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Delivery of virtual home monitoring and point-of-care pathology testing in general practice

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Introduction

Chronic conditions are leading contributors to the disease burden in Australia, accounting for 87% of deaths in 2015.¹ It is estimated that half of the adult population have at least one of eight common chronic conditions: cancer, cardiovascular disease, mental health, arthritis, chronic back pain, chronic obstructive pulmonary disease (COPD), asthma and diabetes.¹

This is compounded by Australia's ageing population, where the prevalence of chronic conditions is expected to continue to rise. It is projected that the population, aged 65 years and over, will nearly double from 3.8 million in 2017 to between 6.4 million and 6.7 million people in 2042.² Additionally, the presence of multiple chronic diseases is common in the older population, with nearly a quarter of Australians having two or more chronic conditions.¹

These chronic conditions are also associated with a decline in health outcomes, such as decreased quality of life and increased hospitalisations, resulting in significant economic burden from loss of productivity through to direct health-care costs.¹ The Grattan Institute have quoted that potentially preventable hospital admissions cost the health system more than \$320 million each year.³

Furthermore, there is a disparity between rural and metropolitan areas in terms of chronic disease, with rural Australians displaying increased levels of health risk factors resulting in higher prevalence of chronic disease.³ In the rural setting, primary care plays a vital role in the detection and management of chronic conditions. Improving the quality of and access to primary care services for patients with chronic conditions has been shown to reduce the use of health care resources and deliver better outcomes for patients with, or at risk of, chronic disease.^{4,5} People living in rural Australia arguably have the most to gain from better prevention and management of chronic disease through primary care.³

Other barriers associated with chronic disease management include timely access to pathology results. Point of care testing (PoCT) allows pathology testing to be conducted during a patient visit, resulting in faster turnaround time of results facilitating stronger support for their clinical decision making.^{6,7} Performing testing while visiting the GP is particularly important in transient populations

who may not have tests performed at pathology laboratory or return to see GP. Having access to PoCT pathology enables GPs to better manage chronic disease more efficiently.

Innovative and collaborative models of care for chronic conditions are required to address the complex challenges and barriers associated with chronic disease management. Evidence from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) telehealth trial over a 12 month period showed decreased hospital admissions by 53%, and reduced length of stay if admitted to hospital by 76%.⁸

In partnership with Country SA Primary Health Network (CSAPHN), Integrated Cardiovascular Clinical Network (iCCnet) Country Health South Australia (CHSA) have implemented a coordinated care approach through the use of virtual home monitoring and point of care testing within the general practitioner (GP) setting. The My Health Point of Care Innovative Technologies Trial (PoCiTT) program has been developed as a tool to provide extra resources to GP's to manage their chronic disease patients in rural and remote locations. This allows for daily monitoring of patients' health status, early identification of condition deterioration and early intervention. The goal is to reduce the demand on hospital services, improve patient outcomes and enable the GP to better provide services to ease the overall burden on increasingly scarce clinical resources.

Methods

In collaboration with CSAPHN, iCCnet have developed two individual, strongly linked support tools for general practice – PoCT and Virtual Home Monitoring (VHM).

The PoCT is performed on the Roche cobas h 232 for NT-proBNP, and the Abbott Afinion AS100 or Roche cobas b 101 for HbA1c, Lipids, CRP and Urine Albumin Creatinine Ratio (ACR only available on the Afinion AS100), as shown in figure 1. The equipment is connected to the GP practice's IT network and software developed by IT company Syslinx, allowing results to be securely transmitted to the My Health PoCiTT database, which is directly accessible online by GPs and nurses performing the tests.

Figure 1 From left to right: Roche cobas h 232, Roche cobas b 101, Abbott Afinion AS100



The equipment and consumables are funded by CSAPHN and provided free of charge to the GP practice, along with a payment to the practice to cover the nurses' time to perform tests. Training is performed on-site, with online competencies and training videos provided to supplement their learning. Testing is performed within a quality framework, with monthly internal and external quality

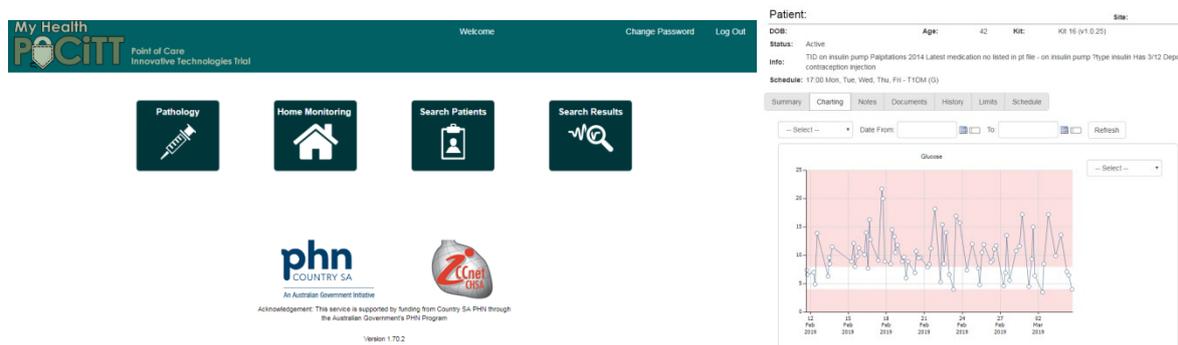
control samples performed on the PoCT devices. Furthermore, 24/7 ongoing support is provided to the practice via telephone and email.

For the VHM arm of the program, GPs identify chronic disease patients who they feel would benefit from VHM. Currently, home monitoring ‘interviews’ have been developed for heart failure, COPD, diabetes and hypertension, in consultation with specialists. These interviews guide the patient to take their vitals (with provided equipment) before being asked clinical questions relevant to their condition(s). The clinical questions use a branching logic system to guide the patient down an appropriate clinical pathway based on previous answers and vital signs. The VHM kits are comprised of a smart tablet and series of peripheral devices customisable to the patient. These devices include a blood pressure machine, pulse oximeter, weight scales, blood glucose meter and/or thermometer, as shown in figure 2. These devices link to the tablet wirelessly through Bluetooth. All results and clinical answers are transmitted from the tablet to the My Health PoCiTT database as shown in figure 3, using an in-built SIM card. Results that are considered to be out of range for the patient, or of particular clinical significance is flagged using a traffic light system (red, yellow, green) to gauge severity.

Figure 2 Virtual Home Monitoring equipment, including smart tablet, weight scales, blood pressure monitor, pulse oximeter, blood glucose meter and thermometer



Figure 3 My Health PoCiTT database dashboard, showing different features including pathology testing, home monitoring and patient search (left); and VHM patient summary page, graphing glucose results for a patient with Type 1 Diabetes (right)



Interview schedules are individualised to the patient. Monitoring is generally performed once per day, 5 days a week (Monday to Friday), but can consist of any selection of days and times.

The Clinical Network Scientists and Nurses at iCNet CHSA review patient results daily, and any flagged clinical questions or results outside the limits set by the GP are referred back to the practice for follow-up according to the practice’s escalation pathway. iCNet CHSA provided first-line

technical support (available 24 hours a day), and provided first-line clinical support when specified in the practice's escalation pathway.

Patients were discharged from the program usually after 12 weeks; however, the GP can nominate to cease monitoring earlier or extend monitoring depending on the status of the patient. Participant feedback surveys were then sent out to patients upon completion of the VHM program.

Results

Implementation of the My Health PoCiTT program began in June 2018, with seven Health Care Home (HCH) practices and one non-HCH practice enrolled by mid-August 2018; with a subsequent expansion into 11 non-HCH practices in South Australia in 2019. Six non-HCH practices were enrolled in January/February 2019, with implementation still occurring in an additional five non-HCH practices, which will be completed in early March, resulting in 19 practices enrolled in total.

Fourteen practices are currently utilising both PoCT & VHM, with five to follow. Of those five practices to follow, two are opting for PoCT only.

To date, a total of 904 PoCT tests have been performed across all sites (64 NT-proBNP, 254 HbA1c, 105 Lipids, 264 CRP and 217 Urine ACR). Approximately 50 patients had an initial HbA1c test performed, with a follow up test performed after three months. Overall, there was an average decrease in HbA1c levels in patients with known diabetes of 3.0 mmol/L for the duration of the program. Furthermore, 132 patients with no known diabetes had a HbA1c result of ≥ 48 mmol/mol (6.5%), indicating diabetes status.

Of the patients that had an ACR test performed, 54 patients had results that indicated microalbuminuria (males 2.5-25 mg/mmol, Females 3.5-35 mg/mmol), and 5 patients had results that indicated macroalbuminuria (males >25 mg/mmol and females >35 mg/mmol).

Anecdotal data from the GPs has been provided to iCCnet, indicating that results have been used to manage the treatment of their patients, particularly CRP results for determining prescription of antibiotics. The Australian Government has labelled antimicrobial resistance (AMR) as one of the biggest threats to human health today, and has acknowledged that the main cause is due to antibiotic use. This study will be able to establish if using CRP to guide antibiotic therapy can reduce prescribing when appropriate.

Analysis of NT-proBNP, Lipids and CRP is yet to be performed as this trial is still underway, and results are transmitted to the PoCiTT website with limited patient information. Once this trial is complete, an in-depth analysis will be conducted, which will involve comparing patient's results with their notes to determine if PoCT affects GP's treatment options and improves patient outcomes.

The average age of participants on VHM is 63 years old (22 – 92 years old), and their chronic conditions are listed in Table 1. To date, 57 patients are currently participating in VHM, with 44 discharged from monitoring and 13 withdrawn for various reasons. 11,182 VHM Interviews have been performed, of which 163 VHM interviews were escalated to practice staff for follow-up.

Table 1 Breakdown of the chronic conditions by patient

	Chronic Conditions					
	Heart Failure	Hypertension	COPD	Type 1 Diabetes	Type 2 Diabetes	Combinations of two or more
Number of patients	24	61	12	4	45	41

Compliance with performing the interviews for each patient was generally high, with overall only 2% of interviews missed (246 missed interviews), with reasons such as having to go to work early or forgetting to perform the interview. Patients that requested to discontinue VHM within one week of utilising the home monitoring equipment were withdrawn from the program. The reasons for withdrawal were: unable to manage the equipment on their own, monitoring causing anxiety, stress or frustration for the patient, travelling for work or family commitments, patient did not think it was useful and found it too repetitive.

We have received feedback survey responses from 20 participants to date. The questions about the VHM program included participants' perception of technology, access to services and support, knowledge of condition and confidence in self-management of their health.

Overall, the survey results indicated enormous positivity surrounding the VHM service. Patients felt well supported during the program (95%) and indicated that the equipment was easy to use (95%).

Patients found that home monitoring improved their knowledge about their conditions (85%) and their ability to monitor their symptoms and early warning signs (90%). They reported that VHM made it easier for them to do regular testing (90%) and improved their self-care by taking action when they showed early signs of deterioration (85%). A large majority (90%) of patients responded that they would be willing to participant again if their condition required it and would recommend VHM to other people.

Patients have expressed their enthusiasm for the VHM service, and were mostly appreciative to feel that "someone is watching over them". A patient commented: 'The program made me more aware of my high blood pressure and more conscious of (managing my condition)'.

One of the significant findings was the VHM program provided support to patients who would otherwise have visited their doctor or presented to the local hospital. Half (50%) of the participants responded that VHM reduced the number of visits to their local doctor, 45% found it reduced the number of visits to their local hospital and 65% reported that it improved access to their local clinic.

Patients who have been monitored on the VHM program have seen improvements in their risk factors. This includes a Type 2 Diabetes Mellitus patient with blood glucose results consistently above 15 mmol/L, decreasing to below 11 mmol/L; and a hypertensive patient, with an average systolic blood pressure above 150 mmHg, decreasing by 15-30 mmHg over the course of the program.

Discussion

The My Health PoCiTT program has been well received by most sites and patients who have been selected to participate. The 904 PoCT performed by sites, indicates that sites are using the PoCT equipment and test types available. The data indicates that CRP, HbA1c and ACR are the most

requested tests performed by clinics, with a high number of lipid tests and NT-proBNP tests performed.

The high uptake of PoCT testing may be attributed to the rural locations of the practices, where there is no on-site laboratory and practices are a long distance away from their closest lab. CRP has been used as an indicator for withholding antibiotics,^{9,10} HbA1c for its use for the screening and management of diabetes,¹¹ and ACR for its diagnosis of Microalbuminuria and Macroalbuminuria.

A high proportion of HbA1c results from patients with no known diabetes were above the cut-off for the diagnosis of diabetes. These patients would benefit from a secondary HbA1c test to confirm diagnosis.

NT-proBNP has predominately been used to rule out Heart Failure; however, recommendations via personal communications with Dr Carmine De Pasquale has suggested that patients with a 25% increase of their NT-proBNP reading from their baseline indicates worsening fluid overload, and increasing the patient's diuretic may be considered. Out of all the tests, NT-proBNP was performed the least, which could be attributed to a low number of heart failure patients, who make up the clinic's demographics.

Implementation of PoCT has come with varying degrees of success and different challenges for each practice. Challenges faced by the practice include incorporating PoCT testing into their workflow and nursing time involved in patient test and performing quality controls. Practices that have incorporated their testing as part of their patient assessment, and had nurses dedicated towards this effort, have had greater success in work efficiency and patient flow.

The other component of the My Health PoCiTT program is VHM. The home monitoring program has had a high level of success, with a high completion rate, and very few withdrawals. The main goal of the VHM is to ensure patients avoid admission to hospital, improve patient's knowledge and confidence of their own health self-management. This has been supported by the feedback received from patients. This indicates that the program is accomplishing its main goals.

Feedback from the practices has also shaped the program, with the iCCnet home monitoring team becoming the first line support if any interviews have been flagged for technical support, or follow up if an interview is missed, or abnormal results received. This enables a succinct overview to the practice to ensure that results are escalated appropriately.

Patients who have withdrawn from the VHM program were across a wide range of ages, from 22 - 92 years old. Feedback received from these patients has been used to improve the program, through the formation of a patient centred consumer group. Patients as old as 92 years old have been using the equipment, which indicates that the design is user-friendly, and that a person's age does not restrict the use of technology. Other factors are to be considered for patient selection to ensure suitability and completion on the program.

As this trial is still ongoing, the data collected is based on what has been submitted by the site and gathered from the referral process. More information is required from the practices such as the patient history and treatment regimes, to be able to determine if the introduction of the My Health PoCiTT program has improved patient outcomes, particularly for PoCT. Current preliminary data submitted does support that patients on the VHM do have better patient outcomes, such as self-reported decrease in hospital presentations, and an increase in understanding of their chronic

disease. As both the PoCT and VHM is continuously evolving and developing in conjunction with patient and clinic feedback, the program is proving to be a success.

Conclusions

Harnessing technology through VHM and PoCT can be an effective strategy to help support rural general practices to manage their chronic disease patients, in turn improving patient outcomes. Timely access to pathology results improves management of patients, in particular those with chronic disease, and prevents additional visits to the practice. Home monitoring has been shown to reduce hospital admissions and enable patients to have a more active role in the management of their disease. A barrier to implementing both of these programs is primarily funding (potential access to Medicare rebates). The results from this program can help to build the evidence for a PoCT and chronic disease home monitoring rebate in general practice.

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Presenter

Rosy Tirimacco is the Operations and Research Manager of the Integrated Cardiovascular Clinical Network Country Health South Australia. iCCnet CHSA supports rural and remote physicians and nurses to deliver evidenced-based cardiac care to country patients regardless of location or facilities available. Major research interests include integration of POCT into clinical care pathways, supporting patients with chronic disease outside of hospital and the development of electronic real time clinical databases. She is currently the chair of the Australasian Association of Clinical Biochemists Point of Care Testing Working Committee, chair of the International Federation of Clinical Chemistry and Laboratory Medicine PoCT Task Force and project manager of the Australian Point of Care Practitioners Network.