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AUSTRALIA

CREATE CHANGE

# International Remote Patient Monitoring Programs

# About the NHMRC Partnership Centre for Health System Sustainability

The NHMRC Partnership Centre for Health System Sustainability (PCHSS) is a collaborative research network hosted by the Australian Institute of Health Innovation at Macquarie University in Sydney, Australia. Key areas of work proposed by NHMRC and partners were organised into various research themes: Using Analytics, Technology and Shared Data; Reducing Waste and Low-value Care; Promoting Better Value for the Health Dollar, and Observatory on Health System Sustainability.

The University of Queensland (UQ) has been a collaborator completing work over a five-year period (2017-2021) and leads "Research Area 1.3: Telehealth", which falls under the Using Analytics, Technology and Shared Data theme. The team has already produced two main reports entitled "Telehealth in Australia: State of Play Report" and "How does telehealth reduce costs to the health system?". These reports provided valuable insights into the current state of telehealth in Australia and the potential mechanisms by which telehealth could improve sustainability in the health system. Current projects are now focusing on the potential of remote patient monitoring (RPM) for chronic disease to improve the sustainability of the Australian health system. This research is made even more timely due to rapid health system changes related to COVID-19.

# About us

## The Centre for Health Services Research

The University of Queensland (UQ) Centre for Health Services Research (CHSR) conducts specialised research programs, with particular focus on ageing and geriatric medicine, kidney medicine and telehealth. The Centre has strengths in the fields of biostatistics, data analytics, health economics, behavioural science and clinical informatics, dedicated to improving health systems and care. The Centre was formed in 2017 and is one of four major research hubs within the Faculty of Medicine at UQ.  The Centre's collective vision is to improve the efficiency and effectiveness of health systems and services for those that need it most.

## The Centre for Online Health

The Centre for Online Health (COH) is world-renowned for its telehealth expertise. The Centre's tripartite mission of telehealth research, teaching and education, and clinical service provision makes it unique amongst university centres. COH is part of the Centre for Health Services Research within the Faculty of Medicine at The University of Queensland (UQ) and was established in 1999. The COH's key areas of activity are:

• Clinically focused research with an emphasis on examining the feasibility, efficacy, clinical effectiveness and economics of telehealth in a variety of settings;
• Academic and vocational education and training in clinical telehealth; and
• As a service provider of clinical telehealth services.

The COH's multidisciplinary team of clinicians, academic researchers, health economists, educators, technicians, engineers, and administrators bring together a broad mix of skills to telehealth.

# Contents

# Introduction

This is third telehealth report produced by the University of Queensland as collaborating partner of the NHMRC Partnership Centre for Health System Sustainability. This report will provide examples of successful remote patient monitoring (RPM) programs for chronic disease used in clinical practice from around the globe. It will focus specifically on the ecosystem required for RPM to be implemented in Australia sustainably including funding models, communication platforms, and recommendations on disease states that should be targeted first.

# What is remote patient monitoring?

We defined RPM as the collection of patient measurements (such as heart rate, blood pressure, and weight) using electronic devices while the patient is at home. These measurements are then transmitted to healthcare staff who review the information. Data can be collected passively (automatically) or actively (the patient enters the data after taking the measurement). The information may be reviewed by the healthcare staff regularly (e.g., once per week) or only when they are alerted to out-of-threshold data.

Examples of common RPM interventions for chronic diseases are presented in Figure 1.
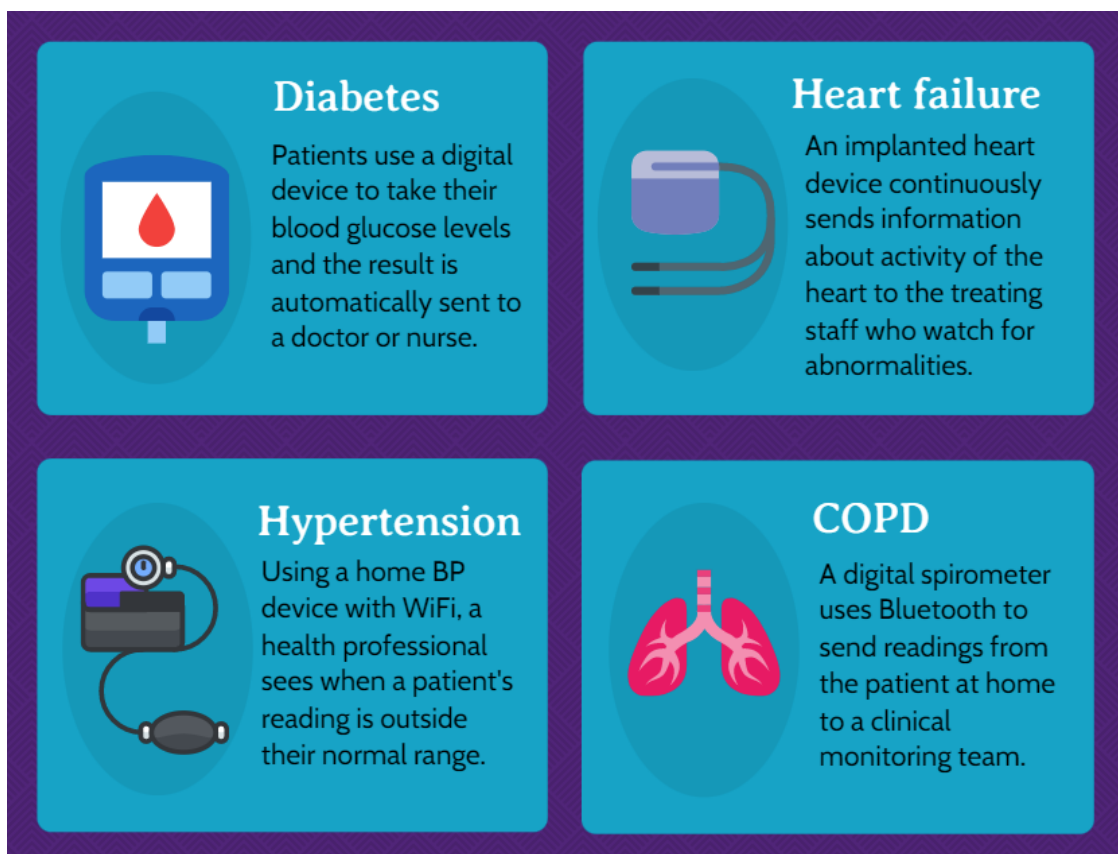


**Figure 1** Examples of what remote monitoring looks like for the common chronic conditions

## Remote patient monitoring for chronic disease

Management of chronic disease is one of the greatest challenges to the sustainability of the Australian healthcare system. According to Australian Institute of Health and Welfare (AIHW), the most common chronic conditions include cardiovascular disease, cancer, chronic respiratory conditions, chronic musculoskeletal conditions (such as arthritis and back pain), diabetes, and mental health conditions (such as depression). It is estimated that 1 of every 4 Australian has two or more of these conditions.

Due to the chronic nature ongoing monitoring the condition is required. Telehealth presents the opportunity to monitor these conditions remotely as opposed to the patient visiting a health care facility. Our other reports and publications[1-3] have highlighted two issues that are relevant to the application of monitoring systems in chronic disease management:

1.  There are no formal funding mechanisms to support RPM in Australia, and
2.  RPM has the potential to increase the sustainability of the health system by preventing secondary care use and reducing health system costs.

# How can remote patient monitoring effect the sustainability of the health system?

**Effectiveness in treating health conditions**

RPM interventions can improve clinical outcomes for patients, which reduces burden on health services. In a review of published studies on RPM, over 75% reported the intervention was effective.[4] Systematic reviews have found compared to standard care, RPM reduces mortality in heart failure patients,[5, 6] and when monitoring implantable cardioverter-defibrillators, the odds of inappropriate are reduced.[7] In hypertensive patients, monitoring remotely and in-person care had similar avoidance of cardiovascular events,[8] and home blood pressure telemonitoring improved blood pressure control.[9]  In a review of studies that remotely monitored diabetes patients, the majority (79%) showed improved HbA1c levels in patients.[10] A systematic review on continuous glucose monitoring through an in-body sensor that transmits the reading to a healthcare professional also showed improved HbA1c as compared to control groups.[11]

**Reducing acute care use**

RPM has the potential to reduce acute care use and keep patients at home instead of in the hospital. These benefits to health system utilisation were uncovered through our systematic review which included 91 RPM studies. For almost half of interventions assessed in the literature, RPM was shown to reduce hospital admissions, emergency department visits, and length of stay across various populations and health conditions by shifting care needs to primary or outpatient care.[2] The remainder of published evaluations on RPM showed no effect on acute care utilisation, with a few reporting an increase in acute care utilisation.

RPM of chronic obstructive pulmonary disease (COPD) had particular influence in reducing emergency presentations, while invasive monitoring of cardiovascular disease (using internal devices such as a cardiac resynchronization therapy device or implantable cardioverter-defibrillator) was the most effective intervention and target condition for reducing hospital admissions.[2]

**Cost-effectiveness**

The cost-effectiveness of RPM as compared to usual care has also been systematically reviewed recently. RPM was found to be highly cost-effective for hypertension with some evidence also suggesting cost-effectiveness for chronic obstructive pulmonary disease and heart failure when evidence from 34 economic analyses were combined.[12] The majority of studies took a health system perspective when conducting the economic analysis.

Whether the RPM intervention was cost-effective depended on the initial costs to implement, the disease severity, the health service context and processes involved, and willingness-to-pay. Cost savings were often realised in the long-term rather than the short term, and were especially pronounced when high-cost health care events (e.g. cardiac arrest or stroke) were avoided.

# RPM in Australia

- **Funding for community remote monitoring does not exist on a large scale in Australia** – there is no funding on the Medical Benefits Schedule for RPM.

- **Hospital-based RPM** – pilot programs and small clinician-led programs for hospital-based remote patient exist but are not yet routinely practiced in any Australian states or territories.

- **Commercial services –** private services also exist where patients pay the full fee themselves.

# Examples of International RPM Models

A selection of well-established remote monitoring models are described below.

## 1.　　　Telehomecare

### by Ontario Telemedicine Network (OTN), Canada

Patients have home remote-monitoring devices where they take their daily vitals and answer questions using a smartphone application. Patients are given a blood pressure monitor, pulse oximeter, and weight scale. The readings are reviewed by a clinical team and if they are out-of-range a message is sent to the patient's GP or other service providers.

*"Telehomecare demonstrated a 70% reduction in emergency room visits and a 76% reduction in hospital admissions compared to pre-Telehomecare"[13]*

*"At six months, the adjusted reduction in systolic and diastolic blood pressure values was between 4.0 - 2.7 mmHg".[14]*

*"An OTN patient survey indicated that over 98% of patients were satisfied with the program and 95% indicated that the program improved their ability to self-manage their condition."[15]*

| Primary population | Patients with chronic obstructive pulmonary disease (COPD) and congestive heart failure |
|---|---|
| Monitoring services managed by | Nurse monitors the results and updates GP regularly |
| Funding | Free for patients. Co-funded by provincial government and national digital health non-profit organisation. It can prevent unnecessary trips to the hospital. |



Image from: https://otn.ca/wp-content/uploads/2019/04/copdProgramDetails.pdf
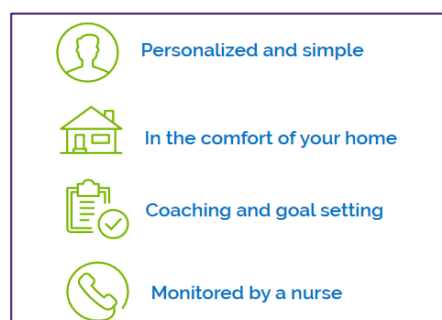
**Publications:**

Sahakyan, Y., Lusine, A., Nida, S., Alexandra, S., Petros, P., Nicholas, M., Welson, R., Murray, K., and Valeria, E. R. (2018) Changes in blood pressure among patients in the Ontario Telehomecare programme: An observational longitudinal cohort study. Journal of telemedicine and telecare 24, no. 6: 420-427.https://journals.sagepub.com/doi/full/10.1177/1357633X17706286

*More information: https://otn.ca/providers/telehomecare/*

# 2. The vEngagement program

## by Mercy Virtual, USA

Patients receive individualised care through monitoring of their vital signs by a care team. The service uses an internet connection, tablet computer and wireless monitoring equipment such as blood pressure cuff, pulse oximeter, and weight scale. Patients can also press a button if they are feeling unwell. Changes in their readings alert the care team who can then intervene before the patient becomes so unwell that they must go to the hospital. The patient's primary care physician is kept informed.

*"50% reduction in emergency department visits and hospitalizations. 98% of patients in the program are extremely satisfied or satisfied."[16]*

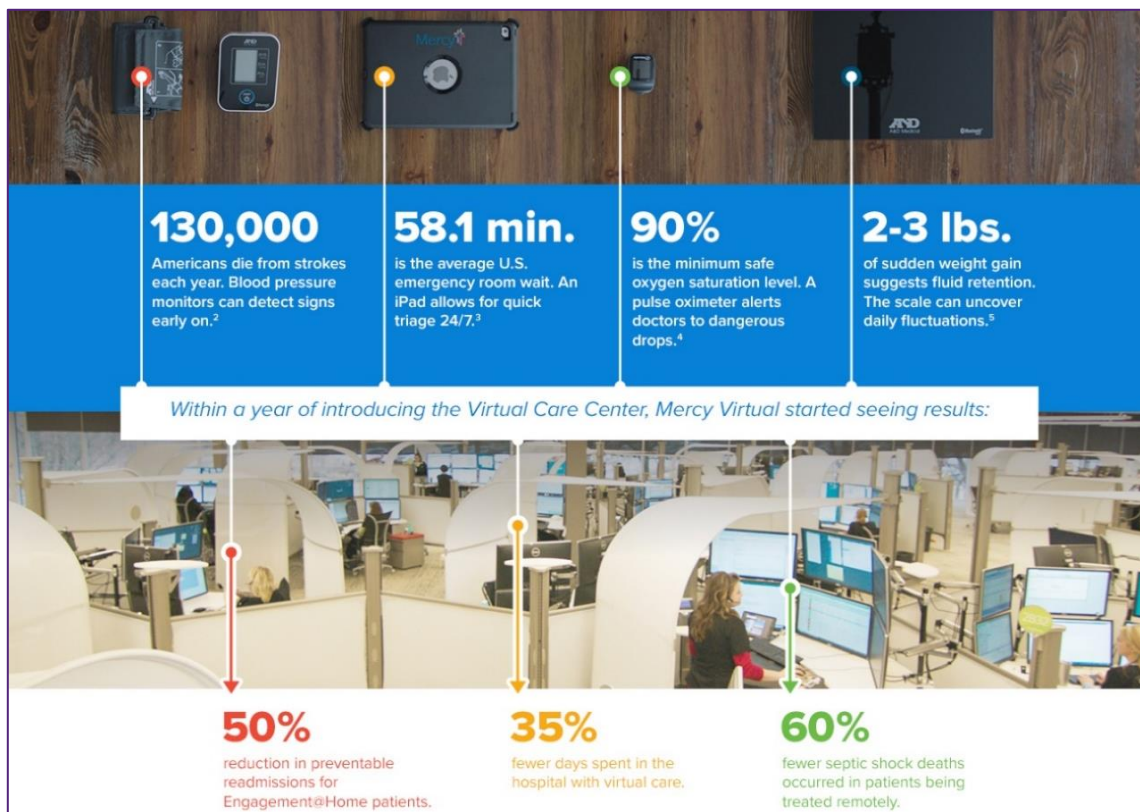| | |
|---|---|
| **Primary population** | Patients of a Mercy Virtual facility with multiple chronic conditions, frequently in and out of emergency department or hospital. |
| **Monitoring services managed by** | Multi-disciplinary Mercy Virtual team members. Includes physicians, advanced practitioners, nurses, navigators and other speciality care (e.g. mental wellness specialists, dieticians, physical therapists). GPs are sent regular updates. |
| **Funding** | Free to patients with certain conditions that are with Mercy Virtual hospitals; funded because it reduces emergency department visits and hospitalisations. |



**130,000** Americans die from strokes each year. Blood pressure monitors can detect signs early on.[2]

**58.1 min.** is the average U.S. emergency room wait. An iPad allows for quick triage 24/7.[3]

**90%** is the minimum safe oxygen saturation level. A pulse oximeter alerts doctors to dangerous drops.[4]

**2-3 lbs.** of sudden weight gain suggests fluid retention. The scale can uncover daily fluctuations.[5]

*Within a year of introducing the Virtual Care Center, Mercy Virtual started seeing results:*

**50%** reduction in preventable readmissions for Engagement@Home patients.

**35%** fewer days spent in the hospital with virtual care.

**60%** fewer septic shock deaths occurred in patients being treated remotely.

Image from: https://www.wwt.com/case-study/mercy-virtual-creates-anytime-healthcare

**Media:** vEngagement Keeps Close Watch Over Patient (2019, April 3), *Mercy.* Retrieved from https://www.mercy.net/newsroom/2019-04-03/vengagement-keeps-close-watch-over-patient/

*More information: https://www.mercyvirtual.net/vengagement/*

# 3. Home Telehealth

## by U.S. Department of Veterans Affairs (VA), USA

VA provides a device to suit a patient's needs and trains them how to use it. Patients are assigned a Home Telehealth remote monitoring care coordinator that contacts hospitals or providers to arrange treatment changes or care. The VA hospital checks on symptoms and vital signs of Veterans from their home (e.g. blood pressure, blood sugar level, weight, pulse, blood oxygen level, heart & lung sounds). The data can be sent using regular telephone lines, modems, or mobile phones.

*" Patients (n = 17,025) showed a 25% reduction in bed days, 19% decrease in hospital admissions and an overall satisfaction score of 86% with the program."[17]*

*"Statistically significant reduction in the likelihood of hospitalizations in diabetes patients."[18]*

| | |
|---|---|
| **Primary population** | Veterans who meet clinical need for service. |
| **Monitoring services managed by** | Patient's physician or a nurse. |
| **Funding** | Veterans Affairs covers cost of remote monitoring services, but patients might have to co-pay charge if video visit provided alongside remote monitoring. |



Image from: https://telehealth.va.gov/type/home

**Veterans accessed VA care through one (or more) of the following telehealth types in the 2016 financial year:**

- **More than 307,000 Veterans used Clinical Video Telehealth**
- **More than 150,000 Veterans used Home Telehealth**
- **More than 304,000 Veterans used Store-and-Forward Telehealth**

**Publications:**

Darkins, A., Ryan, P., Kobb, R., Foster, L., Edmonson, E., Wakefield, B., & Lancaster, A. E. (2008). Care Coordination/Home Telehealth: the systematic implementation of health informatics, home telehealth, and disease management to support the care of veteran patients with chronic conditions. Telemedicine and e-Health, 14(10), 1118-1126.
https://www.liebertpub.com/doi/abs/10.1089/tmj.2008.0021

Barnett, T. E., Chumbler, N. R., Vogel, W. B., Beyth, R. J., Qin, H., & Kobb, R. (2006). The effectiveness of a care coordination home telehealth program for veterans with diabetes mellitus: a 2-year follow-up. American Journal of Managed Care, 12(8), 467.
https://europepmc.org/article/med/16886889

*More information: https://telehealth.va.gov/type/home*

# 4.    Diabetes & Hypertension RPM

## by Kaiser Permanente, USA

Using a smartphone and Bluetooth-enabled glucometer or blood pressure monitor, patients track and share their readings in real time to their electronic medical record at Kaiser Permanente. The patient can also add a note. The care team can set alerts for out-of-range readings and use the information to adjust medications or treatment recommendations. The service is a part of telehealth services including telephone, video, email, and online portals.

*"60% of our members say digital tools from Kaiser Permanente have helped them save time by avoiding an office visit — while still getting the care they need."*
*- Kaiser Permanente User Experience Survey, 2014*

*"After 6 months, change in HbA1c was −2.4 ± 1.6% among frequent users."*[19]

| | |
|---|---|
| **Primary population** | Those insured with diabetes and/or hypertension. |
| **Monitoring services managed by** | Kaiser Permanente care team. |
| **Funding** | Funded by health plan members. During COVID-19 useful to fund this as it protects members, doctors, nurses, and staff by keeping patients at home, as well as providing improved patient experience and outcomes. |



Image from: https://healthy.kaiserpermanente.org/learn/what-is-kaiser-permanente
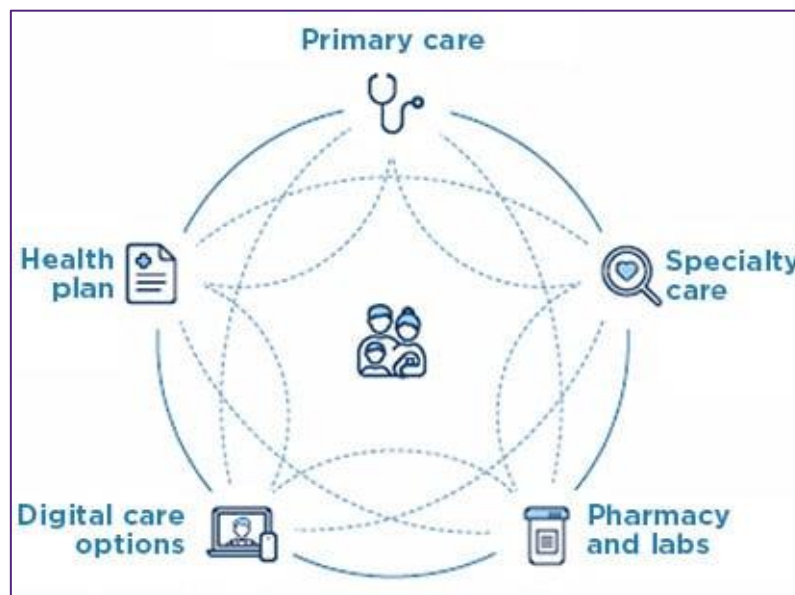
**Publications:**

Lee, M. K., Lee, K. H., Yoo, S. H., & Park, C. Y. (2017). Impact of initial active engagement in self-monitoring with a telemonitoring device on glycemic control among patients with type 2 diabetes. Scientific reports, 7(1), 1-7.https://www.nature.com/articles/s41598-017-03842-2

*More information: https://about.kaiserpermanente.org/our-story/our-care/managing-chronic-health-conditions-from-home*

# 5.    Ochsner Digital Medicine

## by Ochsner, USA

*"We are offering a new way to deliver care in patients with chronic diseases"*
*- Richard Milani, MD, Chief Clinical Transformation Officer, Ochsner Health System.*

**Hypertension:** When patients enrol in the hypertension program through their myOchsner portal they are automatically able to view their blood pressure readings and their medical records. Using a smartphone and a digital blood pressure cuff they can send blood pressure readings to the Hypertension Digital Medicine Team from their home using a smartphone. Patients receive regular feedback from the hypertension care team and monthly reports regarding their progress. All of this information is available to their primary care provider through their electronic medical record, and they can track progress through a smartphone app.

**Diabetes:** Patients still attend clinics for appointments and education, but they are managed day-to-day by an educator who reports back to primary and specialist care providers. They employ a patient portal and remote monitoring, secure messaging and other modalities.

**Implanted devices:** Providers are sent patient data on cardiac issues as well as device functioning.

*"After 60 days of treatment, this system secured BP control in 62% of patients compared to 13% in usual care."[1]*

*"81% of Digital Medicine for diabetes patients achieved their A1C goal after six months versus 62% of usual care patients, and patients experienced a 36% drop in instances of diabetes distress after six months in the program"[20]*

| Primary population | Patients with diabetes and/or hypertension. |
|---|---|
| Monitoring services managed by | Pharmacist and physician assistants with chronic disease expertise, physician adjusts medications. Health coach gets to know patient to give personalised suggestions. |
| Funding | Patients often access Ochsner's healthcare service through their insurance plans, workplace corporate health plans or by subscribing themselves. Ochsner Digital Medicine reduces over-utilization such as unnecessary ER visits as well as hospital admissions and 30-day readmissions. |

*"By investing in comprehensive chronic condition prevention and management of the most common chronic diseases, the U.S. could decrease treatment costs by $218 billion per year and reduce the economic impact of disease by $1.1 trillion annually."[21]*

**Publications:**

Davis, A. P., Wilson, G. M., Erwin, J. P., Michel, J. B., Banchs, J., Saeed, A., & Widmer, R. J. (2021). Use of Web-Based Patient Portals in Patients With Atrial Fibrillation Is Associated With Higher Readmissions. Ochsner Journal, 21(1), 25-29. http://www.ochsnerjournal.org/content/21/1/25

Milani, R. V., Lavie, C. J., Bober, R. M., Milani, A. R., & Ventura, H. O. (2017). Improving hypertension control and patient engagement using digital tools. The American journal of medicine, 130(1), 14-20. https://www.amjmed.com/article/S0002-9343(16)30844-0/fulltext

*More information: https://www.ochsner.org/digital-medicine*

# 6.     Connected Health – Home Care

## by Tunstall, Australia

Patients have home remote-monitoring devices where they take their daily vitals alongside using a smartphone application. These are reviewed by a clinical team and if they are out-of-range a message is sent to the patient's GP or other service providers. May be used for CHF, COPD, CVD, asthma, diabetes, hypertension, cystic fibrosis and renal conditions.

*"44% decrease in emergency admissions, 106% increase in uptake of home dialysis, 59% decrease in cost of care"*[22]

*"Connected health is 40% cheaper than face-to-face."*[23]

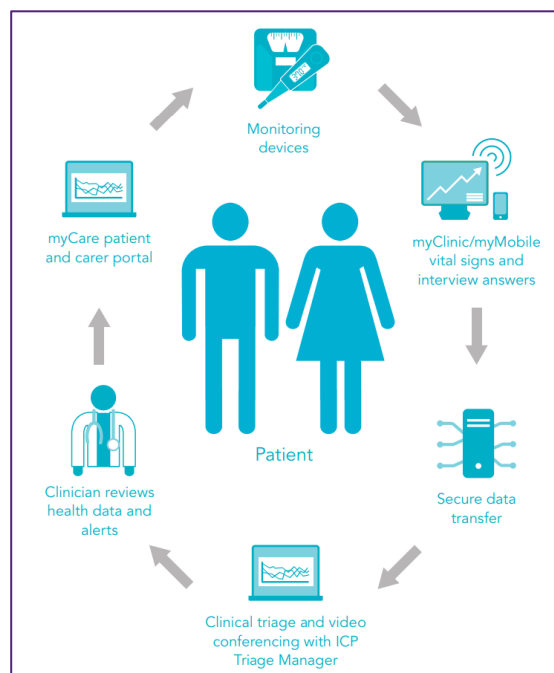| | |
|---|---|
| **Primary population** | People with long term conditions (e.g. COPD, heart failure). |
| **Monitoring services managed by** | Care Consultants and Registered Nurses. GP or specialist is contacted as required. |
| **Funding** | Patients routinely pay for devices and ongoing monitoring support by large care organisations. Organisational benefits include lower associated care costs due to preventing clinic visits, hospitalisations, and ED visits.[23] |



Image from: https://static1.squarespace.com/static/5b67adf2af2096c5aae0d566/t/5becb159352f53b39ffb80d4/1542238564103/Connected+Health+Solutions.pdf

**Brochure:**

Tunstall Healthcare. (n.d.). *Connected Health – Putting the patient at the heart of the journey* [Brochure]. Retrieved from https://static1.squarespace.com/static/5b67adf2af2096c5aae0d566/t/5becb159352f53b39ffb80d4/1542238564103/Connected+Health+Solutions.pdf

*More information: https://www.tunstallhealthcare.com.au/healthcare*

# 7.　　**rpa**virtual (RPA Virtual Hospital)

## By Sydney Local Health District, Australia

The RPA Virtual Hospital, known as rpavirtual, was launched in early 2020 as an alternative, sustainable solution to increasing demand for healthcare in Sydney.

rpavirtual is a new model of care which combines Sydney LHD's integrated hospital and community care with the latest digital solutions. rpavirtual acts as a bridge between hospital specialist services and patient care in the community.

A purpose built 24/7 Virtual Care Centre was established on the Royal Prince Alfred Hospital campus and equipped with 'Care Pods' that include videoconferencing technology and the ability to remotely monitor patients with wearables.

*"Technology gives us the ability to connect our patients and their loved ones to the very best of care, when and where they need it most"*

*- Miranda Shaw, the General Manager of rpavirtual[24]*

*"The model has the potential to cut the number of unnecessary Emergency Department presentations, reduce a patient's length of stay in hospital and to empower patients, especially those with chronic illness, to lead a better quality of life."[24]*

| | |
|---|---|
| **Primary population** | When it commenced rpavirtual cared for palliative patients, cystic fibrosis patients, and wound patients.<br><br>In 2020 they shifted to being a service primarily for patients with coronavirus (COVID-19) at present, although the broad range of monitoring wearables mean they can extend their service in the future. |
| **Monitoring services managed by** | Multidisciplinary team (nurses, doctors and allied health) based at the Royal Alfred Hospital virtual care centre in Sydney |
| **Funding** | Funded by New South Wales Health |

**Media:**

NSW Government. (2020). *RPA Virtual Hospital* [Web Page]. Retrieved from
https://www.slhd.nsw.gov.au/sydneyconnect/story-2020-RPA-Virtua-Hospital.html

*More information:*
*https://www.health.nsw.gov.au/innovation/2020awards/Pages/rpavirtual.aspx*
*https://www.slhd.nsw.gov.au/RPA-Virtual-Hospital/*

# What makes a successful RPM program?

Several factors may influence whether RPM interventions are effective. Program features[3, 25] that are associated with effective interventions include:

- Targeting a population at high risk
- Detecting a decline in health accurately
- Providing responsive and timely care
- Personalising care e.g., set patient-specific thresholds for vital measurements
- Encouraging and enabling patient self-management
- Coordinated collaborative care between the patient, primary care, and hospital staff
- Integrated system of healthcare delivery
- Technology support options and services
- Aligned with payment and reimbursement models
- Clinician champions and stakeholder support

When RPM is used for patients with multiple comorbidities or moderate to severe disease conditions, the effect on hospital use is greatest. It is also useful to schedule monitoring during time periods of high risk such as just after a hospital discharge. Implantable devices such as pacemakers allow continuous monitoring which also promotes detecting issues in the device itself or catching other un-diagnosed conditions proactively.

A literature review of why RPM interventions varied in effectiveness showed a program is only as reliable as the person (or device) collecting and entering the data, and the timeliness of the staff reviewing the information.[3] Automated collection and having a dedicated RPM team (rather than just incorporating the device into an existing care model) can maximise benefits of RPM. If patients are expected to manually enter data, the process and device should be co-designed between consumers and healthcare staff and users should be trained thoroughly on the process.

The review also found successful RPM programs are not usually standalone surveillance of data.[3] Often monitoring of biometric measures is combined with telephone coaching, video consultations with nurses, frequent check ins with a care coordinator, and feedback being provided to patients.[3] All these strategies help with patient adherence to monitoring which is crucial as well.[3]

# Summary

- Personalized digital health programs can meet the growing needs of a rapidly expanding population of older adults.[26]
- Engagement of older adults (65 and older) in a fully digital health platform highlights the potential for widespread adoption, and this supports continued research to optimize digital health interventions for older adult users.[26]
- Many different programs exist internationally, many involve wearable devices which have been validated in various settings and for many health conditions.[25]
- A successful RPM program includes a defined population and disease, a system that integrates with existing systems, technology support, personalised care, a reimbursement model and support from clinicians and stakeholders.

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