65 years. Interestingly, 11 patients (23%) aged greater than 65 years preferred the GP to make all decisions compared to 6 (12%) of those aged less than 66 years. Patients aged greater than 65 years demonstrated very few changes in medical decision-making preference styles between Time 1 and Time 3. However, there was an increase in patients who preferred to make the decision themselves, with or without the GP's input by those aged less than 66 years.

5.1.7 Barwon Health service use

During the CDMS intervention, six types of services were recorded by Barwon Health (BH) relevant to the patient cohort:

- hospital admissions
- allied or community health visits
- emergency department
- medical imaging
- outpatients, and
- pathology.

Of the 99 patients, 42 did not use any of the above BH services, 26 used one service, 13 used two services, two used three services, six used four services, eight used five services and two patients used all six services. Patients aged greater than 65 years were more likely to use one or more BH services than those aged less than 66 years. There were no significant differences in services used between the genders. There was a trend indicating patients who used at least one BH service had a longer duration of diabetes and lower HbA_{1c} at Time 1than those who did not use a BH service (Table 5-32 on page 86).

Patients made between zero and 230 attendances to one or more BH service. Two patients had extremely high numbers of attendances (177 and 230). Excluding the two extreme cases, BH attendances per patient ranged between zero to 125.

Table 5-32: The characteristics of patients who used at least one Barwon Health service (n = 99)

Characteristic	Patients who used at least one BH service (n=57/99 = 57%)	Patients who did not use any BH services (n=42/99 = 42%)
Male	61.4	61.9
Female	38.6	38.1
% reporting they self-monitor blood glucose	73.7	76.2
Mean age (years)	67.81	61.74
Mean duration of diabetes (years)	8.23	7.46
Mean weight (kg)	91.51	91.45
Mean body mass index (kg/m^2)	31.96	32.53
Mean HbA_{1c} (%)	7.08	8.65

5.1.7.1 Patient admissions to Geelong Hospital units

Nineteen patients (9 males and 10 females) were admitted to the Geelong Hospital during the study. The number of admissions ranged from one to four per patient. Patients who were admitted to hospital once during the study period tended to have a shorter length of stay than those patients who were admitted to hospital on more than one occasion (Table 5-33 on page 87).

Table 5-33: Comparison between number of admissions and length of stay for patients admitted as inpatients (n = 99)

Number of admissions	N = 99	Mean length of stay (days)
0	80	0
1	10	1.6
2	6	4.6
3	2	3.8
4	1	4.3

Emergency medicine was the most frequently used hospital unit in these admissions (Table 5-34 on page 87).

Table 5-34: Hospital units to which patients were admitted (n = 32 admissions)

Unit	n
Emergency medicine	9
General medicine	7
Ophthalmology	3
Vascular	2
Cardiology	2
Gastroenterology	2
General surgery	2
Renal medicine	1
Cardiothoracic	1
Neurology	1
Oncology medical	1
Plastic surgery	1

5.1.7.2 Utilisation of allied and community health services

Of the 99 patients in the study, 38 (22 males and 16 females) attended an allied or community health service on between one and 73 occasions (Table 5-35 on page 87). Two patients had high numbers of visits (71 and 73), the range for the remaining 36 patients was 1 – 55. Community health nursing was the most frequently used allied and community health service.

Table 5-35: Barwon Health allied and community health services and the number of visits per service (n = 444 visits)

Service	N
Community health nursing	245
Physiotherapy	96
Podiatry	59
Dieticians	17
Domiciliary nursing *	8
Mental health	5
Community rehabilitation centres	4

Service	N
Community health nursing	245
Physiotherapy	96
Podiatry	59
Dieticians	17
Domiciliary nursing *	8
Mental health	5
Community rehabilitation centres	4
Subacute ambulatory care services	4
Occupational therapy	3
Home referral service *	2
Hospital Admission Risk Program (HARP)	1

* Domiciliary nursing and home referral services provided care to patients in their home.

5.1.7.3 Patient emergency department presentations

Of the 99 participating patients, 17 (7 males, 10 females) presented to the BH emergency department (ED). Twelve patients presented on one occasion, three presented twice, one three times, and one four times. The medical care classification provided during each presentation is shown in Table 5-36 on page 88. Of these, twelve were admitted to an inpatient ward, nine were admitted to the ED and then discharged, and four were not admitted.

Table 5-36: The primary medical care classification provided to patients during Barwon Health Emergency Department presentations (n = 25 presentations)

Medical classification	N
Emergency medicine	13
General medicine 1	7
Gastroenterology	2
General surgery	1
Cardiology	1
Neurology	1

5.1.7.4 Barwon Health medical imaging procedures

Of the 99 patients, 32 (19 males and 13 females) underwent medical imaging procedures at BH during the study period. A total of 135 procedures were conducted during the study. One patient underwent 21 procedures; the range for the remaining 31 patients was one to 14 procedures (Table 5-37 on page 89).

Table 5-37: Medical imaging procedures patients underwent at Barwon Health (n = 135 procedures)

Procedure	N
X-ray	69
Nuclear medicine procedures	25
Ultrasound	18
Computerised Tomography	11
Unspecified other	10
Magnetic Resonance Imaging	2

5.1.7.5 Patient attendances at Barwon Health outpatient clinics

Twenty-seven attendances at BH outpatient clinics were made during the study period by nine (5 males and 4 females) of the 99 patients. Each patient attended between one and eight appointments (Table 5-38 on page 89). Nineteen of the appointments took place in surgical clinics and eight took place in the Diabetes Referral Centre. Appointments in the Diabetes Referral Centre included appointments with diabetes educators, dieticians, podiatrists and endocrinologists.

Table 5-38: Barwon Health outpatient clinics attendances (n = 27 attendances)

Clinic	n
Plastic surgery	8
Vascular	7
Endocrinology	5
Ophthalmology	3
General medicine	3
Ear, nose and throat	1

5.1.7.6 Pathology tests performed at Barwon Health

A total of 775 pathology tests were conducted at BH during the study period. Of the 99 patients, 26 (13 males and 13 females) patients had tests. Three had significantly large numbers of tests (98, 107 and 150 respectively); tests for the remaining 23 ranged between one and 58. One hundred and eighty-eight pathology tests were performed to assess metabolic status (Table 5-39 on page 89).

Table 5-39: Pathology tests performed to assess metabolic status conducted at Barwon Health during the study (n = 26 pathology tests)

Test	n
Liver function tests	55
C-reactive protein	36
HbA_{1c}	29
Cholesterol, triglycerides, LDL, HDL and LDL/HDL	16
Microalbumin	12
Creatinine kinase	9
Fasting glucose	7
Random glucose	7
Haemoglobin	3

5.2 Discussion

This section discusses the quantitative results starting with a comparison of the sample groups with the sampling populations. The major findings are then discussed in relation to the aims and hypothesis, followed by the study strengths and limitations considered, then the performance considerations which are followed by the implications of the findings for practice and areas for further research.

It was hypothesised that CDMS would improve metabolic control, general health and quality of life for the patients enrolled in the study. Results indicated the hypothesis was partially supported. During the study the reductions in LDL, cholesterol, triglycerides and HbA_{1c} all trending in the right direction with moderate changes over the short period, though not significant.

5.2.1 Comparison of participants with the population

The participating GPs were compared with GPs who are members of GPAG and patients with the BR adult population.

5.2.1.1 General practitioners

GPs working in medium (3 – 5 GPs) and large (≥ 6 GPs) practices were represented in the sample. Solo practitioners, GPs working in low socio-economic status areas and female GPs were not.

5.2.1.2 Patients

Compared with the BR adult population, the patient sample included a greater proportion of males, individuals born outside Australia and individuals with a post-secondary qualification.

As 25% of patients did not report their income, no comparison with the population can be made about socio-economic status. However, more than half the patient sample derived their income from a pension or superannuation.

Income and education deficits have been associated with inadequate self-care and poorer diabetes outcomes [1]. In this study, patients with an educational qualification had significantly lower mean HbA_{1c} at Time 1 than patients with no qualification. Compared to the population, a greater proportion of the patient sample was overweight or obese, abstained from alcohol consumption and had previously smoked.

As HbA_{1c} was only recorded for 45% of the sample at Time 1, it is not possible to compare mean HbA_{1c} of the sample with the population.

5.2.2 Findings

5.2.2.1 Allied health service utilisation

Reported increases in attendances with allied health professionals during the study are consistent with recommended team care diabetes management facilitated through TCAs [2].

5.2.2.2 Medicine profile

The finding that patients prescribed an oral hypoglycaemic agent, insulin preparation, lipid lowering agent or antihypertensive agent at Time 1 had a longer duration of diabetes than those not taking one or more of these medicines is consistent with progressive beta cell decline associated with type 2 diabetes [3]. The higher mean HbA_{1c} of those patients prescribed an OHA at Time 1 could have been the trigger to commence OHA therapy; however, this is not known.

The finding that prescribed medicines did not change during the study was unexpected because titration of diabetes medicines is a necessary component of diabetes management [3,4]. The current finding contrasts with those reported by Quinn et al. [4] in an American randomised control trial (RCT) of an interactive web-based diabetes management intervention: where diabetes medicines were adjusted according to individual need for 84% of participants exposed to the intervention over three months (n = 15) compared to 23% of controls (n = 15).

The majority of patients reported they never or rarely forget to take their diabetes medicines (refer to Table 5-19 on page 79) is consistent with Farmer et al. (2005) who used a questionnaire to study 121 individuals with type 2 diabetes on an OHA [5]. Both the current findings and those reported by Farmer et al. (2005) are interesting because medicine non-adherence is a significant problem in diabetes management [6]. Medicine adherence may be over-estimated by self-report because of socially desirable responding through patients' desire to appear compliant with prescribed medicines [5].

5.2.2.3 Metabolic parameters

The moderate changes in metabolic parameters may be due to the short duration of the study period; significant changes in metabolic control may not be apparent across the six to 14 months of the intervention. GPMP and TCA life cycles range from 12 to 24 months [7]. To evaluate the effect of CDMS GPMPs and TCAs on metabolic control, it may be necessary to track metabolic parameters across the complete life cycle of a care plan.

HbA_{1c} is frequently used as a surrogate marker for long-term diabetes complications. While the association between HbA_{1c} and microvascular complications such as retinopathy and neuropathy are well established, the association between HbA_{1c} and macrovascular complications including myocardial infarction and cerebrovascular accidents have yet to be validated [8]. Therefore, further follow up is required to determine the effect of CDMS GPMPs and TCAs on long-term diabetes macrovascular complications.

5.2.2.4 Psychological status

The low level of distress patients reported is of interest because high rates of depression have been reported among individuals with diabetes [9,10]. However, it must be noted that the psychological testing in this study only included one test (ten questions) and the test was only included twice. Therefore, the results must be read in context with how the testing was conducted.

The quantitative finding that most patients prefer to share medical decision-making with their GP is consistent with the qualitative finding indicating most patients felt involved in the process of developing a care plan for managing their diabetes.

5.2.2.5 Barwon Health service use

Due to the short timeline of the study, it was not possible to determine whether the use of GPMPs and TCAs via the CDMS system affected BH services use. However, the reported trend for patients who attended a BH service to have lower mean HbA_{1c} suggests service use may be associated with better metabolic outcomes. A decrease of 3.2% in the number of hospitalisations over the 12 months has been reported following use of an electronic health record for managing diabetes [11].

5.2.2.6 Qualitative results

The qualitative results indicated that, while there was positive critical feedback of CDMS in the early development stages, overall feedback about CDMS use and the impact of the system to diabetes management was positive.

5.2.3 Strengths and limitations

The strengths and limitations of the study need to be considered when interpreting the findings.

5.2.3.1 Strengths

The strengths of the study include:

- the study was undertaken in a ‘real life’ clinical setting in which GPs, practice nurses and allied health professionals were engaged in chronic disease management prior to implementing CDMS
- high interest and participation of practice staff (nurses, receptionists, other staff)
- high interest and participation of allied health professionals (diabetes educators, dieticians, podiatrists, pharmacists, and others)
- patient groups were heterogeneous
- the methodology enabled flexibility during the project, particularly the ongoing upgrades to the CDMS system
- high retention rate of research team staff
- high retention rate of participants – both GPs and patients
- ongoing collaboration between the research team and GPs
- face and content validity of the questionnaire was established by members of the research team prior to using it in the study. Additionally four scales embedded in the questionnaire were formally validated in previous studies [12,13,14,15]
- most questions within the questionnaire were answered, and 17% of questions were answered by all patients, and
- CDMS-generated GPMPs and TCAs contained comprehensive diabetes-related clinical information including metabolic parameters, prescribed medicines and medical complications.

5.2.3.2 Limitations

The limitations of the study include:

- other research projects such as the Australian Primary Care Collaboratives (APCC) and the Diabetes Australia Victoria (DAV), the Life Program, audits and accreditation processes were undertaken in the Barwon Region at the same time as CDM-Net which negatively impacted recruitment to the CDM-Net study
- implementation of CDMS and recruitment to the CDM-Net study were implemented in some practices simultaneously
- CDMS was under continuous development and change during the trial, thus reducing its effectiveness and ease of use
- small sample
- recruitment lower than planned (targets not met)

- the nine month study time frame may have been too short to detect CDMS-related differences in the outcome measures
- patients were included in the study for a variable amount of time due to staggered patient recruitment over seven months, consequently some patients did not complete the study within the time frame
- review of GPMPs and TCAs were not conducted for all patients, and
- there was data missing from 16% of the questionnaires and six of eight recorded metabolic parameters in CDMS GPMPs and TCAs.

Replication of the study is necessary to draw conclusions regarding the impact of CDMS on diabetes outcomes. In particular, the study should be replicated with GPs and patients from other divisions of general practice.

5.2.4 Conclusions

During the study, eight metabolic parameters were recorded in CDMS care plans. When the mean values were compared, seven out of the eight metabolic parameters show an improved reading, suggesting a positive trend emerging in these parameters. Although the metabolic data demonstrated only a limited change during the study, the outcome needs to be taken in consideration with the positive qualitative findings.

5.2.5 References

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5.3 Pharmacy

Author: Professor Colin Chapman

The pharmacy involvement in the CDM-Net project centred on two projects:

1. measuring the impact of the CDM-Net intervention on the quality use of medicines, and medication adherence in particular, and
2. exploring ways to share information about each patient's medications using CDM-Net.

5.3.1 Medication adherence

Medication adherence was measured in two ways. The first was by use of the Medication Adherence Report Scale (MARS) [1], a 5-item self-report measure which has demonstrated good psychometric qualities in a range of illness groups, including those with diabetes, which was included in the patient questionnaires developed for the CDM-Net project at Time 1 and Time 3. The second was by exploration of the possible use of software recently introduced into community pharmacies (MedsIndex) [2] to determine the medication compliance of individual patients recruited into the CDM-Net project. Details about the second component will be discussed in the section about information sharing below.

The MARS was used obtain self-reported adherence to diabetes medicines, and was incorporated into the questionnaires at Time 1 and Time 3.

There were five questions:

- *I forget to take my diabetes medicine*
- *I alter the dose of my diabetes medicine*
- *I stop taking my diabetes medicine for a while*
- *I decide to miss out a dose of my diabetes medicine, and*
- *I take less diabetes medicine than instructed.*

The MARS was scored in accordance with standard practice. A maximum score of 25 was obtained by summing the score from each of the five questions which each had a five-point response scale: Never (0) – Rarely (1) – Sometimes (2) – Very Often (3) – Always (4).

There was little difference in the results at Time 1 and Time 3:

- Mean – at Time 1 = 0.99, at Time 3 = 1.02
- Median – at Time 1 = 0, at Time 3 = was 0
- Range – at Time 1 = 0-11, at Time 3 = 0-11

Most respondents reported they not had forgotten to take their medications at both Time 1 and Time 3. This finding suggests the CDM-Net process did not influence patients self-reported medication adherence.

However, it needs to be remembered that self-reported adherence was excellent at Time 1. Thus was not possible for CDM-Net to improve medicine adherence.

5.3.2 Information sharing

Medicines and medical devices, such as blood glucose meters and wound dressings, are core elements in reducing morbidity and mortality associated with diabetes. They are also used to deal with the complications and co-morbidities of diabetes, such as elevated blood pressure, dyslipidemia and various levels of obesity.

Each person at risk of developing type 2 diabetes and those who have the condition will almost certainly obtain medicines, medical devices and information about medicines from a variety sources under a variety of different conditions:

- prescription-only medicines (POMs) are dispensed at community pharmacies on prescriptions written by one or more GPs, by one or more specialists, by one or more other health care professionals, and by hospital-based medical practitioners
- POMs are dispensed by hospital pharmacies while a person is an inpatient, and also on discharge from hospital
- over-the-counter (OTC) medicines and/or devices are regularly purchased at community pharmacies for weight control, to control dyslipidemia, to monitor blood glucose, to monitor blood pressure and to treat skin wounds and ulcers
- drug/medicine information relevant to diabetes and its co-morbidities is provided in the form of booklets and leaflets in pharmacies, medical practices, hospitals and various clinics. This information usually takes the form of consumer medicines information (CMI) and product information (PI) supplied with some medicines
- medical devices are available from several sources, including Diabetes Australia, medical practices and community pharmacies
- reviews of medications are formally undertaken as home medicines reviews (HMRs) by accredited pharmacists in conjunction with GPs and community pharmacies
- an increasing number of medicines are provided in dose administration aids (DAAs) prepared by community pharmacies.

Currently, records about each patient's prescription medicines and some medical devices are kept in a variety of places and under a variety of ways:

- community and/or hospital pharmacies use computer software provided by several vendors with varying software programs, and
- a large number of medical practices use specialized software for prescription writing, medication records and electronic patient management. Generally, the vendors for this software are not the same as those dealing with community and hospital pharmacies, thus adding further variation in software programs.

The sale of OTC medicines and complementary and alternative medicines (CAMs) is seldom recorded in community pharmacies, despite a large number of these products being used by patients with diabetes, and despite many of these products having the potential to cause adverse drug reactions when used in conjunction with prescribed medicines.

It is estimated that over 90% of pharmacies have broadband, as a result of a nationally funded broadband connection subsidy. The management of PBS medications dispensed from pharmacies is administered by Medicare Australia over the Internet, through electronic authorisations and claims.

Despite the increasing sophistication of the various recording systems for medicines and medical devices there is currently very little connectivity between them; the health care providers largely operate in disconnected silos. Indeed, a recent major research project recommended the development of a medication information sharing process between hospitals and community pharmacies that should incorporate an automated ICT system to transfer this information efficiently. The same could be said about links between hospitals and medical practices, between medical practices and community pharmacies, and between a variety of other sites such as the clinics of other health care practitioners, and hospitals, medical practices and community pharmacies.

5.3.3 Patient medication profiles

There are moves underway to record the sale of all medicines, prescription, OTCs and CAMs, through a patient medication profiling (PMP) service available through community pharmacies. An investigation was undertaken to determine the current use of this recording scheme, and the possibility of making this information available through CDM-Net.

It was determined by way of visits to most of the 40 community pharmacies in the greater Geelong area which had customers participating in the in the CDM-Net project, that few of these pharmacies were actually using the patient medication profiling (PMP) system provided as a joint initiative involving the Pharmacy Guild of Australia and the Commonwealth Government [3]. Those that did use the PMP system were only recording prescription medicines, not OTCs, CAMs or medical devices, so the information was of little use to either the CDM-Net project or to the investigation into improving connectivity, because that information was already available to both GPs and pharmacists through their existing prescribing or dispensing software systems.

In an attempt to improve the breadth and extent of recording by way of the PMP system, assistance was provided in selected community pharmacies by a research pharmacist associated with the CDM-Net project. This brief intervention showed that it was indeed possible to speak with individual patients, many of whom visit community pharmacies several times each month, to obtain important information about all their medicines then assemble comprehensive information about the patient’s prescription medicines, OTCs and CAMs, and medical devices. Almost certainly, this information could greatly assist overall medication management in patients with diabetes. The brief investigation also showed that the process was time-consuming and most community pharmacies did not have the time or the staff to devote to the process. Further, there was little or no financial incentive for community pharmacies to do so.

However, the PMP service has the potential to provide a far more comprehensive record of the medications and devices used by patients, and it should be possible to link this information electronically to other health care providers in the future.

5.3.3.1 Medication refill compliance

A further investigation was conducted into the possible use of MedsIndex to determine the extent of medication compliance associated with prescriptions for individual patients recruited into the CDM-Net project, and the possibility of making this information available through CDM-Net.

As was the case with the PMP system, it was determined by way of visits to most community pharmacies in the CDM-Net project, that few of these pharmacies used the MedsIndex system for monitoring prescription refill compliance of patients. Those that did were able to effectively report on the medication compliance, and in many cases less than ideal compliance was detected.

In an attempt to improve the use of MedsIndex, assistance was provided in selected community pharmacies by a research pharmacist associated with the CDM-Net project. This showed that that it was a time-consuming process for which community pharmacies received little or no remuneration, and that most pharmacies did not have the time or the staff to devote to adequately undertake the process. It is understood that a new system is being introduced, Mirixa, which will greatly streamline the process, thus creating the potential to provide a far more important information on medication adherence to other health care providers in the future.

5.3.3.2 Medication reviews

A final component of this part of the project was to explore the use of HMRs by GPs, and the possibility of electronically linking HMR reports about patients recruited into the CDM-Net project to GPs and other relevant health care providers.

In the CDM-Net project there were two approaches used to review medications taken by patients recruited to the project:

- an ‘in-house’ medication review - conducted using software programs in the commercially-available computer systems used by most GPs, such as Medical Director or Best Practice, and
- a comprehensive medication review, HMRs, conducted by an accredited pharmacist upon the written request of GP, and in accordance guidelines issued by Medicare. GPs, community pharmacies and accredited pharmacists are paid for conducting these reviews.

Only a small number of HMRs were conducted for patients recruited to the CDM-Net project. A review of the circumstances associated with overall medication use by these patients, and the circumstances associated with the conduct of the HMRs revealed the following important observations:

- most of patients recruited took medications to treat diabetes, but not all did so, some were using dietary and other non-drug methods to achieve control of diabetes
- all patients took additional medicines to treat co-morbidities and other medical conditions, in some cases there was significant ‘polypharmacy’ with as many as 25 different medications being used by individual patients

- none of the records used in the CDM-Net project contained information about OTCs, CAMs or medical devices such as glucose meters or wound dressings
- an audit of the records indicated that some patients who could have benefited from some form of medication review did not have this done during the project
- the eligibility criteria/prompts for GPs to request HMRs were limited to only three issues:
    - if the patient is elderly (> 65 years) and/or
    - if a patient is taking 5 medications and/or
    - if a patient has 3 or more co-morbid conditions.

This is an unusually small range of eligibility criteria, particularly as the Medicare criteria for HMRs are far more expansive:

- a GP must assess that a review of a patient living at home is clinically necessary to ensure the quality use of medicines or to address a patient's needs; examples of risk factors include patients:
    - currently taking five or more regular medications
    - taking more than 12 doses of medication per day
    - with significant changes to their medication regimen in the last three months, including recent discharge from hospital
    - taking medication with a narrow therapeutic index or required therapeutic monitoring
    - with symptoms suggestive of an adverse drug reaction
    - having difficulty managing their own medicines because of literacy or language difficulties, impaired sight, and
    - attending a number of different doctors, both general practitioners and specialists.

All HMRs conducted were included as part the care plans and were reported in written form, not electronically, revealing the great potential for this process to be electronic in the future in order to facilitate patient management.

5.3.4 Summary and conclusion

There was no difference in self-reported medication adherence between Time 1 and Time 3 for patients recruited to the CDM-Net project, but this was not unexpected because these patients indicated that their use of medications was already excellent.

The CDM-Net project revealed that there are several opportunities to proactively share information about medicines and medical devices between community pharmacies and the other health care providers using CDM-Net. At present this exchange is virtually non-existent despite there being a wealth of useful information relating to the nature and use of prescription medicines, OTCs and CAMs available through community pharmacies.

Community pharmacies have the potential to utilise existing and new medication profiling and medication adherence systems to a far greater extent than is done at present, and the productive use of this information, such as through systems like CDM-Net, could provide the incentive needed to make this happen.

It would appear that medication reviews are being underutilised.

For future projects which build on the experiences and findings of the CDM-Net project there have been identified many ways in which integrated medication management can be successfully achieved. At present such management is almost certainly sub-optimal.

5.3.5 References

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6 Clinical evaluations: users' perspectives

6.1 Interviews with health professionals and patients

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Interviews were conducted with eight health professionals and ten patients between March and October 2009. Of the twelve GPs involved in the project, four agreed to participate in this component of the research. The other four professionals comprised one diabetes educator (DE) and three practice nurses (PNs) who were purposively selected to ensure a representative sample was interviewed. All professionals were invited to participate by members of the Deakin University research team. When they agreed, the health professionals provided written informed consent.

The patients were also purposively sampled. The 12 GPs were asked to select one of their participating patients for the interviews and of those who expressed interest, ten were invited to participate by their respective GPs. The GPs explained the purpose of the interviews to their patients and were the patient's main source of information about the project. Patients who agreed to participate in the face-to-face interviews provided written informed consent.

Each interview lasted approximately 30 to 45 minutes, was tape recorded and transcribed verbatim. Two questionnaires, both comprising 18 questions, were developed for these interviews to specifically elicit the health professionals' and the patients' views about their involvement in the CDM-Net project and their experience with the CDMS program.

The responses reported from the first interviews are reported in six sub-headings:

1. Demographic data and learning about the CDM-Net project
2. Developing and individualising the care plan and involving the patient
3. The history of care plans
4. Home medicines reviews
5. Using the CDMS care plan process, and
6. Advantages, disadvantages and final comments.

A second interview was conducted and due to time constraints only the four GPs who participated in the first interviews were invited to participate. The second interviews were conducted between August and October 2009, which was approximately six months after the initial interview with each GP. Three questions (1, 2 and 15) were removed from the questionnaire used in the first interviews for the health professionals. Except for the first sub heading, these interviews are reported under the same sub heading as the first interviews:

1. Developing and individualising the care plan and involving the patient
2. The history of care plans
3. Home medicines reviews
4. Using the CDMS care plan process, and
5. Advantages, disadvantages and perceived improvements.

One interview was also conducted with one GP who was only involved in the CDMS component and not the research component of the project using the questionnaire developed for the health professionals' first interviews. This interview is reported in summary only.

6.1.1 First Interviews

6.1.1.1 Demographic data and learning about the CDM-Net project

The professionals comprised four male GPs, and one DE and three PNs who were all females. The professionals' ages ranged from 46 to 68 years. They had worked in the Barwon Region area from seven to twenty years.

GPs reported the number of patients with diabetes they managed annually ranged from ten to twenty. One GP reported '*about 100 are managed in the practice'*.

The health professionals were informed about the project either through the local Division GPAG (three), or by the Division's ex-president (three). The other two were informed by a practice staff member and a staff member from Precedence Health Care.

6.1.1.2 Developing and individualising the care plan and involving the patient

Generally, the health professionals felt the care plan development process suited their diabetes management style. Some suggested ways to improve the care plan system, for example:

- *Extend into co-morbidities.*
- *It's [the system] still a bit 'clunky' with lots of different boxes to click and often you have to go back and forth to change things, if there was a single page that you could just put everything you want in, it would be a lot easier.*
- *At the moment, it's simply a reformulation of information we've already got in the file.*

All professionals reported they individualised the care plan and nine of the ten patients agreed their care plan was developed specially to suit their specific diabetes management needs. The tenth patient commented:

- *Not specially for me; [it] applied to me, but [it] also to other people.*

The health professionals reported they involved the patients in the development of their care plan. This perspective was supported by eight of the ten patients who reported they felt they had been involved in developing their care plan. One patient was unsure and explained:

- *Not really, I was told that these people were the ones I would see. The computer said I'd gone to an eye specialist but I haven't and I wasn't asked. It wasn't explained that I was supposed to make the appointments. The podiatrist was a waste of time, so the podiatrist was changed.*

6.1.1.3 The history of / refining care plans

Some health professionals' and patients' views about the original purpose, or history, of the care plan were similar, while others' views varied. Suggested purposes included to:

- *improve communication of all points*
- *provide financial reimbursement for GPs for taking on the management of complex illness*
- *increase awareness of the need for a co-ordinated approach to diabetes management*
- *guide the patients with self-health care.*

One patient commented:

- *I think [its] just to encourage our gender, males, to take a bit more responsibility for their own health.*

6.1.1.4 Home medicines reviews

The health professionals reported that a home medicines review (HMR) was not routinely a part of the care plan for this patient group. Nonetheless, health professionals generally felt HMRs were valuable because they helped manage the patient's medicines. All health professionals demonstrated a good of understanding of what occurred during a HMR, including what the pharmacist did when visiting and reviewing the patient's medicines. However, not all health professionals knew whether their patients knew what a HMR involved and were unable to explain why they did, or did not know this information.

Not unexpectedly, patients appeared to have limited understanding of what was involved in HMRs, given their limited involvement in the process.

6.1.1.5 Using the CDMS care plan process

All health professionals had accessed the care plans for their patients who were part of the study on their computer. In one practice, the practice nurse had also done so. Not unexpectedly, only two of the ten patients had accessed their care plans on the computer. Of the other eight patients, seven explained they did not own a computer and the eighth owned a computer but did not use it.

The two patients who had accessed their care plans on the CDMS system found it easy to navigate. Half the health professionals found it easy to navigate but the other half reported they found it difficult for various reasons including:

- *When you're using it only every couple of weeks you sometimes get yourself into a little bit of a quandary as to how to find things.*
- *Originally yes, but since the update [of the CDMS program] we've had difficulties.*

There was positive consensus among the professionals about receiving SMS messages, emails and/or telephone calls regarding the care plans, and no problems were reported with the time messages were received or with the content of the message.

Of the ten patients, two reported receiving an SMS and one received emails. One patient who received an SMS reported … receiving the SMS, but I'm not good at sending them. The other had a concern about the time the SMS message was received … it came about 1.15pm for a 10 am appointment, but the appointment read 11pm. Despite these issues the three patients who received a message reported they were able to understand the SMS or email message.

6.1.1.6 Advantages, disadvantages and final comments.

Most, but not all health professionals, had positive comments about the advantages:

- *It [the system] is helpful, I think the fact that the communication, and the ease of that is certainly a benefit.*
- *I think being able to electronically update the care plan via each individual provider.*
- *When it is up and running and working well it is certainly a lot quicker, it saves paperwork, faxing and time.*

- *At the moment they [the advantages] are not jumping out at me.*

Advantages described by the patients were more personal and generally related to managing stress, but not all felt there were advantages:

- *I think a lot of it [managing diabetes] is a very personal matter and [care plans] are really worthwhile for people to realise the stresses that are there.*
- *Yes, very much so, I think the first management of diabetes [including care plans] is managing stress, and if you can manage that, you've got a better chance of getting the blood pressure under control.*
- *If I could access it myself [the care plan on line], it would be good keeping track of when everything's due.*
- *I don't know, you'd have to ask the doctor, I'm not quite sure.*

Similarly, most, but not all health professionals described disadvantages:

- *... [the system] is not user friendly.*
- *It's a bit tedious updating; although you've got all the information [in your medical software] updating the care plan is a bit slow.*
- *People [health professionals] might be afraid to get caught up in this [because] it is something else to take up a good bit of time.*
- *I don't think there's any [disadvantages].*

Most patients felt 'timing' was a disadvantage … depending on when the care plan was developed, patients found they were not able to use all five allied health visits before the end of the calendar year. One patient was more philosophical about the care plan process:

- *Just go along with it, it could help other people if not me.*

All participants were asked whether they had any 'final' comments. Six health professionals commented but no patients had any further comments. The health professionals' comments generally related to the introduction of CDMS; some reflected changes and improvements, others provided suggestions for further improvement:

- *... [this is an improvement on previous software as] we do have a recall system that we've used in the past, but it is a bit ad-hoc.*
- *Having staff involved in the project [research team and Precedence staff] was helpful because they consistently tried to work out difficulties, for example, the IT glitches.*
- *Waiting for medical software updates to come on line prevented some practices from participating in this research.*
- *Creating a care-plan and updating it on CDMS is not easy, it doesn't seem to flow easily for me, it's not something that I find very intuitive, so I need to look at my manual and go step by step with it, which I don't find easy.*

Several GPs indicated that ...adding co-morbidities would be really useful so the care plans can adapt to patients with other illnesses.

6.1.1.7 Summary of key findings

Both professionals' and patients' responses reflected a positive view of their involvement in the CDM-Net project and their experience with the CDMS program. Both groups also provided feedback about the positive and challenging aspects of the CDMS program.

6.1.2 Second interviews

A second interview was conducted and due to time constraints only the four GPs who participated in the first interviews were invited to participate in the second interview. The second interviews were conducted between August and October 2009 with approximately six months between initial and second interview. Three questions (1, 2 and 15) were removed from the questionnaire used in the first interviews for the health professionals. Except for the first sub heading, these interviews are reported under the same sub heading as the first interviews:

- Developing and individualising the care plan and involving the patient
- The history of care plans
- Home medicines reviews
- Using the CDMS care plan process
- Advantages, Disadvantages and Perceived Improvements.

6.1.2.1 Developing and individualising the care plan and involving the patient

As in the first interviews, all four GPs reaffirmed that the care plan development process suited their diabetes management style. However, there was a change in view regarding whether GPs individualised the care plans or not. In the first interviews two were unsure but in the second interview, all four GPs felt they had individualised the care plan for each patient, for example by ... *changing the review times for the patients and also not using the same allied health providers for all patients.* As previously, not all GPs reported involving their patients in developing the care plan ... *as much as I would have liked because I chose the goals that were there* [in the care plan] *but didn't spend time with the patients to check for their goals.*

6.1.2.2 The history of / refining care plans

As in the first interviews, an insightful range of ideas was expressed regarding the history, or original purpose of the care plan. The comments primarily focussed on enabling patients with chronic disease to access allied health professionals, and developing a document co-ordinating details for managing investigations, communication and compliance.

6.1.2.3 Home medicines reviews

All GPs felt home medicines reviews (HMRs) were valuable whether they were included in the care plan or not, and, while not all GPs included HMRs in care plans, all agreed when the HMR was included, it helped them (the GPs) manage the patient's medicines.

6.1.2.4 Using the CDMS care plan process

All four GPs reported, that, since the last interview, they had continued to access the care plans on their computer and three practices had extended access to their practice nurses. The fourth GP explained: ... *other doctors can if they want to, but no one else has authority to access them* [in our practice] *because it's not appropriate for everyone to have access.*

Three GPs felt navigating the system was easy; the fourth had some reservations:

> *I assume there are further refinements that will happen over time. I think it certainly was 'clunky' to start with, but you have to learn how to navigate that particular*

> *document* [the care plan], *but as the document changes so the navigation of the document has to alter and that's been a problem, but I think everyone accepts that.*

6.1.2.5 Advantages, disadvantages and perceived improvements

Comments about advantages in the second interview differed from those expressed in the first interviews, and provided insight into how the GPs perceive changes in the CDMS system:

- *Instant communication with allied health, ease of referral, rapid responses compared to the past of phone tagging, easy to find information and if patients could be contacted, that would be a bonus.*
- *Simplicity and efficiency of the system, it's a single repository, which makes it easy to share information, and it's the way forward for e-health in Australia.*
- *Co-ordinating the information on the patient as a document of communication and as a document of education for the patients, to improve their compliance. It's also a step towards internet based history and that's something I'm very interested in.*
- *The major advantage is it's quite straight forward, when you log on with certain patients you can find easily what stage they're up to, it's a good prompt to follow up and an easy way to follow the rules of Medicare that there's two-way communication.*

Similarly, in these interviews, not all GPs described disadvantages. Suggested 'add-ins' included: ... *the facility to add in co-morbidities and other goals, and, because the directory of Allied Health clinicians is limited, it needs to be significantly improved.*

It was also noted that: ... *the systems don't work as expected, so clinicians get frustrated quickly, then they have to ring the help desk, and this can add to the frustration.*

One GP suggested: ... *the major disadvantage is that you have to enter data manually when it's already in our software program, so if there's a way they could extract that without us having to do it; that would be a good thing.*

Constant changes, described as 'updates to the system' during the study (the formative process) represented difficulties and some GPs were not interested in the system for themselves, but felt: ... *taking the longer term view, the next generation of doctors should be introduced to these documents in an IT format that informs them and encourages them to use IT.*

After using the system for some time, GPs were asked whether they thought CDMS had improved over the study period. All indicated they felt the system had improved; the consensus being that it is: ... *more streamlined with the terms up the top and it's easy to find things.*

Three GPs indicated they will continue to use CDMS, the fourth qualified his response: ... *I understand there is a cost involved and I will need to look at that.*

6.1.2.6 Summary of key findings

The positive view about their involvement in the CDM-Net project and their experience with the CDMS program was generally maintained by the GPs throughout the study. The GPs also provided feedback about the positive and the challenging aspects of the CDMS program.

6.1.3 Interview with the GP not involved in the research component

One interview was conducted using the questionnaire developed for health professionals in the first interview with a GP who was only involved in the CDMS component of the project. His responses were similar to the GPs involved in the research component.

6.2 Communication with patients

Authors: Associate Professor Peter Schattner, Dr Akuh Adaji, Dr Kay Jones

6.2.1 Introduction

This section describes the responses to the Communications section of the ten section patient questionnaire (Table 4-7 on page 68) developed for the project. This section included four questions and was collected at Time 1 and time 3.

The questionnaire was administered to the patients at three points in time: baseline (Time 1), midpoint (Time 2) and near the completion of the project which was approximately nine months after commencement (Time 3).

Of the total cohort of 99 patients who participated in the study, all completed the questionnaire at baseline (Time 1), and 80 completed at Time 3.

In order to be able to draw some comparison, the following tables report gender (61 males and 38 females) and age (48 were < 65 and 51 were aged 65+) when the questionnaire was completed at Time 1.

The four questions were:

1. Do you have access to the Internet where you live?
2. Do you use the Internet for any purpose?
3. How many hours per day would you spend on the Internet on average?
4. Do you use a mobile phone?

6.2.2 Results

More than half the patients indicated they have a broadband Internet connection in their homes. There was negligible difference between males and females, but as would be expected, the proportion was slightly higher in those under the age of 65 than those 65 and over (67% versus 49% respectively) (Table 6-1 on page 108). There was no reported change in Internet access at Time 3.

About half the respondents used the Internet for email and searching purposes and about 20% used it for online banking, paying bills and making purchases, with ‘other’ purposes far less common. Of importance to note for the study, only 1% uploaded/ downloaded glucose readings on the Internet. Those under 65 were more likely to use the Internet for any of these reasons, and males were also slightly more likely to do so than females (Table 6-2 on page 108). There was no significant change in Internet use by the end of the study period by either males or females in either age group.

Table 6-1: Access to the Internet (Time 1) (n = 99)

			Gender (M/F)				Age (< 65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
No Response	1	1.0	0	0.0	1	2.6	0	0.0	1	2.0
No internet connection	32	32.3	18	29.5	14	36.8	8	16.7	24	47.0
Yes, broadband	57	57.6	36	59.0	21	55.3	32	66.7	25	49.0
Yes, dial-up connection	9	9.1	7	11.4	2	5.3	8	16.7	1	2.0
Totals:	**99**	**100.0**	**61**	**100.0**	**38**	**100.0**	**48**	**100.0**	**51**	**100.0**

Table 6-2: Internet use and reasons for use (Time 1) (n = 99)

			Gender (M/F)				Age (<65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
No Response	15	7.6	11	18.0	4	10.5	7	14.6	8	15.7
No	33	16.7	17	27.9	16	42.1	12	25.0	21	41.2
Yes, please indicate your uses	51	30.9	33	54.1	18	47.4	29	60.4	22	43.1
Totals:	**99**	**55.1**	**61**	**100.0**	**38**	**100.0**	**48**	**100.0**	**51**	**100.0**
Email - No	48	48.5	29	47.5	19	50.0	20	41.7	28	54.9
Email - Yes	51	51.5	32	52.5	19	50.0	28	58.3	23	45.1
Internet searching - No	48	48.5	27	44.3	21	55.3	16	33.3	32	62.7
Internet searching - Yes	51	51.5	34	55.7	17	44.7	32	66.7	19	37.2
Voice over IP - No	94	94.9	57	93.4	37	97.4	44	91.7	50	98.0
Voice over IP - Yes	5	5.0	4	6.6	1	2.6	4	8.3	1	2.0
Social networking - No	92	92.9	57	93.4	35	92.1	44	91.7	48	94.1
Social networking - Yes	7	7.1	4	6.6	3	7.9	4	8.3	3	5.9
Internet banking - No	77	77.8	44	72.1	33	86.8	35	72.9	42	82.3
Internet banking - Yes	22	22.2	17	27.9	5	13.2	13	27.1	9	17.6
Paying bills - No	77	77.8	45	73.8	32	84.2	37	77.1	40	78.4
Paying bills - Yes	22	22.2	16	26.2	6	15.8	11	22.9	11	21.6
Making purchases - No	79	79.8	49	80.3	30	78.9	36	75.0	43	84.3
Making purchases - Yes	20	20.2	12	19.7	8	21.0	12	25.0	8	15.7

			Gender (M/F)				Age (<65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
Uploading/downloading glucose readings – No	98	99.0	60	98.4	38	100.0	48	100.0	50	98.0
Uploading/downloading glucose readings- -Yes	1	1.0	1	1.6	0	0.0	0	0.0	1	2.0
Other - No	95	96.0	58	95.1	37	97.4	46	95.8	49	96.1
Other - Yes	4	4.0	3	4.9	1	2.6	2	4.2	2	3.9

Approximately 66% of this patient cohort indicated they used the Internet either sometimes, daily or weekly. There were twice as many males as females who indicated some use but there was little difference in use between age groups. Of those who indicated they used the internet daily (n = 33) 75% were males and 25% females. There was little difference between age groups in use (Table 6-3 on page 109). The hours of Internet usage did not significantly change between data collected at Time 1 to Time 3.

Table 6-3: Hours of Internet use (Time 1) (n = 99)

			Gender (M/F)				Age (<65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
None	33	33.3	19	31.1	14	36.8	15	31.25	18	35.29
Some	66	66.7	42	68.8	24	63.2	33	68.75	33	64.71
Number Who Responded to Question - Per Day	33		25		8		18		15	
Number Who Responded to Question - Per Week	40		25		15		22		18	

Of importance to note for this study, 17% of respondents did not have a mobile phone, and of the 83% who do have a mobile phone only approximately 25% used their mobile sometimes to receive and/or send SMS texts, and even fewer (4%) used their mobile to receive and/or send SMS texts. While approximately twice as many males as females had a mobile, there was there was little difference between the two age groups regarding ownership (Table 6-4 on page 109). Data was not collected for this question at Time 3.

Table 6-4: Mobile phone use (Time 1) (n = 99)

			Gender(M/F)				Age (<65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
No Response	7	7.1	4	6.6	3	7.9	2	4.2	5	9.8
0 - Don't have a mobile phone	17	17.2	9	14.7	8	21.0	2	4.2	15	29.4
1 - Yes - primarily to make phone calls	42	42.4	27	44.3	15	39.4	19	39.6	23	45.1
2 - Yes - phone calls and	17	17.2	13	21.3	4	10.5	13	27.1	4	7.8

			Gender(M/F)				Age (<65, 65+)			
	All	**All (%)**	**Male**	**Male (%)**	**Female**	**Female (%)**	**<65**	**<65 (%)**	**65+**	**65+ (%)**
sometimes receiving SMS text										
3 - Yes - phone calls and sometimes sending SMS text	8	8.1	5	8.2	3	7.9	6	12.5	2	3.9
4 - Yes - phone calls and often receiving SMS text	3	3.0	2	3.3	1	2.6	3	6.2	0	0.0
5 - Yes - phone calls and often sending SMS text	1	1.0	1	1.6	0	0.0	1	2.1	0	0.0
6 - Other	4	4.0	0	0.0	4	10.5	2	4.2	2	3.9
Totals:	**99**	**100.0**	**61**	**100.0**	**38**	**100.0**	**48**	**100.0**	**51**	**100.0**

6.2.3 Summary of key findings

Questions about communication were included on the questionnaire. Approximately two thirds of the participants responded having Internet connected, and of these, approximately 70% were using email, 70% using the Internet for searching, and 30% conducting transactions (for example, banking) using the Internet. Mobile phones were fairly widely used, with approximately 75% of the patient participants owning them, and of the 75%, about 40% were using SMS. Hence CDM-Net interactions with patients, especially reminders for tests and appointments via email or SMS could be sent to around half of this population.

6.3 Beliefs and attitudes to, and satisfaction with CDMS

Authors: Associate Professor Peter Schattner, Dr Akuh Adaji, Dr Kay Jones

6.3.1 Introduction

This section describes the responses to the Beliefs and Attitudes section of the patient questionnaire (see Table 4-7 on page 68) developed for the project. This section included 14 questions and was collected at Time 3 only (n = 80).

6.3.2 Results

The majority (85%) of participants felt that the GP adequately explained what CDMS was, and its purpose, with 13% unsure and 2% not responding. Responses varied little with gender or age.

Similarly, 90% agreed that the GP had adequately explained what their care plan entailed, with 7.5% unsure and 2.5% not responding. Responses did not vary significantly with gender but those who were 65 + (93%) were more likely to agree compared to <65 (85%).

There were fewer (65%) who agreed that they liked their GP's use of computers to help manage their diabetes. Males were more likely to agree (85%) than females (75%) with responses varying little with age.

Sixty one percent agreed that they believed the care plan which was developed through the CDMS improved their control of diabetes. Of note, 29% were unsure. Responses varied with gender (51% of males compared to 66% of females) and age (51% of < 65 compared to 68% of 65+).

Similarly, 62% indicated they understood that one of the benefits of a care plan was that it enabled the patient to get a Medicare Rebate to help them control their diabetes. Of importance to this study, 12% neither agreed nor disagreed with the statement that the care plan enabled them to get Medicare rebates for consultations with allied health professionals, suggesting these patients may not be aware of the availability of rebates. Responses varied little with gender or age.

Alongside this, 62% felt that the CDMS helped them comply with their care plans; of importance, 29% indicated they were unsure. Responses varied little with gender or age.

Twenty nine percent indicated that the CDMS call centre (provided by Diabetes Australia – Vic) was helpful, with 51% unsure and 9% disagreeing. There was little variation in responses with gender but some variation with age (25% of <65 compared to 32% of 65+). This low response rate could be due to the fact that there was little reported use of the Internet and mobile phones, and/or contact between patients and the call centre as a specific entity.

Although only 39% of all respondents found reminders and alerts helpful, this figure needs to take into account that only about half the sample could receive SMS reminders or used email. Hence, of the SMS or email enabled population (approximately 50% of the cohort), approximately 80% have found reminders helpful. Of interest, there was some variation with gender (44% males compared to 31% females) and age (42% of <65 compared to 36% of 65+).

Seven and a half percent of respondents felt there were too many reminders, although 56% were unsure. Given the reported low computer ownership and/or low use, this response may indicate that participants would not have seen the computer-based features of CDMS. There was some variation with gender (40% of males compared to 31% of females) and age (41% <65, compared to 36% of 65+).

Almost three quarters of the participants (73%) indicated they understood the purpose of the care plan, with little difference with gender (73% of males compared to 72% females) and no difference with age.

Few (10%) indicated that viewing their care plan and health information on the internet was helpful. As the majority either did not respond (20%), disagreed (12%) or were unsure (40%) this suggests that this outcome reflects the outcomes to previous questions about ownership and use of the Internet.

Similarly, few (16%) indicated that the CDMS technology was too difficult, with the majority unsure (37%), disagreeing (19%) or not responding (11%). Responses varied with gender (8% of males compared to 28% of females) and age (12% of <65 compared to 19% of 65+).

Of importance to this study, 66% of respondents agreed they would recommend that CDMS be made available to others with diabetes, with 9% unsure. Responses varied little with gender or age.

The majority (85%) indicated they did not mind answering the questionnaire that was used for evaluating the project. Responses varied little with gender and age.

6.3.3 Summary and conclusions

Sixty one percent of patients agreed that they believed the care plan which was developed through CDMS improved their control of diabetes and helped them comply with their care plans, with 29% unsure.

Of the 50% of respondents that used email or received SMS, approximately 80% found CDMS reminders and alerts helpful.

Few respondents (16%) indicated that the CDMS technology was too difficult, with the majority unsure (37%), disagreeing (19%) or not responding (11%). These results probably reflect relatively little interaction by patients with CDMS via Internet.

Of importance to this study, 66% of respondents agreed they would recommend that CDMS be made available to others with diabetes, with 9% unsure.

6.4 Attitudes to and beliefs about web-based care plans

Authors: Associate Professor Peter Schattner, Dr Kay Jones, Dr Akuh Adaji

6.4.1 Introduction

Three focus groups and two face-to-face interviews were held in July 2009. The three focus groups were held at the same venue; two were held in the evening (7.00pm to 9.00pm) and one at lunch time (12.00 – 2pm). All were tape recorded and transcribed verbatim. The first focus group comprised seven practice nurses, the second comprised eleven participants including podiatrists, dieticians and diabetes educators, and the third comprised nine participants including practice nurses, a physiotherapist, dietician, diabetes educator, occupational therapist, and an exercise physiologist. Face-to-face interviews were held with two endocrinologists, these interviews were also tape recorded and transcribed verbatim.

Prior to the commencement of the focus groups and face-to-face interviews, participants were provided with a plain language statement and a consent form to sign. All signed, providing informed consent to participate.

A list of topics for discussion was developed specifically for the purpose of eliciting information from participants about (1) care plans (2) communication (3) electronic communication (4) the care team, (5) collaboration among health professionals in general and (6) looking to the future.

Each session commenced with an introduction by the research team and participants, then the topics were introduced for discussion.

6.4.2 Results

6.4.2.1 Care plans

Allied health professionals working in private and public (community health services) organisations had different experiences with care plans. Those working in publicly funded organisations reported they could not access Medicare funding through TCAs, even though, on occasion, GPs asked them to be a part of a care. This meant these allied health professionals provided some feedback to GPs even though they were not specifically funded to do so, and did not gain any benefit from it. Some felt they were simply being contacted to …*make up the required numbers* in the care team so that a patient could attend a service elsewhere.

Some participants felt being involved in a care plan was not always appropriate. For example, there did not seem to be much point in a podiatrist spending fifteen minutes examining a care plan when they had a very limited role in managing or providing a service for a patient who might have a clinically uncomplicated presentation.

There appeared to be some confusion between accepting a referral and accepting the information presented in a care plan. Similarly, there was uncertainty about the difference between feedback about the patient and feedback about the care plan itself. The confusion arose particularly at the community health service level because many of the participants reported they were uncertain about what to do with the care plan forms when they were not a part of the funding process. Likewise, some participants indicated they were not clear about the differences between the GPMP and the TCA.

Regardless of profession, most participants agreed the concept of a care plan was good, and that it should improve GPs' patient care. However, they also felt there was a lot of paperwork, which was often not satisfactory. For example, either too much information was given or the information was not individualized - just a standard care plan printed from a template.

Some participants disagreed with specific aspects of the funding arrangement such as restrictions on the number of visits to allied health that were allowed, and some felt it was not possible to know in advance how many visits should be allocated to particular allied health professionals. Another anomaly was that the health professionals were often expected to provide feedback when the patient was not present or before they had been reviewed.

The endocrinologists had a different perspective on care plans. While they thought care plans could be a useful tool for GPs, the care plan did not mean a lot to the specialists because they carry the principles of planning in their heads, through their expertise in a limited number of diseases, and therefore, did not feel care planning arrangements assisted them. A small benefit was that the care plan enabled them to know who the members of the care team were. One endocrinologist thought the government had introduced a … *box ticking exercise and the money spent on care plans would be better spent elsewhere*.

The specialists also commented that, given the duration of time between visits, they could, and did receive a care plan some six months after reviewing a patient. Thus, it was unrealistic for them to provide detailed feedback because they did not have time to check their own records without the patient being present.

6.4.2.2 Communication

Many of the participating allied health professionals doubted whether the care plan was a good communication instrument. They suggested that health care professionals still do not really talk to each other, and most participants doubted whether patients really understood the content of care plans. Participants also thought the format of the plans was not patient-friendly because there were too many boxes and the plans looked too technical.

6.4.2.3 Electronic communication

Some participants thought email was a useful tool but one specialist thought there was a risk that too much information could flow between people. In particular, if care plans were available on the Internet (such as with CDM-Net), this particular specialist would want a ‘filter’ for the comments section because he did not have the time to consider communication occurring between an allied health professional and a GP. At most, he only wanted to read information directed to him.

Most participants felt patients would not want to electronically contribute to their own care plans by, for example, adding in clinical data. They felt patients with diabetes and many other chronic diseases were in an older age bracket and computer or SMS-based communication was beyond them.

The CDM-Net service was demonstrated to all participants. Most commented that, while it might have some advantages over a template that was only loaded onto the GP’s computer, and was clearly the ‘way of the future’, it would mean learning yet another computer program. Some participants suggested that CDMS might not be compatible with various clinical software programs and if it was not universally compatible, problems could arise because health professionals may not want to use different systems in parallel.

One specialist thought … *too many people were taken in by technology*. He found asking patients direct questions such as ‘Are you seeing an educator or a dietician?’ elicited the required information. He also thought the telephone was still a useful tool to help sort out difficult problems, that is … *one simply phones the GP or other health professional and speaks directly to them*. Other participants pointed out the advantages of email for busy health professionals who either did not want to be interrupted by phone or were at another location.

Finally, other frustrations with electronic communication such as the need to encrypt patient information in an environment where incompatible programs existed emerged. Participants commented that not all health professionals worked with computers, and not all were online at all of their practice locations. These and other technical matters made relying on computers problematic at this stage.

6.4.2.4 The care team

The concept of a ‘team’ when allied health professionals are involved in the care of patients with chronic diseases was discussed. Many thought TCAs had brought them a little closer to GPs and there was more communication and coordination than previously. However, one specialist thought the model … *followed a hub and spoke pattern, with the GP at the hub and there was little need for regular communication between ‘spokes’.*

Participating allied health professionals appeared to be surprised that GPs might be annoyed or frustrated when patients were referred to them to ‘get a referral’ to access Medicare funds. These participants thought the GP was in the best position to know about MBS CDM items eligibility for individuals, therefore, felt it was reasonable to ask the GP to advise patients.

Participants also commented that many patients did not seem to understand why they were referred to members of a care team, and not infrequently, patients did not return for follow up. These comments suggest patients do not fully understand the ‘care team’ concept and the benefits of team care, or were not what patients wanted. Although a good communication tool such as CDM-Net might help health professionals consider themselves as part of a team, participants felt this was relevant for patients.

One specialist was annoyed that he could not access CDM items and make Medicare funding available to the members of the team, for example, the diabetes educators he refers to in tertiary settings.

6.4.2.5 Collaboration between health professionals in general

Participating practice nurses explained how they are involved in developing care plans and that the process worked best if they also reviewed the patients rather than trying to develop care plans from the existing medical record. Having the patient present was particularly useful in developing individualised realistic goals and strategies. The nurse's ability to develop a care plan was further enhanced by conducting a formal 'health assessment' using the Medicare item number to accomplish the health assessment.

Some participants were concerned about how a care plan would contribute to an electronic medical record and, in particular, patient confidentiality when all the information was being shared. They felt writing more notes, as happens in nursing home records, does not necessarily assist patient care because health professionals do not bother to read other practitioners' contributions. Many felt there is simply too much information to cope with.

Another suggested barrier to better collaboration was that patients do not always remain with the same GP, or they may consult more than one GP. However, it was noted that most people with chronic diseases tended to be in the older age group and usually prefer to have the one GP. Nevertheless, some participants mentioned patients sometimes thought they could 'play the system' and obtain separate TCAs from different GPs so that they could have additional visits to allied health practitioners. However, when Medicare rejected the bills for these visits, participants reported that health professionals were sometimes left with a bad debt.

Overall, most participants doubted – indeed some expressed deep cynicism – that an essentially bureaucratic process involving paper shuffling, could possibly improve care planning to such an extent that it would lead to health benefits. These participants felt it is a process that has become focused on increasing access to allied health practitioners via Medicare funding that led to distortions in the way care planning takes place.

6.4.2.6 Looking to the future

While most participants agreed that electronic health communication was inevitable, there were many problems that still needed to be overcome. Thus, it is important that health professionals remain patient-focused, especially given that younger health care professionals belong to the 'Facebook' generation. Communication between allied health professionals and GPs remains difficult with or without care plans; participants reported they particularly found it hard to know when to refer a patient to a GP when they were uncertain whether the patient would return for follow up. For example, one participant commented … *does one write at the end of the first visit or at the end of a course of treatment? If it is at the end, then the final report might slip through if the patient does not turn up.*

It was felt difficulties such as this are not solved by the current care planning process or by electronic communication. In other words, there are a range of challenges.

One specialist was not enthusiastic about the care team …*all holding hands on the web*, however the majority of participants agreed that one way or the other, electronic communication was ‘the way of the future’ and was going to happen anyway, therefore health professionals need to try to ensure that it works best for the patients and the health professionals.

6.4.3 Conclusion

One clear message from the three focus groups and the interviews was that neither a web-based care plan nor electronic communication can be separated from other aspects of chronic disease management because all the pieces of the picture need to be considered together. For example, care planning cannot be separated from the funding and bureaucratic requirements that go with it. In addition, planning cannot be divorced from the understanding that patients do or do not have about GPMPs and TCAs. Quite naturally, the patient’s concerns are usually far more immediate. While the demonstration of CDM-Net attracted some interest as an exemplar of web-based communication, participants raised a range of issues that went well beyond communication difficulties. The concept of a care plan, the nature of inter-professional engagement, the time and financial pressures in clinical practice, and most importantly, the need to have the patient at the centre of the process, all add layers of complexity to chronic disease management.

6.5 Care plans and adherence to diabetes management: Medicare data analysis

Authors: Dr Akuh Adaji, Associate Professor Peter Schattner, Dr Kay Jones

6.5.1 Introduction

The management of patients diagnosed with diabetes requires that care should be coordinated and structured over time [1, 2]. This care should proactively engage patients to promote lifestyle changes [3], adhere to prescribed medications, monitor key biological parameters and prevent complications. One way of achieving this is through the use of care plans initiated by GPs in collaboration with allied health professionals, pharmacists and medical specialists [4]. In Australia, care plans are written documents that outline a management strategy to be achieved during a 2 year period for patients diagnosed with a chronic disease such as diabetes. GPs are compensated by Medicare when they create care plans for chronic disease management using either a GPMP and/or a TCA, the former being a prerequisite for the latter. GPs are also compensated when they review a care plan.

Some researchers have sought to discuss the value of care plans in Australian general practice, especially from the view of understanding their use in general practice [5] and improving clinical outcomes [6]. Zwar et al studied whether multidisciplinary care plans improved processes and outcomes of diabetes care following the preparation of a care plan [6]. They conducted a retrospective medical record audit of patients diagnosed with diabetes (before and after the introduction of care plans) from the practices of 26 GPs based in five divisions of general practice in New South Wales, Australia. Their findings suggested that care plans improved adherence to process and outcome of guidelines, and changes in outcome measures. Segal attributes these findings to multidisciplinary team care [7]. However, their findings were limited by the small sample size of the participants recruited in the study.

6.5.2 Aims

This study aims to assess whether the use of care plans (GPMP and TCA) is associated with improved adherence to Australian guidelines for diabetes management by analysing data provided by Medicare (from ‘billing’ only). In order to make comparisons, two data sets were requested. The specific aims are:

- to examine the association between care plans and clinical indicators (as suggested by the diabetes ‘annual cycle of care’ guideline) [8] in patients with diabetes, and
- to test the association in patients with a diagnosis of diabetes between having care plans (GPMP) and having the recommended number of tests (according to the diabetes ‘annual cycle of care’ guideline) including:
    - HbA_{1c},
    - HDL and
    - microalbumin.

6.5.3 Results

Data for the first period; 1/1/2005 - 31/12/2006, shows the number of patients with diabetes who were not on care plans during that time. This cohort was defined as having diabetes based on having at least one HbA1 test conducted during that time period (Table 6-5 on page 117). Based on this definition, a total 557,181 patients were identified. This reflects a prevalence of diabetes of about 2.8% in the Australian population, which is similar to previously reported prevalence [9]. The most reliable current (2009) estimates of known (diagnosed) cases are > 3.6% of the population.

Table 6-5: Number of patients with and without care plans during two periods: 1/1/2005 to 31/12/2006, and 1/1/2007 and 31/12/2008

	Data collection period 01/01/2007 to 31/12/2008			
Identification Group period 01/01/2005 to 31/12/2006		**HbA1c(>=2) 66551**	**HDL(>=2) 66536**	**Microalbumin (>=2) 66560**
Diabetic patient defined as having had at least one HbA1c test done in this period and no care plan (721, 723, 725, 727) 557,181	Group 1 Number of patients with no care plans	155,088	68,540	86,434
	Group 2 Number of patients with GPMP (item number 721) but no TCA (723)	20,273	7,584	14,754
	Group 3 Number of patients with TCA (item number 723)	62,367	24,492	43,552

Data for the second period, 1/1/2007 – 31/12/2008, shows that 27.8% of the cohort (i.e. 155,088/557,181) did not have care plans but met the diabetes guideline requirement for HbA1c test. A smaller group with no care plans met the criteria for HDL and microalbumin testing (12.3% and 15.5% respectively). This trend is also seen in those patients diagnosed with diabetes who had a GPMP (3.6% HbA1c, 1.4% HDL and 2.6%), and a TCA (11.1% HbA1c, 4.4% HDL, and 7.8%) during the data collection period.

6.5.4 Discussion and Conclusion

The data suggests that more than half (319,453/557,181 = 57.3%) of the patients did not meet the guideline criteria for HbA_{1c} (>=2 tests per year). The percentage is not entirely accurate as different time frames apply (2005/06 and 2007/08), but nevertheless it seems likely that the estimate of approximately half those with diabetes not meeting the guideline for HbA_{1c} is true.

Of further interest is that a large proportion of those that did meet the guideline criteria for HbA_{1c} did not have care plans (155,088/237,728 = 65.2%). Does this mean it is 'easy' to conform with the guidelines without doing a care plan, or does it mean that GPs select their cases carefully and do not bother doing care plans for those that are already being appropriately managed?

In order to compare the relative benefits of the three groups (without care plans, with GPMPs alone and with TCAs) in ensuring that GPs adhere to clinical guidelines in all three parameters (BbA1c, HDL, and microalbumin), additional data are needed. That is, for each group, one needs to know the number who did not meet the guidelines as well as the number that did.

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6.6 Organisation Dynamics

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6.6.1 Introduction

The growing burden on health care systems as a result of the aging population and the increasing prevalence of chronic disease has highlighted the need for alternate health care delivery models that enhance the efficiency of care [1]. Chronic care models have now gained prominence in the academic literature as the quality improvement approach that can deliver cost effectiveness whilst improving patient health outcomes [2,3,4]. Successful implementation of chronic care models involves system change which is being increasingly facilitated by the use of information and communication technologies (ICT)[5]. Whilst ICT is not a panacea for this systems change it is an innovative technology that will enable the clinicians to communicate patient information instantly and securely and hopefully promote teamwork and collaborative care.

Research suggests that failure in implementing ICT is not only due to the technology but also to the inability of individuals in organizations to work with each other [6,7]. Pagliari states that 'part of the problem lies in the differing languages, cultures, motives, and operational constraints of producers and evaluators of ehealth systems and services' [8]. The dynamics of collaboration are complex and failure to attend to these relational issues can thwart the implementation process of ICT. A theoretical understanding of these challenges is needed in order to at least create a climate of greater awareness of the difficulties ahead, unearth the various overt and covert issues, and find a way of mitigating them. The benefits of this exercise in research endeavour will contribute towards (a) the testing and development of theories (b) extrapolation of successes to future ehealth initiatives and implementation and (c) the expansion of the body of knowledge about ehealth. This is important because the issues at stake are major, as is the investment of effort and money in ehealth initiatives.

6.6.2 Aims and objectives

The overall aim of the research is to theoretically examine and analyse the organisational dynamics of the implementation process of an ICT project in primary care. Specifically the research examines the human and organisational dynamics associated with the collaboration between multidisciplinary stakeholders (or role holders) involved in the implementation of a web-based care plan for diabetes management in general practice in Geelong. Specifically collaboration within CDM-Net occurred between multidisciplinary professionals working within healthcare related organizations (Monash, Deakin and Victoria Universities, CSIRO ehealth Research Centre, Barwon Health), small and large ICT companies (Precedence Health Care, Working Systems Solutions, IBM, CISCO and Intel) and the community (GPAG and allied health community centres).

The working hypotheses are:

- effective implementation of ICT requires collaboration within multidisciplinary teams and
- the dynamics of collaboration are complex and failure to attend to these relational issues can thwart the implementation process.

A number of questions arose which the research explored.

6.6.2.1 Primary research question

- how does collaboration between multidisciplinary stakeholders influence the success or failure of ICT implementation in primary care?

6.6.2.2 Secondary research questions

- what were the challenges experienced by stakeholders working in their roles as collaborators in the CDM-Net project
- how did stakeholders deal with these challenges, and
- how did these challenges affect the implementation of ICT in the CDM-Net project?

6.6.3 Methods

An intensive case study design was used to examine the organizational dynamics within the CDM-Net project. In-depth interviews, participant observations, and documentary analysis were conducted in order to examine the human and organizational dynamics inherent in this ehealth project. The proposed framework is the systems psychodynamic framework as a prism through which the dynamics in the change process can be understood. In particular the anxieties and the ensuing defence mechanisms that are inherent in the dynamics of a complex change process such as ICT implementation are explored.

6.6.4 Data analysis

Data analysis has been informed by one of Yin's thematic approach to case study analysis [9]. The most preferred of these is to rely on the theoretical propositions that informed the case study and to use a technique called explanation building to arrive at empirically based conclusions. In this case study the theoretical propositions were based on the systems psychodynamic theory. It is typical in ehealth research, as demonstrated by Greenhalgh et al [10] to rely on a theoretical model of complex change in order to understand the implementation process.

6.6.5 Current progress

1. One year participant observation documented and completed
2. Twenty four interviews conducted and transcribed
3. Interviews are being analysed
4. Documentary analysis ongoing
5. Results and analysis ongoing
6. Thesis writing ongoing.

6.6.6 References

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7 Medico-legal studies

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7.1 Introduction

Two key legal issues were researched within the context of the CDM-Net project. First, privacy presents two related but separate problems: (a) how to ensure compliance with information privacy and health records laws and other health-related legislation and, more generally, (b) how to ensure a level of protection of patient privacy consistent with the legal and ethical obligations or medical and allied health providers.

Second, shared electronic health care plans may increase the exposure of the treating professional to negligence claims as well as creating uncertainty concerning the nature and extent of the potential legal liabilities of the various individuals and organisations involved in a patient's treatment.

Three forms of data were developed collected:

1. six questions regarding sharing health information electronically and privacy were included on the patient questionnaire at Time 3
2. face-to-face interviews that included similar questions were conducted with eight professionals and ten patients. Follow-up interviews were conducted with four of the professionals and another interview was conducted with a professional involved in the CDMS component only, and
3. A 'round table discussion' was held with experts in law in the health sector.

The results from these three data collection forms are presented in this section.

7.2 The questionnaire

Of the total cohort of 99 patients, 80 completed the questionnaire at Time 3. Of these, 48 (60%) were males and 32 (40%) were females; 33 (40%) were under 65 years of age and 47 (60%) were 65 years or older.

The 6 questions included at Time 3 were:

- I was comfortable with the fact that all health professionals involved in my care can see all of my clinical details on the computer
- I was fully informed as to the range of health professionals and others who have access to my information
- I am comfortable with the nature and extent of information sharing that takes place to develop a care plan for me
- I understand how privacy of my personal information will be protected within the Chronic Disease Management Service
- I am confident that my personal information will stay private, and
- Based on the way my privacy was managed by CDMS, I would be willing to participate in other projects that involve sharing my information.

The responses to the six questions indicate that generally, the respondents felt comfortable with their health information being shared electronically, they understood privacy issues and their information would stay private (Table 7-1 on page 124). Of note, fewer indicated they were willing to participate in future projects.

Overall, the non-response rate was low; there was little difference between males' and females' responses, and little difference between the two age groups, suggesting that regardless of gender or age, these respondents held similar views about sharing health information electronically and the importance of privacy.

Table 7-1: Responses to the six questions on the questionnaire at Time 3 (n=80)

Question	'No' response	Males 'Agreed' N=48	Females 'Agreed' n=32	<65 'Agreed' n=33	65+ 'Agreed' n=47
1	3 (4%)	39 (81%)	28 (86%)	26 (79%)	41 (87%)
2	4 (5%)	42 (87%)	26 (81%)	26 (79%)	42 (89%)
3	4 (5%)	42 (87%)	24 (75%)	28 (85%)	38 (80%)
4	2 (2.5%)	39 (81%)	30 (94%)	26 (79%)	43 (91%)
5	2 (2.5%)	40 (83%)	28 (88%)	28 (85%)	40 (85%)
6	5 (6%)	34 (71%)	22 (69%)	25 (76%)	31 (66%)

7.3 The interviews

Interviews were conducted with eight professionals (four GPs, one diabetes educator (DE) and three practice nurses (PNs) and ten patients between March and October 2009.

Approximately six months later, between August and October 2009, a second interview was conducted with the four GPs. The interview questions included questions about how patients had been informed about the CDM-Net Project, sharing health information, and privacy. See Section 4 for further details about the interviews.

7.3.1 The first interviews

7.3.1.1 How patients were informed about the CDM-Net project

Nine of the ten patients had been informed about the CDM-Net project by their GP and, of these; one had also been informed by *one of the practice nurses.* The tenth patient was informed by members of the Deakin University research team. The patients were invited to participate in this component of the project by their respective GPs; all agreed and all provided written informed consent.

7.3.1.2 Sharing patients' health information electronically

Seven of the eight health professionals felt that sharing patients' health information electronically with other health professionals such as the diabetes educator, podiatrist, dietician and pharmacist, was a positive thing to do. Six of the eight professionals felt sharing health information electronically had made a difference to the care they provided for the patients.

Significantly, all ten patients' responses supported the professionals' views. One patient said:

- *I think it's much better because when you go to see one of the other health providers, they have access to the latest path tests and where normally if it's a* *written report they wouldn’t have the full history and they can always have access to the latest one.*

The patients were also asked whether they felt that sharing health information electronically impacted in any way on what information they disclosed when they visited the doctor. Two responded ‘yes’ with no further explanation, four responded ‘no’ with no further explanation, and the remaining four responded with comments that supported this form of information sharing:

- *It just personalises it a lot more.*
- *Yes, because having it in a system like this, I think there’s more likelihood of your GP keeping track that you are seeing these other health providers and reminding you that you need to.*

All professionals and eight of the ten patients agreed that sharing patients’ health information electronically with other health professionals significantly reduced the need to repeat information every time they [the health professionals] referred a patient to another health professional, or when [the patient] was referred to, or consulted another health professional. However, some professionals suggested ‘caution’ when sharing health information electronically; for example one GP reflected:

- *You have to be careful that it’s [the information transferred] cleared with the patients and that you don’t put on [the transfer] delicate sort of information like a termination [of pregnancy] or a psychiatric situation.*

Participants in both groups had different opinions about whether sharing patients’ health information electronically helped the process of accessing other health professionals.

Five of the eight health professionals felt sharing patients’ health information electronically did not make a difference to the way they managed their patients with diabetes. In contrast, six patients felt it had made a difference, three were unsure and one felt it made no difference.

- *I think it’s much better because when you go to see one of the other health providers, they have access to the latest path tests and where normally if it’s a written report they wouldn’t have the full history and they can always have access to the latest one.*
- *Oh, I don’t think that it has one way or the other.*

Likewise, health professionals and patients had mixed opinions about whether using care plans improved the way health professionals managed the patients’ diabetes. There were also mixed responses from the health professionals about whether they (the health professionals) felt they understood their role in managing their patients’ diabetes, and whether they (the health professionals) felt that their patients understood their role in managing their diabetes. In contrast, seven of the ten patients stated they were clear that the care plan did improve their understanding of their role (the patients) in managing their diabetes.

Patients were also asked whether knowing their health information would be shared electronically with other health professionals affected the information they disclosed when they visited their doctor. Opinion was divided; two indicated it did but did not explain how or why, four said ‘no’ but did not say how or why and the remaining four provided positive comments about electronic information sharing among health professionals:

- *Yes, because, partly due to the GP, it helps remind you to keep on the ball.*
- *Yes, because [it makes it] easy for health professionals to confer, especially the pharmacist.*

Regarding whether the care plan helped communication between groups, opinion from the health professionals was mixed:

- *Yeah, I think so because it gives you some structure to address at the subsequent interviews in terms of how they're tracking and what are the key aims, goals and lifestyle changes the professional communicate with the patient and other health professionals about management issues.*
- *No and they never question anything, especially elderly people.*

While patients had mixed opinions, they were generally more positive than the health professionals:

- *Probably yes because he [the GP] asked a lot more questions to fill in the form than they normally do, they probably pick up a lot more information.*
- *I don't think it makes much difference. It would for some but I'm very verbose with him [the GP].*

7.3.2 Patients' right to privacy

The eight professionals' comments about the patients' rights to privacy indicated they take patient privacy seriously. In addition, two professionals commented that they were unsure whether the patients understood what, and how much, information was being transferred:

- *There seemed to be no issues with privacy due to the fact that it [the system] is over very good secure systems and patients were very comfortable. I guess the patients do give us a licence to include what we think is relevant whenever we make a referral, and I guess the patients felt that this was pretty much like a referral.*
- *We don't send anything sensitive in their past history, they do give us a licence to include what we think is relevant whenever we make a referral.*
- *I guess if they realise they need to consent and that the information is used within a professional circle, they're aware of that, then I don't see that as a problem, if they've consented and know about it.*
- *I think they understand that specific providers are going to have access to those records, so I think they could all withdraw their consents to that type of care plan if they didn't like that record being shared.*
- *Most patients are happy to transfer information to allied health ... no I don't think so.*

All ten patients felt CDM-Net did not make any difference to their sense of privacy (*no, no issues, no problems*). Three made additional comments:

- *Well I think it would, but it doesn't matter.*
- *They do share what information I give. I assumed it was on kind of an anonymous basis, isn't it?*
- *No, I don't worry about that much; just that I don't believe the privacy people claim is there is there actually. And I don't worry about it; some people perform like anything, don't they?*

Allied health professionals and patients' opinions were equally divided regarding whether sharing information by electronic transfer helped them access other health professionals such as the diabetes educator, podiatrist, dietician and/or the pharmacist:

- *It gave a better line of communication (professional).*
- *It hasn't really helped us access them anymore; we could access them before (professional).*
- *Yes, I guess so, I wouldn't have thought of going to a podiatrist (patient).*
- *No, I was seeing those other people before I had this care plan (patient).*

Five professionals felt that sharing information by electronic transfer did not make a difference to their diabetes management. Two of the five patients felt it had made a difference, two did not, and one was unsure.

Two professionals felt care plans improved the way the patients managed their diabetes, two felt it did not, and four were unsure. The patients were similarly divided, four felt it did, three felt it did not, and three were unsure.

7.3.3 The second interviews

Follow-up interviews with the four participating GPs were conducted between August and October 2009. The same questions were used in both interviews.

7.3.3.1 Sharing patients' health information electronically

The four GPs agreed that sharing their patients' health information electronically with other health professionals was positive, but only ... *as long as it's a secure environment* and *everyone who signs up to the program understands the importance of confidentiality.*

In addition, all four GPs agreed that sharing information electronically made a difference to their diabetes care. Positive changes included ... *being more punctual with timelines of reviews*, and *improving clinical records because other people are viewing the record and it* [the care plan] *also targets areas you*[the GP] *may not be fully aware of.*

All four reaffirmed the value and importance of not having to repeat information every time they (the GPs) referred a patient to another health professional or when the patients were referred to or consulted another health professional.

Opinions remained varied about whether sharing information by electronic transfer helped GPs access other health professionals. The major challenge was ... *we don't have all the providers* [in the local area] *on the* [CDMS] *system.*

All agreed that having a care plan improved the way the study patients managed their diabetes care. One GP commented; *I think it's a positive step in greater compliance with the treatment regimens and an understanding of what they've got* [the patients] *and how they should manage it.*

While three of the four GPs agreed developing care plans helped them (the GPs) improve their understanding of their role in managing diabetes: ... *well, I think it has me made more aware about calling people,* all agreed the care plan process improved their understanding about their role in managing diabetes, helped them communicate with other health professionals, and made a difference to the way they (the GPs) managed their patient's diabetes care: ... *because it makes me more punctual with timelines and reviews* and *because other people are viewing it* [the care plan] *it improves clinical records and targets areas you may not be fully aware of.*

7.3.3.2 Patients' right to privacy

The right to privacy continued to be taken seriously:

- *That's why I take the patient through it and explain it to them.*

Opinion remained evenly divided regarding whether sharing health information by electronic transfer helped them access other health professionals such as the diabetes educator, podiatrist, dietician and pharmacist:

- *Probably not because we don't have all the providers on the system.*
- *It's probably made me more focussed on involving them, yeah.*

Opinion about whether the care plan improved the way the patients managed their diabetes also remained divided, two said 'yes', one was unsure and the fourth commented:

> *A loaded question, yes, I don't know, I guess they see that we're all working for a particular aim and it probably has to make some benefit.*

7.4 Round table discussion

In May 2009 a roundtable discussion was held at Monash University with experts in medico-legal matters for the purpose of providing some clarification of the key legal and ethical issues arising from the use of electronic health care plans. Central to the discussion was the need to ensure the best interests of patients and to minimise privacy breaches and other medico-legal risks.

The experts comprised a lawyer with experience in the health sector, a medical ethicist, a GP who has been closely involved with GP organisations, including divisions of general practice and the Royal Australian College of General Practitioners, an academic GP and members of the research team. All participants provided written informed consent. The experts were purposively selected because of their particular expertise. The meeting lasted for approximately two hours, was audio-taped and transcribed verbatim. A summary was written based on the main themes emerging from the discussion and was sent to the round-table discussion participants to allow for any corrections to be made to the text.

Points discussed included:

1. Privacy - Risks from creating and sharing a 'super' record:
    - whether it is it in patients' interest to create and share so much information
    - security
    - compelled access by others (for example, employers)
    - information 'slipping out' of the care plan (to other team members) and out of the GP's control
    - the reality of consent to sharing, do patients really understand what is happening, and
    - risk/implications of data storage by private companies.
2. Other points raised included:
    - who owns and is responsible for the record
    - who is responsible if the treatment plan is inappropriate

- to what extent can an inappropriate care plan be addressed by contract and if so, how successfully can a contract protect against liability
- whether the process increases potential liability if the health professional fails to follow up
- who is responsible if the system fails to generate follow-up prompts
- who is responsible if incorrect information is entered and used
- what happens if mistakes are the direct (problem in the program or mis-keying) or indirect (hacking into the system) fault of Precedence, and
- whether the benefits outweigh the risks involved.

7.4.1 Outcomes – privacy

The consensus advice stressed the privacy dangers inherent in creating a “super” record accessible by multiple treating professionals and the private sector intermediary IT provider, and the difficulties in ensuring appropriate informed consent on the part of patients. The advice also stressed the uncertain legal status of the care plan as a legal document and the potential additional risks associated with failures to follow up specific aspects of patient treatment.

7.4.1.1 Patient privacy

Key questions raised were:

- whether it is in the best interest of patients to create a care plan and share so much of their personal and health information, and
- whether patients would have difficulty understanding the ramifications of sharing a considerable amount of personal and health information that had been stored in a doctor’s computer.

7.4.2 Outcomes – medico-legal

The consensus advice stressed the uncertain legal status of the care plan as a legal document and the potential additional risks associated with failures to follow up specific aspects of patient treatment. The round table also highlighted the potential for the care plan document to operate quite differently in a legal sense from a general practitioners’ view of a care plan document and for it to create additional duties in terms of follow up.

7.4.2.1 Medico-legal questions

Key questions raised were:

- how to ensure that the care plan reflects best practice and how to clarify mutual rights and responsibilities arising from it, and
- whether patient would have difficulty understanding the ramifications of sharing a considerable amount of personal and health information that had been stored in a doctor’s computer.

7.4.2.2 Consensus guidelines

In the light of these considerations, the following set of consensus recommendations was developed with the aim of guiding GPs about appropriate ways to share electronic care plan arrangements:

- participants (health professionals and patients) need to have a clear understanding of the privacy issues involved in creating and sharing a comprehensive record of patient's health status and treatment
- shared care plan documents should contain only as much information as is relevant and appropriate to a patient's treatment under that plan
- patients should be made aware of the nature and extent of the information that is put into their shared care plans when they are initially created
- measures should be implemented to ensure ongoing and fully informed consent by patients to sharing their information and that patients are made aware of, and continue to retain some control over, what personal information is included in the care plan
- the template for the care plan should reflect best practice treatment for the condition/s it is designed to treat and should be reviewed on a regular basis and amended where necessary to ensure that it continues to do so
- patients should be made aware of the nature and extent of the information entered into their shared care plans when they are initially created
- there is a need for documentation that clearly spells out the nature of the contractual relationship between the parties to the care plan and the mutual responsibilities of members of the care team, the IT providers and patients in relation to patients' treatment under that plan
- members of the care team need to have a clear understanding of the extent to which they can rely on the care plan and the extent to which they need to rely on their own personal records, and
- members of the care team also need to have a clear understanding of the nature and extent of their duty to follow up and recall patients and the extent to which the electronic care plan can safely be relied on to issue appropriate prompts, to do so.

7.4.3 Conclusions

It is likely that shared electronic care plans will become more prevalent in Australia which raises new legal and ethical issues that need to be understood and addressed if GPs and other care team members are able to participate with confidence in programs where patient data is electronically shared. Measures to ensure privacy receives appropriate protection in a context of informed consent, that care plans reflect best practice, and that the mutual rights and responsibilities of participants are clearly documented should provide a useful way of addressing legitimate concerns.

8 Quality of Life and health service expenditure

Authors: Mr Duncan Mortimer, Professor Leonie Segal

8.1 Introduction and general health

Participants categorised their general health to one of five categories: excellent, very good, good, fair, and poor, at both Time 1 (n = 99) and Time 2 (n = 93). Figure 8-1 on page 132 describes count data and proportions by category at Time 1 (n = 99) and Time 3 (n = 80). The majority reported the same general health at both time points (45/80 = 56.25%) but some 32.5% (26/80) participants who responded at both Time 1 and Time 3 reported an improvement in their general health. A much smaller proportion reported a decline in their general health (9/80 = 11.25%). These positive and negative general health ratings equate to a significant pre-post difference in the distribution of general health using the Wilcoxen signed ranks test (z = -2.498, p = 0.012) under the assumption that our five ordered categories constitute an interval scale.

8.2 Preference-based quality of life

Cost-effectiveness analysis is increasingly shunned in favour of cost-utility analysis where the quality adjusted life year (QALY) provides a common metric for the valuing of mortality and relevant dimensions of health-related quality of life (HRQoL). In this study, QALY-weights were obtained using a multi-attribute utility instrument (MAU): the six dimension version of the Assessment of Quality of Life (AQoL-6D) instrument [1,2]. The AQoL scoring algorithm assigns a ‘stock’ reference-weight (obtained from another population during scaling) to questionnaire responses describing participants’ own HRQoL and yields an index score reflecting preference-based HRQoL [1,2,3,4].

The AQoL-6D questionnaire has 15 items 12 of which are used to compute the utility index [1,2]. Each item has four levels. There are five dimensions: illness (not used in utility computation), independent living, social relationships, physical senses and psychological well-being. A multiplicative model is used to compute the utility index wherein interactions between HRQoL dimensions are permitted and the assumption of additive utility independence is relaxed [2]. The upper boundary is 1.00, which designates full HRQoL equivalent states, 0.00 designates death equivalent states, negative scores designate states worse than death and the lower boundary of -0.04 designates the AQoLs all worst HRQoL state. The AQol-6D as a utility instrument has equal interval properties and a defined relationship with years of life. (For example a score of 0.5 indicates that people in that health state would, on average, be prepared to trade 50% of their remaining life expectancy to achieve full health.) For the present analyses, missing values on individual items were replaced with the mean of responses to other items within the relevant dimension.

The distribution of AQoL scores at time T1 (baseline) is shown in Figure 8-1 on page 132 where the columns give the percentage of the patients with baseline AQoL scores below zero and then in 0.10 point segments on the AQoL scale. The estimated mean AQoL score at Time 1 was 0.68 (SD=0.26), demonstrating participants’ relatively poor HRQoL compared with 0.83 (SD=0.20) the Australian non-institutionalised population [5]. This is not surprisingly given an older population, with diabetes (and often other health conditions). Only 45% of respondents reported ‘good’ HRQoL towards the upper end of the scale, returning scores in excess of 0.80 on the AQoL scale. A sizable minority 23.1% report very poor quality of life (less than 0.6).

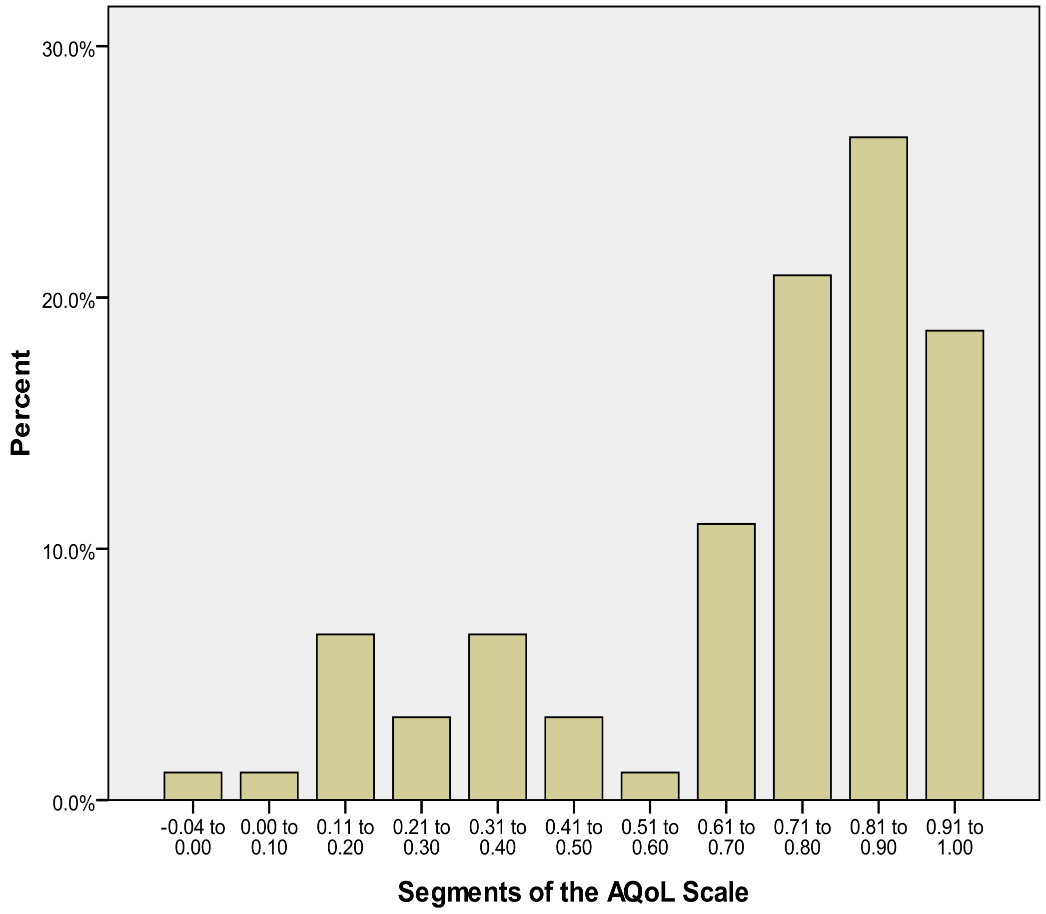

Figure 8-1: Distribution of AQoL scores at T1

8.2.1 Comparison of HRQL between baseline and trial end

Paired t-tests for the 80 participants from whom responses were available at both Time 1 and Time 3 failed to demonstrate a statistically significant difference between the AQoL scores ($Diff_{T1-T3}$ = 0.013, t = -0.789, p = 0.432). Likewise, paired t-tests for the 99 participants from Time 1, using last observation carried forward (LOCF) failed to demonstrate a statistically significant difference between Time 1 and Time 3 AQoL scores ($Diff_{T1-T3}$ = 0.011, t = -0.789, p = 0.432). Pre-post differences in the distribution of AQoL scores using Wilcoxen signed ranks test also failed to reach significance (z = -0.943, p = 0.346).

The proportion of participants achieving a minimally important improvement of 0.06 on the AQoL [5] between Time1 and Time3 (25/99 = 25.3%) was more than matched by the proportion suffering a minimal important decrease (28/99 = 28.3%). Likewise, the proportion of participants achieving twice the minimal important improvement of 0.06*2 = 0.12 on the AQoL between Time 1 and Time 3 (12/99 = 12.1%) was more than matched by the proportion suffering twice the minimally important reduction (17/99 = 17.2%)

8.3 Self-reported allied health service expenditure

The questionnaire included questions about health service utilisation, frequency and intensity at Times 1, 2 and 3. Specifically, participants were asked whether or not they consulted or visited a dietician, podiatrist, diabetes educator, optometrist, eye specialist, or chemist/pharmacy during the previous three months and, if so, to list the number and duration of visits. Allied health service expenditure in the three months prior to Times 1, 2 and 3 was calculated for each category of allied health providers except pharmacy by combining the scheduled fees depicted in Table 8-1 on page 133 with the number of allied health occasions of service (OOS) by type reported in Table 8-2 on page 134. Scheduled fees were obtained from Department of Veterans' Affairs fee schedules for the relevant category of allied health care. Numbers of allied health occasions of service for each category of allied health care were obtained from patient self-reports as described above. Multiplying the scheduled fee by the number of services for each category of allied health care and for each time period gives allied health service expenditure by time period and category as reported in Table 8-3 on page 135.

Cost calculations assume reported durations refer to the average duration per consult rather than the total duration of all consults (note: costs were not calculated for pharmacy visits because it is not clear that the frequency or duration of pharmacy visits correlates with intensity of resource use). Totals over categories were not calculated because of the difficulties in interpreting totals that exclude major categories of health service utilisation such as GP and specialist services, pharmaceuticals, and inpatient care.

Table 8-1: Scheduled fees for allied health occasions of service

	Type	Fee	Reference	Coding
Dietician services MBS Item 10954 Dietetics Services Fee equivalent to fee for subsequent consult.	Initial Consult	\$80.30	DVA[6]	Duration ≥ 45 mins but <60mins
	Initial Consult, extended	\$100.35	DVA[6]	Duration ≥ 60 mins
	Subsequent Consult	\$57.55	DVA[6]	Duration <30 mins
	Subsequent Consult, extended	\$60.20	DVA[6]	Duration ≥ 30 mins but < 45 mins
Podiatry services MBS Item 10962 Podiatry Fee: \$57.55	Any consult at rooms	\$57.55	DVA[7]	Consult, any duration
Diabetes Educator services MBS Item 10951 Diabetes Education Service Fee: \$57.55	Initial Consult	\$78.40	DVA[8]	Duration ≥ 60mins but < 90 mins
	Subsequent Consult	\$57.55	DVA[8]	Duration < 60 mins
	Extended consult	\$98.00	DVA[8]	Duration ≥ 90 mins
Optometrist services	Professional attendance	\$65.65	DVA[9]	Duration > 15 mins

	Type	Fee	Reference	Coding
MBS Item 10915 (Examination of the eyes of a patient with diabetes mellitus): $65.65. MBS Item 10916 Brief Initial Consultation Fee: $32.85.	Brief consultation	$32.85	DVA[9]	Duration ≤ 15 mins

Notes: MBS = Medicare Benefits Schedule
DVA = Department of Veterans' Affairs Fee Schedules

Table 8-2: Number of Allied Health Occasions of Service (OOS) for each category of allied health care and each time period

	Type	Fee	Count			Duration
			T1	T2	T3	
Dietician services	Initial Consult	$80.30	0	0	0	Duration ≥ 45 mins but < 60 mins
	Initial Consult, extended	$100.35	5	20	22	Duration ≥ 60 mins
	Subsequent Consult	$57.55	3	15	12	Duration < 30 mins
	Subsequent Consult, extended	$60.20	3	1	0	Duration ≥30mins but <45mins
Podiatry services	Any consult at rooms	$57.55	58	77	53	Consult, any duration
Diabetes Educator services	Initial Consult	$78.40	4	26	11	Duration ≥60 mins but < 90 mins
	Subsequent Consult	$57.55	12	15	10	Duration < 60mins
	Extended consult	$98.00	11	13	1	Duration ≥ 90 mins
Optometrist services	Professional attendance	$65.65	35	46	35	Duration>15mins
	Brief consultation	$32.85	8	5	4	Duration ≤ 15 mins

Table 8-3: Allied Health Service Expenditure for each category of allied health care and for each time period

		N=	Min	Max	Median	Mean	SD
Dietician services	Time 1	99	$0.00	$301.05	$0.00	$8.64	$38.59
	Time 2	90	$0.00	$301.05	$0.00	$32.56	$60.59
	Time 3	80	$0.00	$345.30	$0.00	$33.02	$62.93
Podiatry services	Time 1	99	$0.00	$345.30	$0.00	$33.72	$64.74
	Time 2	91	$0.00	$345.30	$57.55	$48.70	$58.14
	Time 3	79	$0.00	$172.65	$57.55	$38.61	$43.93
Diabetes Educator services	Time 1	97	$0.00	$490.00	$0.00	$21.47	$71.07
	Time 2	91	$0.00	$940.80	$0.00	$45.89	$112.81
	Time 3	79	$0.00	$156.80	$0.00	$19.44	$38.95
Optometrist services	Time 1	99	$0.00	$328.25	$0.00	$25.86	$55.34
	Time 2	91	$0.00	$656.50	$0.00	$34.99	$82.29
	Time 3	79	$0.00	$328.25	$0.00	$30.75	$53.95

Comparison between the median and mean expenditure confirms that the distribution of health service expenditure for each category is highly skewed due to the large number of participants reporting zero health professional occasions of service (OOS) in the three months prior to Times 1, 2 and 3. However, there were significant pre-post differences in the distribution of allied health service expenditure using Wilcoxen signed ranks test for dietician services at both Time 2 and Time 3 ($z_{T2\text{-}T1}$ = -2.954, p = 0.003, n = 90; $z_{T3\text{-}T1}$ = -2.837, p = 0.005, n = 80), and diabetes educator services at Time 2 ($z_{T2\text{-}T1}$ = -2.736, p = 0.006, n = 89) but not Time 3 ($z_{T3\text{-}T1}$ = -0.081, p = 0.935, n = 78). Pre-post differences in the distribution of podiatry expenditure approached statistical significance at Time 2 ($z_{T2\text{-}T1}$ = -1.944, p = 0.052, n = 91) but not Time 3 ($z_{T3\text{-}T1}$ = -0.270, p = 0.787, n = 79). Pre-post differences in the distribution of optometry expenditure did not approach significance at either Time 1 ($z_{T2\text{-}T1}$ = -0.812, p = 0.417, n = 91) or Time 3 ($z_{T3\text{-}T1}$ = -0.018, p = 0.986, n = 80). In each case, positive ranks exceeded negative ranks.

8.4 Discussion

The observed pre-post differences for some categories of allied health expenditure and with respect to general health are difficult to interpret due to limitations of the study design. Specifically, the single-arm pre/post design is subject to a number of threats to validity that stem from the reliance on pre-exposure measures as a proxy for what would have happened to CDM-Net patients if they had continued on usual care. The problem is that maturation (disease-progression, ageing) and history (introduction of new health care interventions, availability of new evidence, peaks and troughs in the business cycle) may intervene between pre and post measures to render pre-exposure measures incomparable with post-exposure measures. Put another way, maturation and history may drive a wedge between pre and post measures such that the pre/post comparison would then fail to control for confounders such as variation in disease-stage or changes in the accessibility and effectiveness of health care (not attributable to CDM-Net).

It may, however, be possible to discount the role of some potential confounders as an explanation for observed pre/post differences. For a progressive condition such as diabetes, maturation (ageing, disease-progression) cannot plausibly account for the much higher proportion of respondents reporting a pre/post improvement in their general health than reporting a pre/post deterioration in their general health. Unfortunately, pre/post changes in health-related quality of life (AQoL-6D) scores are inconsistent with the observed pre/post changes in general health. Specifically, the proportion of participants achieving a minimally important pre/post improvement in health-related quality of life (25.3%) was more than matched by the proportion suffering a minimal important deterioration (28.3%).

With respect to allied health service utilisation, observed pre/post increase in allied health service utilisation may plausibly relate to the introduction of CDM-Net, of a number of reasons. The short time elapsed between the before and after period reduces both the possible independent effect of policy and technological change and the possible impact of disease progression. Disease progression is an unlikely explanation of any increase in allied health service use, as multi-disciplinary team care is recommended for diabetes management from initial diagnosis; and it is a specific objective of care planning.

Systematic pre/post variation in the time of year for which patients were asked to make their self-reports might in theory be problematic as cyclical variation in utilisation/expenditure is established for some categories of health services [10,11,12]. However this is unlikely to be relevant to the use of dietetic services.

8.5 Conclusions

Limitations in the study design preclude firm conclusions to be drawn regarding the presence or absence of any CDM-Net treatment effect. It is, however, encouraging that the empirical results are consistent with the program logic of CDM-Net. We would expect CDM-Net to increase allied health service expenditure if CDM-Net is to bring patients closer to best-practice disease-management and to impact significantly on disease-progression. Further research would, however, be required to obtain unbiased estimates of any CDM-Net treatment effect.

8.6 References

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9 Estimating the health benefits of CDM-Net

Authors: Professor Leonie Segal, Mr Duncan Mortimer

9.1 Introduction

An enhanced primary care system is universally identified as one of the core elements of a strong health care system, especially as chronic diseases becomes the dominant cause of ill health in Western societies, including Australia. Thus, primary care reform has been on the Australian health reform agenda since the early 1990s, for example:

- funding for the National Coordinated Care Trials (an important primary care health system reform experiment)
- the creation of Divisions of General Practice
- revisions to the Medicare Benefits Schedule (MBS) to include a range of ‘extended primary care’ (EPC) items, largely for various categories of health check, care planning and medications reviews
- the introduction of ‘pay for performance elements’ via Service Incentive Payments (SIP) and Practice Inceptives Program (PIP), for example, for cervical cancer screening, asthma and diabetes cycles of care, and
- health workforce reform including adjusting health professionals’ scope of practice and a large increase in funded clinician training.

The Australian Primary Care Collaboratives [1] is an on-going initiative to support GPs to adopt best practice care largely through changing practice culture, data audit and feedback. Despite these initiatives, primary care in Australia continues to display a considerable gap between best practice evidence and actual care practices, relating to preventive care [2,3] as well as chronic disease management [4,5].

This has resulted in a new wave of strategy documents that comment on primary care, including the Draft National Primary Care Strategy [6] which was informed by the report of the External Primary Care Reference Group, recommendations on primary care by the National Health and Hospital Reform Commission [7] and the National Preventative Health Taskforce [8].

Common themes to emerge from the recent reform initiatives and strategy documents, which draw on an extensive health system reform literature and a large number of submissions, include the challenges of ‘better management of chronic conditions consistent with care protocols’ and ‘improving the quality, safety, performance and accountability’ of primary care [9]. Current problems are related in part to structural barriers to service integration and multi-disciplinary team care, to a care system that is largely reactive rather than proactive, identified in reviews going back to the early 1990s. [10,11].

Core suggestions to address these concerns include regional integration, patient enrolment and the adoption of e-health strategies to ensure better access to information when and where needed to drive effective communication between providers and patients. Electronic information exchange is a means to promote care that is best practice, inter-disciplinary and more efficient. It also provides the basis for quality assurance process designed to reduce the risks of adverse events and improve patient outcomes. Selected jurisdictions are seeking to improve quality of care, using clinical governance and accountability models as a means to modify clinician behaviour. An example is the

Northern Territory Extending Health Service Delivery Initiative (EHSDI) [12]; which has at core a comprehensive quality assurance and accountability framework, supported by regional fund-holding, patient enrolment and encouragement of care planning and the appointment of quality officers at the community and state level.

In summary, system level changes that involve, at a minimum: enrolled populations, mechanisms to support protocol driven care, and convenient opportunities for dialogue among members of the patient's care team care and the patient are required to address known impediments to quality-driven chronic disease management. The CDM-net initiative, described below, incorporates elements designed to accomplish these aims. Specifically CDM-Net is designed to encourage care planning for patients with chronic disease and to facilitate high quality evidence-based care plans, care plan reviews, on-going and high quality dialogue among members of the clinical team involved in the patient's care and patient involvement in that dialogue. CDM-Net provides a convenient, time efficient and profitable way for GPs to develop evidence based care plans. In combination, these elements should support better quality patient care, including more effective self care, and better health outcomes. Whether CDM-Net achieves the expected improvement in quality of care and patient outcomes, and in a way that is efficient from a societal perspective, is an empirical question.

The CDM-Net logic and specific components have been built around the Wagner chronic disease self management model [11], incorporating features designed to promote better quality care and more effective self care. The program logic of CDM-Net can be described as follows:

CDM-Net offers a convenient, time efficient, profitable way for GPs to develop care plans, which, for eligible patients, should result in an increase in the number of patients with care plans and care plan reviews for eligible patients

1. CDM-Net incorporates best practice guidelines and patient data to develop an evidence-based care plan that identifies with all members of the care team
2. sharing the care plan electronically with other providers engaged in the patient's care and with the patient:
   a) CDM-Net provides opportunity for dialogue with other clinicians and the patient about the patient's care plan to improve the quality of care to increase the likelihood that the plan will be followed
   b) It assists patients in obtaining care defined in the plan by alerting other providers to their (the provider's) role in the patient's care
   c) CDM-Net sends reminders to patients, assisting in the achievement of more effective self-care
3. CDM-Net incorporates alerts for the GP and a record of whether referrals were actioned promotes better patient follow up by the GP, thus
4. CDM-Net contributes to achieving the goal of high quality and efficient chronic disease management.

The logic should translate into better patient outcomes as illustrated in Figure 9-1 on page 141, whereby CDM-Net should support the first 3 boxes; which are logically related to the last box, better health.

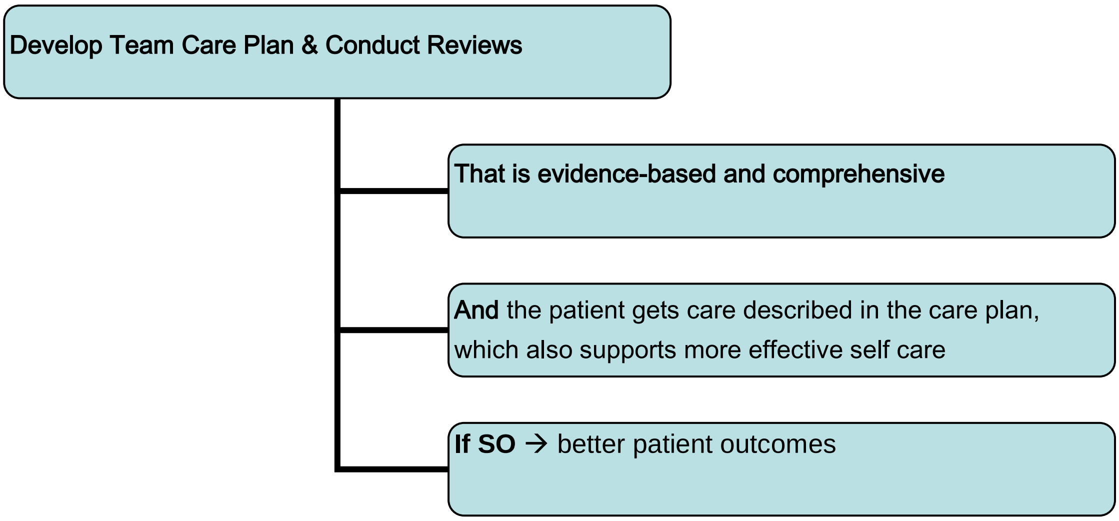

Figure 9-1: Program logic CDM-Net

Generating a care plan that nobody uses, or that does not reflect best practice care increases costs to the health system, without improving the quality of care. Zwar et al's study [13] drew on an audit of patient records of 230 diabetes patients who had a multi-disciplinary team care plan developed during 2000 and 2003. At that time, there was one care planning item for team care. This was replaced in July 2005 with care plan items that paid for either a GP 'only' care plan (Items 721, 725) and/or Team Care Arrangements (Items 723, 727, 729). The impact on key clinical risk markers for the group as a whole and for a sub-group of patients (63%) who actually received multi-disciplinary team care was analysed [13]. Team care was defined to have occurred if the patient was reviewed by at least two care providers other than the GP and at least one of these was diabetes related (podiatrist, diabetes educator, dietician, endocrinologist, ophthalmologist). A small but statistically significant improvement in blood pressure and cholesterol in the 12 months following care plan development was reported. For those meeting the definition of team care, improvements were greater and also observed for HbA_{1c} [13]. A re-interpretation of the results by Segal, concluded that the clinical outcomes for the 37% who, despite having a team care plan, did not actually receive multi-disciplinary team care did not improve [14]. A care plan without team care is unlikely to be beneficial.

9.2 Estimating benefits of CDM-Net

Estimating the health benefits arising from new innovations or processes in health care is difficult. The challenges of observing the immediate, let alone the wider, downstream and on-going impacts of an infrastructure development are considerable. RCTs are most uncommon, with the National Coordinated Care Trials (5 of 10 sites) a rare exception. This can reflect an unwillingness of health agencies to introduce reform through a randomised control trial (RCT) design (CDM-Net a case in point) or, an RCT may not be feasible; for example with, high level system change, such as regional fund holding, or a move away from fee-for-service payment of clinicians. In the absence of a controlled design, describing the counterfactual is compromised, especially when a number of initiatives are simultaneously introduced. In addition, whilst long follow up (> 5 years) is desirable to capture longer term impacts, studies are rarely resourced to follow up participants for such long periods. Also, because changes in care management occur over time, for example, access to new medicines, the ability to generalise to future patients is compromised. The poor quality of Australian health care system information and the inherent challenge of distinguishing the impact of an e-Health initiative in the context of other health sector reform elements undermine the capacity for sound evaluation.

Thus, estimating the health impact of the CDM-Net initiative at this time has several challenges:

- The short period CDM-Net has been operating, combined with progressive patient recruitment and on-going system development affects the likelihood of observing health benefits or savings in health care costs. Less than 9 months has elapsed between the first participant care plan and final observation, limiting the opportunity for any improvements in clinical practice to result in observable impacts on patient health. The relatively small number of patients (99) enrolled in the study, and fewer with a CDM-Net initiated care plan prepared at least six months prior to the 'final' data collection further compromises the capacity to observe any improvement in health outcomes. However, if CDM-Net were successful, we should observe an increase in metabolic tests and referrals to other health professionals (dieticians, podiatrists and for home medication review). A trend to improvement in clinical risk markers such as blood pressure, cholesterol, HbA_{1c}, might also be observable. We note that GPs/practices participating in the Australian Primary Care Collaboratives (APCC) report increases in the proportion of patients having relevant tests, but the impact on metabolic risk markers is not clear [15].
- The lack of a randomised or matched control group to enable the impact on intermediate health outcomes such as clinical risk factors or final health outcomes such as quality of life, mortality, disease progression and costs, to be attributed to CDM-Net. The only source of comparison is the patient themselves, prior to and post enrolment in CDM Net. Potentially confounding factors such as the effect of other initiatives, and changes in medical management/technology that might have occurred at the same time are not adjusted for. On the other hand, diabetes tends to be a progressive condition; therefore any health benefits would be under-estimated using a simple before/after analysis. Significantly, the impact on health service use and cost of care are less amenable to a before/after analysis, partly because these are highly variable.
- The lack of mechanisms for capturing any broader system-wide benefits. For example, creating better networks and communication between GPs and other clinicians might impact more broadly on the quality of care for patients not in the study, and/or on the management of health problems other than diabetes. These impacts could potentially be identified through the qualitative analysis.

Therefore, the economic evaluation initially focussed on process variables, which are core to the model's success. The first measure of performance is the ability to implement the program; that is to set up a web-based care planning system that supports evidence-informed, individualised patient care plans, which offer the means for interaction among all health professionals engaged in the patient's care, together with the patient. The next level of performance is whether desirable changes in clinician behaviour are observed; first in developing more care plans and care plan reviews and other EPC items, second in referral to, and dialogue with other health care providers and third with respect to process is the quality of care plans.

The key process performance variables described in this were:

- the successful development of a workable web-based care planning mechanism
- an increase in the number of patients with care plans including care plan reviews (relative to a suitable comparator)
- the development of high quality of care plans; for example, as established via independent audit
- evidence that the pattern of care actually delivered to and accessed by patients reflects that described in the care plan, and
- evidence of effective inter-disciplinary dialogue, including engagement with the patients.

Observing clinical risk markers in patients prior to their enrolment in CDM Net and how they changed over time could also be informative. The desirable finding would be a trend to improvement.

If diabetes management is enhanced, health at the current ‘disease stage’ together with a reduced rate of disease progression should improve. Health gains should enhance productivity within the family, community and wider society. A possible outcome over time is increased workforce participation, reduced absenteeism and an increase in GDP, although not necessarily an increase in GDP/head, if much of the health gain is in people who are not in the paid work force.

The Council of Australian Governments (COAG) Human Capital Reform Agenda recognised the impact of chronic disease on workforce productivity, participation rates and GDP. They postulated that care planning was an effective means of enhancing quality of care and reducing the impact of chronic disease on the workforce. However, it is unrealistic to expect any improvement in final health outcomes; such as morbidity, quality of life or mortality and thus production, in the short term.

Health service cost measured by MBS fees, will almost certainly rise, driven by the high reimbursement rate for preparing care plans. The GP is able to claim $130.65 for a GP Management Plan (GPMP) (Item 721), plus $103.50 for coordinating a TCA, Item 723 for the same patient. Separate fees are payable for GPMP reviews and TCA reviews when due, as well as health assessments and case conferences. The total fee for developing a care plan is thus $234.15 (January 2010), which is considerably more than the MBS schedule fee of $63.75 for a long (20-40 minute) GP consultation (Item 36), or $93.80 (Item 44) for a visit of > 40 minutes to cover activities such as preparation of a management plan. This is an additional cost to government of between $140 and $170 per additional formal care plan generated, but with no certainty of improved quality of care, given the absence of any formal accountability process. It should also be noted that as CDM-Net reduces the time required by the general practitioner and/or their practice nurse, for the care planning activity, GP productivity would be increased, measured in real terms ie time allocated. However if measured by payments, to achieve a given output, a care plan - a fall in productivity would be suggested. Although, productivity should also take into account the quality of the care plan and impact on health, which hopefully is improved.

Whilst there is the possibility of offsetting health care cost savings, for example, through reducing emergency department attendances, hospital admissions or hospital length of stay; if CDM-Net does improve quality of care. Even then, savings are unlikely to be realised in the short to medium term. Whether any cost savings would compensate for additional care planning and other health care costs, for example, for additional specialist or allied health consultations or even planned hospital admissions, is a question that cannot be answered at this time and in the absence of a control group.

What is almost certain is a shift in cost burden will occur with increased costs to the Australian Government for extra MBS items, but potential cost savings to the hospital system largely accruing to the state as the majority funder. Although, it is often observed that a net reduction in hospital demand from one client group, rather than resulting in cost savings, supports delivery of services (and benefits) to another group, with any unmet need. CDM-Net makes the care planning process simpler and quicker for GPs and provides a more efficient way of developing a care plan in the available consultation time, GPs would therefore have time to review more patients or spend more time per patient. This could well further increase MBS payments and costs to the Commonwealth, although possibly achieving better health outcomes.

9.3 Economic outcomes

The primary observable outcomes that could inform understanding of the economic impact of CDM-Net are:

- evidence that CDM-Net is able to perform as intended by supporting best practice care plan development and dialogue among clinicians and patients
- the number of patients enrolled in CDM-Net
- additional MBS Chronic Disease Management items, designed to support quality care in chronic disease management; primarily, claimed during the study
    - GP Management Plans (GPMPs) and reviews (items 721, 725)
    - Team Care Arrangements (TCAs) and reviews (items 723, 727)
    - contribution to multi-disciplinary care plan or review,(Item 729)
    - completion of diabetes annual cycle of care (item 2517)
    - home medicines review (HMR)
- evidence of improved quality of care plans measured against best practice guidelines, determined via selective audit
- evidence of multi-disciplinary team-based care
    - documented in care plans and based on care plan analysis
    - evidenced by greater dialogue among clinicians evidenced though audit of CDM-Net communication and the qualitative interview data
    - as evidenced by patient care/actual services used
- evidence of improved patient self-care, based on self-report in the interviews and questionnaires
    - healthier eating patterns
    - increased level of physical activity
    - better medication compliance and blood glucose self-monitoring
    - quit smoking, reduced alcohol consumption
- clinical risk markers before and after CDM-Net was implemented
    - HbA_{1c}, SBP, DBP, lipid profile.

The pertinent cost is the cost of rolling out the technology; the ‘fixed cost’ plus the cost of running the service; the ‘variable cost’, which needs to be calculated assuming a minimum ‘viable’ enrolled population. The task is to estimate the cost of a fully operational model, serving the optimal, or realistic, population compared with the benefits as listed above. However given the weak trial design and gaps in data collection this can only be partially attempted.

9.4 Results

9.4.1 GP behaviour – generation of care plans

CDM-Net aims to increase the number and quality of care plans created and followed up, as well as assisting collaboration by sharing care plan information with other care providers and the patient. GP claims of the CDM MBS item numbers for GPMPs, TCAs, GPMP reviews and TCA reviews are most relevant as they are designed to support continuous planned care, patient self management and multi-disciplinary team care.

For the 9 GPs (7.6 FTE) using CDMS who provided data on care plan activity prior to and post their involvement in CDMS, there appears to have been an increase in the rate of care planning. Over the 2 years prior on average 8 GPMPs/FTE GP/year; which more than doubled post CDMS to 24 GPMPs/FTE GP. For TCAs per FTE GP the rate of preparation also increased by around threefold, from 7.3/EFT GP/year to 21.9 post CDMS (see Section 3). With an average of 80 patients with diagnosed diabetes per FTE GP in this sample, the proportion of diabetes patients on care plans is still low, even with CDMS. For comparison, the mean numbers of GPMPs and TCAs per FTE GP for all chronic diseases in the region are 42 and 24, respectively. It is unknown how many of these are for diabetes.

9.4.2 GP behaviour – follow up of care plans

As described above, a care plan is of uncertain value in the absence of follow up, to support effective patient self-care through compliance and/or adjustment to the plan. As reported in Section 3, for those patients on a GPMP, the proportion of patients that were subsequently provided a review of their GPMP seems to have increased from 26% prior to the use of CDMS to perhaps 60% after using CDMS (depending on assumptions related to extrapolating from the relatively short follow-up period). For TCAs, the estimated increase was from 22% of care plans prior to CDMS to 34% after CDMS. These reflect a larger increase in the rate of care plan review, as it sits on top of the rise in the rate of care planning. The CDMS rates compare to a regional average of 18% follow up (review) of GPMPs and 8% follow up for TCAs, with almost no change between the periods before and after CDMS. These preliminary findings are particularly significant as the reviews are a critical part of care planning and management.

9.4.3 Evidence of communication among the multi-disciplinary care team

The CDM-Net data base was also interrogated to establish the impact on levels of communication among providers. What was observed was considerable use of CDM-Net for communication amongst clinicians; notably between the GP and the practice nurse, the diabetes educator, podiatrists, dieticians and optometrist. Examination of these communications shows considerable on-going communication between members of the care team, not only at time of care plan creation and review. Over all users of CDMS in the BSWR to 15 December 2009, there were approximately 44,000 interactions with the CDM-Net system, of which approximately one quarter were by allied health, pharmacy and other non-GP providers.

9.4.4 Evidence of greater access to multi-disciplinary care

Analysis of Medicare claims data for the 99 patients in the BSWR trial shows that patients using CDMS receive a greater proportion of these services than patients on care plans prior to the use of CDMS. The proportion of patients on a care plan who received the recommended services increased by:

- 25% in HbA_{1c} tests
- 5% in Microalbumin tests
- 0% in HDL (high density lipoprotein) tests
- 707% in dietician services
- 68% in podiatry services, and
- 185% in Home Medication Review services.

Of particular interest is the large increase in healthcare provider services: dietician services increasing from a mean of 2% per patient care plan to 17%; podiatry services from 23% to 39%, and home medicines reviews from 4% to 12%. These changes are further multiplied by the threefold increase in number of patients on care plans, resulting in a very large increase in the number of such services provided.

Quality of care: there was a substantial increase in testing of HbA_{1c} (from 40% of patients on care plans to over 50%), but relatively small changes in testing of the other key metabolic markers of microalbumin and the full lipid profile. (Blood pressure was already collected in 100% of patients at baseline). Again, the actual number of tests performed is multiplied by the increase in number of patients on care plans resulting from the use of CDMS.

Clinical Indicators: a slight fall was observed in mean HbA_{1c} and a small improvement in mean lipid profile. However, the percent of patients with good or poor metabolic control remained the same, with both increasing between Time 1 and Time 4 (Table 9-1 on page 146).

Table 9-1: Percent with well controlled diabetes

	Time 1 (n=99) n (%)	Time 4 (n=99) n (%)
HbA1c < 7%	30 (30)	39 (40)
HbA1c >= 7%	21 (21)	27 (27)
Not recorded	48 (49)	33 (33)

9.4.5 Patient self care behaviours

Little change was observed in patient self care and lifestyle behaviours, except a small increase reported in men in having a dietary plan.

9.4.6 Cost of CDM-Net

The cost of delivering CDM-Net will need to be derived to reflect expectations under an extended roll out and based on either expected, or minimum, enrolment of GPs and patients.

9.5 Summary and conclusions

The hypothesised health economic impact from the CDM-Net trial is difficult to establish, because of the short trial period, the small number of participants, and the weak before/after trial design. The program logic of the intervention is however sound, reflecting the literature on chronic disease management and current barriers to high quality care. CDM-Net is designed to encourage GPs to prepare and review care plans, to promote multi-disciplinary team care and management that follows care protocols. The expectation is that this will result in higher quality care and better outcomes for patients.

GPs involved in the research trial achieved a large increase in the *rate* of care planning activity up approximately 200% in care plan preparation and team care arrangements and the *rate* of reviews also appeared to have increased substantially, by an estimated 385% and 225% for GPMPs and TCAs respectively. Observations suggest multi-disciplinary team care is being encouraged by CDM-Net. Patients also report greater use of dietician, podiatry and diabetes educator services during than before the trial; based on self-report and also as suggested from Medicare data. The care plan process also demonstrates considerable dialogue between GPs and other members of a patient's care team. It is not possible at this stage to know whether the initiative has or will result in better patient outcomes, in terms of health and wellbeing, or a reduction (or increase) in use and cost of other health services.

As yet, any benefits are not translating into quality of life improvements, as measured by the AQoL, which shows no change between base-line and follow up. However, the capacity to observe any change in quality of life was compromised by the short follow up period and lack of a control group.

The increase in care planning activity and the greater utilisation of related health care services will result in an increase in cost to government. CDM-Net provides for the GP a potentially more efficient approach to care planning, in terms of GP time.

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10 Economic and Social Benefits of Wider Implementation of CDM-Net

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10.1 Introduction

This section revisits the business case for CDM-Net and the possible wider public benefits of rolling out CDMS, which were addressed in the proposal presented to government to obtain support for the project. The proposal argued that the advantages of CDMS would extend beyond improved health for individual patients to broader public benefits. These would be primarily in the form of economic benefits arising from reduced disability from diabetes such as higher workforce participation rates and social returns that were expected to arise from public investment in the development of CDMS.

Each of these issues is discussed, as are the business case and the public benefits in the form of broader economic and social benefits.

10.2 Returns to innovation

In general, public support for investment in innovation is based on the argument that the social returns of research and development are higher than the private returns because it is difficult for private investors to capture all the returns to their investment. Some of the benefits of research and development, such as the value of new products and services, are said to ‘spill over’ to other users. These ‘spill overs’ arise because of the nature of the knowledge on which innovation is based. The creation and use of knowledge has ‘public good’ characteristics of non rivalry and non excludability. Non rivalry means knowledge can be made available to multiple users without additional cost. Non excludability means other users cannot be denied access. As a result, despite the operation of patent and copyright laws, the benefits of new discoveries are not entirely captured by the inventors. There are almost inevitably spill overs effects of any new innovation, so successful new ideas can be imitated without adequate compensation to the original inventors.

Accordingly, the level of investment in research and development by private investors is lower than is socially optimal and the government is justified in supporting investment in research and development, with the objective of lifting it to the socially optimal level.

While these considerations apply to investment in health research and development in general, and much of the investment in e-health in particular, there are other complications involved in investing in e-health research and development that go beyond the special nature of knowledge. In the health sector, the relationship between consumer and service provider is far from simple. In a more usual market environment, the consumer, in deciding to buy a particular product or service, makes an informed choice between competing products based on price. In the health sector these choices are influenced by many factors such as physicians, hospitals, insurers and government agencies, which effectively remove the consumer from the purchase decision. Thus, despite the considerable benefits, which greater use of information technology (IT) in the health sector could yield to health consumers, the normal market pressures for the investment are muted by the many intermediaries who have other concerns and interests.

There is serious underinvestment in health IT compared with similar information-intensive industry sectors. Figure 10-1 on page 150 shows investment in IT in the health care sector in Australia is only $1.25 billion or about 1.4% of total expenditure compared with $7.4 billion in the financial services sector or 9% of expenditure [1]. The high expenditure on IT by the financial services sectors over the last two decades has reduced costs and increased efficiencies, which is reflected in a steep decline in the cost to income ratio. It has also resulted in the introduction of a range of new services which, through the integration of many different databases, has enabled consumers to, for example bank remote and access accounts from anywhere in world.

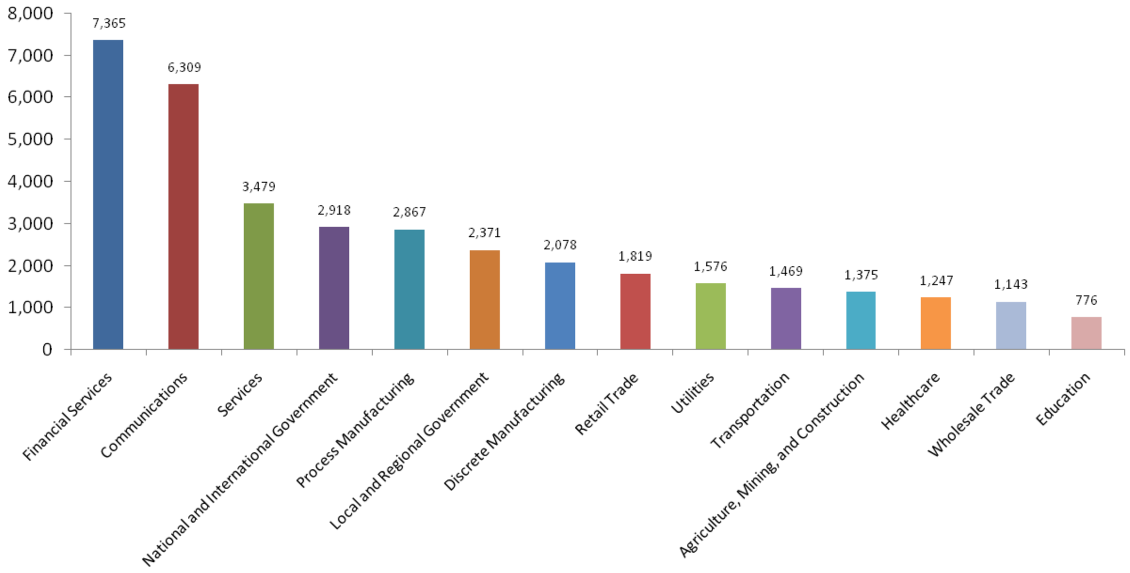

Figure 10-1: Estimated Australian IT spent by industry 2007 $m [1]

The issue in establishing an e-health strategy is not simply one of underinvestment, but also the allocation of that investment. In the United States of America (USA), a country with one of the lowest per capita investments in e-health in the developed world, both issues were addressed in a recent report published by the USA National Research Council of the National Academies. The report was written by a committee established by the National Library of Medicine for the purpose of examining how the effectiveness of IT applications to health care could be increased and how these applications could be improved through additional research and development [2].

The report was highly critical of the current application of IT in the health sector, particularly of the failure to provide ‘computer based tools and systems that offer clinicians and patients assistance to think about and solve problems related to specific instances of health care’ [2]. The report describes this failure to provide computer based tools and systems for clinicians and patients as ‘the central conclusion’ [2], and argues that existing IT investments tend to focus on the automation of business processes implemented in a ‘monolithic fashion that makes even small changes hard to introduce’ [2]. While they serve the interests of health care organisations, these investments have done little towards providing clinicians with the tools to deliver better patient health outcomes. This is one of the implications of separating the consumer from the service purchase decision.

Deciding which strategy to adopt in allocating resources to e-health is a vexed issue. One follows a centralised strategy which emphasises building a single uniform platform to which other tools could be attached later. The other, a decentralised strategy, emphasises the development of the tools, incrementally dealing with the construction of a common information platform. The future of the roll out of CDM-Net was clearly formulated on the latter strategy.

The latter strategy was also suggested by the Deloitte report [1] and is largely reflected in the National eHealth Strategy published by the Australian Health Ministers' Conference in December 2008. In developing a common information platform, this strategy is relatively decentralised. It focuses on formulating governance structures to achieve the connectivity between new and existing systems and coordinating the development of new systems to avoid duplication. The vision emphasises the advantages of developing tools to improve health care delivery and patient outcomes. The strategy proposes that IT solutions to identified health care problems would be developed in an innovative and responsive way by drawing on the experiences of small scale projects, which could be rolled out nationally if their success can be demonstrated. The report recommends a development fund be established to help finance such small scale initiatives in high priority areas. Improved chronic disease care management through health care plans is specifically mentioned as such a priority [1].

At the heart of the two approaches, one centralised and the other decentralised, is the creation of a patient e-health record. Largely reflecting the structure of their health systems, the USA and the UK represent the examples of polar extremes of the two approaches are being developed, decentralised and centralised respectively.

One is to develop, via a centralised top down approach, a single platform e-health record. The UK's nationalised health scheme lends itself to such centralised approach because it is one of the few national single payer schemes in the world. The rollout of the NHS National Program for IT (NPFIT) is a necessary enabler for a larger health care reform program. The scheme is delivering tangible benefits to patients and health providers but at a massive cost, and by necessity, renders many existing IT investments obsolete, because it forces compatibility on all non-complying systems. It is also relatively inflexible and risks being substantially out-of-date by the time it is implemented as health needs and management requirements change [3]. Such monolithic IT systems come at very high cost. The NPFIT costs 12.7 billion pounds sterling, the largest e-health project in the world. The House of Commons parliamentary review (The National Programme for IT in the NHS 2009) found the project to be four years behind schedule may substantially exceed budget and two of four vendors had left the program making delivery more difficult [4]. Thus it is a high risk project for any government for a large and complex health system.

In contrast, such systems are more appropriate in smaller countries. Hong Kong has been working on a centralised health record since the 1990s, progressively adding functionality over time. Patient hospital records were introduced first; pharmaceuticals were added in 2000 and they are currently working towards adding private health clinics. Most of the development has been undertaken within the Hong Kong hospital Authority and, therefore extended with maximum consultation with end users [5]. Singapore has adopted a somewhat different approach by enlisting the help of software vendors, but again the scale (population of less than 5 million) is more compatible with implementing a uniform system [6].

An alternative is a bottom up approach, which seeks to link existing systems to create a Health Information Exchange (HIE) which has the advantage of retaining the value of as much of the existing investment in health IT systems, while focussing new expenditure on the particular objective of the e-health record, which is to link information about a single patient to multiple health providers. It has the further advantage of reflecting local institutional needs. Particular elements can be added or deleted to meet local needs without necessarily undermining the whole system. It retains a capacity for the HIE to be innovative. New services can be trialled by particular institutions, tested and, if successful, adopted elsewhere.

However, some of the problems of the monolithic systems may remain. In particular, the needs of government and individual health providers differ. The task of establishing common standards to achieve sufficient interoperability to serve centralised needs such as those of central government agencies may delay the implementation of the HIE [4].

The Australian National eHealth Strategy represents a third way [1,3] which is variant of the HIE but perhaps gives the government a greater role in setting common standards and technical goals. Part of this is for the government to provide incentives for clinical providers to acquire systems that are functionally compliant with common standards. This is a framework in which CDM Net could clearly function effectively.

10.3 Literature on costs and benefits relevant to CDM-Net

Governments and private organisations around the world are in the process of committing to or rolling out large scale information technology programs within the health care sector. Associated with these initiatives there is an extensive literature on the application of information technology in health care and its associated costs and benefits. The results of these studies are mixed. Chaudry et al (2006) found that health information technologies (HIT) improve the quality and efficiency of health services [7], a review by the US Congressional Budget Office (2008) was more sceptical [8], while Shekelle and Goldzweig (2009) updating a previous comprehensive RAND review concluded that “While predictive analyses, based on statistical modelling techniques, suggest that HIT has the potential to enable a dramatic transformation in the delivery of healthcare, the empirical research evidence base supporting HIT benefits is more limited” [9].

There is a somewhat smaller body of literature on the effectiveness of chronic disease management approaches in improving patient health and reducing the costs of chronic disease. Meyer and Smith (2008) recently reviewed 27 studies in this area, three of which were meta-analyses of 148 studies and two were literature reviews [10]. As well as diabetes, the review concentrated on congestive heart failure, asthma/COPD, depression, multiple conditions in older people and high-risk pregnancies. The authors observed that the available research evaluates different interventions and different diseases in different settings among different populations according to different methodologies [10], leading to the conclusion that the literature produces mixed results. Nonetheless, they conclude that well-designed chronic disease management programs can produce a return on investment when they are characterized, inter alia, by:

- targeting patients according to predictors of continued high utilization which substantially enhances the opportunity for savings
- strong individualization with interventions customized to the particular patient
- engagement of patients with multi-disciplinary teams to provide support and treatment across multiple interventions, e.g. dietary, pharmaceutical, social service

support, self-management, early symptom spotting and access to physicians to prevent exacerbations
- health information technology that is frequent, highly interactive with patients, facilitates contact with clinicians, and provides information and decisions-support to clinicians [10].

The review found that most of the savings associated with chronic disease management are due to reductions in hospitalization and emergency department use. For congestive heart failure this reduction was in the range 21% to 48%, for asthma/COPD it was 11% to 60%, and in diabetes from 9% to 43% [10].

Where costs were measured they were relatively modest ranging from $100 to $1399 per patient. While most studies reported overall costs declining, pharmaceutical costs rose with greater adherence to medication. However, dietician-based management of diabetics could reduce this use [10].

It was concluded that:

- predictable savings can be achieved if chronic care management is based on individualized care plans with periodic reassessment; there should be continuous monitoring of patients, including self-monitoring, adherence to medication regimens, and reporting on conditions, and
- incentives should be provided to clinicians to adopt health information technology and electronic medical records that can be used as decisions support tools and to track patient treatment and interventions [10].

Concentrating on CDM for diabetes, Meyer and Smith (2008) refer to other studies [11,12] to demonstrate that intensive interventions including use of multi-disciplinary teams applying type-specific treatment algorithms, monitoring that includes adjustments in medications, meal planning, exercise reinforcement , follow-up, and extended education lead to reduced HbA1c levels [10]. The Center for Health Care Strategies reviewed seven studies of similar interventions and found significant reductions in utilization of hospitals and emergency rooms [13].

Meyer and Smith (2008) drew on other studies [12,13,14] to estimate that intensive interventions of this type result in a US$685-$950 drop in per patient per year costs, a 9% drop in all-cause hospitalization, a 71% fall in emergency room utilizations and 21% fewer insurance claims [10].

A study has recently been reported that evaluates a system similar to CDM-Net [15]. The Computerization of Medical Practices for the Enhancement of Therapeutic Effectiveness (COMPETE) II study was carried out in 2002 and 2003 in Ontario, Canada and involved 46 primary care providers and 511 patients. The intervention was an electronic decision support system which integrated a Web-based diabetes tracker with the provider's electronic medical record and an automated telephone reminder system. Using a composite measurement of patient condition, the intervention improved outcomes for 61.7% of patients compared to 42.6% of patients in a control group. The intervention group had significantly better outcomes with respect to blood pressure and glycated hemoglobulin levels. A cost-effectiveness analysis of this trial is being undertaken [15].

The Center for Information Technology Leadership has estimated the costs and benefits associated with a number of models of information technology-enabled diabetes management [16]. The model closest to CDM-Net is their Integrated Provider-Patient Systems which if fully implemented in the USA would improve average levels of HbA1c by 0.68, blood pressure by 4.2 mm Hg and lower cholesterol by 45 mg/dl. This would result in a reduction in diabetes-related mortality of 920,000 over ten years. The cost of implementing this would be US$58.8 billion; savings would come to US$16.98 billion with a net cost of US$41.9 billion [16]. However the extent to which costs and benefits for US programs can be translated into similar cost and benefits in Australia is limited by the very real differences between the health care systems in the two countries.

In Australia, Zwar and associates analysed 141 studies and 23 systematic reviews of the effects of interventions on the management of chronic physical disease taking the Chronic Care Model as a framework [12,17,18]. They concluded that the interventions most likely to be successful in Australia were engaging primary care in self-management support through education and training for GPs and practice nurses, including self-management support in care plans linked to multidisciplinary team support [17]. An audit of GPs in Southwest Sydney found that patients introduced to multidisciplinary care plans for diabetes had improved metabolic control and cardiovascular risk factors in terms of blood pressure and cholesterol levels [19,20].

10.4 Costs and benefits of web-based chronic disease management for type 2 diabetes

This section presents some estimates of the likely cost and benefits associated with a full scale implementation of CDM-Net in Victoria concentrating on its use for the management of type 2 diabetes. Because CDM-Net is designed to cover all chronic disease, including both type 1 and type 2 diabetes its overall benefits will be much larger than those given in this section when fully implemented. Costs and benefits are presented for a range of stakeholders and these are summarized in Table 10-1 on page 154.

Table 10-1: Stakeholders, benefits and costs

Stakeholder	Benefits	Costs
Doctors/Practices	Increased revenue from MBS for health plans Better use of practice staff	Cost of CMD-Net subscription
Dieticians, podiatrists other health professionals	Increased revenue from MBS and/or fee for service	Costs of access to CDM-Net
Hospitals/Victorian Government	Decreased use of hospital services, reduced adverse events	
Patients	Improved health measured in QALYs and converted to $ using value of life estimates Reduced out of pocket expenses for health services Reduced travel and other expenses Income from greater workforce participation and productivity	Increased out of pocket expenses from increased use of CDM services – visits to health professionals, medicines, other services
Commonwealth Government	Increased tax revenue, decreased welfare payments from greater workforce participation	Greater payments for MBS and PBS services
Economy	Increased workforce Increased productivity	Increased taxes to pay for increased use of MBS and PBS

Aside from the cost and benefits estimated in this section, there will be additional benefits for the providers of healthcare software and for unpaid carers.

10.4.1 Modelling assumptions

10.4.1.1 Number of GPs

According to the AIHW (2009) there were 6,186 full- and part-time primary care clinicians in Victoria in 2007 and 24,121 Australia wide [21]. There were 5,736 and 21,919 in 2003 implying an annual growth rate of 1.9% and 2.4% respectively. Applying these growth rates gives estimates for the number of primary care physicians in Victoria in 2010 of 6,547 and 25,916 across Australia. If these growth rates are maintained the number of GPs in later years will be as shown in Table 10-2 on page 155.

Table 10-2: Number of primary care physicians

	Victoria	Australia
2007	6,186	24,121
2010	6,547	25,916
2014	7,060	28,520
2019	7,759	32,145

Source: AIHW 2007 actual [22], 2010-2019 estimated

Reaching all these physicians in Victoria over a five year period means seeing about 1,400 per year or about 27 per week. Over ten years this would mean 800 contacts per year or about 15 per week.

10.4.1.2 Number of people with type 2 diabetes

From the 1999–2000 AusDiab study, it has been estimated that nearly 840,000 Australian adults aged 25 years or above had type 2 diabetes in 1999–2000, which constitutes 7.1% of the population [23]. Based on self-reported data from the National Health Survey [24], type 2 diabetes accounted for 83% of all diabetes in 2004–05. This corresponds to an estimated 582,800 (3%) of Australians. Prevalence estimates based on measured data are much higher than those based on self-reports because they include people with undiagnosed diabetes. In addition, the figures from the National Health Survey apply to the whole population, while AusDiab only covers adults aged 25 years and over [23,24].

Based on constant prevalence rates as reported above and using ABS projections of population to 2019 this means that the number of people with type 2 diabetes is estimated to be as shown in Table 10-3 on page 155. The estimates for Victoria are based on that state's share of population in a particular year.

Table 10-3: Number and estimated number of people with type 2 diabetes

	VIC	VIC	AUS	AUS
	ABS Survey	**AusDiab Study**	**ABS Survey**	**AusDiab Study**
1999-00		208,000		840,000
2004-05	144,241	221,096	582,800	893,327
2010	157,688	241,707	638,980	979,441
2014	167,488	256,730	683,839	1,048,202
2019	180,475	276,636	743,348	1,139,419

Source: AIHW (2008) [23], ABS 2006 [24] actual, 2010-2019 estimated

For Victoria this implies an average of 24.1 diagnosed type 2 diabetes patients per primary care physician or about 36.9 people with diabetes per physician in 2010. The averages for the whole of Australia are 24.7 and 37.8 respectively.

10.4.1.3 The number of people with chronic disease

According to AIHW based on the ABS National Health Survey, some 77% of Australians in 2004-05 had at least one long term condition defined as one which has lasted or is expected to last for at least six months. Vision and hearing problems and allergic conditions were common as were chronic conditions such as asthma (10.0% of the total population), osteoarthritis (7.9%), depression (5.3%) and diabetes (3.5%) [25].

In their analysis of chronic disease and participation in work, AIHW estimates that there were 3,431,100 people aged 25 to 64 in 2004-05 that had one or more of the following chronic diseases: arthritis, asthma, chronic obstructive pulmonary disease (COPD), coronary heart disease (CHD), depression, diabetes, osteoporosis and stroke [21]. This represents about 31.7% of the population in this age group. The numbers of people aged 25 to 64 with the most common chronic diseases in 2004-05 are listed below. Adding together the numbers in the table overstates the number of people aged 25 to 64 with chronic disease as people can have more than one disease, especially in older age groups (Table 10-4 on page 156).

Table 10-4: Number of people with chronic disease aged 25 to 64, Australia, 2004-05

Arthritis	1,773,300
Asthma	990,100
CHD	87,300
COPD	298,500
Depression	761,400
Diabetes	287,700
Osteoporosis	238,400
Stroke	67,900

Source: AIHW (2008) [21].

Based on the numbers of primary care physicians in 2003 and 2007 reported earlier, it is estimated there were 23,550 physicians in Australia in 2004-05. This implies about 152.8 people aged 25 to 64 with chronic diseases per physician.

10.4.1.4 Progressive adoption of web-based CDM services

This section estimates how many people with type 2 diabetes will be on CDMS plans if web-based services similar to CDMS are adopted by doctors across Victoria. Two scenarios are modelled. In the first all doctors are visited over the five years 2010-2014 which as noted earlier means that about 1400 per year are visited or 27 per week. The second scenario sees this occurring over ten years with 800 visits per year or 15 per week.

Within the two scenarios we make three assumptions about the adoption rate among doctors. In the first it is assumed that 50% of doctors use the web-base services. For the other two the assumed adoption rates are 75% and 25%.

Based on the growth rates for doctors and type 2 diabetes patients and assuming a ten year recruitment profile and a 50% adoption rate, the numbers of patients on web-based care plans over the period is as shown in Table 10-5 on page 157. The numbers begin at

7,884 in 2010 but increase rapidly as new patients are added each year to reach the maximum of 50% of patients in 2019.

Table 10-5: Recruitment of doctors and patients, 10 year recruitment period, 50% adoption

	Doctors	Type 2 diabetes patients	Patients per doctor	New doctor visits in year	Doctors adopting	Stock of doctors using	New patients on service	Stock of patients on service
2010	6,547	157,688	24.1	655	327	327	7,884	7,884
2011	6,671	160,094	24.0	731	365	693	8,765	16,650
2012	6,798	162,528	23.9	744	372	1,065	8,898	25,548
2013	6,928	164,992	23.8	759	379	1,444	9,033	34,581
2014	7,060	167,488	23.7	773	387	1,831	9,170	43,751
2015	7,195	170,018	23.6	788	394	2,225	9,308	53,060
2016	7,332	172,580	23.5	803	401	2,626	9,449	62,509
2017	7,472	175,178	23.4	818	409	3,035	9,591	72,100
2018	7,614	177,810	23.4	834	417	3,452	9,735	81,835
2019	7,759	180,475	23.3	850	425	3,877	9,881	91,716

Source: Model calculations

10.4.2 Calculation of benefits and costs

10.4.2.1 Health professionals

The income generated from Medicare Australia for services provided to this stock of patients is calculated as follows. It is assumed that a patient on a care plan incurs the following number of Medicare Benefits Schedule services per year at the fee for the service current in December 2009 assuming all items are bulk-billed (Table 10-6 on page 157). Five allied health payments per patient per year are allowed and the five listed in the table are chosen as the most likely to be used by type 2 diabetes patients. In addition each general practitioner receives an outcomes payment of $20.00 per year per diabetes patient under the Practice Incentives Program – Diabetes Incentive.

Table 10-6: Assumptions for modelling income from MBS

Number	Description	Permitted annual frequency	Assumed annual frequency	Medicare fee $
721	GPMP	1	0.5	133.65
723	TCA	1	0.5	105.90
725	GPMP review	3	1.5	66.80
727	TCA review	3	1.5	66.80
10951	Diabetes Education Service	1	1	58.85
10953	Exercise Physiology	1	1	58.85
10954	Dietetics Services	1	1	58.85
10960	Physiotherapy	1	1	58.85
10962	Podiatry	1	1	58.85

Source: Medicare Australia 2009 [26].

Applying these assumptions to the stock of patients in Table 10-6 on page 157 gives revenue streams to doctors and allied health professionals as shown in Table 10-7 on page 158, assuming they charge the Medicare fee.

Table 10-7: Income from MBS for health professionals, $million

	MBS Item 721	**MBS Item 723**	**MBS Item 725**	**MBS Item 727**	**MBS item 10951**	**MBS item 10953**	**MBS item 10954**	**MBS item 10960**	**MBS item 10962**	**GPs 721-727**	**Allied 1095-10962**	**PIP – diab-etes**	**Total**
2010	0.5	0.4	0.8	0.8	0.5	0.5	0.5	0.5	0.5	2.5	2.3	0.2	5.0
2011	1.1	0.9	1.7	1.7	1.0	1.0	1.0	1.0	1.0	5.3	4.9	0.3	10.6
2012	1.7	1.4	2.6	2.6	1.5	1.5	1.5	1.5	1.5	8.2	7.5	0.5	16.2
2013	2.3	1.8	3.5	3.5	2.0	2.0	2.0	2.0	2.0	11.1	10.2	0.7	21.9
2014	2.9	2.3	4.4	4.4	2.6	2.6	2.6	2.6	2.6	14.0	12.9	0.9	27.8
2015	3.5	2.8	5.3	5.3	3.1	3.1	3.1	3.1	3.1	17.0	15.6	1.1	33.7
2016	4.2	3.3	6.3	6.3	3.7	3.7	3.7	3.7	3.7	20.0	18.4	1.3	39.7
2017	4.8	3.8	7.2	7.2	4.2	4.2	4.2	4.2	4.2	23.1	21.2	1.4	45.7
2018	5.5	4.3	8.2	8.2	4.8	4.8	4.8	4.8	4.8	26.2	24.1	1.6	51.9
2019	6.1	4.9	9.2	9.2	5.4	5.4	5.4	5.4	5.4	29.4	27.0	1.8	58.2
Total	32.7	25.9	49.1	49.1	28.8	28.8	28.8	28.8	28.8	156.8	144.1	9.8	310.6

Source: Model calculations

Over the ten year period doctors gain $156.8 million, allied health professionals $144.1 million with practice incentive payments of $9.8 million for a total of $310.6 million.

With different assumptions about how fast doctors can be recruited to develop web-based care plans and their rate of adoption of web-based services the revenues estimates vary, as shown in Table 10-8 on page 158.

Table 10-8: Income from MBS for health professionals, $million -alterative scenarios

	Doctors MBS Items 721-727	**Allied MBS Items 10951-10962**	**Total**
Ten year – 50% adoption	156.8	144.1	310.6
Ten year – 75% adoption	235.2	216.1	466.0
Ten year – 25% adoption	78.4	72.0	155.3
Five year – 50% adoption	223.2	205.1	442.2
Five year – 75% adoption	334.7	307.6	663.3
Five year – 25% adoption	111.6	102.5	221.1

Source: Model calculations

The faster that doctors can be recruited to take up developing web based care plans, the more patients there are on care plans. Similarly the greater the adoption rate, the higher the revenue. At one extreme, income for doctors is $663.3 million if 75% adopt the service over five years and at the other extreme, income is $155.3 million if 25% adopt over ten years.

10.4.2.2 Public hospitals

In 2007-08 the following indicates the use of public hospitals in Victoria by diabetics [23] and the number of separations in Victorian public hospitals in 2007-08 for diabetes-related diagnostic reference groups (DRG) (Table 10-9 on page 159). Table 10-9 also includes the rate for each in terms of the number of separations as a percentage of all type 2 diabetics in Victoria in 2007-08, and the average cost per separation for each DRG.

Table 10-9: Separations for diabetic procedures, Victorian public hospitals, 2007-08

Diagnostic Reference Group (DRG) description	Separations	Rate, %	Average cost per DRG,$
K01Z Diabetic foot procedures	787	0.52	22,229
K60A Diabetes with catastrophic or severe complications	1,508	0.99	8,328
K60B Diabetes without catastrophic or severe complications	5,107	3.36	3,155

Source: DoHA 2009 [27].

The cost savings to Victorian public hospitals can be calculated by comparing the cost if all those on care plans no longer make use of these services in hospitals. Without the introduction of web-based care plans, the use of these services would cost $513.3 million over the period 2010-2019 while the cost would be $364.5 million with a 50% adoption rate, a savings of $148.8 million. This assumes that the average cost per DRG remains at 2007-08 levels.

Table 10-10 on page 159 shows the savings under different assumptions about recruitment and adoption.

Table 10-10: Savings in hospitals, $million - alterative rollout and adoption scenarios

	Savings $m
Ten year – 50% adoption	148.8
Ten year – 75% adoption	223.2
Ten year – 25% adoption	74.4
Five year – 50% adoption	211.8
Five year – 75% adoption	317.7
Five year – 25% adoption	105.9

Source: Model calculations

10.4.2.3 Patients

The primary beneficiaries of the widespread adoption of web-based chronic disease management plans are the patients enrolled in such plans. Their health will either improve or not deteriorate and they will avoid many of the potential negative consequences of type 2 diabetes.

The number of patients benefiting in this way for the purposes of this modelling are shown as the last column in Table 10-5 on page 157 with the numbers rising from 7,884 in 2010 to 91,716 in 2019 assuming a recruitment period to 2019 and a 50% adoption rate.

A conservative assumption is that the quality of life for patients enrolled in the service improves or does not deteriorate by 5% compared to patients not on a care plan; that is, there is a 5% increase in quality-adjusted life years (QALY) for each patient, from say 0.70 to 0.75. This assumption is not inconsistent with the results of studies seeking to measure the impact of a range of similar interventions on diabetes health outcomes which tend to be in the range 5-10%. [12, 14 and 28]. This improvement can be expressed in monetary terms by assuming a value for a life year. Estimates in Australia for the value of a life year range from about $50,000 (the implicit value used in decisions about listing medicines on the PBS and in other health technology assessments) to about $100,000 [29,30]. A recent review of estimates of the value of a life and a life year by Access Economics for the Australian Safety and Compensation Council suggested an average value for the latter for Australia of $252,014 in a range of $155,409 to $340,219 in 2006 dollars [31].

Taking the conservative estimate of $50,000 means that the value of the benefit for each patient on a web-based care plan would be 0.05*$50,000 or $2,500. Applying this value to all patients enrolled in the service as shown in Table 10-5 on page 157 gives a value of the service to patients of $19.7 million in 2010 rising to $229.3 million in 2019. This is value is imputed based on estimates of the value of life made in the literature and does not represent market transactions.

Patients will also benefit in terms of:

- increased income if they return to the workforce or increase hours spent at work
- increased income if better health leads to greater productivity at work
- savings on the use of health and other services associated with improved health.

These are explored further in Section 10.4.2.5 on economy wide benefits below.

The extent to which patients using web-base services will incur extra costs depends on the out-of-pocket expenses associated with greater use of health services including MBS services and PBS medicines. For this modelling it is assumed that all MBS items are bulk-billed so there is no charge to the patient.

If an average patient on a care plan has three PBS medicines dispensed per month for a total of 36 prescriptions per year this would cost a general patient $1,184.40 per year at a fixed co-payment of $32.90 per prescription. For patients with concessional health cards or general patients under the safety net, the cost would be $190.80 at a co-payment of $5.30 per prescription. Finally for concessional patients under the safety net the cost would be zero. General patients were responsible for about 6.3% of PBS prescriptions for diabetes medicines in 2007-08, with concessional patients at 62.6%, general safety net patients at 5.0% and concessional safety net patients at 26.1%. Applying these percentages implies an average annual cost to the patient of $203.5 per patient or $99.6 million over ten years.

10.4.2.4 Commonwealth Government

For the Commonwealth Government there are benefits arising from the tax revenue generated through increased workforce participation of type 2 diabetes patients and concomitant reduced social service payments. These are explored further below.

The principal cost of web-based chronic disease management services is the increase in MBS and PBS payments. The cost of increased MBS services as income for health professionals is shown in Table 10-6 on page 158 above.

In 2007-08, the Government paid 89.6% of the cost of supplying PBS medicines to treat diabetes at an average cost of $45.38 per prescription. The cost to the Government of supplying the cohort of patients using web-based chronic disease management plans assuming 36 prescriptions per year would be $13.2 million in 2010 rising to $75.8 million in 2019 or $569.3 million over the ten year period.

10.4.2.5 Economy wide benefits

According to the AIHW analysis of the 2004-05 National Health Survey [21], the labour force participation rate of persons aged 25-64 with diabetes was 69.0% compared to 83.0% for all persons aged 25-64.

This suggests that of the estimated 157,688 persons with type 2 diabetes in Victoria in 2010, there were 108,805 in the labour force. If persons with type 2 diabetes participated at the same rate as all persons this would be 130,881 or 22,076 more. Assuming an unemployment rate of 5% this means that potentially 20,973 extra persons with diabetes could be employed.

In 2008-09, Australian GDP was $1,095,264 million and average employment was 10,793,005 meaning GDP per employed person was $101,479 [32]. In the same year compensation for employees was $569,031 million or $52,722 per employed person.

An extra 20,973 persons therefore would add $2,128 million to GDP and $1106 million in compensation to employees.

Given the assumptions about the numbers of people with type 2 diabetes on web-based CDMS in Table 10-5 on page 157, this means that an extra $109.1 million would be added to GDP in 2010 rising to $625.9 million in 2019 or $4,703.4 million over the ten years. This would also mean an extra $2,443.6 million in employee compensation and $733.1 million in extra tax revenue assuming an average tax rate of 30% (Table 10-11 on page 161). In addition, the Commonwealth Government will receive a further $93.2 million in the form of taxation payable by health professionals on the extra $310.6 million paid to them by MBS (Table 10-8 on page 158), for a total of $826.5 million over ten years.

Table 10-11: Additional employment, GDP and taxation revenue

	Employment	**GDP**	**Employee compensation**	**Taxation revenue**
	Number	$m	$m	$m
2010	1,075	109.1	56.7	17.0
2011	2,166	219.8	114.2	34.3
2012	3,301	335.0	174.0	52.2
2013	4,453	451.9	234.8	70.4
2014	5,622	570.6	296.4	88.9
2015	5,728	581.3	302.0	90.6
2016	5,836	592.2	307.7	92.3
2017	5,944	603.2	313.4	94.0
2018	6,055	614.5	319.2	95.8
2019	6,167	625.9	325.2	97.5
Total		4,703.4	2,443.6	733.1

Source: Model calculations

10.5 Summary of benefits and costs

The literature on the costs and benefits of health information technology in general are mixed in their conclusions. However, the much smaller number of studies on the effectiveness of chronic disease management approaches in improving patient health and reducing the costs of chronic disease are more positive. For instance, Meyer and Smith conclude that:

- predictable savings can be achieved if chronic care management is based on individualized care plans with periodic reassessment. There should be continuous monitoring of patients, including self-monitoring, adherence to medication regimens, and reporting on conditions, and
- incentives should be provided to clinicians to adopt health information technology and electronic medical records that can be used as decisions support tools and to track patient treatment and interventions [10].

Based on the experience with CDM-Net, the following benefits might be expected to flow from a full scale rollout of web-based CDM services in Victoria over a ten year period with a 50% take-up of the service by doctors.

Over the ten year period doctors would gain $156.8 million, allied health professionals $144.1 million with practice incentive payments of $9.8 million for a total of $310.6 million.

Victorian public hospitals would save $148.8 million due to a reduction in diabetes related separations.

The benefit to patients from better chronic disease management would be $19.7 million in 2010 rising to $229.3 million in 2019, for a cumulative total over the ten year period of $1.22 billion. Offsetting this is a cost of $99.6 million over the ten years for medicines.

The cost to the Commonwealth Government of supplying the cohort of patients with chronic disease management plans would be $310.6 million derived by health professionals from MBS items and $569.3 million for PBS medicines over the ten year period.

Given the assumptions about the numbers of people with Type 2 diabetes on web-based CDM services in the study, an extra $109.1 million would be added to GDP in 2010 rising to $625.9 million in 2019 or $4,703.4 million over the ten years. This would also mean an extra $2,443.6 million in employee compensation and $733.1 million in extra tax revenue assuming an average tax rate of 30%.

Overall, based on these assumptions, a wider rollout of CDM-Net would provide doctors and allied health professionals with a gain of $311 million and benefits to the Victorian public hospital system of about $149 million at a cost to the Commonwealth of almost $880 million. This would be compensated for by the improved health of individuals and their consequential higher workforce participation rate which could result in additional tax revenue of about $730 million. In addition, the Commonwealth would receive a further $93 million from taxes on the increased payments to healthcare professionals.

The above analysis only considered diabetes patients and the costs and benefits to Victoria of a wider rollout of CDM-Net. Clearly, these costs and benefits will be multiplied by extending the analysis to all chronic diseases covered by CDM-Net and a national rollout.

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Appendices

Appendix 1: The evidence for collaborative care

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There is a growing amount of local and international research that suggests collaborative care in chronic disease management, enabled by appropriate information and communication technologies, could provide higher quality, safer, more equitable and more efficient care for people with chronic disease.

In Australia, the rationale for promoting collaborative care in chronic disease management is widely supported by research evidence in Australia [1-3]. In the following sections, we review some of the related national and international evidence for collaborative care.

1. Higher quality and safer care

Specifically, collaborative care in chronic disease management can lead to:

- Improved control of chronic disease.

Intensive interventions which include the use of multi-disciplinary teams applying specific treatment guidelines, monitoring of patients to include adjustments in medications, exercise reinforcement, follow-up and extended education, have been demonstrated to cause HbA1c levels to fall from 9 percent to 7.3 percent over 12 months, compared to people in a control group who maintained HbA1c levels from 8.9 to 8.3 percent with usual care [4]. Multi-disciplinary teams and integrated quality management have been shown to lead to similar reductions in HbA1c s and significant improvements in the proportion of patients able to achieve desirable levels (78 percent compared to 69 percent at baseline) [5]. A retrospective chart review demonstrated that where HbA1c levels were reduced by one percent and sustained over five years, mean per patient costs were $685-$950 less per year than the per patient costs of people in the control group, who by definition did not achieve glycemic control [6]. Evidence therefore supports the view that intensive, rigorous follow-up of patients with diabetes leads to better outcomes as measured by intermediate markers such as HbA1c.

- Empowering consumers to better manage their own health.

Active consumer management and engagement in their health conditions have been shown to have a significant positive impact on health outcomes. Studies have shown reduced use of hospital bed days, reduced numbers of emergency room visits and improved clinical conditions for consumers that actively manage their own healthcare. The flow on effects have included a reduction in costs of over US$500 per patient per year, as well as secondary benefits such as improved social activity and reduction in depression [7].

2. Access by providers to decision support tool knowledge sources at the point of care.

- Increased adoption of best practice care and improved compliance.

Studies have shown that clinical decision support systems can enhance clinical performance for drug dosing, preventive care, and administration of recommended care [8].

People with chronic disease should be provided with a care plan, detailing medications, treatments, tests, and referrals tailored to their specific circumstances. Currently, Medicare data (Australia, 2008) show that less than 25% of people with a major chronic disease are provided with care plans, and fewer than 5% are tracked for adherence to their care plans. Collaborative CDM can be used to facilitate and enable effective management of these conditions by providing tools to support practitioners in the management of chronic disease, such as the electronic creation and management of care plans, disease registries, home monitoring and associated decision support. In Australia, Zwar et al have shown that following a care plan led to an increase in practitioners adhering to diabetes guidelines with a subsequent improvement in metabolic control and cardiovascular risk factors [9]. This is not limited to Australia alone, as studies of care plan management systems in the US with in-built alerting or reminders have demonstrated a 15% to 20% increase in the number of consumers receiving recommended care over the control group, and 40% to 60% improved compliance in disease control and planning [10].

- Reduced incidence of medically avoidable adverse events.

It is estimated that up to 40% of consumers are non-compliant with prescribed medication regimens, and non-adherence to medications has been linked to increased utilisation of health care resources, including emergency department and hospital admissions, general practice visits and nursing home admissions. Studies of automated monitoring systems for patients with chronic illness or who are otherwise at risk in the USA and the UK indicated that inpatient bed days per patient can be reduced by between 30 and 60% [11-13], while reducing the number of primary, emergency and ambulatory care visits by a similar amount.

3. More accessible and equitable care

Information Technology can enhance the provision of more accessible and equitable delivery of healthcare services, irrespective of a consumer’s demographic, socioeconomic or geographic profile [39]. In particular, for patients with chronic disease, broadband-based healthcare services will help support a more accessible and equitable health system by providing consumers with better visibility of care providers, the services offered and their availability.

For rural and remote communities, the development of online tools and remote care support will enable patients in these communities to gain access to more frequent care and support than would otherwise be available. For example, due to a shortage of specialist skills in a remote area of Sweden, a diagnostic imagery solution was used to provide online consultations. This resulted in a 50% reduction in waiting times and a 34% per cent increase in the number of tests conducted whilst minimising travel for patients [14].

4. Research data and analysis

- Improved service provision through access to better quality datasets of population health and treatment effectiveness.

By using the collection of information on health care delivery and management across the full care continuum, decision support tools and systems provide critical information to support care providers in determining the most appropriate treatment plans. This information can also support healthcare managers in expanding knowledge about diseases and the effectiveness of treatment regimes.

- Access to timely and comprehensive data to support the more effective surveillance and management of public health.

Collaborative CDM tools will support the collection of clinical data to support health surveillance and monitoring, improving the quality and safety of care through research [15]. A USA study found that the early detection of public health concerns was improved by an automated electronic laboratory reporting tool for notifiable diseases. The study found that there was an increase of 29% in the number of identified cases during reported disease outbreaks [16].

- Access to quality data sources to inform service and workforce planning and development and to effectively identify and address system throughput inefficiencies.

The health system is comprised of many distinct physical and human resources, all of which need to be effectively procured, allocated and scheduled. Improved management of these resources, a key element of a sustainable health system, is dependent on successful coordination, integration and sharing of information. IT-enabled Collaborative CDM can provide the tools and information needed to make the deployment and performance of resources more visible, supporting better planning and demand management.

5. More efficient care management

- Reduced hospitalisations and Emergency Department attendances.

The most common sources of savings from Collaborative CDM are reductions in hospital admissions or readmissions and cost per stay, regardless of the length of stay.

Among targeted CHF populations with more intensive interventions, the decline in hospital admissions ranged from 21 percent to roughly 48 percent, with 35 percent reductions in hospital costs [18-20]. In asthma/COPD, the decline in hospital admissions or readmissions ranged from 11 percent to 60 percent. Reductions in ED use ranged from 24 percent to 69 percent [17-21].

In diabetes, HbA1c values fell at least 1 percent and hospitalizations dropped from 9 percent to 43 percent. However, some studies show it may take up to 10 years for realize savings in diabetes [20].

Among elderly patients with multiple conditions, declines in hospitalization ranged from 9 percent to 44 percent. For example, Counsell [19] observed no changes until the second year, after which there was a 23% reduction in ED use. Sicker patients showed 44% fewer hospitalizations and 55% fewer ED visits in Year 2.

- Reduced incidence of adverse events.

The costs of adverse events and medical errors are significant. It has been estimated that 10% of hospital admissions are due to adverse drug events and that up to 18% of medical errors are due to the inadequate availability of patient information [26]. Adverse events broadly account for as much as 3.8% of total costs of care each year which represents approximately $3 billion [27] in avoidable annual expenditure.

Collaborative CDM will directly reduce the risk of adverse drug events through supporting care providers with access to clinical decision support tools and up to date consumer information at the point of care leading to a reduction in the number of prescribing errors. For example, implementation of computerised physician ordering systems (included alerting) in both the hospital and primary care settings reduced adverse drug events by up to 75% in the US [28], Canada [29], Sweden [14] and the UK [30,31]. The prevention of adverse drug events through the implementation of collaborative CDM is estimated to be in the order of $1.3 billion in net present value over ten years. This estimate is based on international evidence demonstrating that a minimum of 25% of adverse drug events can be avoided due to the availability of patient information at the point of care.

It is estimated that direct hospital costs of adverse events in Australia range between $483 million [32] and $900 million per annum [34]. Rates for adverse events in Australia are 16% [34]. It is estimated that half of these adverse events are preventable [32]. After adjusting for age and comorbidity, the presence of an adverse event is estimated to add $6826 to the cost of each admitted episode. The total cost of adverse events is estimated to be 15.7% of the total expenditure on direct hospital costs, or an additional 18.6% of the total inpatient hospital budget [27].

A major cause of preventable adverse events is lack of knowledge or incorrect information regarding existing patient medications, allergies, and prior adverse reactions [33]. Collaborative CDM can be expected to significantly reduce the incidence of such adverse events.

- Reduced time care providers spend manually developing care plans, ordering treatments, and repeating and sharing information across the health sector.

It is estimated that 25% of a clinician’s time is spent seeking information about patients [24] while 35% of referrals are inappropriate due to insufficient direct access to specialists and insufficient information being passed from primary care to specialists [22]. Collaborative decision support implementations overseas demonstrate significant direct productivity improvements for specialists, GP and pharmacists by helping to automate routine interactions between care providers such as referrals, prescriptions, and image processing. For example:

E-prescription implementations in Sweden, Boston and Denmark reduce provider costs and save time to improve productivity per prescription by over 50% [14]. E-referrals in Denmark reduced the average time spent on referrals by 97% [14] by providing more effective access to patient information for both clinicians [24].

Test ordering and results management systems reduce time spent by physicians chasing up test results by over 70% in implementations in America and France [22].

The estimated benefit for care provider time, reflecting a conservative 10% reduction of total time spent on messaging costs for clinical and ancillary staff and improvements from improved messaging quality, is in the order of $2.8 billion in net present value over ten years.

- Reduced time and cost spent undertaking unnecessary or duplicated treatment activities.

Studies in hospital environments have indicated that between 9% [35] and 17% [23] of tests are unnecessary duplicates [23]. Based on an estimate of A$36 as the mean cost of tests prevented [36] and a conservative estimate of a 15% reduction in tests, which could realise benefits in the order of $800 million in net present value over ten years.

6. Reduced community burden

- Reduced non-health costs.

The Diab Cost Study [39] determined that the non-health costs, for example, carers, travel, special foods, for diabetes sufferers is $1064 per year. While some of these costs are unavoidable, the total costs could be considerably reduced by better control of the disease and less adverse events. Moreover, better access via telehealth and remote monitoring could have a significant impact on travel and carer costs.

- Reduced travel required to/from rural and remote communities.

US studies also indicate significant cost savings from telehealth investments. One implementation of in-home monitoring generated a return on investment of more than 200% and total savings of US$5,271 per patient per year. Assuming that an estimated 20% of trips to and from care providers can be avoided as a result of IT-enabled Collaborative CDM in Australia, travel time savings are estimated to be of the order of $60 million in net present value over ten years.

7. Workforce productivity benefits

The annual loss in workforce participation from chronic disease in Australia is estimated to be about 537,000 person-years of participation in full-time employment, and approximately 47,000 person years of part-time employment [37]. Of the total loss in full-time employment, 40% was associated with arthritis, approximately 25% with depression, and around 10% each with asthma and chronic obstructive pulmonary disease. The overall loss to the workforce associated with the chronic diseases amounts to around half a million person-years.

Collaborative CDM provides improved quality of life and more accessible care for Australian patients and impacts in the economy from increased labour force productivity, reduced pressure on health sector wages and the more effective allocation of resources. For example, Castro [17] demonstrates that Collaborative CDM for asthma/COPD can result in a 76% reduction in lost school/work days.

The Productivity Commission [38] estimates that reductions in the prevalence of chronic disease through health initiatives could increase the participation rate of the workforce by around 0.65% or 175,000 people by 2030. This equates to approximately $8.5 billion per annum in input labour costs/household income. This evidence assumed a “non-compliance” rate of 55%, which adherence support systems such as CDM-Net would be expected to reduce significantly. This should further increase the workforce participation rate. Based on the estimates in that report, State and Territory and local government and Commonwealth net revenue would, as a result, go up by around $0.7 billion and $1 billion per annum (2005-06 dollars), respectively.

The Allen Consulting Group (ACG) [25] summarises research into potential benefits from implementation of an electronic health record over a ten-year period. The modelling indicates that the productivity of the Australian health sector would improve by between 4.8 and 6.0% within ten years based on IT-enabled efficiency and effectiveness improvements. This equates to approximately $4.3 – 5.4 billion per annum in 2008-09 dollars. ACG estimate that a national approach will increase real Australian GDP by between $7.5 and $8.7 billion (in 2008-09 dollars) per annum within ten years.

8. Acknowledgement

Some of the above data and analysis has been obtained from the Deloitte National E-Health Strategy report to the Commonwealth.

9. References

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Appendix 2: The CDMS care planning process

CDMS is a web-based interactive software service designed for monitoring and supporting care management. The range of chronic disease management processes provided through CDMS includes:

- creating evidence-based GPMPs and TCAs that included information about medications, treatment, laboratory investigations, and referrals to nursing and allied health (AH) professionals, that could be tailored to the specific needs of the patient
- tracking key health parameters against GPMPs and TCAs, sending reminder notices to patients about scheduled allied health visits, and supporting the timely review of GPMPs and TCAs
- enhancing collaboration by sharing of health information among the care team and with the patient
- monitoring key metabolic targets such as blood glucose and lipid levels and body weight, and
- providing feedback to patients and health professionals to enable them to initiate necessary interventions and changes to the GPMP and TCA

The CDMS care planning process commences when a participating GP decides a CDM-Net chronic disease management plan is required to manage a patient with type 2 diabetes and the patient agrees to participate in the project and provide informed consent.

Once the GP registers as a new CDM-Net user, he or she is provided with a secure login and password to enable him or her access to the CDMS website that included the shared electronic health records and care plans that were created for his or her patients. The GP forwards a referral for a GPMP including patient health information electronically to CDMS. CDMS then creates a draft GPMP for the GP. Upon final approval of the GPMP (possibly after modifying some of the elements of the plan), a TCA is automatically created and distributed to the selected care team. Once the care team has agreed on the TCA using CDMS, CDMS then tracks both the GPMP and TCA. At the appropriate time, usually six months after creation of the GPMP and TCA, CDMS generates a draft GPMP and TCA Review for the GP to undertake with the patient.

All patient information sent to Precedence Health Care during the CDMS referral process is encrypted using a Public Key Infrastructure (PKI) certificate, which is installed on the GP's computer. The process of creating and approving CDMS GPMPs and TCAs is depicted in Figure A 1 on page 174. The GPMP and TCA Review process follows a similar workflow.

1. Creating a General Practice Management Plan (GPMP) *

- The general practitioner (GP) opened a Chronic Disease Management Service (CDMS) referral template in *Best Practice* or *Medical Director 3* clinical software compatible with CDMS.
- Patient health information contained in the GP's electronic medical record was uploaded into the CDMS care plan template.
- The GP securely emailed a CDMS care plan referral containing relevant patient health information to Precedence Health Care (Precedence).
- An evidence-based care plan was automatically generated. The GP received email notification that the care plan had been created and was available on the Precedence website.

Approving a GPMP

- The GP accessed the care plan on the Internet, made any necessary changes, and then approved the care plan.
- The GP electronically saved the GPMP in his/her clinical software program.
- The GP was then eligible to claim Medicare benefits Schedule (MBS) item number 721.

* Note: GPs needed to be using Best Practice or Medical Director 3 clinical software

2. Creating a Team Care Arrangement (TCA)

- A draft TCA was generated at the discretion of the GP.
- Precedence sent emails to nurses and allied health (AH) team members registered with CDMS. AH professionals were nominated by the GP and were invited to participate in the patient's care plan.
    - Nurses and AH team care members accessed the care plan on the Internet to document information, provided comments, and agreed to participate in the TCA.
- Once two AH team care members agreed to participate, the TCA was ready to be approved by the GP. An email was sent to the GP notifying them the TCA was ready to be approved.

Approving a TCA

4 The GP accessed the TCA on the Internet, reviewed comments made by care team members, made any necessary changes to the care plan, and approved the care plan.

5 AH referral forms were automatically generated and prefilled with the GP details and the number of annual AH visits the GP had nominated for each care provider. The GP downloaded the prefilled forms and forwarded them the AH team care members who required one for MBS purposes.

6 The GP electronically saved the TCA in his/her clinical software program and claimed the MBS item number 723.

7 Nurses and AH team care members electronically saved the TCA in their clinical software programs.

3. Reviewing the approved GPMP and TCA

- The GP reviewed the CDMS care plan every 3 to 6 months in consultation with the patient and claimed MBS item number 725 (GPMP review) or item number 727 (TCA review).

4. Patient involvement in the care plan process

1) Patients were able to access their approved care plan using a secure password on the Internet. Patients could view their care plan, answer health professional (HP) questions, provide comments, or enter self-care data, e.g. weight and blood glucose (BG) test results.

- Reminders were sent to patients via Short Message Service (SMS), email, or landline to schedule appointments with allied health.

Figure A 1: Flow chart of the steps observed in the CDMS care planning process, which includes creating and approving a CDMS GPMP, creating and approving a CDMS TCA, and conducting care plan reviews

Appendix 3: Estimating the effect of CDMS on population service use

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10. The Model

Treatments are specified as follows:

T: new CMDS treatment
S: standard car plan
U: unmanaged i.e. not on care plan

Use 0/1 to denote prior/post intervention date. Potentially the probability of an event E could depend both on treatment and period. So, for instance, let π_{1U} be the probability of an event for an unmanaged patient after the intervention date.

There is also a distinction between probability, population proportions and sample proportions. Let p_{1U} be the corresponding proportion of unmanaged patients who record event E post intervention. For the large populations considered here, p_{ij} the values for π_{ij} and will be very close and we could effectively ignore the sampling error of their difference.

Denote the number of patients in each group by n_{ij} and those who record and event by m_{ij}. The total population of patients under care in the two period as T_0, T_1. Therefore, the population proportions above can be expressed as

$$p_{ij} = m_{ij}/n_{ij}.$$

11. Numbers in prior population

The prior population $T_0 = n_{0S} + n_{0U}$. Suppose that it is known that

$$n_{0U} = Fn_{0S}$$

so that

$$T_0 = n_{0S}(1+F).$$

The number of prior events E is

$$\begin{aligned} m_0 &= m_{0S} + m_{0U} \\ &= n_{0S}\, p_{0S} + n_{0U}\, p_{0U} \\ &= n_{0S}\, (p_{0S} + Fp_{0U}) \end{aligned}$$

12. Numbers in post population

The post population $T_1 = n_{1T} + n_{1U}$ as it is assumed that $n_{1S} = 0$. Suppose that it is known that the proportion of patients on care has increased by a factor R i.e. that

$$n_{1T}/T_1 = R\, n_{0S}/T_0$$

The number of post events E is

$$\begin{aligned} m_1 &= m_{1T} + m_{1U} \\ &= n_{1T}\, p_{1T} + (T_1 - n_{1T})p_{1U} \\ &= T_1 R n_{0S}/T_0\, p_{1T} + (T_1 - T_1 R n_{0S}/T_0)p_{1U} \\ &= n_{0S} T_1/T_0\, (Rp_{1T}) + T_1/T_0\, (T_0 - Rn_{0S})p_{1U} \\ &= n_{0S} T_1/T_0\, (Rp_{1T}) + T_1/T_0\, (n_{0S}(1+F) - Rn_{0S})p_{1U} \\ &= n_{0S} T_1/T_0\, (Rp_{1T} + (1+F-R)p_{1U}) \end{aligned}$$

13. Effect of intervention

The effect of intervention is measured by the change in the proportion of events from prior to post i.e. by the $(m_1/T_1)/(m_0/T_0) = T_0/T_1(m_1/m_0)$. Substituting the previous expressions we obtain this ratio as

$$(Rp_{1T}+(1+F-R)p_{1U})/\, (p_{0S} + Fp_{0U})$$

If it is further assumed that $p_{1U} = p_{0U} = p_U$ then this becomes

$$(Rp_{1T}+(1+F-R)p_U)/\, (p_{0S} + Fp_U)$$

The factors R and F are known. The proportions p_{1T}, p_{0S} and p_U are estimated directly from the sample. The ratio T_1/T_0 has dropped out of the expression from which is to be expected.

14. Assumptions

The assumption $n_{1S} = 0$ reflects a future hypothetical scenario in which all patients are moved onto the new regime and none are left on the standard care plan. This assumption then is a logical necessity for assessing the intervention. The assumption $p_{1U}=p_{0U}=p_U$ requires that there is no systematic difference between unmanaged patients prior or post the intervention. Again, one may consider this a logical necessity if we are assessing the effect of the intervention on care plan management and want to separate out any changes to unmanaged patients that may incidentally occur in the mean time.

15. Estimation

The proportion p_{1T} is estimated from the sample. This is non controversial.

Estimating the proportion p_{0S} in the same way requires that the sample may be considered a random selection of the n_{0S} in the prior population. The fact that patients were selected depending on whether they were on existing care plans does not invalidate this assumption. The key issue is that there was *no systematic bias towards a particular kind of* previous care plan patient.

Estimating the proportion p_U in the same way requires that the sample may be considered a random selection of the n_U in the prior population. Again, the key issue becomes that there was *no systematic bias towards a particular kind of* unmanaged patient.

16. Standard error

It is more common to assess error of ratios on the logarithmic scale. Our estimate of the effect of intervention on this scale is

$$\log(Rp_{1T}+(1+F-R)p_U)-\log(p_{0S} + Fp_U).$$

The three empirical estimates of p_{1T}, p_{0S} and p_U are independent since they are calculated on separate sets of patients. So there is a fairly simple formula for the sampling error of the log-ratio measure. Let V_{1T} be the variance (i.e. the squared standard error) of each empirical proportion. The general form for this is

$$V_{1T} = p_{1T} (1- p_{1T})/N$$

where N is the size of the sample (here 99). Then the variance of the log-ratio measure is

$$a_{1T}V_{1T}+ a_{0S}V_{0S}+ a_UV_U$$

where

$a_{1T} = R/(Rp_{1T}+(1+F-R)p_U)$

$a_{0U} = -1/(p_{0S} + Fp_U)$

$a_{0U} = (1+F-R)/(Rp_{1T}+(1+F-R)p_U)-F/(p_{0S} + Fp_U)$

All the theoretical probabilities p_{ij} in this expression are themselves replaced by the empirical estimates. The square root of this whole expression measures the sampling variation in the log-ratio.

If a standard error is required on the original un-logged ratio, then the answer given above is to be multiplied by the estimated value of the un-logged ratio. In other words, the standard error of the log-ratio above is just the proportional error of the ratio.

Confidence intervals or tests are typically done on the log-scale.

SUPPLEMENTARY OR SUPPORTING DOCUMENTATION

List of major presentations

	Presentation Title	Presenter	Location	Presentation Type
1	e-Health and the Transformation of Health Care	Prof M Georgeff	Health Informatics Industry Workshop The University of Melbourne 15 August 2007	Presentation
2	Software Agents and the Transformation of Health Care	Prof M Georgeff	Fifth German Conference on Multi-Agent System Technologies Leipzig, Germany, 24-26 September, 2007	Invited Presentation
3	The ICT Challenge and Opportunity of Chronic Disease	Prof M Georgeff	Mumbai, India, November 2007	Invited Presentation
4	Enabling e-Health Transformation: The Chronic Disease Management Network	Prof M Georgeff	Chronic Disease Management, Sydney, Australia 1–3 April 2008	Invited Presentation
5	How can information and communication technology (ICT) improve chronic disease management?	Dr A Adaji	GP Conference Hobart, Tasmania 6 June 2008	Presentation
6	Can information technology improve the management of patients with diabetes?	Dr P Schattner, Dr Adaji Prof M Georgeff Dr K Jones	WONCA Europe conference Istanbul Turkey 2008	Presentation
7	Innovation in Chronic Disease Management	Prof M Georgeff	Innovation in Healthcare Workshop, Darwin, NT, 15 June 2008	Invited Workshop Presentation
8	CDMS: A Broadband Health Service for Transforming Chronic Disease Management	Prof M Georgeff	Clinical Networks and the role of ICT Melbourne 24 July 2008	Invited Presentation
9	CDMS: A Broadband Health Service for Transforming Chronic Disease Management	Prof M Georgeff	Health Informatics Conference 08, Melbourne 1 September 2008	Presentation
10	The Implementation of an Intelligent Disease Management Service	Prof Michael Georgeff	Chronic Disease Management Summit, Informa, Sydney, December 2008	Invited Presentation
11	Experiences with Web-Based Collaborative Care	Prof M Georgeff	Health Informatics Society of Australia Melbourne 15 April 2009	Invited Presentation
12	E-Health and the Transformation of Healthcare	Prof M Georgeff	Australian Centre for Health Research Melbourne 1 May 2009	Invited Presentation

	Presentation Title	Presenter	Location	Presentation Type
13	Web-based care plans for chronic disease management	Dr A Adaji	WONCA (Europe) 2009	Refereed Presentation
14	How do health professionals collaborate in the uptake of new ICTs for chronic disease management?	Dr A Adaji Prof LPiterman Dr P Schattner A/Prof H Piterman	WONCA (Asia Pacific) 6 June 2009	Refereed Presentation
15	Information Management in General Practice	Dr P Schattner	WONCA (Asia Pacific) 6 June 2009	Refereed Presentation
16	E-Health for Private Health Insurance: The Impact of Chronic Disease and Collaborative Care	Prof M Georgeff	8th Annual Health Insurance Summit Sydney, 28-29 July 2009	Invited Presentation
17	The Use of CDMS for Collaborative Care (Wagner Chronic Care Model)	Prof M Georgeff	17th Annual HISA Health Informatics Conference in Canberra 19-21 August 2009	Invited Presentation
18	E-Health: The way forward	Prof M Georgeff	Financial Review Health Conference 2009 – Investing in Healthcare 26 August 2009	Invited Presentation
19	Web-Enabled Collaborative Care and the Management of Chronic Disease	Prof M Georgeff	ADMA 5th Annual National Disease Management Conference 3-4 September 2009	Invited Presentation
20	CDM-Net Launch	Prof M Georgeff	Official Launch of CDM-Net by Department of Broadband and Communications 4 September 2010	Host
21	Evolution of thought	Prof M Georgeff	Evolution Symposium 1 December 2009	Invited Presentation
22	SS 2 - Reality Check e-Health	Prof M Georgeff	*Realising Our Broadband Future* forum University of New South Wales, 10 December 2009	Panellist
23	First International Workshop on Collaborative Agents - Research and Development (CARE) workshop	Dr Christian Guttmann A/Prof Frank Dignum Prof Michael Georgeff	Collocated with the 22nd Australasian Joint Conference on Artificial Intelligence (AI 09), Melbourne, Australia, 1 December 2009	Organised workshop
24	Second International Workshop on Collaborative Agents - Research and Development (CARE) workshop	Dr Christian Guttmann A/Prof Frank Dignum	Collocated with the International Conference on Intelligent Agent Technology (IAT 2010), Toronto, Canada, 31 August 2010	Organised workshop

List of major publications

	Presentation Title	Presenter	Location	Publication Type
1	The use of information technology to enhance diabetes management in primary care: a literature review	Dr A Adaji Dr P Schattner Dr K Jones	Informatics in Primary Care 2008,16(3):229-237	Publication – journal
2	Effectiveness of IT-based diabetes management interventions: a review of the literature.	Dr B Costa Ms K Fitzgerald Dr K Jones Prof T Dunning	BMC Family Practice 2009, 10:72 doi:10.1186/1471-2296-10-72/	Publication – journal
3	Multiagent System Technologies. 5th German Conference, MATES 2007.	Prof P Petta Prof J Müller Dr M Klusch Prof M Georgeff	Proceedings of the Fifth German Conference on Multi Agents System Technologies (MATES 2007), Leipzig, Germany, EU, 24-26 September 2007.	Publication – edited book
4	Proceedings of the International Workshop on Collaborative Agents -- REsearch and Development	Dr C Guttmann A/Prof F Dignum Prof M Georgeff	Proceedings of the first international workshop on Collaborative Agents -- REsearch and Development (CARE 2009), Melbourne, Australia, 1 December 2009	Publication – edited book
5	Towards an Intelligent Agent Framework to Manage and Coordinate Collaborative Care	Dr C Guttmann Dr IThomas Prof M Georgeff Dr K Wickramasinghe Dr H Gharib Dr S Thompson Prof H Schmidt	Proceedings on Collaborative Agents – REsearch and development (CARE 2009), Melbourne, Australia, 1 December 2009	Publication – book chapter
6	Agent-based Intelligent Collaborative Care Management	Dr K Wickramasinghe Dr C Guttmann Prof M Georgeff Dr H Gharib Dr I Thomas Dr S Thompson Prof H Schmidt	Proceedings of Eighth International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2009)-Volume 2, Budapest, Hungary: IFAAMAS, ISBN 978-0-9817381-7-8, May, 2009	Publication – book chapter
7	Towards an Intelligent Agent Framework to Manage and Coordinate Collaborative Care	Dr C Guttmann Prof M Georgeff Dr K Wickramasinghe Dr H Gharib Dr I Thomas Dr S Thompson Prof H Schmidt	Workshop Proceedings on Behaviour Monitoring and Interpretation - Well Being (BMI 2009), Paderborn, Germany, 15 September 2009	Publication – book chapter

	Presentation Title	**Presenter**	**Location**	**Publication Type**
8	Making Allocations Collectively: Iterative Group Decision Making under Uncertainty	Dr C Guttmann	Sixth German Conference on Multi Agent system Technologies (MATES) 2008. Kaiserslautern, Germany: Springer, ISBN 3540878041, 2008	Publication – book chapter
9	Towards a Taxonomy of Decision Making Problems in Multi-Agent Systems	Dr C Guttmann	Proceedings of the Seventh German Conference on Multi Agent system Technologies (MATES), Hamburg, Germany: Springer, ISBN 978-3-642-04142-6, 2009	Publication – book chapter
10	The disconnect between following the current care plan paperwork and reality	Dr K Jones Dr I Thomas Dr K Wickramasinghe Dr C Guttmann Prof M Georgeff Prof H Schmidt Prof L Piterman	Submitted to Australian Journal of Primary Health (AJPH), CSIRO Publishing	Publication – journal
11	Collective iterative allocation: Enabling fast and optimal group decision making	Dr C Guttmann Prof M Georgeff Dr. I Rahwan	International Journal of Web Intelligence and Agent Systems (accepted in October 2008, to appear in 2010)	Publication – journal
12	An Adherence Support Framework for Service Delivery in Customer Life Cycle Management	Dr K Wickramasinghe Dr C Guttmann Prof M Georgeff Dr I Thomas Prof H Schmidt	The 9th International Workshop on Coordination, Organization, Institutions and Norms in Multi-Agent Systems (COIN 2010), Toronto, Canada: Springer, May, 2010	Publication – refereed
13	Goal-Directed Approach for Process Specification and Service Composition in Customer Life Cycle Management	Dr K Wickramasinghe Dr I Thomas Prof M Georgeff Dr C Guttmann Prof H Schmidt	Workshop Proceedings on Agent-based Technologies and applications for enterprise interoperability (ATOP 2010). Toronto, Canada: Springer, May, 2010	Publication – refereed
14	The Intelligent Collaborative Care Management (ICCM) Project	Dr K Jones Dr I Thomas Dr K Wickramasinghe Dr C Guttmann Prof H Schmidt Dr S Thompson Dr H Gharib Prof M Georgeff Prof L Piterman	Proceedings of the 2009 General Practice and Primary Health Care Research Conference (PHCRIS 09), Melbourne, Australia, July, 2009	Publication – refereed

CLEVER NETWORKS KEY PERFORMANCE INDICATOR (KPI) FRAMEWORK

The following tables report the achievements on the KPIs as at the conclusion of the project on 15 December 2009.

Table KPI-1: Measuring increased broadband takeup

	BSWR	**Nationally (including EGR)**
Number of new subscribers (GPs) to CDM-Net services	57	97
Number of new CDM-Net users (care =providers and consumers)	574	1098
Number of new users by role		
General Practitioner	57	97
Practice Nurses	16	29
Consumers	388	733
Allied Health	104	223
Medical Specialists	9	16
Health Services	Barwon Health, includes Geelong Hospital, Community Health Services at Belmont, Torquay and Anglesea Kalgoorlie Hospital	
User locations (rural, regional or remote)	The 14 participating GP practices in the Barwon region are classified as follows according to the Rural, Remote and Metropolitan Areas (RRMA) classification:	
	RRMA 2	8
	RRMA 4	2
	RRMA 5	4
User locations (rural, regional or remote)	The 21 participating GP practices nationally are classified as follows according to the Rural, Remote and Metropolitan Areas (RRMA) classification:	
	RRMA 2	8
	RRMA 4	2
	RRMA 5	4
	RRMA 6	5
	RRMA 7	2

Table KPI-2: Measuring increased range and use of broadband applications, content and services

<table>
<tr><th colspan="4">Extent of the impact of CDM-Net use on the online activities of users</th></tr>
<tr><td rowspan="15">Number, type and frequency of interactions with CDM-Net Services</td><td></td><td>BSWR</td><td>Nationally</td></tr>
<tr><td>Practice Nurse</td><td>11,773</td><td>30,083</td></tr>
<tr><td>Pharmacist</td><td>845</td><td>2,186</td></tr>
<tr><td>GP</td><td>21,214</td><td>34,684</td></tr>
<tr><td>Speech Pathologist</td><td>86</td><td>86</td></tr>
<tr><td>Ophthalmologist</td><td>612</td><td>1,031</td></tr>
<tr><td>Diabetes Educator</td><td>4,003</td><td>8,033</td></tr>
<tr><td>Podiatrist</td><td>3,184</td><td>6,486</td></tr>
<tr><td>Dietician</td><td>1,543</td><td>4,007</td></tr>
<tr><td>Optometrist</td><td>260</td><td>2,989</td></tr>
<tr><td>Exercise Physiologist</td><td>444</td><td>444</td></tr>
<tr><td>Nurse</td><td>5</td><td>5</td></tr>
<tr><td>Community Health (WA only)</td><td>NA</td><td>491</td></tr>
<tr><td>Physiotherapist</td><td>10</td><td>67</td></tr>
<tr><td>Psychologist</td><td>0</td><td>511</td></tr>
<tr><th colspan="4">Examples of CDM-Net use and growth in data downloads</th></tr>
<tr><td>Remote monitoring services</td><td colspan="3">Consumers are able to enter their own result. Number of times consumers have accessed the Measurements tab: 123.</td></tr>
<tr><td>SMS (including GPRS- based SMS)</td><td colspan="3">CDM-Net has been configured and tested to send SMS reminders to patients, e.g., to make or attend appointments. As of 15th December 2009, 856 messages had been sent.</td></tr>
<tr><td>Voice over IP (VOIP)</td><td colspan="3">Available on all care plans – VOIP use dependent on user choice, e.g. to download an appropriate application such as Skype. This cannot be tracked.</td></tr>
<tr><td>Email</td><td colspan="3">8,941 emails have been sent from CDMS</td></tr>
<tr><td>Internet</td><td colspan="3">Total number of CDM-Net page downloads: 43,979 in Barwon; 91,103 nationally</td></tr>
<tr><th colspan="4">Examples of use of CDM-Net services</th></tr>
<tr><td>Shared Electronic Medical Record services (care coordination)</td><td colspan="3">A record of patient clinical status is available to the care team and the patient from the CDM-Net web portal via the Health Summary and Measurements tabs. Number of web page downloads since rollout: 3,141 in Barwon, 9,626 nationally</td></tr>
<tr><td>Health Services Bus (application services)</td><td colspan="3">All transactions with CDM-Net are communicated via the Health Services Bus. As of 15TH December, 2009 total number of transactions since rollout: 9,797</td></tr>
<tr><td>Care Plan Creation services</td><td colspan="3">Care plan creation services include access to the plan goals and tasks available from the CDM-Net web portal via the Goal, Notes, Care Team and Documents tabs. Number of web page downloads since rollout: 9,832 in Barwon; 32,909 nationally</td></tr>
</table>

Self-Education services	Management of type 2 diabetes resources are available from within the CDM-Net web portal via the Resource tab, e.g., links to Diabetes Australia and National Diabetes Services Scheme. Number of web page downloads since rollout: 333
Examples of use of CDM-Net for remote services	
Remote monitoring of key health parameters	Patients are able to manually enter self recorded blood sugar levels, blood pressure and weight onto the Measurements screen of the CDM-Net web portal. Target and historical values are displayed to assist the patient and care team track progress against care plan goals. Number of web page accesses since rollout: 2,271 in Barwon; 6,666 nationally
Care plan adherence support services	Adherence support services (i.e., automated SMS and email reminders and notifications) are in place to assist patients to adhere to care plan tasks. As of 15th December, 9,797 reminders had been sent by SMS or email.

Table KPI-3: Measuring increased use of broadband in the health sector

Use of CDM-Net by health sector (e.g. general practitioners, hospitals, pharmacies, specialists, health centres, allied health, nursing homes)			
Number, type and frequency of interactions with CDM-Net Services		**BSWR**	**Nationally**
	Practice Nurse	11,773	30,083
	Pharmacist	845	2,186
	GP	21,214	34,684
	Speech Pathologist	86	86
	Ophthalmologist	612	1,031
	Diabetes Educator	4,003	8,033
	Podiatrist	3,184	6,486
	Dietician	1,543	4,007
	Optometrist	260	2,989
	Exercise Physiologist	444	444
	Nurse	5	5
	Community Health	0	491
	Physiotherapist	10	67
	Psychologist	0	511
Services used by CDM-Net users for service delivery			
Care plan creation services	Care plans created: 725.		
Care plan tracking services	Reviews completed 186, measurements collected 30,922; appointments entered 2,030		
Care plan adherence-support services	SMS Reminders: 322; Email Reminders: 385		
Care plan coordination services;	Number of notes entered 552, number of appointments entered 2,030 (+ care plan adherence support services above)		

Economic and social benefits of CDM-Net use by the health sector

Improved access to chronic disease management services for residents in regional, rural and remote Australia

Postcodes of registered users and count of users by postcode

BSWR:

3212	Lara	2
3214	Norlane	7
3214	Corio	17
3214	Norlane West	2
3215	Geelong North	2
3215	Bell Post Hill	34
3215	Hamlyn Heights	5
3215	Manifold Height	1
3215	North Geelong	14
3215	Rippleside	1
3215	Bellpost Hill	1
3215	Bell Park	25
3216	Waurn Ponds	2
3216	Grovedale	13
3216	Belmont	38
3216	Highton	23
3216	Marshall	1
3218	West Geelong	2
3218	Geelong West	11
3218	Newtown	2
3218	Herne Hill	5
3218	Manifold Heights	2
3219	Geelong East	1
3219	Breakwater	4
3219	East Geelong	18
3219	Newcomb	6
3219	Whittington	4
3219	St Albans Park	3
3220	Newtown	7
3220	Geelong	51
3221	Anakie	1
3221	Barrabool	1
3221	Lovely Banks	2
3221	Batesford	1
3221	Waurn Ponds	1
3222	Drysdale	14
3222	Clifton Springs	3
3223	Drysdale	1
3223	Indented Head	1
3223	Point Lonsdale	1
3223	St Leonards	10
3223	Portarlington	8

3224	Leopold	5
3225	Point Lonsdale	3
3225	Queenscliff	1
3226	Ocean Grove	4
3227	Connewarre	1
3228	Wombah Park	1
3228	Torquay	97
3228	Bellbrae	3
3228	Jan Juc	13
3230	Anglesea	40
3231	Aireys Inlet	1
3232	Lorne	2
3233	Apollo Bay	1
3240	Paraparap	1
3240	Moriac	2
3241	Winchelsea	1
3243	Barwon Downs	1
3304	Drumborg	1
3321	Inverleigh	9
3328	Teesdale	4
3329	Shelford	1
3330	Rokewood	1
3331	Bannockburn	36
3331	Gheringhap	1
3332	Lethbridge	4
3332	Leopold	1
3333	Meredith	9
3451	Grovedale	1
3525	Buckley	1

Increased quality of life for residents in regional, rural and remote Australia arising from improved delivery of chronic disease management services	No measurable effect on quality of life over the period of the trial
Increased uptake of care plans for chronic disease population	BSWR: • 205% in GPMPs (compared with a regional change of 21% over the same period) • 201% in TCAs (compared with 45% regionally) Eastern Goldfields Region: • 88% in GPMPs (compared with a regional *decrease* of 12% over the same period) • 80% in TCAs (compared with a *decrease* of 10% regionally)

Increased adherence to care plans by chronic disease population	Patients on a care plan increased adherence to recommended healthcare services by: • 25% in HbA_{1c} tests • 5% in Microalbumin tests • 0% in HDL (high density lipoprotein) tests • 707% in dietician services • 68% in podiatry services, and • 185% in Home Medication Review services.
Increased uptake for extended primary care items associated with chronic disease by GPs parameters	BSWR: • 205% in Item 721 (compared with a regional change of 21% over the same period) • 201% in Item 723 (compared with 45% regionally) • 385% in Item 725 – first (6 month) GPMP review (compared with 10% regionally) • 224% in Item 727 – first (6 month) TCA review (compared with 49% regionally) Eastern Goldfields Region: • 88% in Item 721 (compared with a regional decrease of 12% over the same period) • 80% in Item 723 (compared with a decrease of10% regionally) • 310% in Item 725 – first (6 month) GPMP review (compared with a decrease of 14% regionally) • 220% in Item 727 – first (6 month) TCA review (compared with an increase of 32% regionally)
Increased percentage of patients who have stabilised blood glucose levels	National Baseline: 50.9% HbA1c <= 7 in 2008 CDMS National statistic: Percentage of patients with HbA1c <=7 and > 7 prior to care plan commencement, that is where HbA1c measurement date is < 2 weeks after care plan valid date (and all earlier) 49.7% with stabilised blood glucose levels (91 <= 7, 92 > 7) CDMS National Statistic: Count of patients with HbA1c <= 7 and > 7 at most recent measurement: 52.1% with stabilised blood glucose levels (187 <=7, 172 > 7)

Australian Government
Clever Networks

Barwon Health

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