



The Australian e-Health Research Centre

Innovation partner for Queensland and Australian health services

Mobile Health and Home monitoring: a fad or the future

Dr David Hansen

5th August 2016

HEALTH & BIOSECURITY
www.csiro.au



Big ideas start here



Fast WLAN

Wireless Local Area Network



POLYMER BANKNOTES



AEROGARD



BARLEYmax™



RELENZA FLU TREATMENT



TOTAL WELLBEING DIET



HENDRA VACCINE



EXTENDED WEAR CONTACTS



SOFTLY WASHING LIQUID



SELF TWISTING YARN



SNOROCKET DL REASONER



NOVACQ™ PRAWN FEED

The Australian e-Health Research Centre

- Australia's leading national eHealth research centre
 - Headquarters at RBWH
 - 75 scientists/engineers and 30 students in Brisbane and around Australia
- Success built on partnering - Government, clinicians, industry



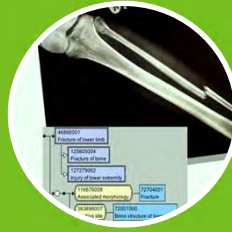
Australian e-Health Research Centre



Biomedical Informatics

Biostatistics, imaging and genomics based - based clinical workflows

How: Leveraging operational & clinical data through analytics, modelling, decision support & automation



Health Informatics

Improving health system performance & productivity from electronic health data

How: Meaningful data interoperability and analysis for decision support, analytics, modelling and reporting



Health Services

Improving access to services & management of chronic diseases

How: Service delivery models utilising telehealth, mobile health & remote monitoring

Clinical Terminology Tools

Shrimp, Snapper, OntoServer, snorocket, SnoMAP...

The screenshot displays the Shrimp Terminology Browser interface for SNOMED Clinical Terms Australian extension. The main area shows a hierarchical diagram of clinical terms, with 'Acute appendicitis with peritoneal abscess' selected. The diagram branches from 'finding' to 'Bowel finding', 'Disorder of digestive organ', 'Disorder of lower gastrointestinal tract', and 'Inflammation of specific body systems'. It further narrows down to 'Intestinal disease', 'Inflammatory disorder of digestive tract', 'Disorder of large intestine', 'Disorder of appendix', 'Abscess', and 'Appendicitis'.

On the right, a search bar contains 'ac ap pe' and a list of related terms is shown. Below this is a table of properties for the selected term:

PROPERTY	VALUE
Code	51036000
Preferred	Acute appendicitis with peritoneal abscess
Full Name	Acute appendicitis with peritoneal abscess (disorder)
Active	true
Primitive	false
Module Id	90000000000207008
Effective Time	20040731
Refsets	Clinical finding foundation reference set Emergency department reference set Emergency department diagnosis reference set Problem/Diagnosis reference set



Automating Cancer Registry tasks

Applying Natural Language Processing in the real world

Daily trickle feed processing
3750 Histo/Cyto
AUSLAB
messages
processed per
week

Current prototype
system is
processing SNP
and QML
pathology feeds
on test servers

Study of 2009 data
Identified 16,563
cancer patients

Sensitivity 96.4%
Specificity 95.6%

Found 663
cancer patients
(4%) not in the
Cancer Registry



Patient Admission Prediction Tool

Informing Hospital planning

On the ground planning tool

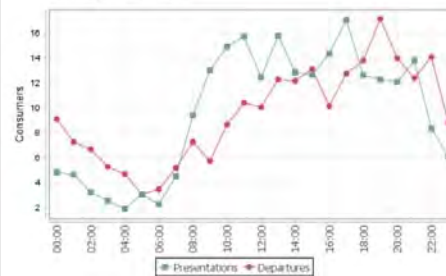
Presentations by hour of day or week/month and year

14 day outlook

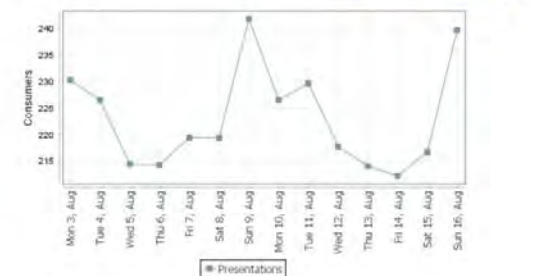
Subgroups by triage, pediatrics, ambulance arrival

Emergency Department

Hourly for Today



Daily



Today (03 Aug 15)

	Today	Night	Morning	Afternoon	Night
Presentations	230	22	70	110	28
- Road Ambulance	67	10	20	29	8
- Paediatric	44	4	9	25	6
Discharges	227	40	47	105	35
Total	-3	18	-24	-5	7

Tomorrow (04 Aug 15)

	Today	Night	Morning	Afternoon	Night
Presentations	226	27	71	103	26
- Road Ambulance	68	14	17	28	8
- Paediatric	44	4	11	22	7
Discharges	231	44	50	103	34
Total	5	17	-21	0	8

14 Day Outlook

	Mon 03 Aug	Tue 04 Aug	Wed 05 Aug	Thu 06 Aug	Fri 07 Aug	Sat 08 Aug	Sun 09 Aug	Mon 10 Aug	Tue 11 Aug	Wed 12 Aug	Thu 13 Aug	Fri 14 Aug	Sat 15 Aug	Sun 16 Aug
Presentations	230	226	214	214	219	219	242	227	230	218	214	212	217	240
- Road Ambulance	67	68	69	69	69	63	64	66	66	68	67	68	62	62
- Paediatric	44	44	44	38	40	48	58	46	46	44	38	40	49	57
Discharges	227	231	211	213	224	225	230	222	233	214	217	219	220	225

Research

The National Emergency Access Target (NEAT) and the 4-hour rule: the target

Clair Sullivan, Andrew Staib, Sankalp Khanna, Norm M Good, J Heiniger, Bronwyn R Griffin, Anthony Jr Bell, James Lind and la

Med J Aust 2016; 204 (9): 354.

doi: 10.5694/mja15.01177

From: DG Connect <DGConnect@health.qld.gov.au>

Date: 15 June 2016 at 9:14:20 AM AEST

Subject: Improving emergency department performance indicators



DG Connect

Michael Walsh
Director-General

Colleagues

We are about to change the performance measure for emergency departments (ED) across the state.

The Collaboration for Emergency Access and Reform (CLEAR) analysed 12.5 million ED episodes of care across Queensland

The research, which was recently published in the Medical Journal of Australia, clearly identifies that an emergency access to the best outcome when a person was admitted to hospital.

We will now lead Australia by setting a Queensland Emergency Access Target of greater than 80 per cent.

This target is set by clinicians who know the system better than anyone else, and I am very happy to take their advice on this

This approach clearly demonstrates an evidence-based and clinically supported approach to monitoring the performance of

From 1 July 2016, every hospital in the state will now report their emergency access times against this new target.

Kind regards

Michael Walsh
Director-General
Department of Health

Article

Authors

References

Responses

[Add a response](#)

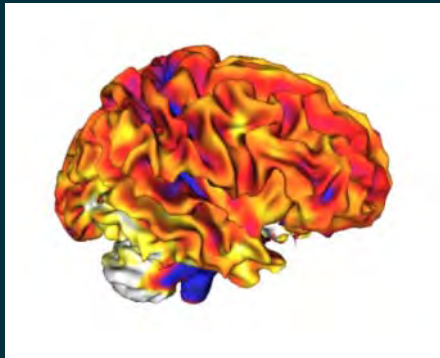
Abstract

Objective: We explored the relationship between the National Emergency Access Target (NEAT) compliance rate, defined as the

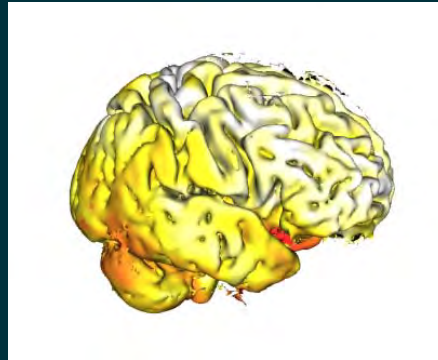


Biomedical imaging : Anatomical variability in Alziehmer's disease

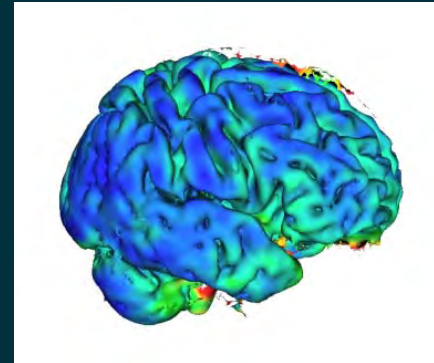
Cortical thickness



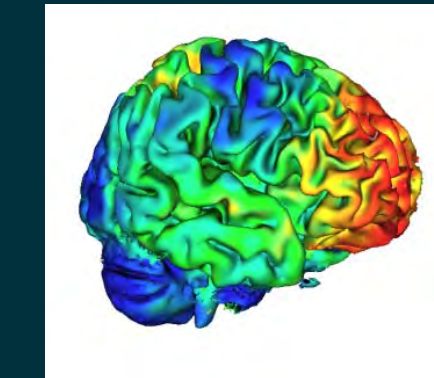
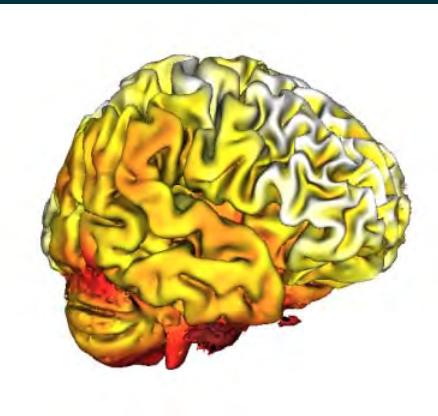
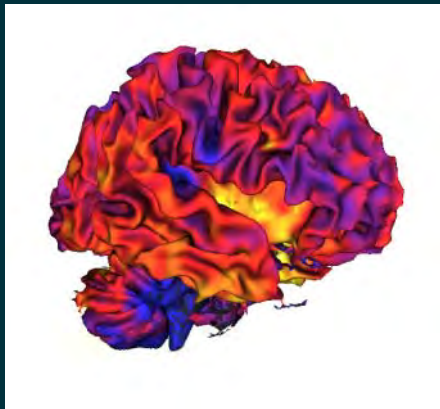
neuronal activity



Amyloid accumulation

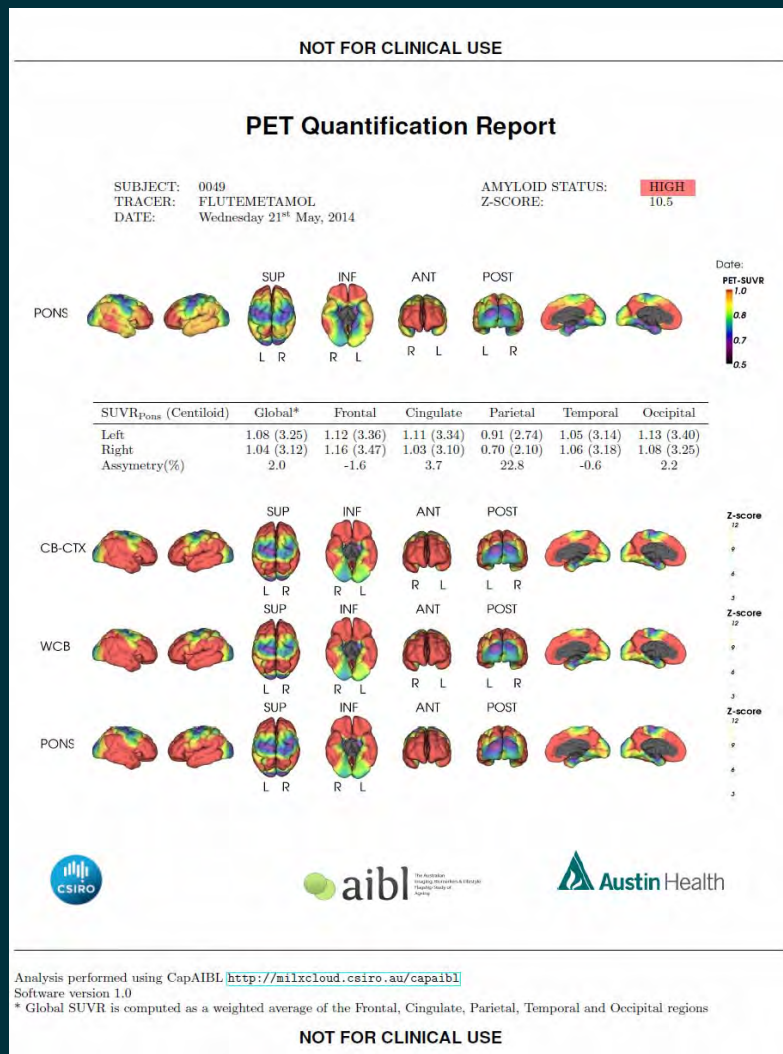


Healthy
Control

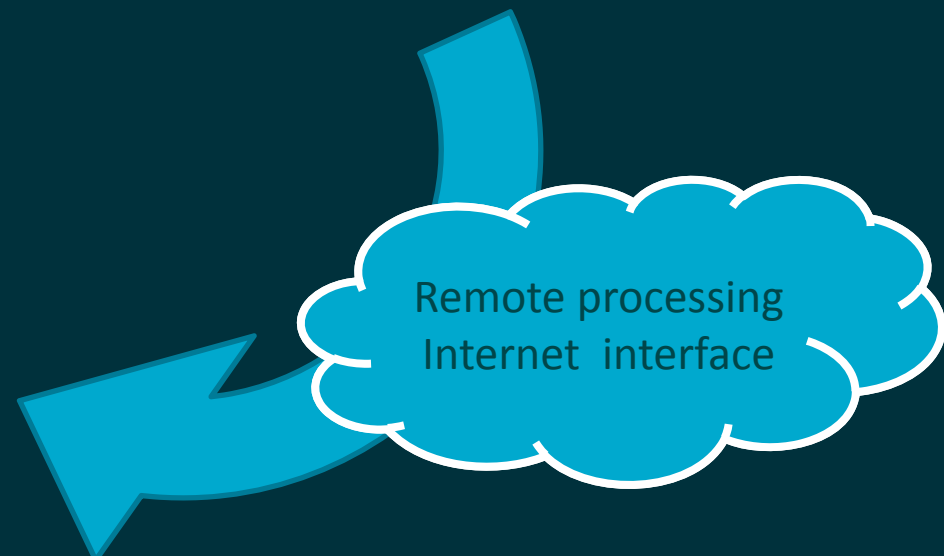
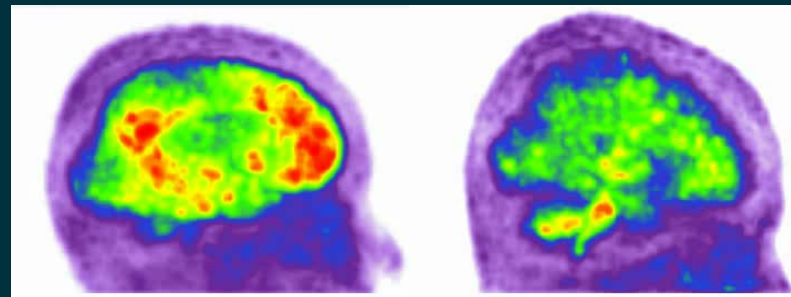


Alzheimer's
Disease pati

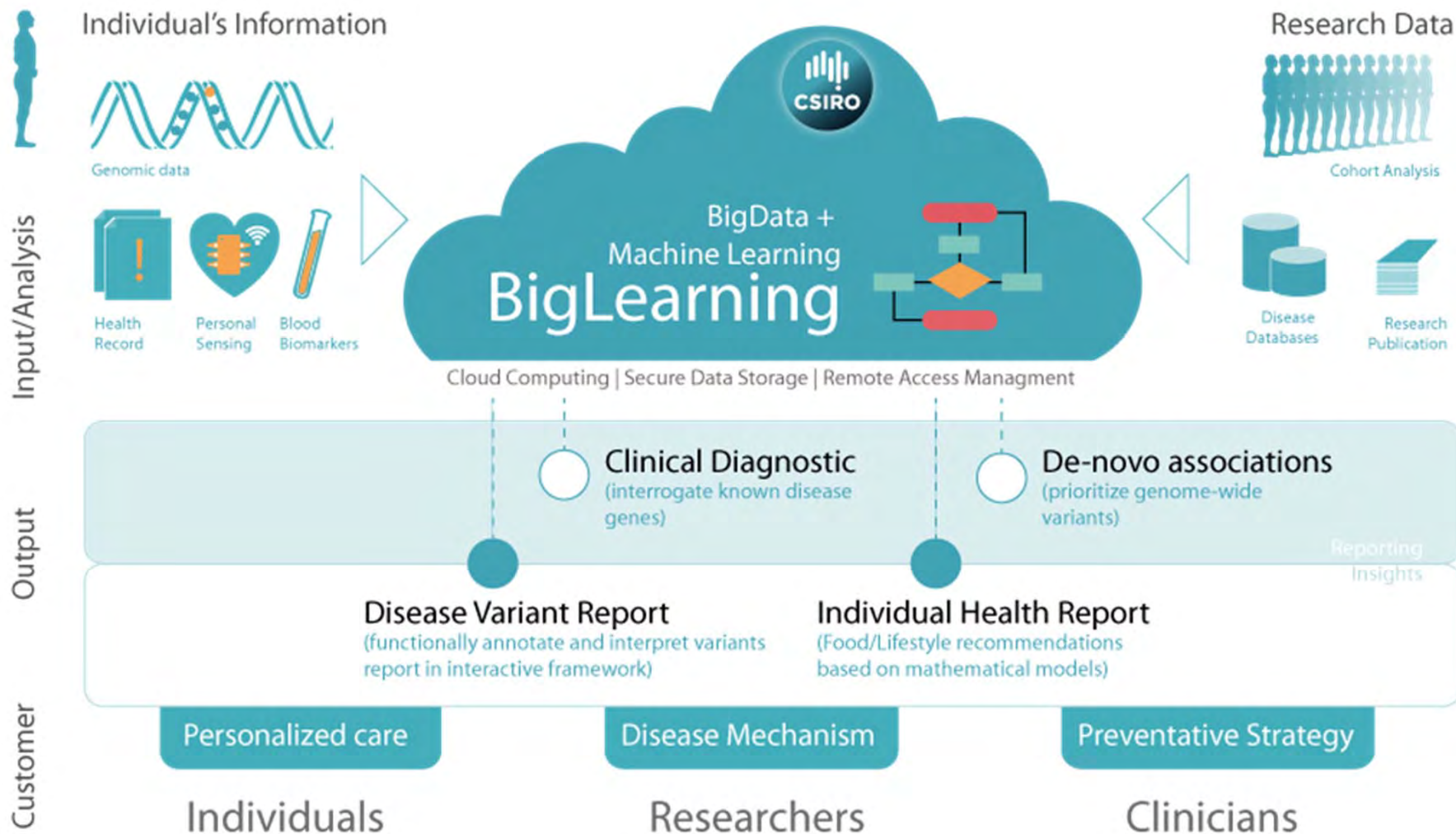
Cloud based personalized reporting



3D scans



Overview



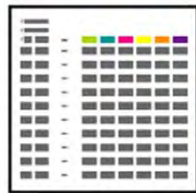
RESEARCH

VariantSpark: Population Scale Clustering of Genotype Information

Aidan R. O'Brien^{1,2}, Neil F.W. Saunders¹, Yi Guo⁵, Fabian A. Buske^{3,4}, Rodney J. Scott² and Denis C. Bauer^{1*}

BMC Genomics 2015, 16:1052 PMID: 26651996 (IF=4)

Genomic Data



E.g. genomic variants (VCF)



VariantSpark
Machine Learning for
Genomic Variants

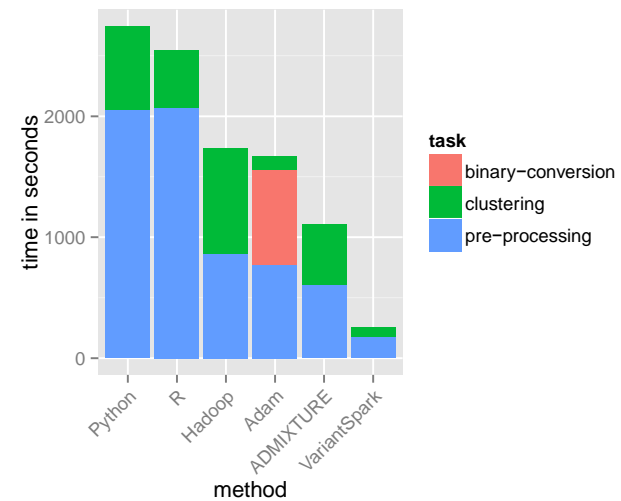
Spark

E.g. k-means clustering or random forest

Insight



E.g. determine patients' ethnicity



Bringing **bigLearning** tasks to genomics applications.

It can **cluster 3000 individuals and 80 million variants** in under 30 hours using minimal memory (24GB)

Mobile Health and Home Monitoring: Fad or the Future?

Reginald

- 55 year old male, 157kg, 187.5cm (BMI 44.7)
- Irregular heart beat at home -> ambulance -> ED -> Cardiology
- Diagnosed as atrial fibrillation (AF) -> medication intervention
- Referred to cardiac rehab as a secondary prevention measure
- “I got a big fright. Tell me what to do & I’ll do it” (to CR nurse)
- Interstate truck driver.
- Scheduled to return to work during week 2 of 6 week CR program.
- Unable to complete face-to-face CR.

WM HHS Remote Cardiac Rehabilitation

- Reginald was offered the West Moreton HHS Mobile phone enabled cardiac rehab program
 - 1x face-to-face visit
 - 6x telephone calls
 - Patient smartphone app: record blood pressure, weight, automatic step count, etc; record symptoms; view educational videos & messages; listen to relaxation audio.
 - Clinician web portal: set goals for each week (e.g. step count); review data supplied by patient; take clinical notes during phone calls; generate discharge letter.
- Service: Weekly phone calls from where ever he happened to be; app provided an objective measure of exercise component.

Outcomes for Reginald

- Lost 5kgs in 6 weeks (from 157kg -> 152kg)
- Significantly reduced alcohol consumption
- Significantly increased exercise
 - 20mins most days while away for work
 - 30 minutes when at home using treadmill
- Uses pill box to organize medications
- Able to verbalise self management principles
 - chest pain action plan and use of GTN spray
- Able to identify personal risk factors for coronary artery disease

World's first, clinically validated smartphone based Cardiac Rehab

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Smartphone-based home care model improved use of cardiac rehabilitation in postmyocardial infarction patients: results from a randomised controlled trial

Marlien Varnfield,^{1,2} Mohanraj Karunanithi,^{1,2} Desre Arnold,⁴ Hang Ding,^{1,2} and Tim Gough^{1,2}

ABSTRACT
Objective Cardiac rehabilitation (CR) is an effective strategy for preventing recurring events of myocardial infarction. This study aims to investigate the effectiveness of a smartphone-based home service (the Care Assessment Platform) of CR (CAP-CR) compared with a traditional CR programme (TCR) in post-MI patients. **Methods** In this unblinded randomised controlled trial, 120 post-MI patients were randomised to CAP-CR (n=60) or TCR (n=60). CAP-CR included supervised group exercise, motivational text, and weekly monitoring. TCR included supervised group exercise and weekly monitoring. **Results** CAP-CR uptake, adherence and completion were significantly better than TCR. CAP-CR improved clinical outcomes (moderate risk factors and health-related quality of life) at baseline, 6 weeks and 6 months, and between groups using regression.

nature REVIEWS CARDIOLOGY

REHABILITATION

Smartphone-based cardiac rehabilitation—a first RCT

The uptake of cardiac rehabilitation (CR) has many barriers, including the time taken to complete a programme and patient reluctance to be involved in group programmes. However, can the growing use of smartphones enable new home-based methods of CR delivery? In the first known randomized, controlled trial of smartphone-delivered CR, investigators report that patient uptake, adherence, and completion of the programme was significantly better using this new technology than with a traditional programme.

"We wanted to investigate whether innovative home-based CR delivery using smartphone and the internet, called the Care Assessment Platform (CAP), could improve the use of CR services and equally provide similar benefits as those of traditional CR programmes," says Dr Mohanraj Karunanithi from the Australian e-Health Research Centre.

The team randomly assigned 120 patients with a previous myocardial infarction to receive either traditional CR (TCR; n = 60), which included supervised group exercise and educational sessions, or cardiac rehabilitation via a smartphone using the CAP (n = 60). Each participant using the CAP received a smartphone with preinstalled software to record a health diary, activity levels, and blood pressure, and receive motivational text, audio, and video messages.

Patient uptake of CAP was 80% (n = 48) compared with 62% (n = 37; P < 0.05) for those undertaking TCR. Adherence and overall completion

higher than with TCR (94% vs 68%, and 80% vs 47%, respectively; P < 0.05 for each comparison). Patients receiving TCR were more likely to leave the study owing to competing life demands (work and stress) or logistical reasons (time constraints, transport, or the location of CR appointments) than those using the CAP. Only three patients using the CAP left the study owing to difficulty in using the technology.

Importantly, "CAP-CR was as effective as traditional CR programmes in improving physical activity, diet intake, and lowering depression," explains Karunanithi. "The outcomes of this study are already being taken up by Queensland Health, Australia by the implementation of CAP as a validated option within their CR services."

Tim Gough

Original article Varnfield, M. et al. Smartphone-based home care model improved use of cardiac rehabilitation in postmyocardial infarction patients: results from a randomised controlled trial. *Heart* doi:10.1136/heart-2014-305783

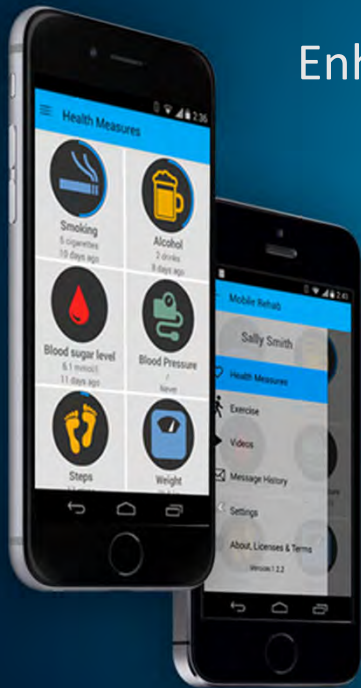
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Clinically equivalent health outcomes

CARDIHAB

Convenient cardiac rehabilitation
Enhancing relationship between patient and mentor
Digital data collection
Equitable access



ACCESS
ANYTIME



SAVE
MONEY



SAVE
TIME



Mrs Elle

- 87 year old female
- Living alone in an independent living facility close to but not serviced by a Nursing home facility
- On the morning of November 5th 2013 a neighbour alerted facility staff after the curtains remained closed two days running
- Mrs Elle was found unconscious in bed at around 9.30am on 5 November and died two days later

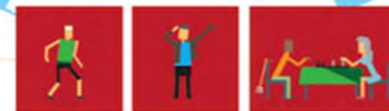
Smarter, Safer Homes for Australia's Ageing Population

1 in every 10 Australian homes is occupied by a person or persons over 65 years and living independently. As our population continues to age, we'll need new technologies and platforms in the home to support how older Australians live and stay healthy.

The Cloud

When it comes to sensor data, the whole is vastly more valuable than the sum of its parts. CSIRO's Smarter Safer Homes platform collates and analyses all this sensor data, giving residents and carers insights that they can act on to improve things.

The Activities of Daily Living criteria are a set of metrics that help carers and clinicians gauge the ability of an older person to live independently. The insights from the analytics platform help inform these criteria in a comprehensive and real-time manner.



To protect residents' privacy, the platform defaults to a "traffic-light" system that only shares the status of a particular indicator – not the specifics about a resident's behaviour or habits.

Self-Management



Residents can monitor and track their own wellbeing indicators and control data privacy settings through easy-to-use tablet apps.



Complementing, not replacing, human interaction

Family



Social interaction correlates positively with physical and mental health. Shared wellbeing insights and telepresence help family members support each other while maintaining their independence.



Personal control over information

Community and Social Care

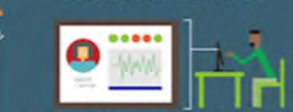


Central analysis of data from all sensors gives carers a comprehensive picture of residents' ability to live independently, and where they could do with some help.



Non-intrusive monitoring

Doctors and Nurses



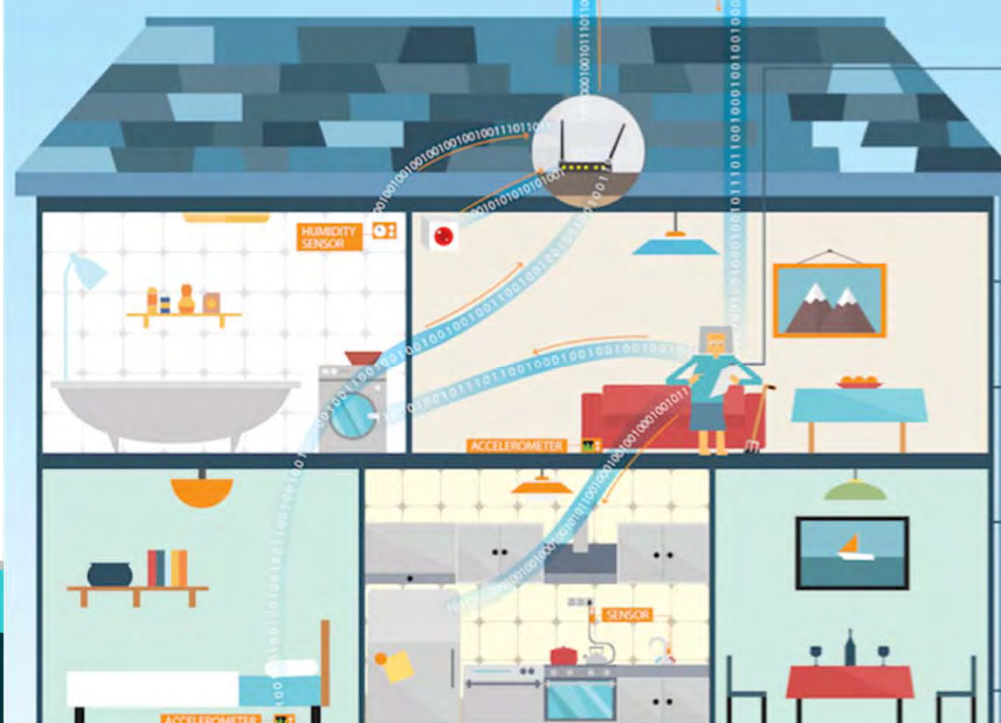
Doctors and nurses can incorporate deep analysis of residents' wellbeing into their consultations – or take action if an alert is detected.



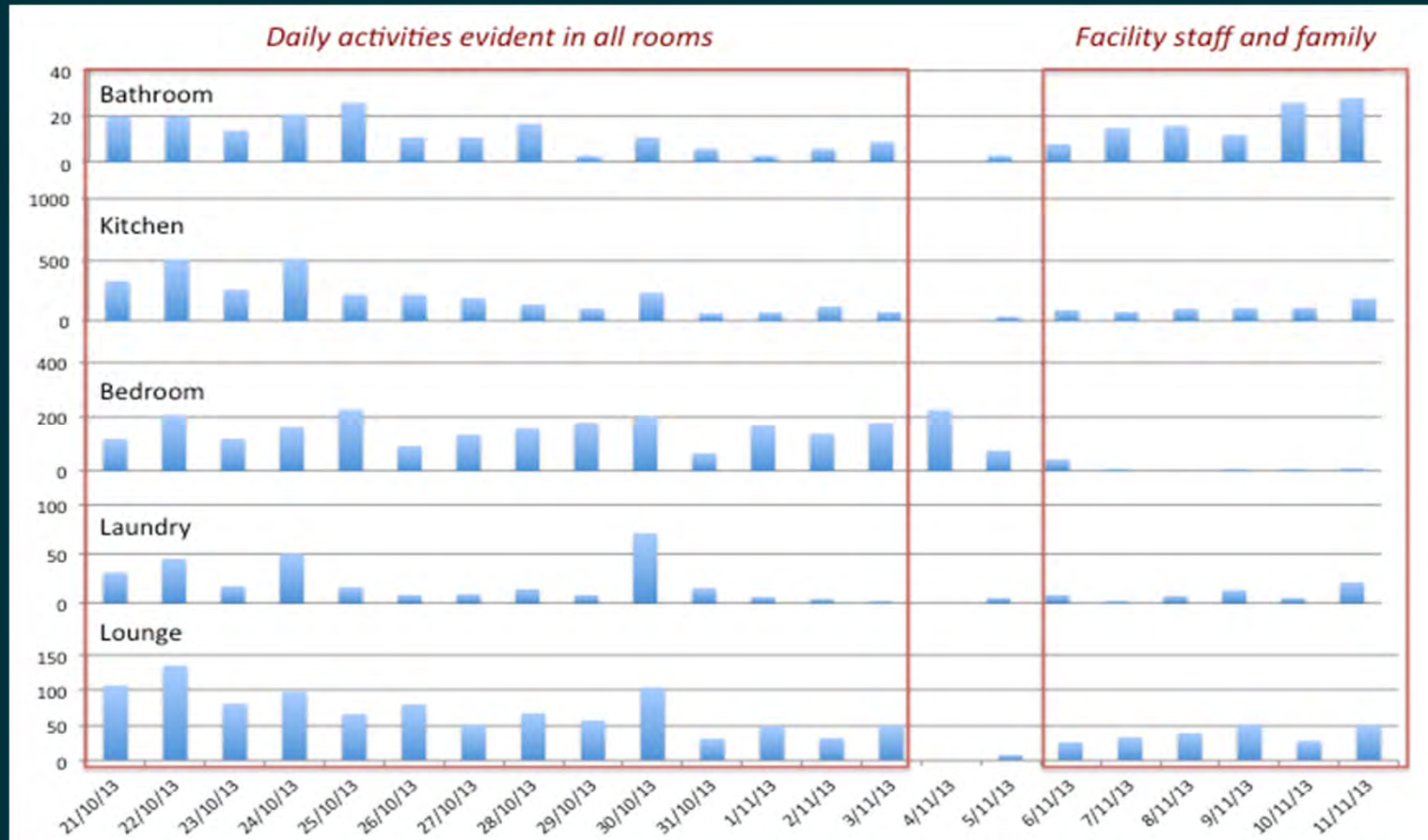
Coaching and education



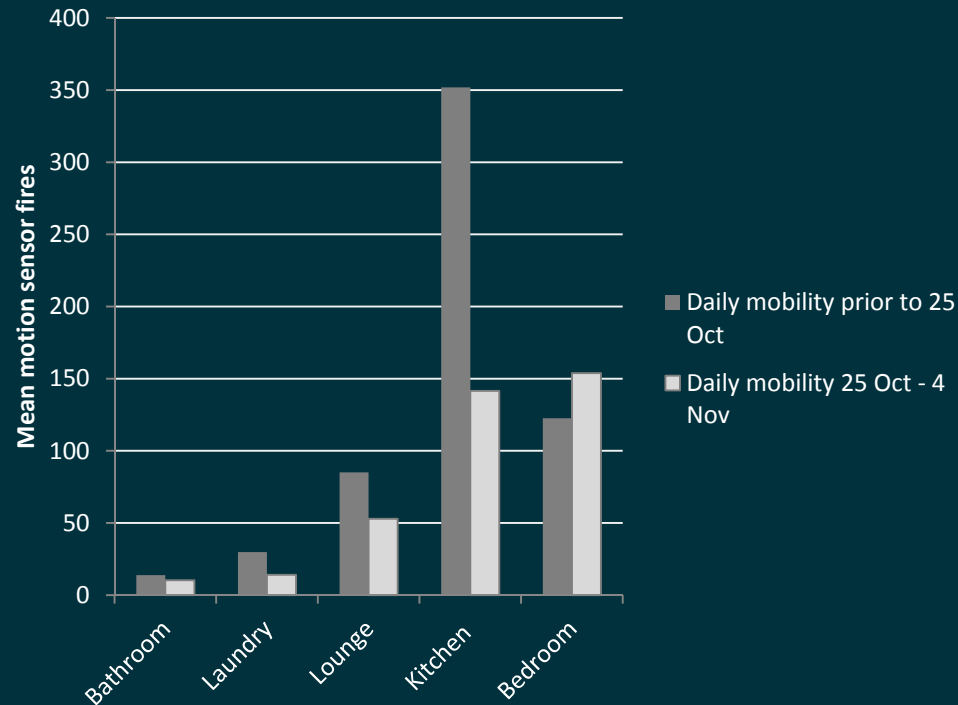
Simple, reliable, affordable



Could this have saved Mrs Elle?

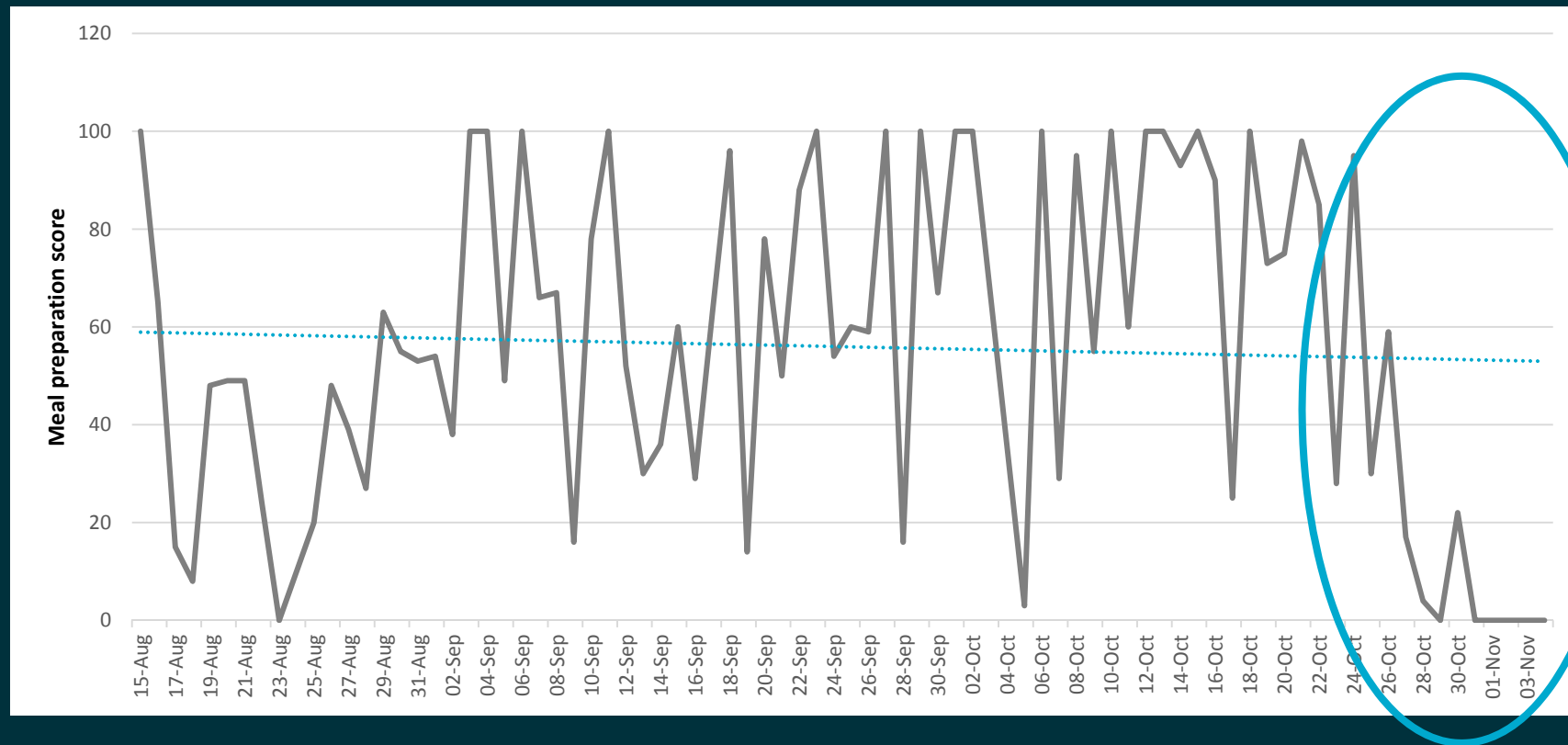


Secrets in the Sensors — Motion



Room	$\Delta\%$
Bathroom	-26
Laundry	-53
Lounge	-38
Kitchen	-60
Bedroom	+26

Secrets in the Sensors — Meal Preparation



Secrets in the Sensors — Medical data

- Temperature
 - M=35.5°C
 - Fluctuating < 1°C
- Weight
 - M=73kg
 - Fluctuations up to 3kg
 - Overall loss 2kg
- Cardiovascular
 - Pulse steady decline to <50 bpm
 - Several systolic readings of >140mmHg
 - Fluctuations



Summary of physiological and behavioral changes

- reduced mobility
- reduced meal preparation and
- reduced attention to hygiene

Indicative of fatigue

- high blood pressure
- odd fluctuations in blood pressure
- low pulse rate
- high red blood cell count

Recently visited GP with her concerns and had medication changed

- low body temperature
- losing weight
- missed weekend activities and intrastate drive

Could SSH have saved Mrs Elle?

- Information available from the sensors and devices can provide a predictive picture far more detailed than the glimpses currently seen by medical professionals.
 - In-home monitoring is effective for determining Activities of Daily Living (ADLs)
 - The algorithms are subtle enough to detect potential impending stroke.
- But the prevention of such incidents will depend on coordinated action between the monitoring system, the response service and the medical health team.

Thank you

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