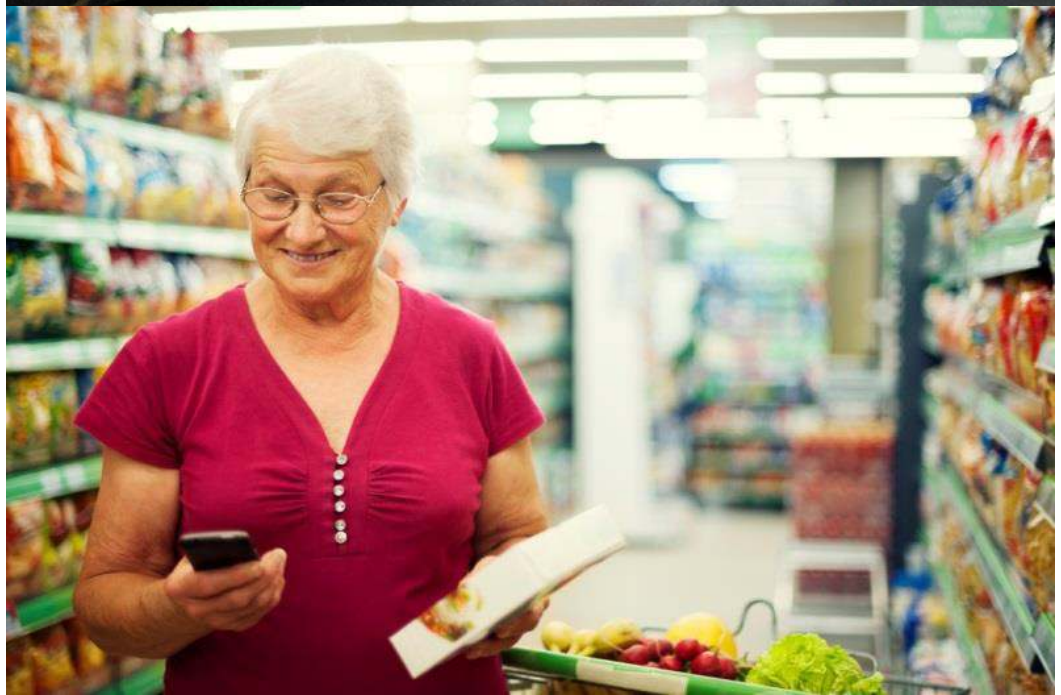


Edinburgh Napier UNIVERSITY

Can mobile apps help prevent cardiovascular disease across the lifespan?

Professor Lis Neubeck
School of Health and Social Care
Edinburgh Napier University

Background

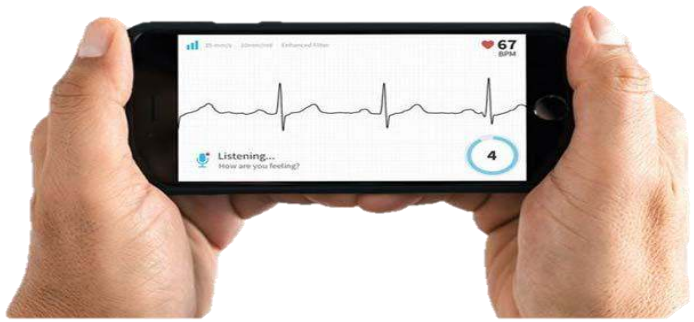
- Cardiovascular disease remains the biggest killer globally
- 50% of all CVD hospitalisations are repeat events
- Attendance at cardiac rehab lowers cardiovascular risk factors, improves quality of life and decreases morbidity and mortality
- Cardiac rehab is typically time-limited, facility-based and conducted in groups
- Use of mobile apps may be a solution to increase access to effective prevention
- Explosion of low-cost health-related apps that are not based on evidence

What models?

- Telehealth, home-based and programs delivered in general practice all effective
- Many services now delivering flexible models
- Mobile interventions could provide additional options for those who do not access facility-based CR

eHealth, mHealth, telehealth, Internet, mobile apps…

- eHealth- use of emerging communication and information technologies, especially Internet, to improve health and health care
- mHealth- use of mobile computing and technologies for health services and information



Quality of apps

- Overall health apps are of low quality

Healthcare apps- IMS review

- Assessed 16,275 apps
- 2/3 aimed at consumers
- Remainder are for health care professionals
- Almost half of apps are misclassified
- Evaluated type and quality of information, data tracking, communication processes and quantity of device capabilities
- On a scoring system of 0-100, average score was 40

http://www.imshealth.com/deployedfiles/imshealth/Global/Content/Corporate/IMS Health Institute/Reports/Patient_Apps/IIHI_Patient_Apps_Report.pdf

Negative messages in mobile apps

- 107 apps promoting smoking available
  - Downloaded by >6 million users
  - Contain information about smoking
  - Share images of favourite brands
  - Advocate smoking
- Food industry developed advergames
  - Product being promoted is a reward or goal for character in a game

BinDhim et al, Tob Control 2014; Dietz, Health Aff 2013


FRIDAY
22

Primordial prevention

- Establishment of healthy living patterns to prevent the emergence of risk factors
- Behavioural, cultural, environmental, economic, or social actions to minimize the potential for developing CVD risk factors
- Examples
  - targeted tobacco control programmes for non-smokers at times when they might adopt smoking behaviour, such as in childhood or adolescence
  - targeted dietary intervention in school-age children to increase fruit and vegetable consumption at home

Primary prevention

- Primary prevention specifically targets known CVD risk factors, such as smoking, excess weight or obesity, or hypertension
- Many apps, but few evidence based
- Apps for diet, fitness trackers, quit smoking…

Secondary prevention

- Limited evidence that apps effectively reduce multiple CVD risk factors
- Many apps available
- Choose reliable source, e.g. Heart Foundation
- Many pharmaceutical companies developing apps
- Takes 18 weeks to develop typical app

App use in children

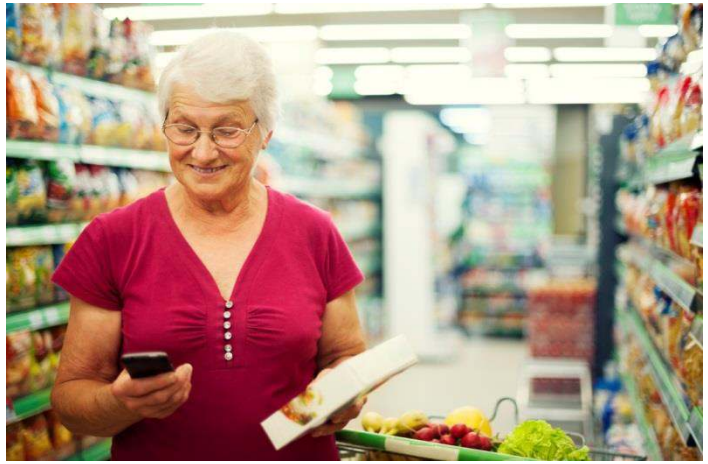
- 75% children aged >8 years have access to either smartphones or tablets at home
- Although a socioeconomic gap exist for device access and ownership, it is rapidly diminishing
- 80% of high-income parents download apps for their children, whereas only 31% of low-income parents do

App use in adolescents

- Almost 80% of teenagers having their own mobile phone, half of which are smartphones
- At least half of the teenagers with a smartphone access the Internet
- predominantly via this device rather than any other
- Teenagers use apps for social media or gaming
- In a survey of 7,000 teenagers in the USA, social media apps were the most popular
- Using the principles of social connectivity might benefit young people's access to CVD prevention

Apps and older adults

- Age itself is not a barrier to app usage
- Apps have been successfully used in the older population to improve physical activity and cognitive function.
- At least 75% of smartphone users aged >65 years have downloaded an app to their device



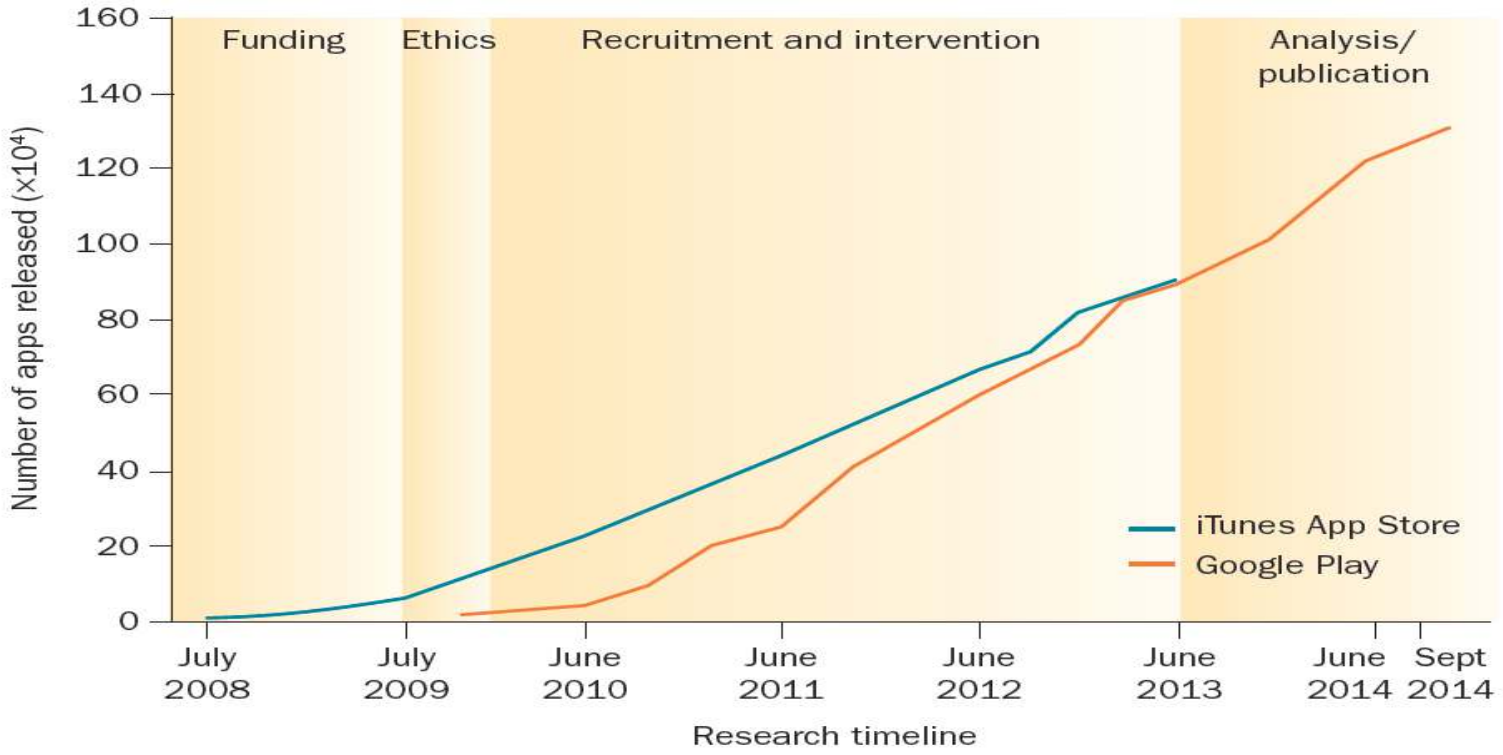
Apps and older adults

- Challenges of complicated data-usage plans
- Apps that have not been developed for those with declining vision, reduce the likelihood of apps being downloaded and used by older adults
- Some smartphones might even be too small for older users to hold, and challenges are associated with small buttons
- Prefer to refer to a user manual

Digital divide

- 28% of the world's population currently own and use a smartphone
- 25% increase since 2013
- The rapid development in affordable technology has led to predictions that >50% of people globally will own a smartphone by 2018
- People in low socioeconomic groups retain older technologies, eg mobile telephones that can only send and receive text messages, and which do not have apps

Timeline to app development



Mobile phone apps for secondary prevention

Blasco et al.	ACS patients with 1+ cardiovascular risk factor (Spain)	Combination: Telephone, internet, risk factor monitoring by cardiologist, individualised SMS feedback
Chow et al. (TEXT ME)	Patients >18 years with CHD (Australia)	Text messages, based on American Heart Foundation guidelines, regular semi-personalised messages, individualied risk factor modification
Johnston et al. (SUPPORT)	MI patients prescribed Ticagrelor (Sweden)	Combination: Smartphone app, self-managed, risk factor monitoring, automated feedback SMS
Karhula et al.	Patients >18 years with CHD or diabetes (Finland)	Combination: Internet, health coaching, mobile phone coaching to risk factor targets, self-management
Maddison et al. (HEART)	Patients >18 years diagnosed with IHD within past 3-24 months (New Zealand)	Combination: Internet, web-based exercise intervention, self-managed, behaviour change, internet behavior monitoring, SMS encouragement
Pfaeffli Dale et al. (Text4Heart)	CHD patients with home internet access (New Zealand)	Combination: text messaging, based on CR, patient education, risk factor management, daily messages, Internet support
Varnfield et al. (CAP-CR)	Post-MI patients referred to CR (Australia)	Combination: smartphone, mentor-managed, motivational/education messages, weekly phone consultation, web monitoring with weekly consultation

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Care Assessment Platform

- RCT (n=120)
- Intervention included daily text messages, multimedia education topics, relaxation audio files, and a light-to-moderate physical activity programme
- Control was usual CR
- Participants using the smartphone app had significantly higher adherence and completion than usual CR group
- Both the intervention group and usual CR significantly improved their 6-min walking test distance (by 60 m and 47 m, respectively)
- Improved depression scores measured using the Depression and Anxiety Stress Scale
- The intervention group lost a small, but significant, amount of weight, but the difference between the groups at follow-up was not significant

Varnfield et al, Heart 2014

TEXT 4 HEART

- RCT (n=123)
- Patients in the intervention group received a personalized 24-week mHealth program, framed in social cognitive theory, sent by fully automated daily short message service (SMS) text messages and a supporting website
- Control was standard cardiac rehab
- A significant treatment effect in favour of the intervention was observed using a self-reported composite health behaviour score at 3 months (P=.03), but not at 6 months (P=.13)
- The intervention group reported significantly greater medication adherence score (P=.004)
- The majority of intervention participants reported reading all their text messages (85%)
- The number of visits to the website per person ranged from zero to 100 (median 3) over the 6-month intervention period

Dale et al, J Med Internet Res 2015

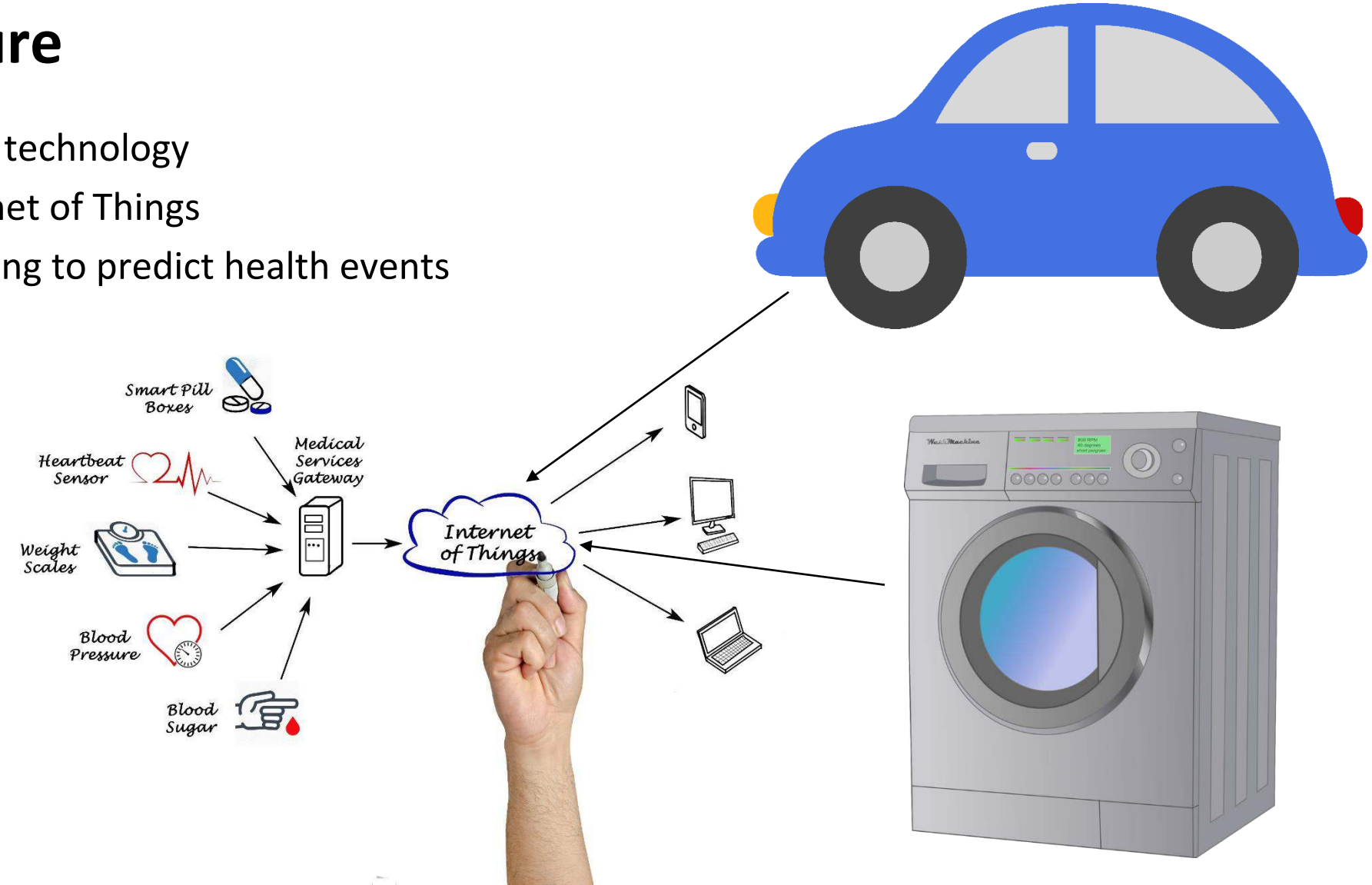
TEXT ME

- RCT (n=710)
- Patients in the intervention group (n = 352) received 4 text messages per week for 6 months in addition to usual care
- Text messages provided advice, motivational reminders, and support to change lifestyle behaviours
- Control was usual care
- At 6 months risk factor were significantly improved in intervention group
  - LDL-C ↓5 mg/dL (*P* = .04)
  - Systolic blood pressure ↓ 7.6 mm Hg (*P* < .001)
  - BMI ↓ 1.3 (*P* < .001)
  - Physical activity↑345 METS (*P* < .00)
  - Smoking 26% vs 44% (*P* < .001)
- The majority reported the text-message program to be useful (91%), easy to understand (97%), and appropriate in frequency (86%)

Chow et al, JAMA 2015

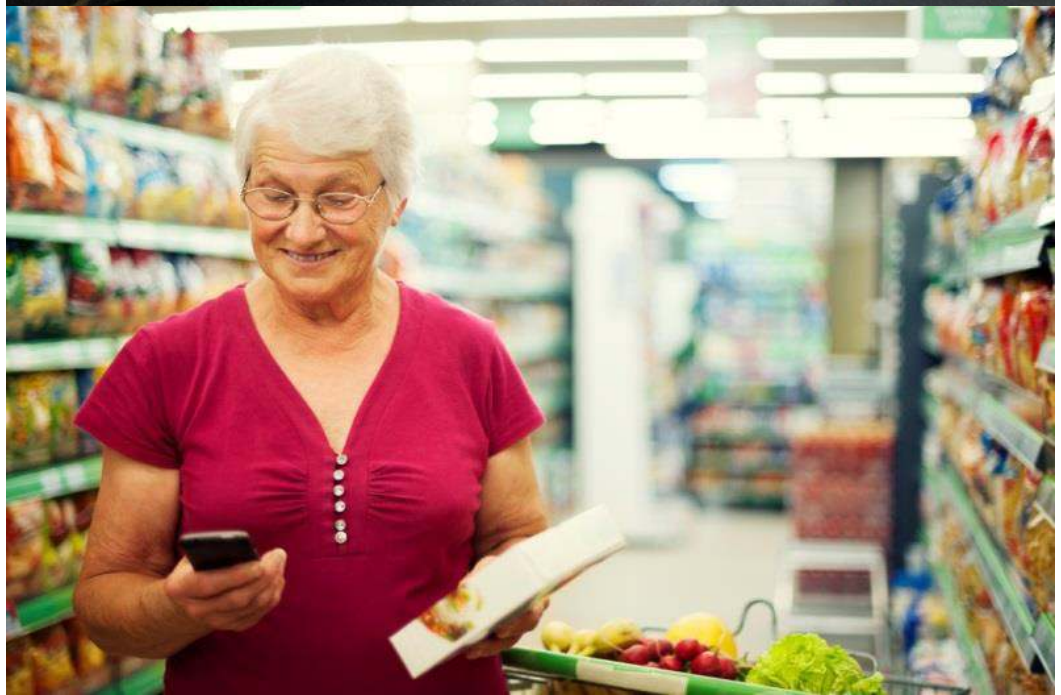
The future

- Wearable technology
- The Internet of Things
- Data sharing to predict health events



Conclusion

- Mobile apps can add to the suite of available options for prevention of cardiovascular disease
- Text messaging has been successful in promoting behaviour change in cardiac patients
- The technology is evolving rapidly and understanding principles is likely to be more important than awareness of every advance in technology



Edinburgh Napier UNIVERSITY

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CARDIHAB

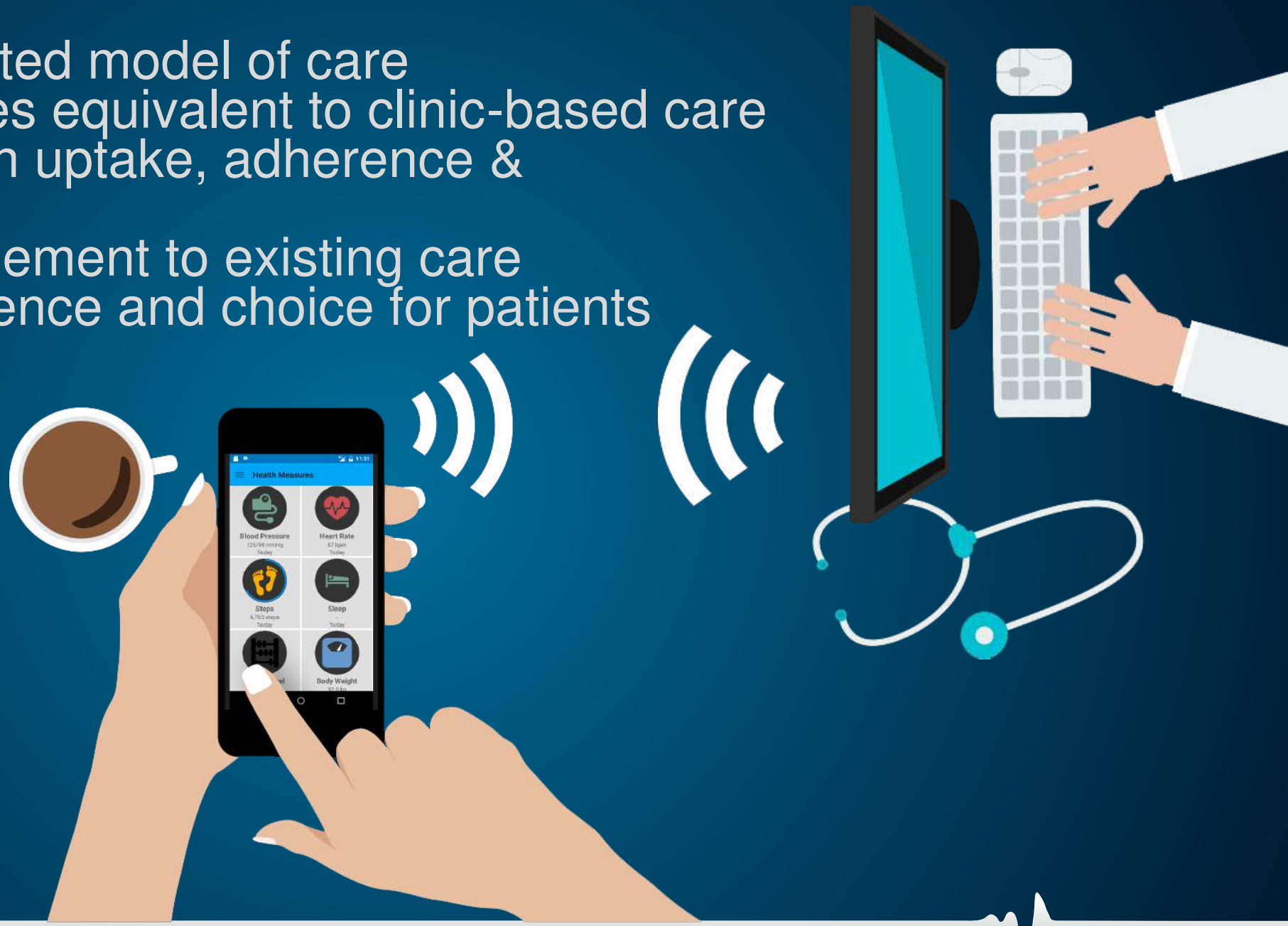
GET BACK TO LIFE

SMART CR

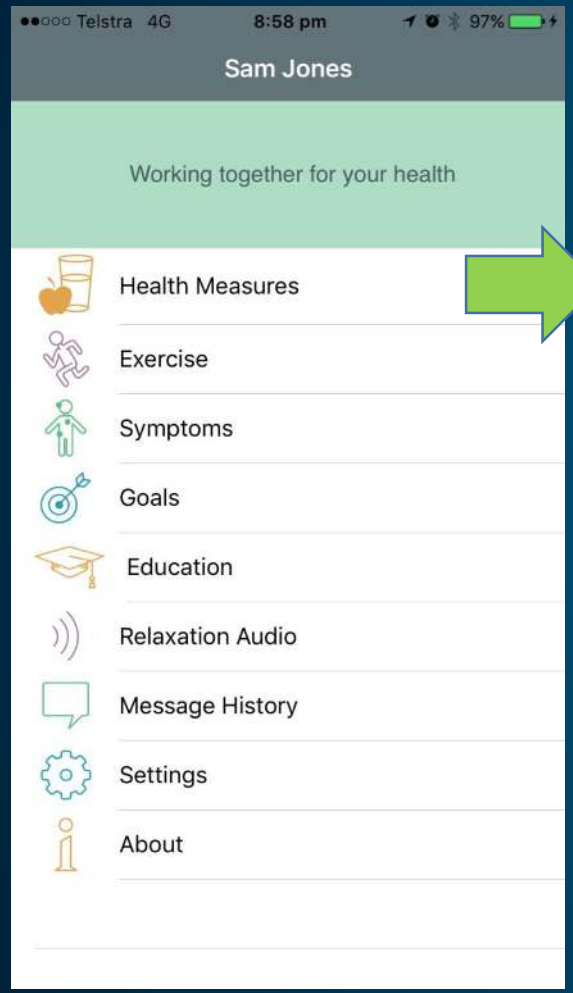
Simon McBride
Chief Technology Officer

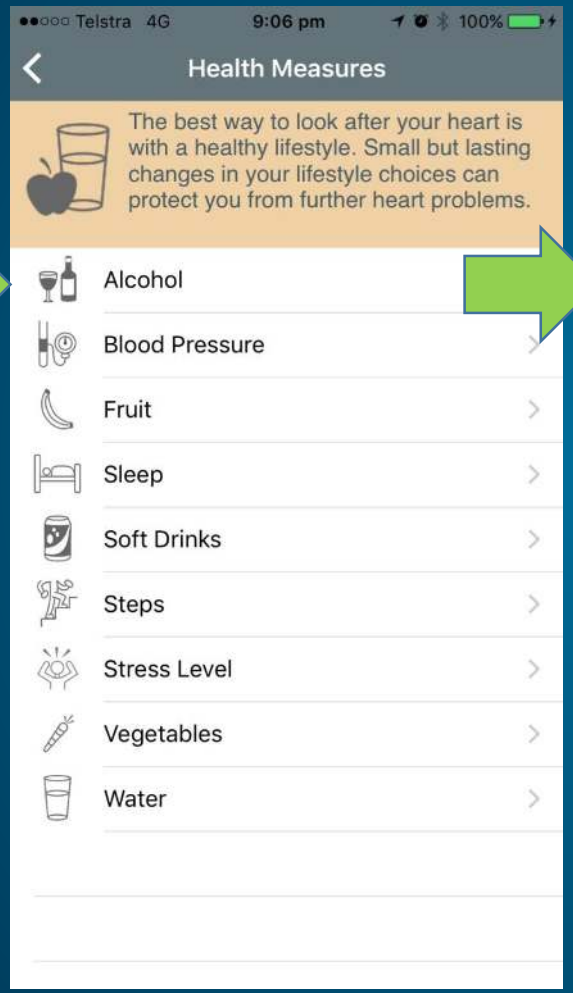
Australian Cardiovascular Health and Rehabilitation Association
Annual Scientific Meeting 2017

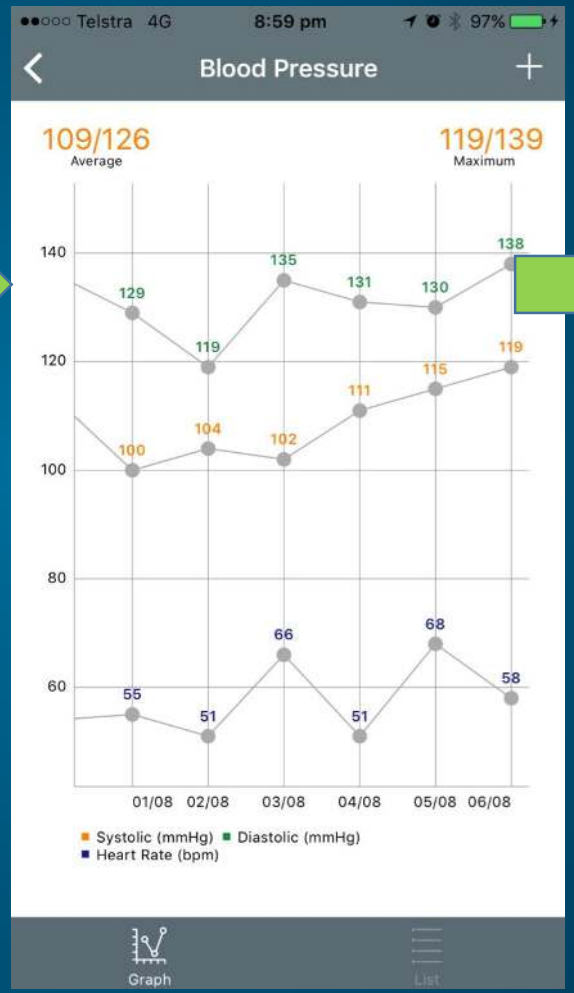
- Scientifically validated model of care
  - Clinical outcomes equivalent to clinic-based care
  - Improvements in uptake, adherence & completion
- Clinician led complement to existing care
- Increases convenience and choice for patients

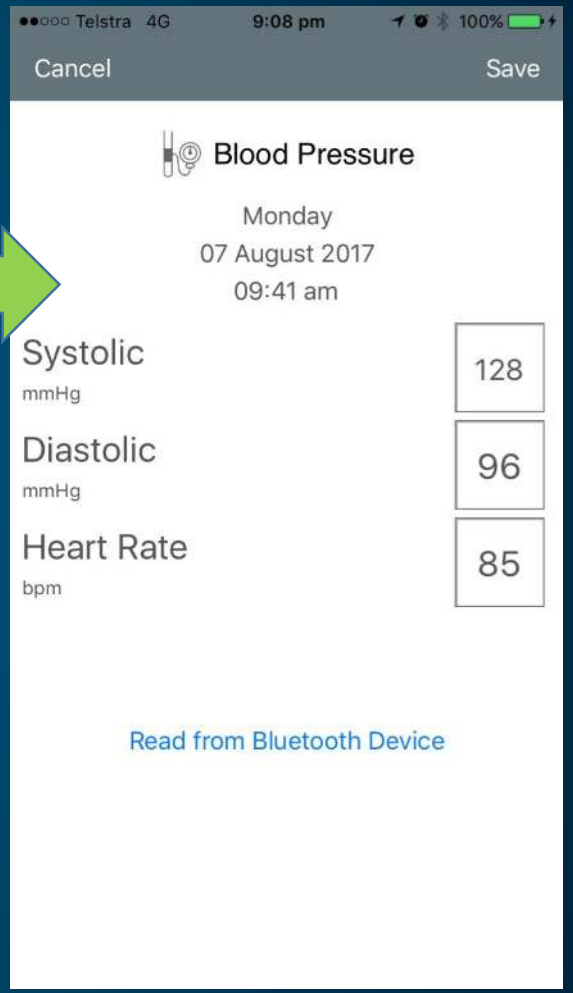


SMART CR: Patient App

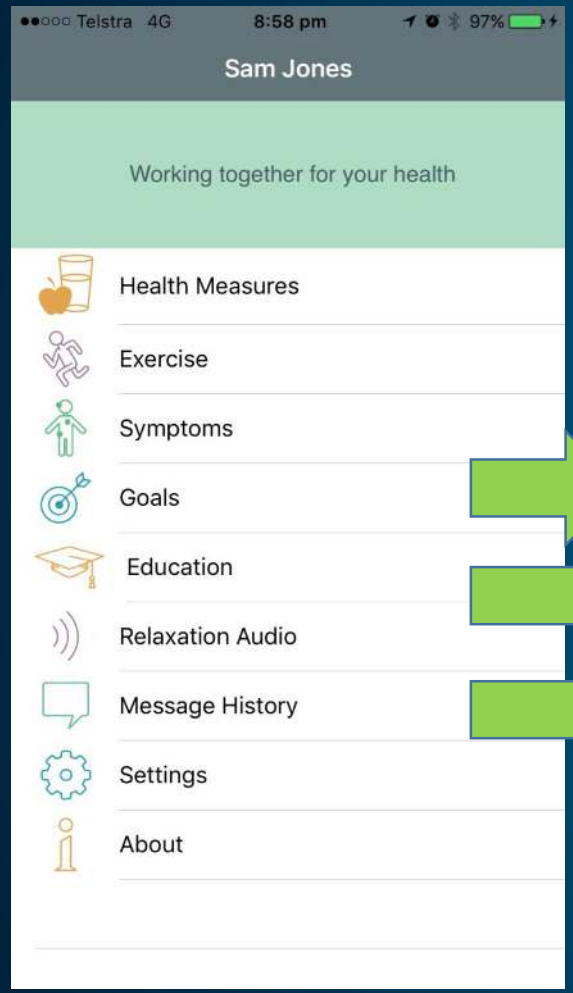


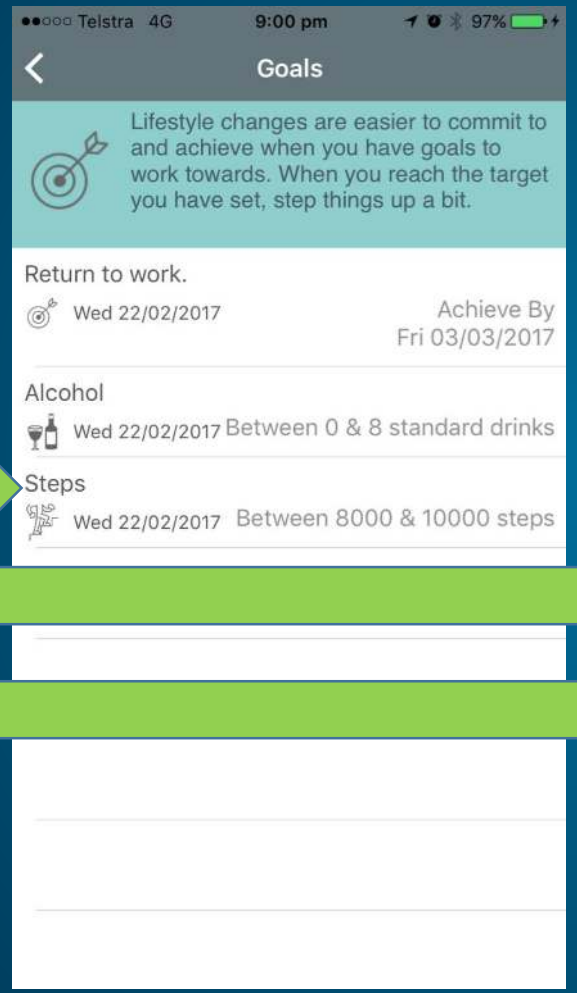


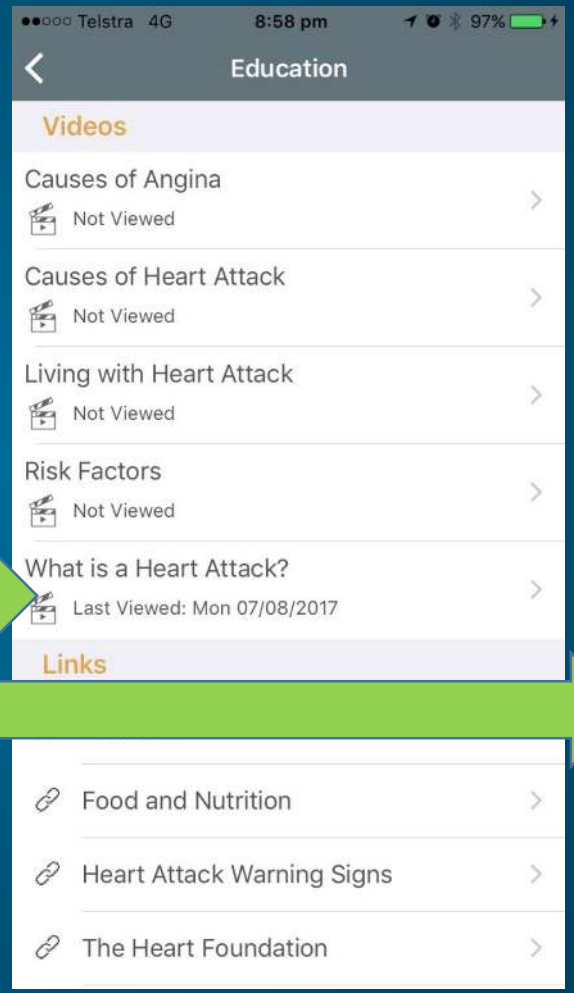


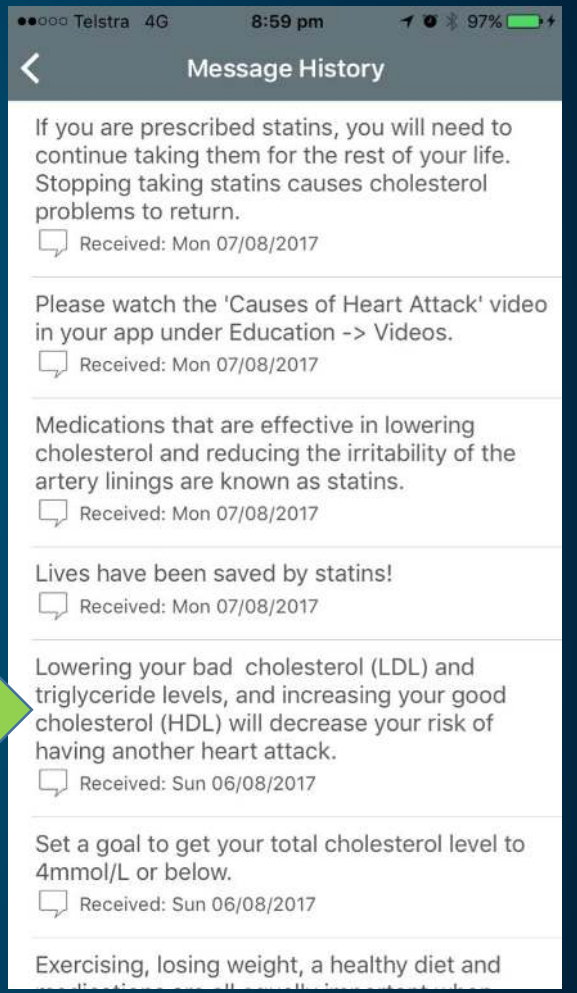


SMART CR: Patient App

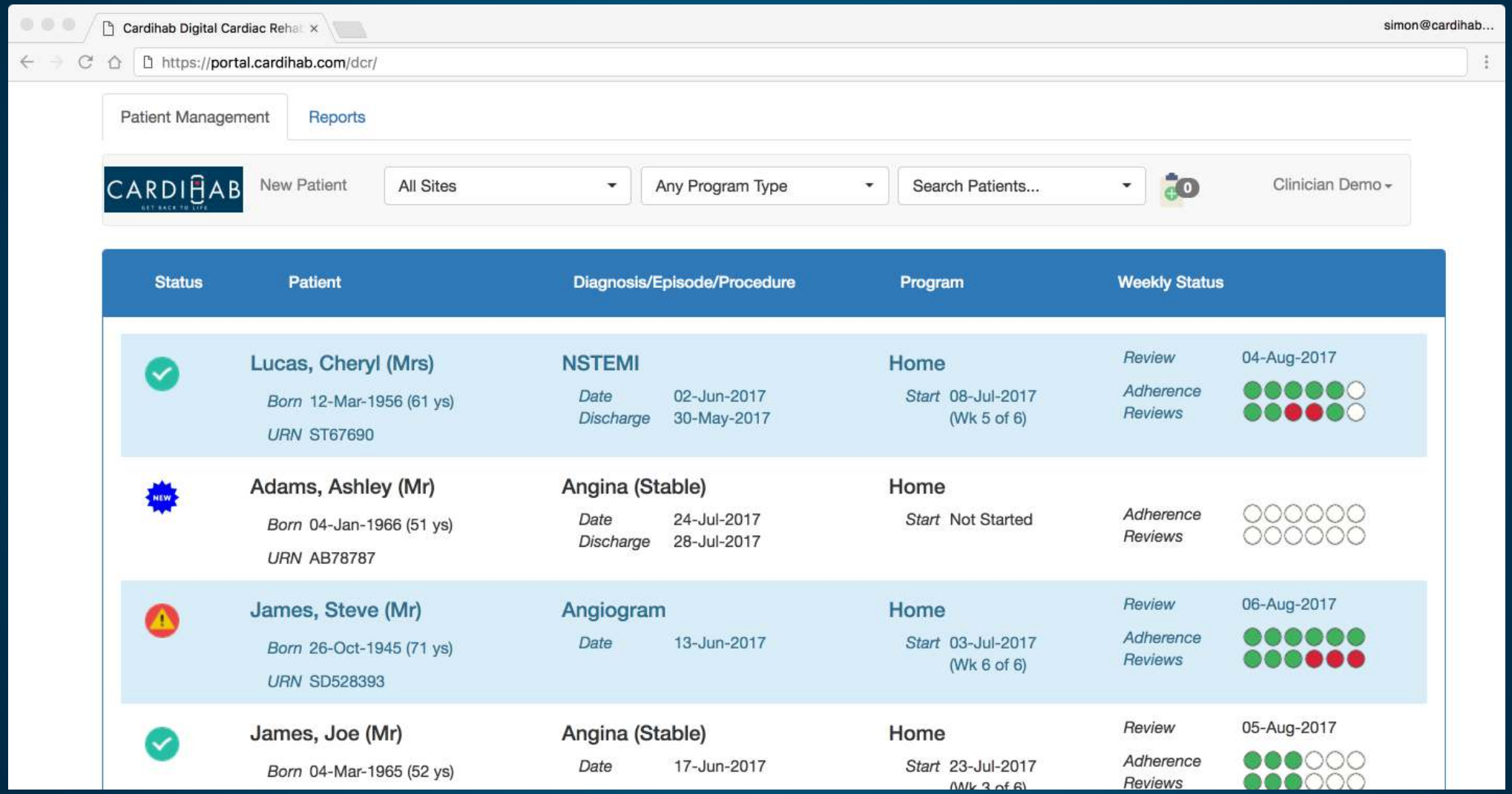




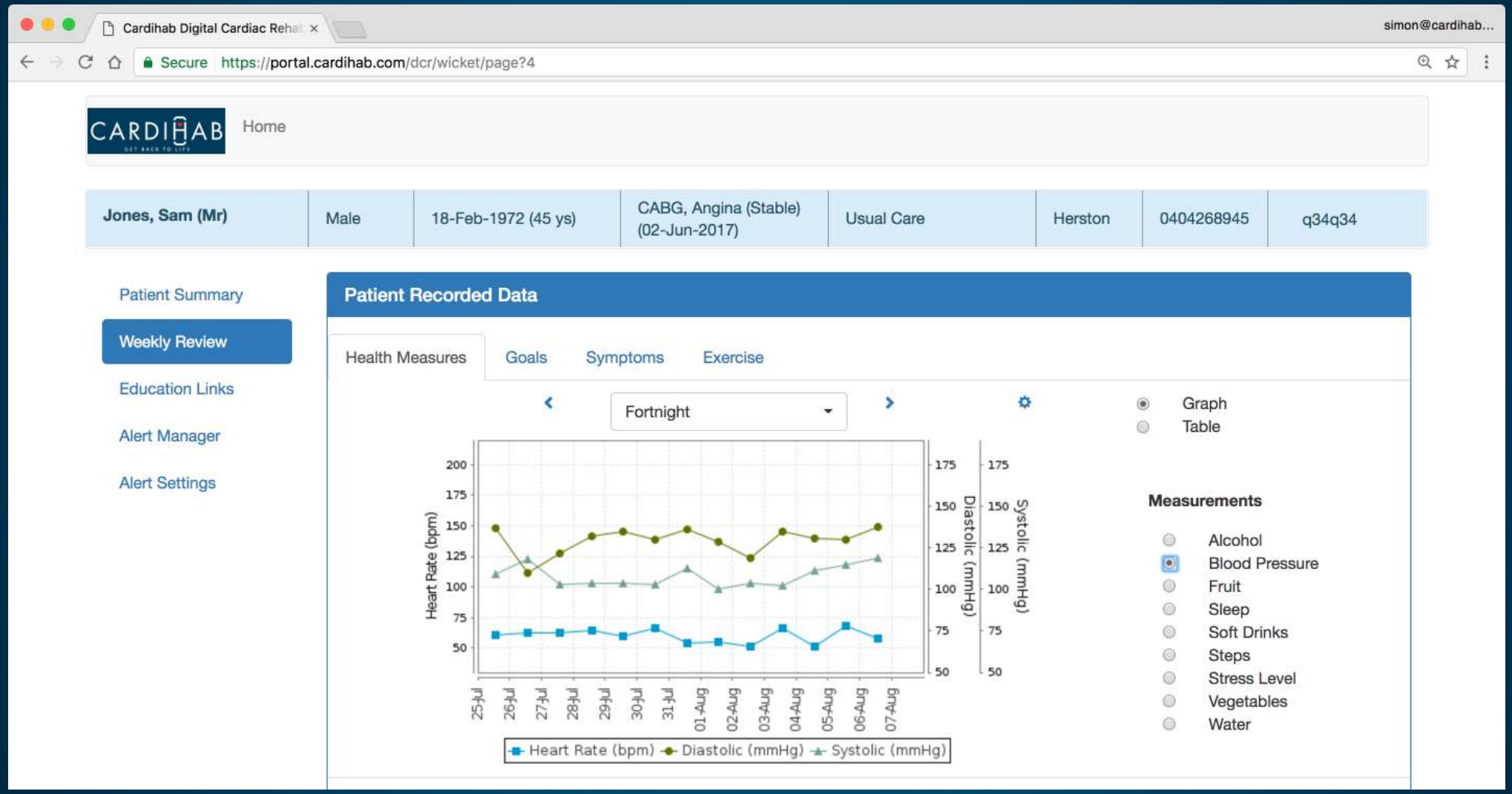




SMART CR: Clinician Portal: Dashboard



SMART CR: Clinician Portal: Weekly Review



Smart CR Roadmap

- Long term recovery
  - Phase 1,2,3/maintenance
  - +12 month
- Updated messaging
  - Longer term
  - Evidence-based
- Medication adherence
- Survey capability
  - Auto follow up (3/6/12 months)
  - PROMs
- Support for wearables
  - Fitbit, Garmin, etc
- Integrations
  - MyHealthRecord

SMART CR Implementation

- Pre-implementation
  - Educational webinars, demonstrations, site visits.
  - Assistance with business case development
    - Clinical evidence
    - Economic evidence
    - Other specialist information (e.g. questions from IT team)
- Implementation
  - Staff training
  - Staff help desk
  - Software maintenance
  - Software updates
  - Roadmap influence
  - Backups, recovery
  - Uptime, security

Next Steps

- Visit our booth
  - Demos of app and portal
  - Brochures
  - Register for a follow up call or webinar

Health Technologies Workshop

Time	Topic	Speaker
3.15	Introduction	Chairs: Sandy Hamilton and Robyn Gallagher
3.15	Introduction to health technology for cardiac patients and related evidence	Lis Neubeck
3.35-3.55	Australian health technologies for cardiac patients which incorporate health professional advice and/or support	Chair: Sandy Hamilton
3:35-3:40	Cardihab	Simon McBride
3:40-3:45	Telemonitoring Enhanced Care for Heart Failure	Nicole Chen/Andrew Maiorana
3.45-3.50	Avatar-based technology	Robyn Clark
3:50-3:55	Total cardiac care	Cate Ferry
3:55-4:05	Cardiac specific apps publicly available • My Cardiac Coach (AHA) • My Heart My Life (NHFA) • MyHeartMate (Figtree, Neubeck, Gallagher et al.,)	Robyn Gallaher
4.05-4.15	Panel Question and Answer	Chairs: Robyn and Sandy

CHF TELEMONITORING

VITELMED – MANAGEMYHEALTH – MD ANALYZE

S. H. CHEN
A. MAIORANA

Government of **Western Australia**
Department of **Health**

State Government Victoria Department of health

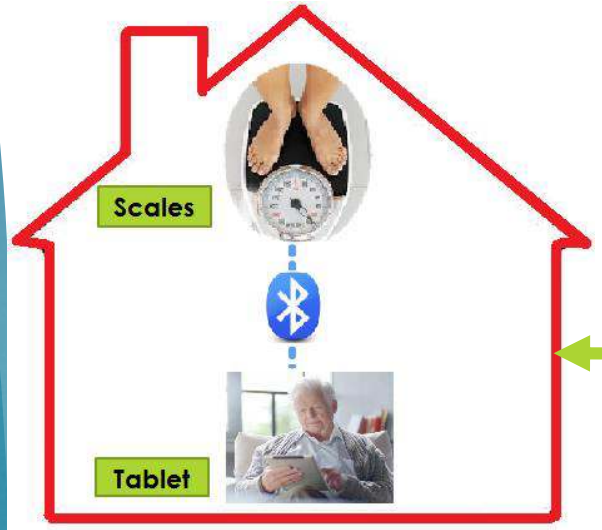
medtech

Curtin University

Peninsula Health | Building a Healthy Community, in Partnership

System Overview

- Daily weight monitoring is important for CHF
- Rapid weight gain reflects fluid retention
- Only 40% patients monitor weight[1]



FROM HOME

MANAGE MY HEALTH

MD Analyze

CHF Nurse

MEPACS

Call Centre

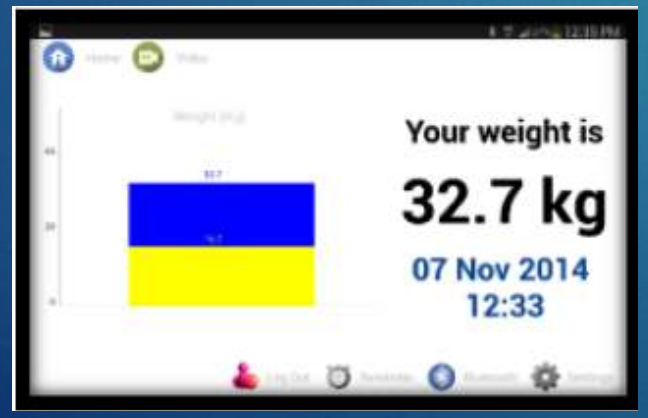
GP

1. Jaarsma T, et al. Comparison of self-care behaviors of heart failure patients in 15 countries worldwide. Patient education and counseling. 2013; 92(1):114. OI:10.1016/j.pec.2013.02.017.

Process flow diagram for CHF Telemonitoring system

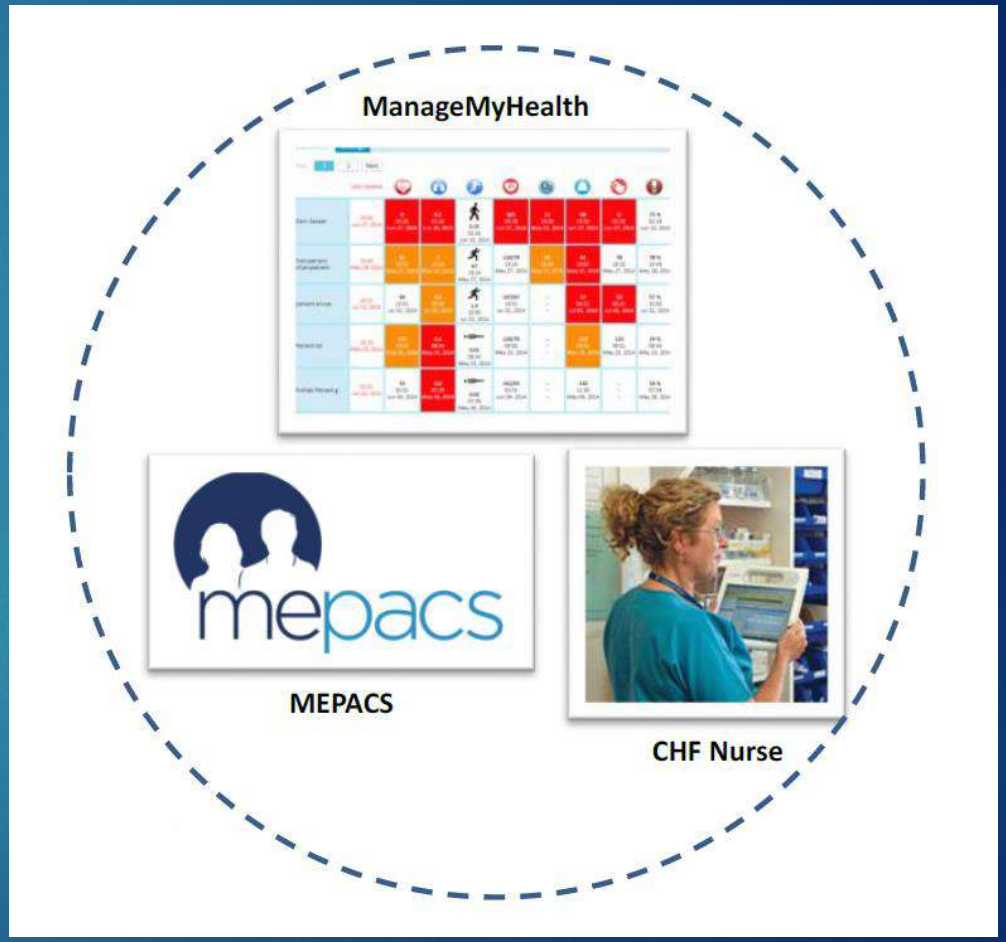
Weight scales

MEPACS call or Questionnaire



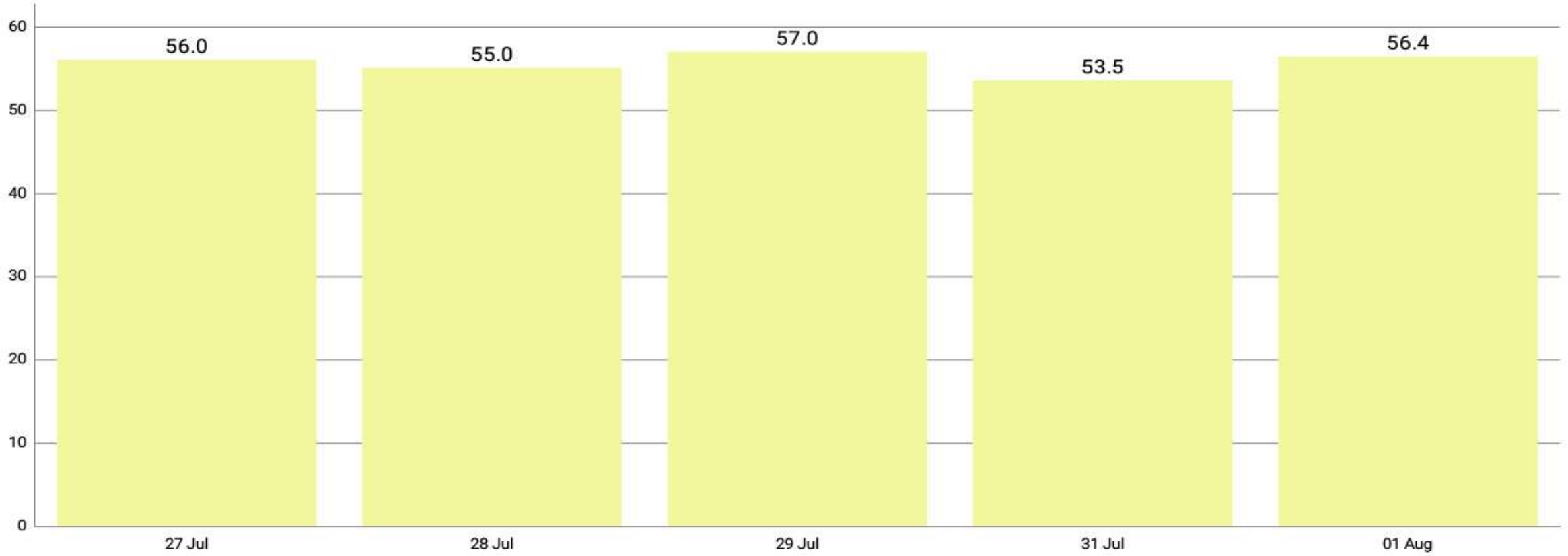
VitelMed app

Sends weight data to ManageMyHealth



Weight (Kg)

56.4Kg Your latest recording 01 Aug 2017 06:28 pm



Chronic Heart Failure

d2.00.07(46)

Welcome Mr Richard Kennedy

Video | Home

Please answer the following questions.

Feeling unwell?	YES	NO
More short of breath than normal?	YES	NO
Short of breath while lying flat?	YES	NO
Had any light-headedness?	YES	NO
Ankles more swollen?	YES	NO

SUBMIT

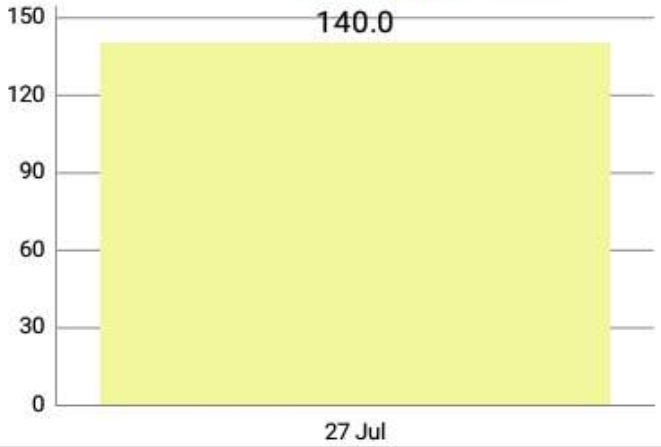
Chronic Heart Failure

d2.00.07(46)

Welcome Mr Richard Kennedy

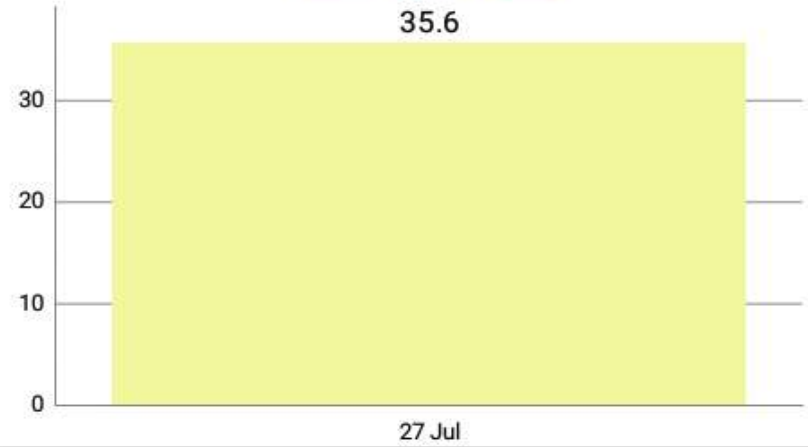
Video | Home

Glucose (mmol/L)



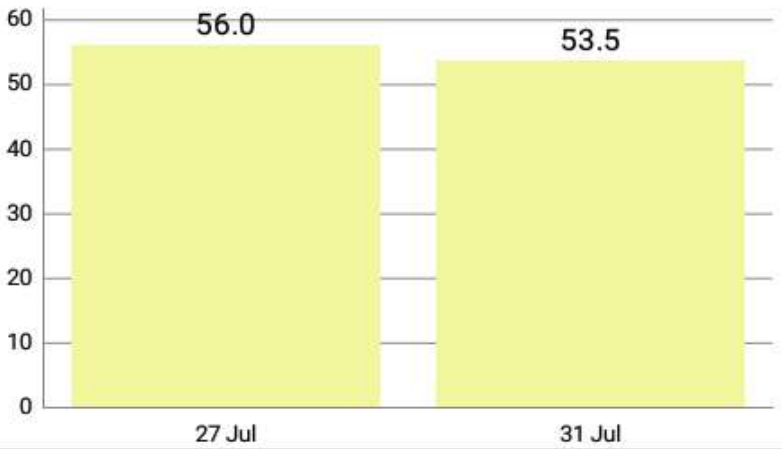
140mmol/L
27 Jul 2017
10:26 am

Temperature (°C)



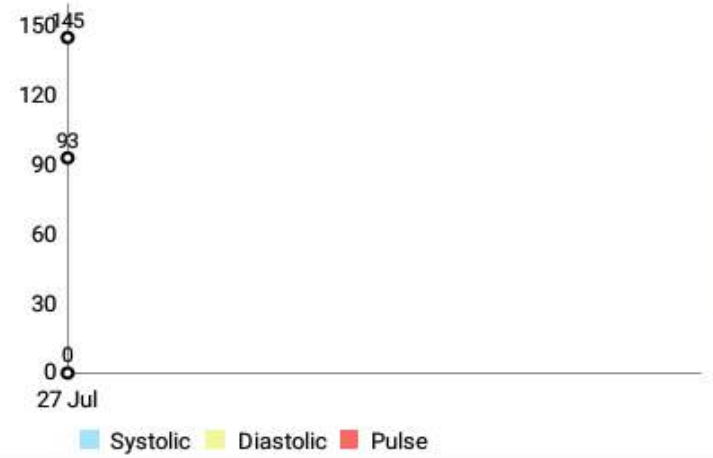
35.6°C
27 Jul 2017
10:27 am

Weight (Kg)



53.5Kg
31 Jul 2017
12:43 pm

Blood Pressure (mmHg)



145/93
27 Jul 2017
10:28 am

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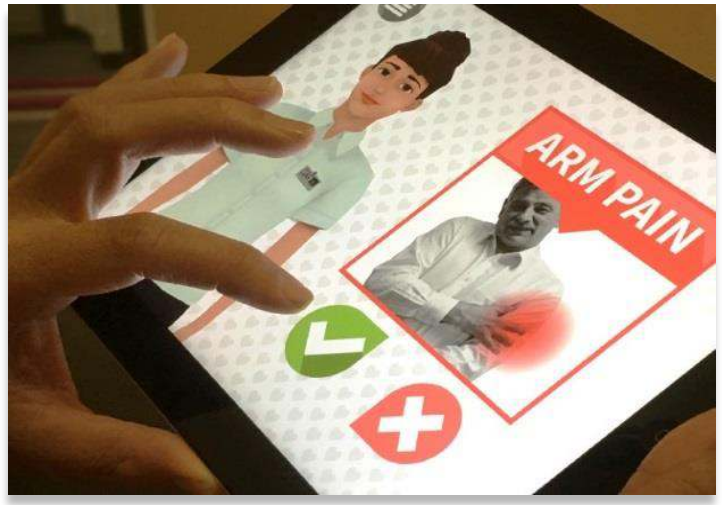
Objectives

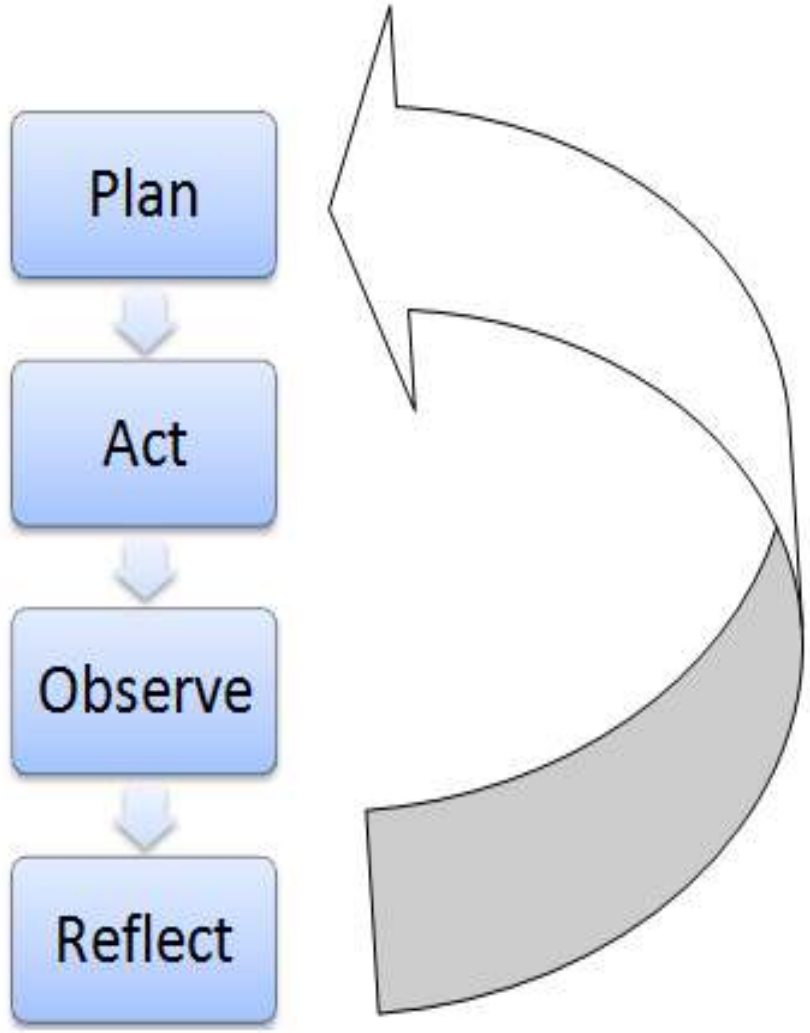
1. to *develop* an avatar-based education application for teaching heart attack symptom recognition and management who are at risk of a heart attack

2. to *evaluate the acceptability* of the avatar-based education application among a group of ACS patients



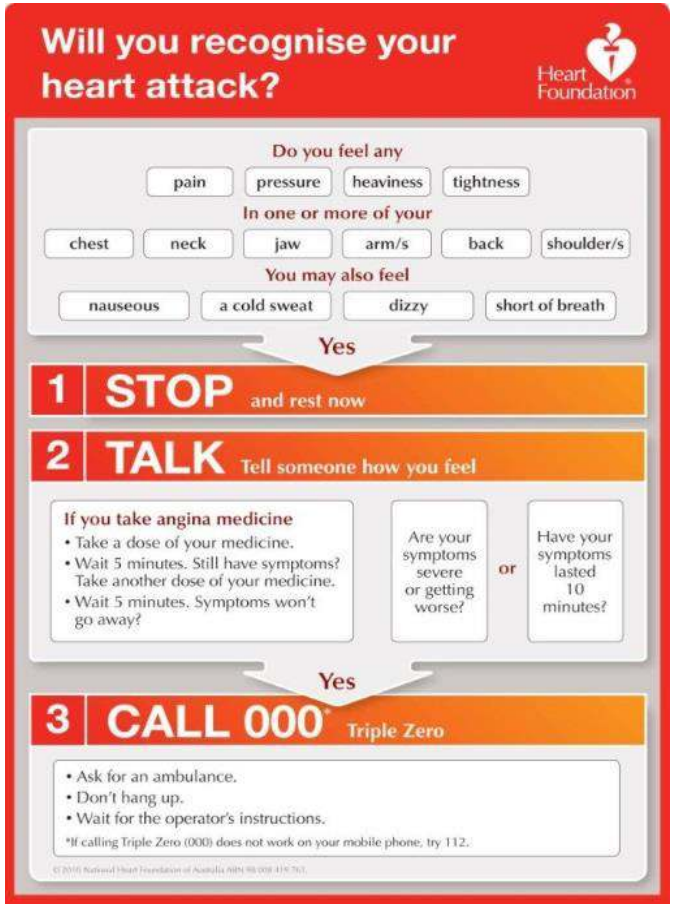
Action Research

- Content development
- Storyboard/App development
- Expert panel review
- Consumer group reviewed

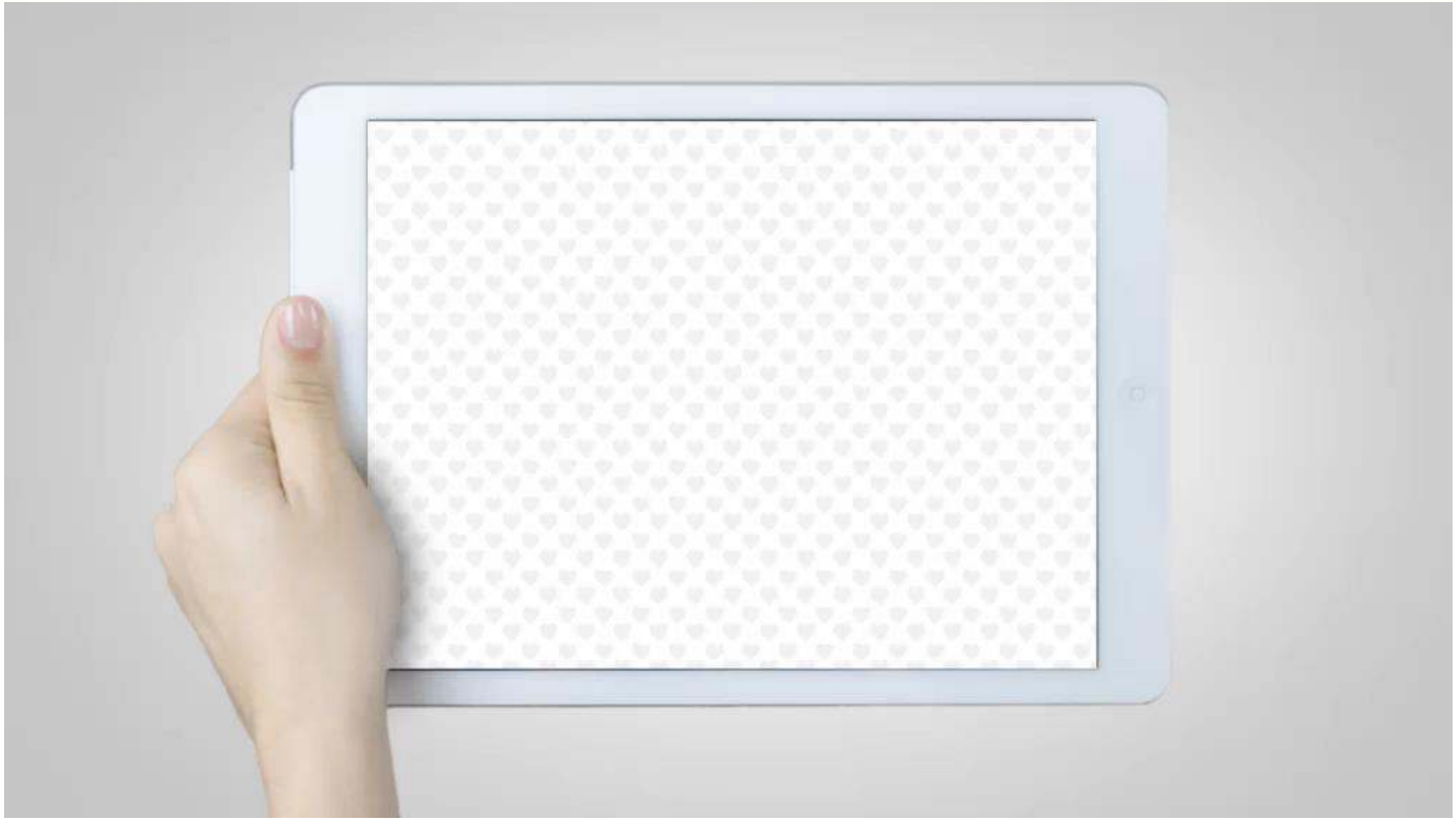


(Kemmis & McTaggart, 2000)

Content development



(Heart Foundation,2015)



Preliminary evaluation

Table 1: Changes in ACS response index scores (n=10)

Domains	Pre-intervention	Post-intervention	Percent change
	Percent correct Mean±SD	Percent correct Mean±SD	
• Knowledge	62.4 ±13.4	78.1±9.3	↑15.7
• Attitude	77.0 ±5.4	97±6.3	↑19.5
• Belief	73.2 ±6.1	98.9±1.7	↑25.7
• Symptom recognition	72.5±5.6	96.7±8.1	↑24.2
• Help-seeking	83.8 ±11.9	97.5±7.9	↑13.8
• Expectation	79.4±5.2	100	↑20.6
• Action	65.0±10.9	97.5±4.0	↑32.5

App's satisfaction

- Easy
- Helped participants' understanding of heart attack symptoms and
- recognising and responding to those symptoms
- Increased confidence
- Liked Cora (the Avatar)
- Content is clear and concise
- Learnt something they were not taught before

mHealth to improve completion rates in a hospital-based cardiac rehabilitation program

Cate Ferry
Heart Foundation NSW

The problem being addressed

Whilst home-based alternatives have successfully increased the proportion of patients who attend/complete a cardiac rehabilitation program (CRP) following a cardiac event, comparatively little attention has been devoted to reducing patient dropout rates in hospital-based CRP.

The design and purpose

- A pilot study was conducted in 2015/16 at the Prince of Wales Hospital (POWH) NSW in collaboration with the Heart Foundation NSW to determine if a smartphone-based adjunct to standard care could maintain patient engagement between CRP sessions increase the completion rate of a hospital based CRP.
- 66 participants who attended a CRP at POWH, were randomized so that half received 3 devices embedded with near-field communication, a smartphone (preinstalled with an app) designed specifically for cardiac rehabilitation, portable blood pressure monitor, and weight scale whilst completing the CRP.

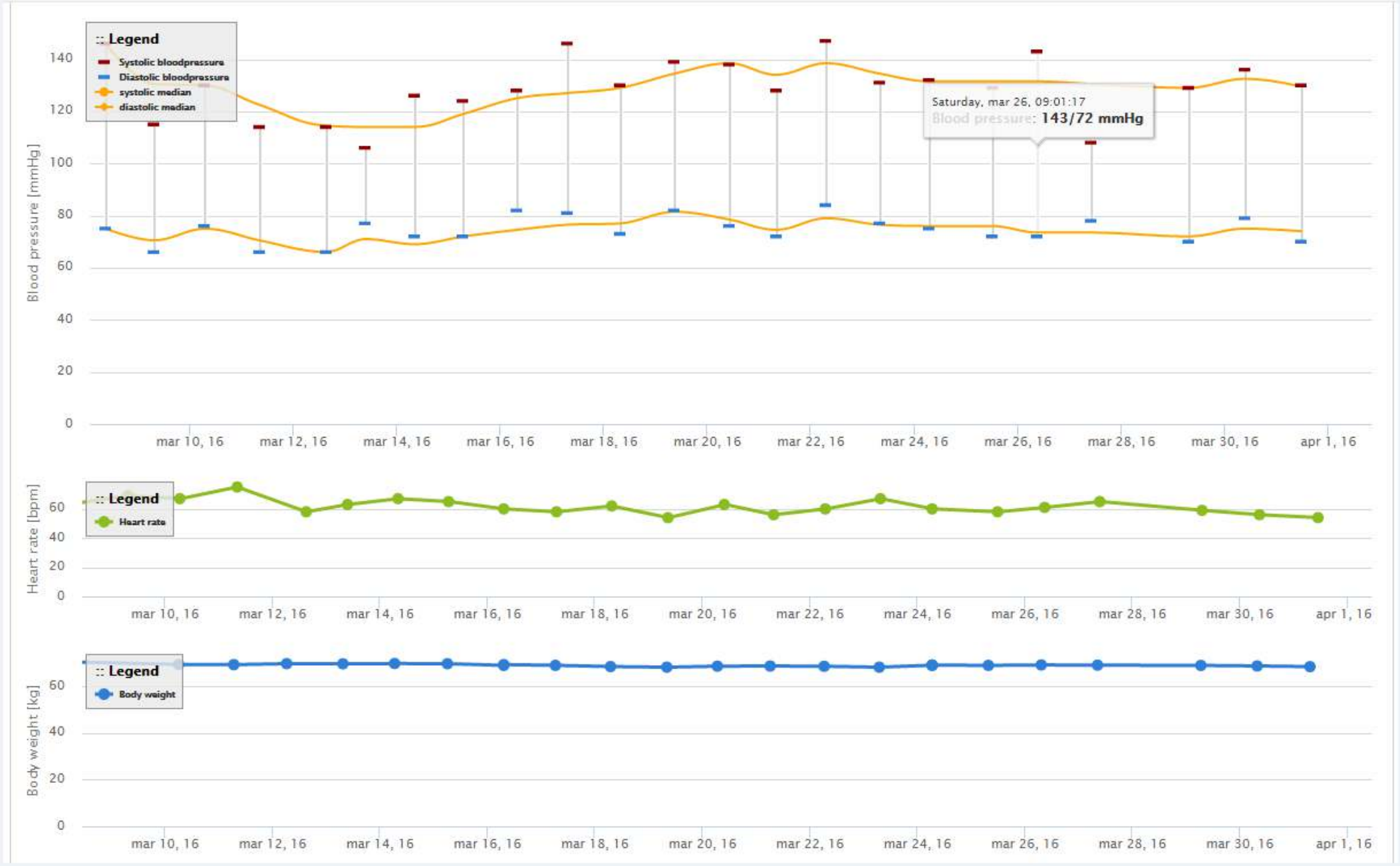
Design (continued)

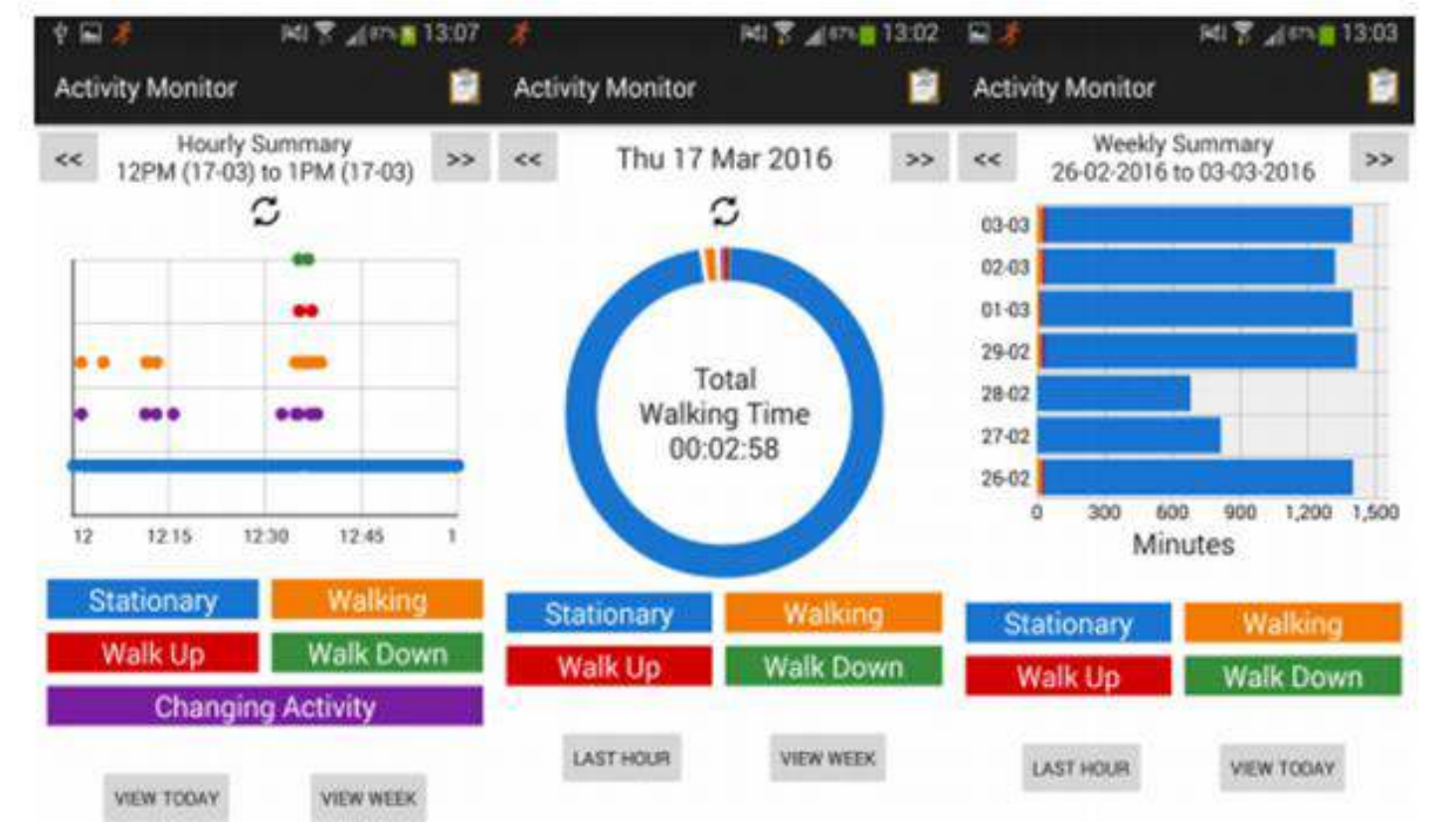
- The Graduate School of Biomedical Engineering at the University of New South Wales designed a smartphone app ‘Smartphone Technology and Heart Rehabilitation’ (STAHR) in conjunction with the Austrian Institute of Technology.

- The app monitored the patient’s activity level, blood pressure and weight.

- Android smartphone (Samsung Galaxy SIII (SG3) preinstalled with STAHR sought to maintain engagement with patients between CRP sessions (every Monday and Thursday) via an automated feedback engine that delivered messages to the participants periodically.

Peripheral devices. Once a weight or BP measurement has been completed, the smartphone can retrieve the readings using the Near- Field – Communication (tap the phone against the device) This information is then transmitted to the Kiola server.


:: Legend
Systolic bloodpressure
Diastolic bloodpressure
systolic median
diastolic median
Blood pressure [mmHg]
140
120
100
80
60
40
20
0
Saturday, mar 26, 09:01:17
Blood pressure: 143/72 mmHg
mar 10, 16
mar 12, 16
mar 14, 16
mar 16, 16
mar 18, 16
mar 20, 16
mar 22, 16
mar 24, 16
mar 26, 16
mar 28, 16
mar 30, 16
apr 1, 16
:: Legend
Heart rate
Heart rate [bpm]
60
40
20
0
mar 10, 16
mar 12, 16
mar 14, 16
mar 16, 16
mar 18, 16
mar 20, 16
mar 22, 16
mar 24, 16
mar 26, 16
mar 28, 16
mar 30, 16
apr 1, 16
:: Legend
Body weight
Body weight [kg]
60
40
20
0
mar 10, 16
mar 12, 16
mar 14, 16
mar 16, 16
mar 18, 16
mar 20, 16
mar 22, 16
mar 24, 16
mar 26, 16
mar 28, 16
mar 30, 16
apr 1, 16



Three screenshots from the STAHR app showing the activity timeline throughout the day (left), daily summary (centre) and weekly summary of activity (right).

Current status

- The pilot RCT confirmed the application improved the completion rates of a 12 session cardiac rehabilitation program (88% vs. 67%; p = 0.038).
- The app provides robust monitoring of patient activity, weight and blood pressure.

Mobile apps for cardiac patients

Robyn Gallagher

Table 2 | Importance of CVD app features during different life stages

App features	Importance at different stages of life*			
	Childhood	Adolescence	Adulthood	Late adulthood
Gaming principles	+++	+++	+++	++
Rewards	+++	+++	+++	+
Credible information	–	+	+++	+++
Credible referrer	–	+	+++	+++
Personalization	+	++	+++	++
Self-monitoring or tracking	–	+	++	++
Contact with health-care professionals	–	+	++	++
Social comparison and support	+	+++	++	+
Simplicity	+++	++	++	+++
Privacy	–	+	+++	+++
Concise information	–	+	++	+++
Simple data download	–	++	++	+++

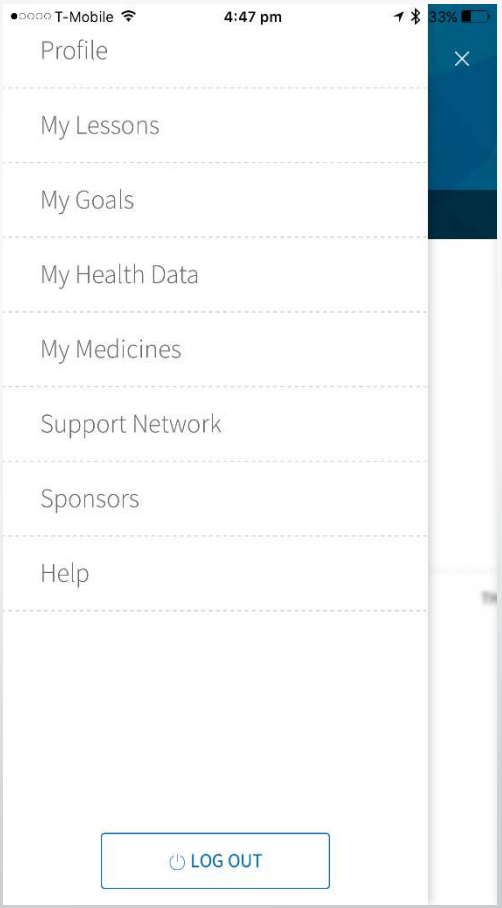
*Importance was rated on the basis of frequency in the literature, evidence from the literature, and consensus of a multidisciplinary team of expert clinician researchers. Abbreviations: –, feature is not relevant to the target audience; +, feature of low importance to target audience; ++, feature of moderate importance to target audience; +++, feature of high importance to target audience; CVD, cardiovascular disease.

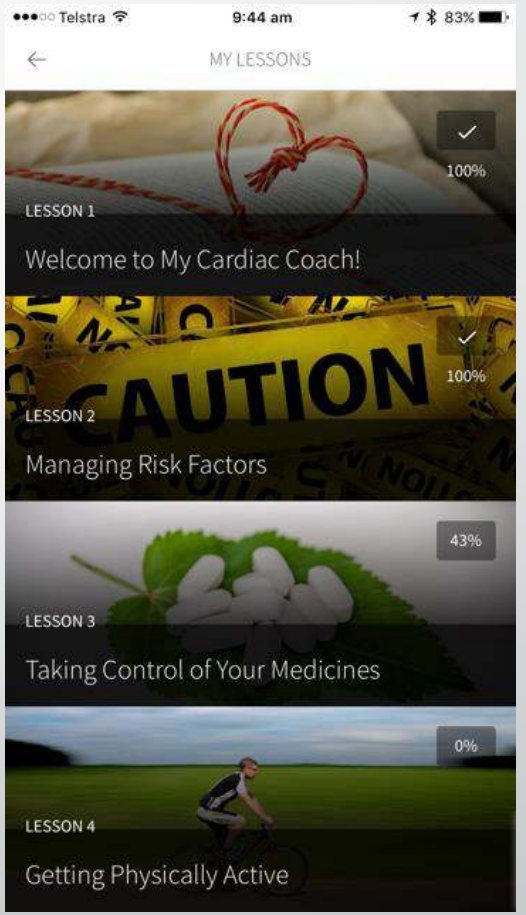
Neubeck, L. *et al.* (2015) The mobile revolution—using smartphone apps to prevent cardiovascular disease *Nat. Rev. Cardiol.* doi:10.1038/nrcardio.2015.34

My Cardiac Coach - American Heart Association

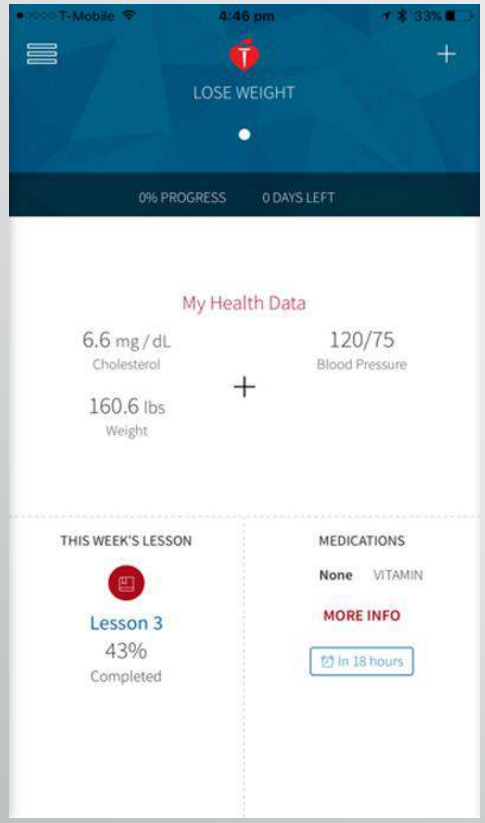
PURPOSE

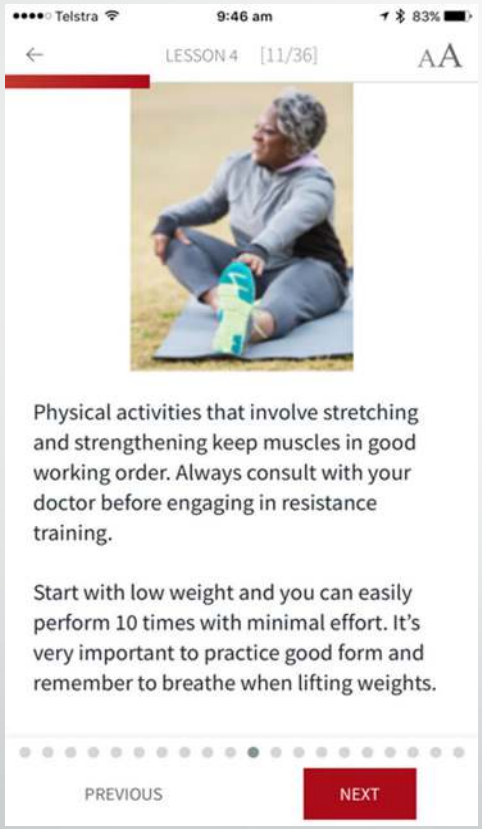
- Provide trustworthy information from experts
- Interactive lessons to help you learn what you need to know
- Progress-trackers for monitoring blood pressure and weight
- Tools for logging physical activity and managing medications
- Connections to other survivors through our Support Network





My Cardiac Coach



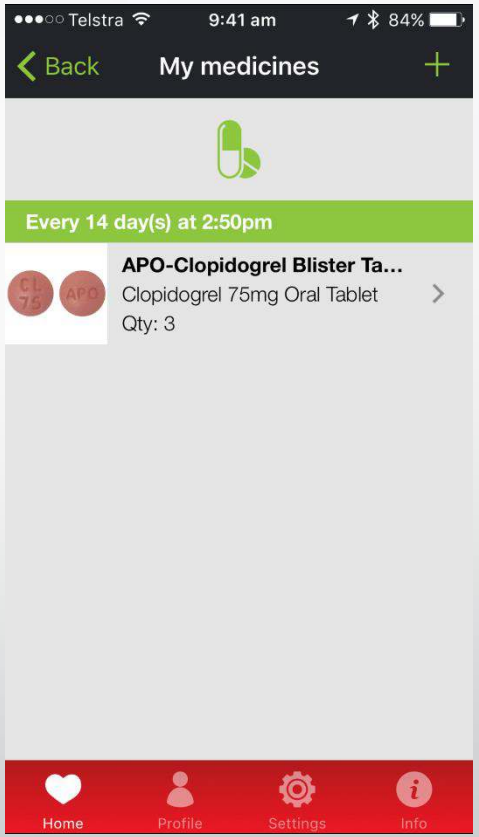


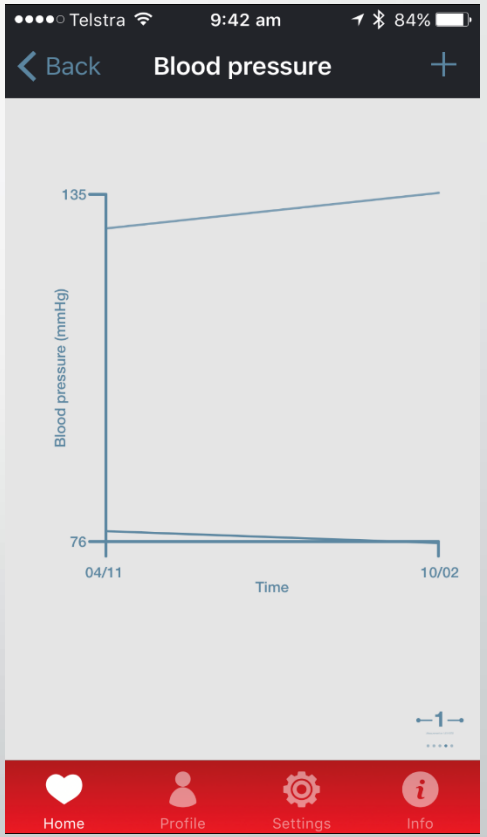
Features	
Credible information	★
Personalisation	★
Self-monitoring	★
Privacy	★
Reminders - tasks	★
Simplicity	×
Health literacy match	×
Rewards	×
Game principles	×
Social comparison/support	×

My Heart My Life National Heart Foundation

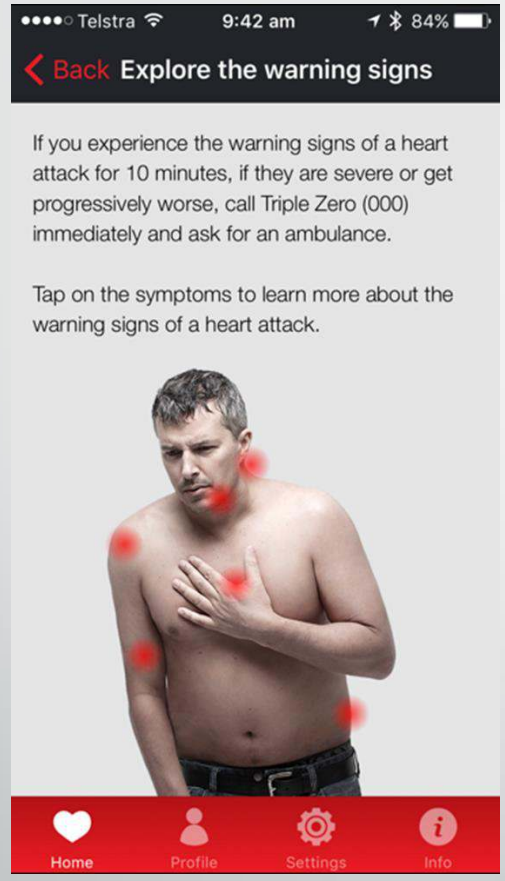
PURPOSE

- record and manage medicines
- manage health stats including blood pressure and cholesterol
- learn the heart attack warning signs and what to do
- find healthier recipes





My Heart My Life

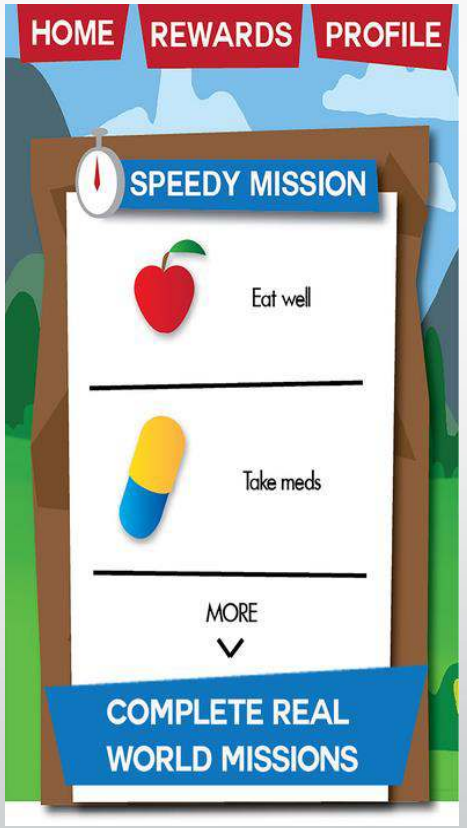


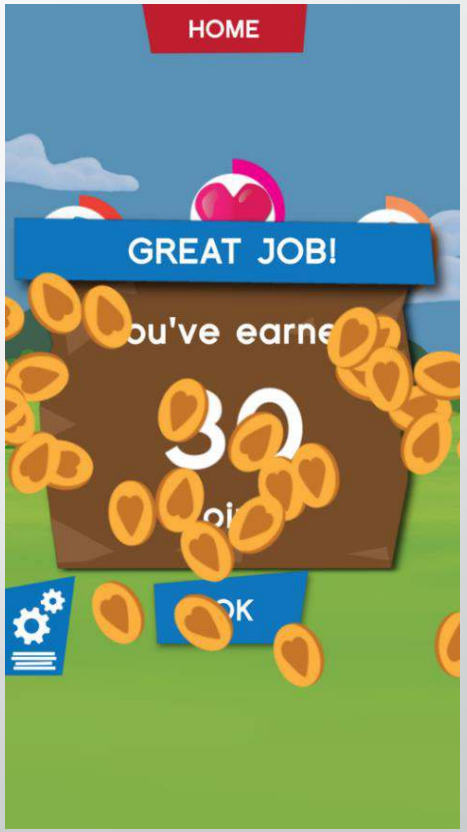
Features	
Credible information	★
Self-monitoring	★
Privacy	★
Reminders - tasks	★
Simplicity	★
Health literacy match	×
Personalisation	×
Rewards	×
Game principles	×
Social comparison/support	×

MyHeartMate Figtree, Gallagher, Neubeck et al.,

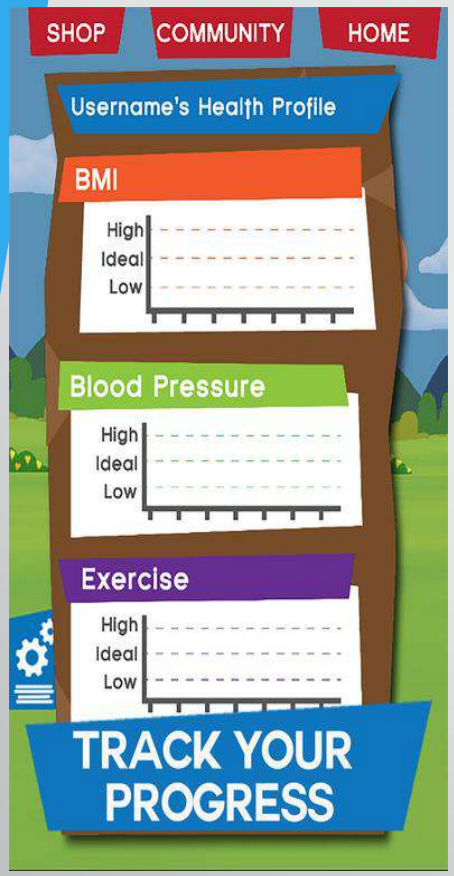
PURPOSE

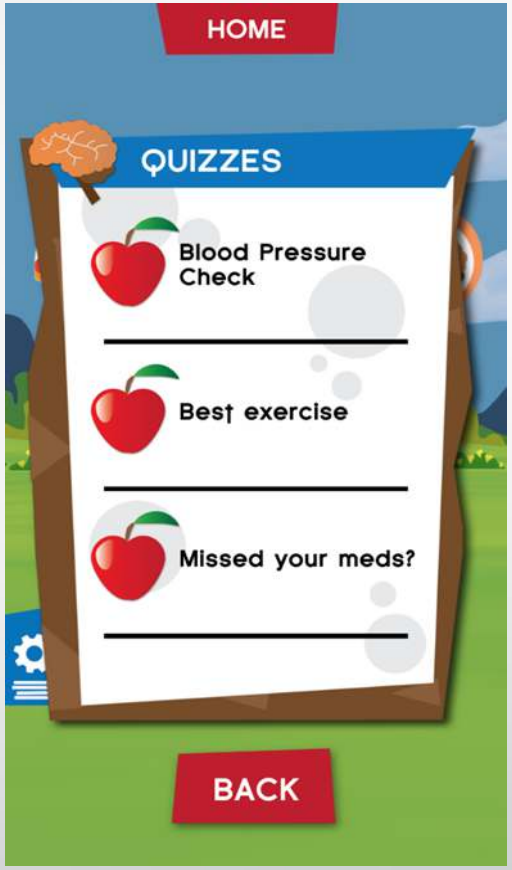
- Increase critical health behaviours through setting and achieving and competing with others for short and long term goals for medication prescriptions, exercise, diet, smoking and stress management recommendations
- Track key behaviours (weight, exercise, cholesterol)





MyHeartMate





Features	
Self-monitoring	★
Privacy	★
Reminders - tasks	★
Simplicity	★
Health literacy match	★
Personalisation	★
Rewards	★
Game principles	★
Credible information	×
Social comparison/support	×

Health Technologies Workshop

Time	Topic	Speaker
3.15	Introduction	Chairs: Sandy Hamilton and Robyn Gallagher
3.15	Introduction to health technology for cardiac patients and related evidence	Lis Neubeck
3.35-3.55	Australian health technologies for cardiac patients which incorporate health professional advice and/or support	Chair: Sandy Hamilton
3:35-3:40	Cardihab	Simon McBride
3:40-3:45	Telemonitoring Enhanced Care for Heart Failure	Nicole Chen/Andrew Maiorana
3.45-3.50	Avatar-based technology	Robyn Clark
3:50-3:55	Total cardiac care	Cate Ferry
3:55-4:05	Cardiac specific apps publicly available • My Cardiac Coach (AHA) • My Heart My Life (NHFA) • MyHeartMate (Figtree, Neubeck, Gallagher et al.,)	Robyn Gallaher
4.05-4.15	Panel Question and Answer	Chairs: Robyn and Sandy