How networks of cloud services can transform the management of chronic illness

Professor Michael Georgeff

mHealth2013

4 July 2013
Chronic Disease: Big and Growing

Major burden on the health system:
Australia $60 billion per annum; US $1,270 billion

Over 7 million Australians, drastic effect on quality of life, morbidity and mortality

Major economic burden in developed and developing economies:
GDP Loss (2015): Australia $12B; US: $2,000B, China $75B
The model of care for chronic illness recommended by the World Health Organisation, Royal Australian College of General Practitioners, ADMA, etc requires

• Longitudinal, planned care
• In collaboration with a multidisciplinary care team
• With support for patient self management
• Requiring regular follow up and review
• Applied systematically to all chronically ill patients

Source: http://www.racgp.org.au/guidelines/sharinghealthcare
Why this doesn’t work: What GPs are telling us

• Not enough time to handle the added complexity
• Too much paperwork and bureaucracy to meet Medicare requirements
• Too high a risk of negative Medicare audit
• Distracts from patient needs
• Only 25% of patients with chronic illness have a care plan
• Only one in five patients who do have a care plan are regularly followed up and reviewed
• 50% of care plans are probably not best practice
• Cost of “wasted” expenditure on unreviewed care plans in 2012 = $440 million, growing at $70 million per year
cdmNet
cdmNet: What is it?

A “cloud” service for coordinating and managing the entire lifecycle of chronic disease
# Measurements and Pathology

### Observations

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Latest</th>
<th>Target</th>
<th>15/12/2008</th>
<th>16/12/2008</th>
<th>17/02/2009</th>
<th>22/02/2009</th>
<th>02/08/2009</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure (mmHg)</td>
<td>150/90</td>
<td>&lt; 140/90</td>
<td>140/90</td>
<td>140/90</td>
<td>150/95</td>
<td>140/90</td>
<td>150/90</td>
<td>History</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78</td>
<td>&lt; 74.0</td>
<td>75</td>
<td>75</td>
<td>78</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>30</td>
<td>29</td>
<td>29</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>History</td>
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</table>

### Test Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Creatinine (µmol/L)</td>
<td>120</td>
<td>133</td>
<td>-</td>
<td>-</td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>7.2</td>
<td>&lt; 7</td>
<td>7</td>
<td>7</td>
<td>7.2</td>
<td>7.2</td>
<td>7.2</td>
<td>History</td>
</tr>
<tr>
<td>Microalbumin (Spot Albumin : Creatinine Ratio) (mg/mmol)</td>
<td>2.6</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>Proteinuria (mg/24 hours)</td>
<td>18</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>Blood Glucose Level (mmol/L)</td>
<td>5</td>
<td>&lt; 7</td>
<td>7.5</td>
<td>8.5</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>History</td>
</tr>
<tr>
<td>Estimated GFR (eGFR)</td>
<td>54</td>
<td>48</td>
<td>-</td>
<td>-</td>
<td>54</td>
<td>-</td>
<td>-</td>
<td>History</td>
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</tbody>
</table>

### Lipids

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Latest</th>
<th>Target</th>
<th>02/04/2007</th>
<th>04/02/2009</th>
<th>13/03/2010</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDL (mmol/L)</td>
<td>2</td>
<td>≥ 1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>5.6</td>
<td>&lt; 2.5</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>Total Cholesterol (mmol/L)</td>
<td>7.6</td>
<td>&lt; 4</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>4.8</td>
</tr>
<tr>
<td>Triglycerides (mmol/L)</td>
<td>4</td>
<td>&lt; 1.5</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2.5</td>
</tr>
</tbody>
</table>

### Self Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Latest</th>
<th>Target</th>
<th>02/04/2007</th>
<th>04/02/2009</th>
<th>13/03/2010</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure (mmHg)</td>
<td>-</td>
<td>&lt; 140/80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>- 8</td>
</tr>
</tbody>
</table>

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[Image of the table]
# Personalised Evidence-Based Plan

## General

<table>
<thead>
<tr>
<th>Goal</th>
<th>Task</th>
<th>Responsible</th>
<th>How Often</th>
<th>Last</th>
<th>Next</th>
<th>Comment</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear understanding of conditions</td>
<td>This goal has no tasks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: Patient has received education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Lifestyle

<table>
<thead>
<tr>
<th>Goal</th>
<th>Task</th>
<th>Responsible</th>
<th>How Often</th>
<th>Last</th>
<th>Next</th>
<th>Comment</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain healthy diet</td>
<td>Education</td>
<td>Mr P. Hicks (Dietitian)</td>
<td>Every 2 years</td>
<td>16 Sep 2009</td>
<td>Due Sep 2011</td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: Patient maintaining healthy diet</td>
<td>Action to achieve target</td>
<td>Patient</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain physical activity</td>
<td>Action to achieve target</td>
<td>Patient</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: 30 Minutes per day of selected exercise 5 days per week, within patient limitations</td>
<td>Education and review</td>
<td>Dr M. Georgeff (GP)</td>
<td>Every year</td>
<td>6 May 2010</td>
<td>Due May 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider deferring physical activity</td>
<td>Consider deferring physical activity</td>
<td>Dr M. Georgeff (GP)</td>
<td>As required</td>
<td>As required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage body weight</td>
<td>Counselling and review</td>
<td>Dr M. Georgeff (GP)</td>
<td>Every 6 months</td>
<td>16 Feb 2010</td>
<td>Due Aug 2010</td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: Weight &lt; 74.0 kg</td>
<td>Assessment and Counselling</td>
<td>Mr P. Hicks (Dietitian)</td>
<td>Every 2 years</td>
<td>16 Sep 2009</td>
<td>Due Sep 2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action to achieve target</td>
<td>Patient</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage alcohol consumption</td>
<td>Education</td>
<td>Mr G. Wang (Diabetes Educator)</td>
<td>Every 2 years</td>
<td>28 May 2009</td>
<td>Due May 2011</td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: ≤ 2 Standard Drinks per day</td>
<td>Action to achieve target</td>
<td>Patient</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control blood pressure</td>
<td>Measure blood pressure</td>
<td>Dr M. Georgeff (GP)</td>
<td>Every 6 months</td>
<td>2 Aug 2009</td>
<td>Due May 2010</td>
<td></td>
<td>Add Task</td>
</tr>
<tr>
<td>Target: Blood Pressure &lt; 140/80 mmHg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control lipids</td>
<td>Lipids test</td>
<td>Dr M. Georgeff (GP)</td>
<td>Every month</td>
<td>13 Mar 2010</td>
<td>Due May 2010</td>
<td></td>
<td>Add Task</td>
</tr>
</tbody>
</table>
Dear Mr. Perrington,

I would kindly request that a Home Medication Review be conducted for Peter Hardy, age 78. The patient's current medications and condition summary is attached for the information. You can view the patient's full details and care plan by going to the CDMS website [https://precedencehealth.org:443/cdms](https://precedencehealth.org:443/cdms).

This patient fits the HIC criteria for HMR and has provided me with informed consent for you to proceed with this item number. I am this patient's usual GP.

**ATSI Status**

Patient does not identify as Aboriginal or Torres Strait Islander

### Past Medical History

**Date**

- 2/12/2003
- 25/8/1979
- 25/7/2005
- 15/1/2003
- 7/4/2006
- 24/11/2005
- 27/5/2005
- 20/2/1998
- 2/3/1997
- 1/2/1998
- 1/12/2005
- 11/11/2004
- 29/6/2004
- 5/5/2006

Hypertension

### Current Medications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Strength</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intelligent Tracking and Alerting
Hi XX, thanks for your note, which I need to get into the habit of reading regularly. BP today and in the past was reasonable (125/90). I added Coversyl anyway because of his Diabetes and your reading.

**Added by XX (Diabetes Educator) on XXX 5:45 PM**

Now using 40 units Lantus. Could PatientP please have a script for LANTUS SOLOSTAR, BP elevated again today (156/96). Not testing BGL’s. Urged to do so. I have asked PatientP to start taking 90mgs of Diamicron MR and have also requested that he makes a GP appointment as soon as possible. I will review him in 1 week with view to increasing insulin dosage.

**Added by YY (Optician) on XXX 7:33 PM**

PatientP attended for eye examination. VA was 6/5 OU. No Rx required. Dilated fundus examination carried out. No signs of DR present. IOPs normal at 14 mm Hg OU.

**Added by YY (Optician) on XXX 6:38 PM**

POSTED CLINICAL FOLLOW-UP

**Added by XX (Diabetes Educator) on XXX 11:37 AM**

Hi Dr AA. PatientP is due to come in to see you next week as per his wish list for January health checks. He is using 28 units Lantus daily and his damicor MR twice daily. He has been using 90mgs of Diamicron MR to 60mg daily on 20/2/09. He is currently using 24 units Lantus.

**Added by XX (Diabetes Educator) on XXX 11:37 AM**

I am continuing to see PatientP on a regular basis. He is non conforming with lifestyle changes as well as medications. His BGL’s continue to be above 12.0mmol/L. Have asked PatientP to put in a big effort with taking his medications as prescribed. He seems resigned to the fact that he is going to get all these complications from diabetes anyway so why bother trying to control it. Tiritation of Lantus has been very slow due to non-attendance at appointments and non compliance with dose alterations.

**Added by XX (Diabetes Educator) on XXX 12:23 PM**

PatientP did not attend his follow up appointment today.

**Added by ZZ (Podiatrist) on XXX 3:30 PM**

PatientP seen today (assessment form sent). Dr AA, would you mind providing me with 2 more visits. PatientP has some mechanical issues that need attention. Thanks in advance.

**Added by XX (Diabetes Educator) on XXX 12:56 PM**

PatientP seen today and commenced on 10units of Lantus Nocte. I will review him when he returns to town in 2 weeks.

**Added by Dr. AA on XXX 11:24 AM**

PatientP wants and should start with Insuline (Lantus) He works at XXXXX and is 2 weeks away and 1 week in XXXXXXX
Stakeholder Reports

Clinical Change Report for INTERVENTION_1
Highlights progress in reducing clinical metric out-of-range, and maintaining metrics in-range

% HbA1c change

Systolic blood pressure change

Total cholesterol change

Body mass index change

New hospitalisations per 100 patients

New diabetic complications per 100 patients
Linked clinical and service delivery data

Data to enable
• Evidence-based research
• Improved service delivery
• Rational policy development
• Predictive analysis
Accessible Anywhere, Anytime
cdmNet Trials
Improved Planning, Collaboration, and Follow Up

- 88-205% increase in GPMPs
- 80-201% increase in TCAs
- 310-595% increase in GPMP Reviews
- 220-358% increase in TCA Reviews

Results from Barwon South Western (Vic) and Eastern Goldfields (WA) trials (n = 13, t-test, p < 0.01)
Regular reviews do make a difference

Analysis by Monash University of diabetes patients using cdmNet for 12 months or more indicates large improvements in quality of care

- Adherence to best practice guidelines/pathways:
  - **90% compliance** for GPs that do formal reviews (GPMP/TCA Reviews) vs
  - **50% otherwise** (p < 0.001)

Patients on cdmNet for 13 months (p < 0.01), Wickramasinghe L. K. et. al., *The Collaborative Care Cluster Australia (CCCA) project – Data Mining Study, Final Report (Unpublished)*, Monash University, Australia.
and cdmNet helps them happen

GP Management Plans (GPMPs) and Team Care Arrangements (TCAs) without Reviews are ineffective

• Nationally: less than 20% GPMPs/TCAs regularly reviewed
• cdmNet users: 80% of GPMPs/TCAs regularly reviewed

![Graph showing GPMPs/TCAs with Regular Reviews](image)
### Improved Clinical Outcomes

Patients on cdmNet for 13 months ($p < 0.01$), Wickramasinghe L. K. et al., *The Collaborative Care Cluster Australia (CCCA) project – Data Mining Study, Final Report (Unpublished)*, Monash University, Australia.
Improved financial returns

Regular users of cdmNet increase annual GP revenues by over $45,000

Safe Medicare audits
Towards a network of cloud healthcare services
Current situation: siloed health care

Currently, most healthcare services operate as isolated silos poorly integrated with one another

- Patient-focused disease management services that do not involve the clinical team
- eHealth solutions that do not interoperate with one another (including the national PCEHR)
- mHealth solutions that do not connect with broader clinical systems and the patient’s care team
Vision for Connected Care

- Corporate healthcare
- Assessment services
- Health insurers
- Coaching services
- Collaborative Care services
- Patients
- mHealth
- GPs, allied health, pharmacy, community services
- Hospitals, specialists
- Nursing services, aged care
- Data services
- National Infrastructure & PCEHR
- Healthcare Authorities
Linking to the National Infrastructure
Connecting to Telehealth Services

Schedule Telehealth Conference

You are about to schedule a telehealth conference session between selected members of the patient’s care team.

These pilot telehealth services are provided at no cost to comNet users courtesy of Cisco Australia as part of the Commonwealth’s Digital Regions Initiative program until 31st October 2012.

Please read the instructions for scheduling and conducting a telehealth conference.

Prior to proceeding, make sure the participants:
- are available to attend at the scheduled time; and
- have the appropriate equipment (webcam, microphone, and reliable Internet).

Fill in the details in the box below to schedule the teleconference.

- Indicates a required field

- Date: 29-Jul-2012 11:00 PM
- Invite: Graham Draper (Patient)
  - Dr Jane Doe (Ophthalmologist)
  - Goldfields Physiotherapy Services (Physiotherapist / Physical Therapist)
  - Mr Peter Hicks (Dietitian)
  - Mr Kim Ingot (Psychologist)
  - Mr David Roger Parker (Optometrist)
  - Mr Alex Perrington (Pharmacist)
  - Dr Sharon Stavropoulos (Podiatrist)

Notes: Graham is having trouble with his diet and medications

29 July 2012 at 10:39 PM: Dr Michael Georgeff (GP) scheduled a telehealth conference:
Telehealth conference on 29 July 2012 at 11:00 PM with Graham Draper (Patient), Dr Michael Georgeff (GP), Mr Alex Perrington (Pharmacist)

Graham is having trouble with his diet and medications

Join Telehealth Conference (Host Key: 330674)
Connecting to Pharmacy Services

**Medical Status**
- Smoking Status: Smoker (daily)
- Drinking Status: Drinker (0 drinks in 2-3 days a week)
- Family History: None recorded

**Current History**
- Date: 24/4/1978
  - Problem: Asthma
- Date: 1/5/1997
  - Problem: Atrial Fibrillation
- Date: 31/1/1999
  - Problem: Diabetes Mellitus - Type 2
- Date: 14/1/2000
  - Problem: Reflux oesophagitis
- Date: 1/3/2003
  - Problem: Peripheral Neuropathy
- Date: 26/6/2006
  - Problem: Glaucoma
- Date: 6/5/2006
  - Problem: Hypertension

**Past History**
- Date: 13/6/1986
  - Problem: Colorectal cancer
- Date: 2/6/1999
  - Problem: Esophageal hiatal hernia
- Date: 10/1/2004
  - Problem: Microbiuria
- Date: 26/5/2005
  - Problem: Cystoscopy
- Date: 26/10/2003
  - Problem: Gastritis
- Date: 6/2/2003
  - Problem: Prostatectomy - TURP
- Date: 30/1/2005
  - Problem: Colorectal cancer
- Date: 6/4/2006
  - Problem: Benign positional vertigo

**Current Medications**
- **DRYLAN Turbuhaler**
  - Strength: 500mg/500mcg
  - Dosage: 1 puff 4 times a day
  - Route: Inhale
  - Response: Decrease
- **azymaline Tablet**
  - Strength: 500mg
  - Dosage: 1 tab daily
  - Route: Oral
  - Response: Decrease
- **FLAVIPE Tablet**
  - Strength: 250mg
  - Dosage: 1 cap 1 cap 3 times a day
  - Route: Oral
  - Response: Decrease
- **MAHAN Tablet**
  - Strength: 500mg
  - Dosage: 1 cap 3 times a day
  - Route: Oral
  - Response: Decrease
Connecting to mHealth Services
Connecting across the care continuum
Contact and Acknowledgements

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Faculty of Medicine, Nursing and Health Sciences, Monash University
Email: michael.georgeff@precedencehealthcare.com
Phone: +613 9023 0800

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