

CareTrack Australia

AUSTRALIANS RECEIVING THE RIGHT CARE AT THE RIGHT TIME



Professor Bill Runciman
Professor Jeffrey Braithwaite
Mr Peter Hibbert

The aims of healthcare

Do:

- The right thing
- In the right way
- At the right time
- For the right people

A perfect storm

- An ageing population
- Increasing possibilities
- New, better types of care
- A limit to funding for healthcare
- An affordability crisis

An affordability crisis

- Nearly 20% of public expenditure goes on healthcare (Grattan report)
- Direct costs of nearly 10% of GDP -
- BUT ALREADY
- Some patients are being denied cost-effective care they want and need
- Some patients are waiting too long for essential care

The problem

- There is lots of evidence that much of the care delivered today is not appropriate
- US estimates are that there is no net benefit for 20-30% of the care provided
- Only 55% receive “recommended care”
- Poor baselines and existing interventions produce little change

Acute back pain

3,533 patient visits



Recommended care:

basic advice	21%
simple analgesics	18%
imaging contra-indicated	25%

Ref: Williams CM, Maher CG, Hancock MJ, et al. Low back pain and best practice care: a survey of general practice physicians. Archives of Internal Medicine 2010;170(3):271-277.

NHMRC CareTrack Program Grant



MACQUARIE
University

A population-based study of appropriateness of care

- 22 common conditions
- 522 indicators
- 35,000 telephone calls to recruit 1,154 participants
- Ethics approval for over 220 sites
- Over 270,000 encounters assessed
- Over 35,500 eligible encounters



NHMRC CareTrack Program Grant



MACQUARIE
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Appropriate Care – 57%

- Australians get appropriate care at only 57% of encounters
- Compliance is the same for evidence-based as for consensus-based guidelines
- Compliance ranged from 13% to 90% for conditions

NHMRC CareTrack Program Grant



MACQUARIE
University

Appropriate Care – 57%

- Compliance ranged from 32% to 85% for practices
- Very low compliances for some aspects of care (e.g. risk assessments)
- Differences between types of providers

Condition

Coronary Artery Disease

Dyspepsia

Chronic Heart Failure

Hypertension

Low Back Pain

Panic Disorder

Chronic Obstructive Pulmonary Disease

Diabetes

Venous thromboembolism

Osteoporosis

Depression

Atrial Fibrillation

Cerebrovascular Accident

Community Acquired Pneumonia

Osteoarthritis

Preventive Care

Surgical Site Infection

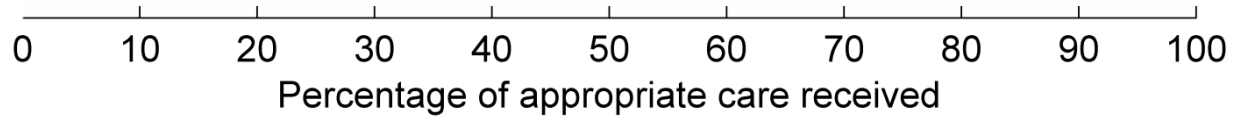
Asthma

Hyperlipidemia

Obesity

Antibiotic use

Alcohol Dependence



Usability issues with clinical guidelines and indicators



- **Duplication** and **overlap**
- **Inconsistent** structure and content
- **Large document size**
- Large number of **repositories** and **guidelines**
- **11 systematic reviews** and **75 RCTs published** every day

What can we do about it?

Surely not more of the same?

Cochrane EPOC reports

- conventional solutions don't work (4 to 12%)
- are certainly not cost-effective

Guidelines and protocols can be effective, with timely, focussed feedback

But, to date, most doctors won't use them

My hypothesis

Daniel Kahneman



-
- Doctors are busy
 - Busy people have to use system I thinking
 - This is virtually beyond voluntary control
 - The production pressure paradox
 - Routine care is almost impervious to change
 - But unusual, complex problems may be better managed

How can this be changed?

Theory - Don Norman

- Change the affordances of the system
- Make it easy to do the “right thing” and hard to do the “wrong thing”
- Introduce some “forcing functions”, or better, some “nudges”
- Provide rapid, relevant, transparent tools and feedback
- Provide incentives to do the right thing

Clinical standards

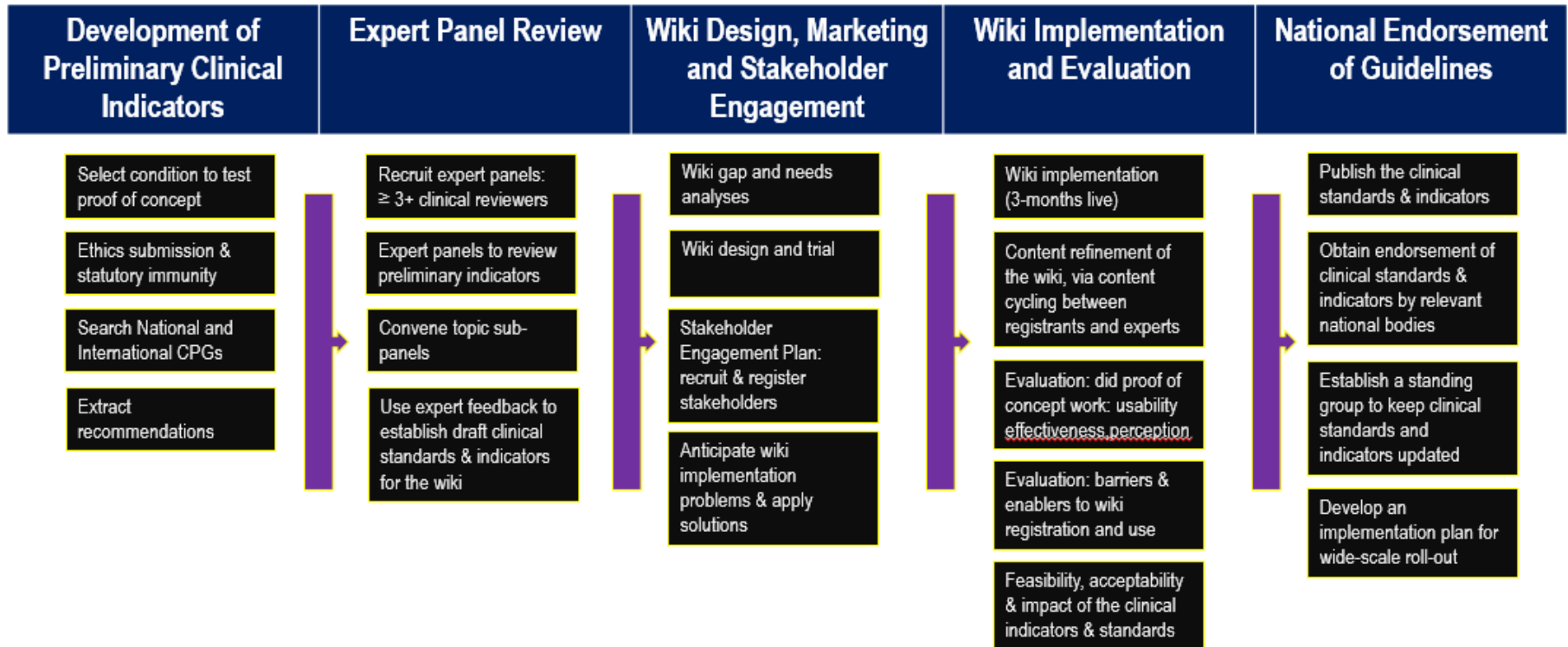
- Distillate of selected pathways & guidelines
- Succinct, standard definitions, language & format
- Suitable to be given to patients
- Suitable for hand-held devices, electronic records
- Versions to be kept up to date
- Provide a basis for monitoring and feedback at personal, facility and national level
- Provides a basis for evidence-based policy

Initial thoughts for this project

Choose conditions based on explicit criteria, such as

- Adequate prevalence
- Evidence of a demonstrated problem
(CareTrack baseline, “headspace”)
- An intervention that is practical and effective
- Some interest and motivation for meaningful change by a relevant group of clinicians and administrators

The project – proof of concept

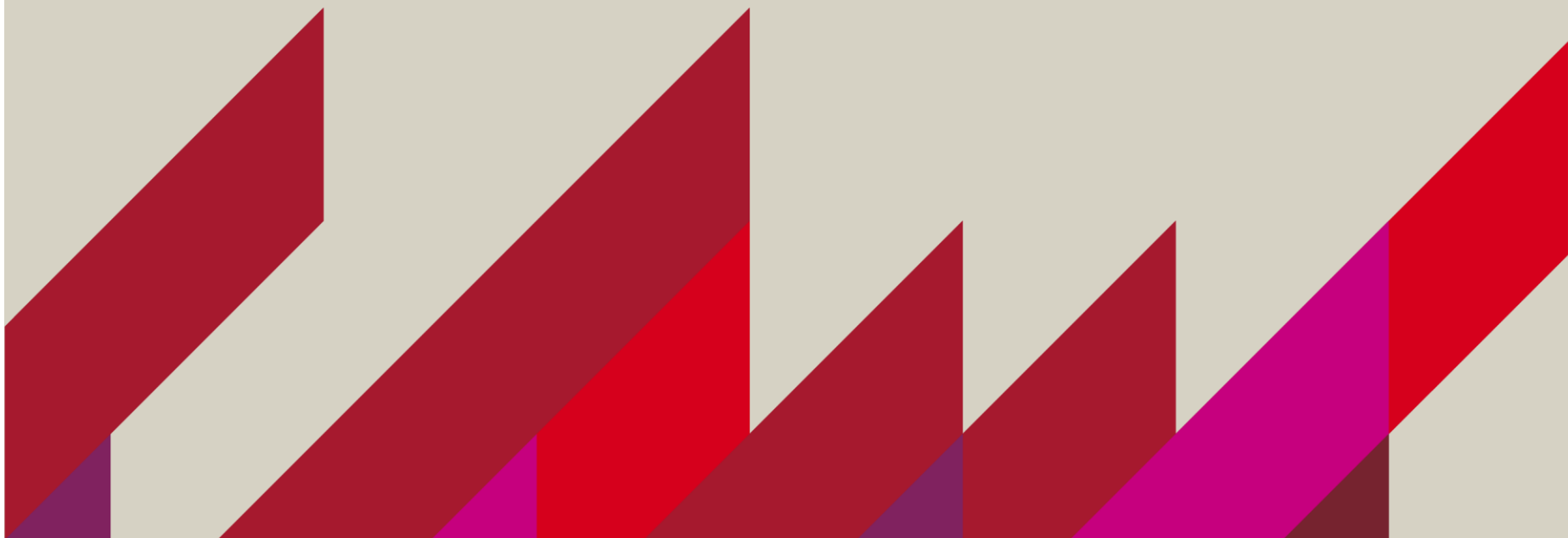


What is needed?

- Tools incorporated into workflow which are consistent with care pathways
- Routine, prospective monitoring of the appropriateness of care
- Routine audit and feedback to patients, healthcare providers, administration
- Duplicate, redundant, overlapping, inaccessible, hard-to-use guidelines should be retired from the frontline

Thank you

END



Implementation: the uptake of evidence into healthcare

Guy Tsafnat and Adam Dunn



Collaborators



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Bond University
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Harvard Medical School
Therapeutic Guidelines
Johns Hopkins Medicine
Ben Gurion University
Bond University
Sydney University

The evidence-practice disconnect

Regulatory bodies that make up policies about how clinicians should treat patients update their policies intermittently.

2-8y²⁵⁰⁰⁹⁶⁸¹

Clinicians change their practice based on new information provided by their colleagues, pharmaceutical representatives, online searches, decision-support systems, and sometimes peer-reviewed studies and reviews.

5-12y²²⁸⁷⁶⁸⁶⁷

21%^{bit.ly/1KnXLuE}

Despite having been thoroughly discredited, large portions of the public believe that vaccines cause autism, especially young adults.

Problem 1: Evidence synthesis is slow and inefficient

Automating systematic reviews

Evidence synthesis is slow

In Australia we don't always deliver the care that guidelines and experts agree on as appropriate.

13-90%

22794056

17638714

7%, 15%, 23%

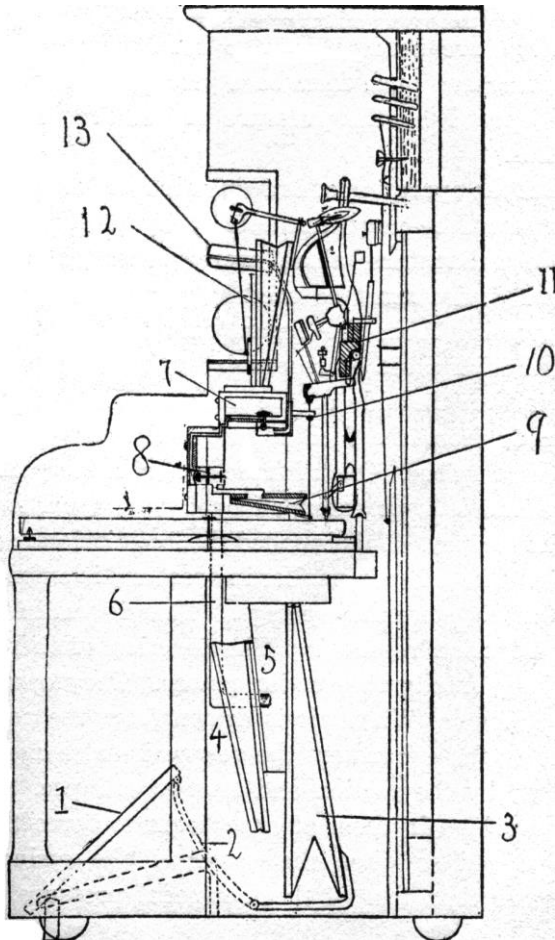
Systematic reviews could be updated as soon as a new study results are available (this means we need to do the right trials).

Systematic reviews can take years to complete and are extremely resource-intensive, so many are out of date – some as soon as they are published.

32.7%

20644625

Automating systematic reviews



We need to improve evidence synthesis; so is it possible to **reliably** automate the tasks required to undertake systematic reviews?

BMJ
2016;353:g1191. doi: 10.1136/bmj.g1191. Published 10 January 2016
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EDITORIALS

The automation of systematic reviews
 Would lead to best currently available evidence at the push of a button

Guy Tsafnat senior research fellow,¹ Adam Dunn research fellow,² Paul Glasziou professor³, Enrico Coiera professor⁴

¹Centre for Health Informatics, Australian Institute of Health Innovation, University of New South Wales, Sydney, NSW 2052, Australia; ²Centre for Research on Evidence Based Practice, Bond University, Gold Coast, Australia

Identify specific information elements in a document ("PAC" for example), is designed to help systematic reviewers by highlighting content and phrases containing information about population, intervention, control, outcome ("PICO") and implementation. This algorithm has a reported precision and recall of greater than 90%.¹

Many from information extraction to its synthesis is far more challenging and will depend on computational reasoning across multiple documents.² An early attempt is a system that merges the literature and abstract reviews when new evidence appears that is likely to change the conclusions of a systematic review.³ Although test systems algorithms typically use statistical methods to identify specific content and documents, machine learning systems will probably require manual methods that harness specific knowledge about the structure and process of clinical trials to guide interpretation.⁴ While statistical methods are needed both for meta-analysis and for single trial reports to multiple places—for example, if randomisation is reported in a protocol paper but not in the results paper.

Natural language generation algorithms can help publish systematic reviews by generating human readable text from trial reports or trials. Together with visualization tools like concept, for creating CONCEPT diagrams, understanding automation may lead to more efficient and systematic synthesis of the evidence.

In light of systems already available, intelligent systems could probably be devised to help review these four main tasks of performing systematic reviews, to train new reviewers, and then incorporate their experience, to reliably improve their work. Tools will move from aiding humans to becoming reliable autonomous reviewers that can replace systematic reviews with the latest available evidence.

Currently, many systematic reviews, and Cochrane reviews, require well-structured peer reviewed protocols before any review of the evidence base, to ensure objectivity and transparency of the review. These protocols are a formal representation of the actions that a reviewer is about to execute.

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Tsafnat G, et al. *Systematic Reviews* 2016, 5:24
http://www.systematicreviewsjournal.com/content/5/1/24

SYSTEMATIC REVIEWS
Open Access

COMMENTARY
Systematic review automation technologies
 Guy Tsafnat¹, Paul Glasziou², Miew Keen Choong³, Adam Dunn¹, Filippo Calgaro⁴ and Enrico Coiera⁵

Abstract
 Systematic reviews, a cornerstone of evidence-based medicine, are not produced quickly enough to support clinical practice. The ease of production, availability of the requisite expertise and sometimes are often quoted as major contributors for the delay. This directed survey of the state of the art of information systems designed to support or automate individual tasks in the systematic review, and in particular systematic reviews of randomised controlled clinical trials, reveals trends that see the convergence of several parallel research projects.

We surveyed literature describing informatics systems that support or automate the processes of systematic review or each of the tasks of the systematic review. Several projects focus on automating, simplifying and/or streamlining specific tasks of the systematic review. Some tasks are already fully automated while others are still largely manual. In this review, we describe each task and the effect that its automation would have on the entire systematic review process, summarise the existing information systems support for each task, and highlight where further research is needed for realising automation for the task. Integration of the systems that automate systematic review tasks may lead to a revised systematic review workflow. We envisage the proposed workflow will lead to systems in which each systematic review is described as a computer program that automatically retrieves relevant trials, appraises their relevance and synthesises data, evaluates the risk of bias, performs meta-analysis calculations, and produces a report in real time.

Keywords: Systematic reviews, Process automation, Information retrieval, Information extraction

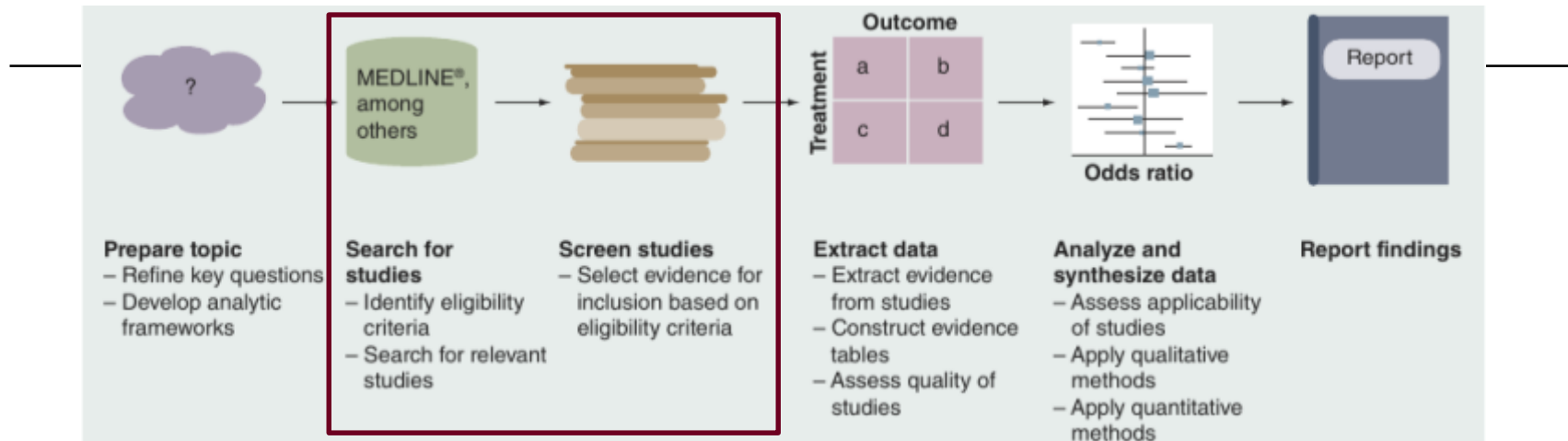
Background
 Evidence-based medicine stipulates that all relevant evidence be used to make clinical decisions regardless of the length of time between them [1]. Systematic reviews are considered a means to enable clinicians to use evidence-based medicine [2]. However, even the conduct and updating of updated systematic reviews required to assess a significant proportion of clinical questions, is beyond our means without automation [3-6].

Systematic reviews are conducted through a robust but slow and resource-intensive process. The result is that undertaking a systematic review may require a large amount of resources and can take years [6]. Proposed decision support systems for systematic reviews include ones that help the basic tasks of systematic reviews [3,4,7,8]. The full automation of systematic reviews that will deliver the best evidence at the right time to the point of care is the logical next step [9]. Indeed, research aims to automate the review process, to reduce the time and effort when needed and at a push of a button.

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BioMed Central

Speeding up evidence synthesis



Systematic reviewers may need to read hundreds of articles to identify a handful of studies that might need to be included in a review.

Training a machine to do this requires a bit of extra ingenuity relative to standard machine learning techniques, so we have started to use structural information (citation networks), which can be also help with retrieval, de-duplication, etc.

25274020, 24725642

46%

22515596

70%

Can we produce a **reliable** signal to trigger the automatic update of reviews?

Problem 2: Clinical evidence is often biased or hidden

Evidence surveillance

Clinical evidence is biased

24411643

Due to biases in the design, undertaking, reporting, and synthesis in clinical research, about 85% of it is wasted.

\$200b

20679560

32% v 62%

Trials that are funded by industry are less likely to be published within 2 years, and when they are, they are more likely to have favourable results.

23861749

When trials are published, some outcomes are incompletely reported or not reported at all. Safety outcomes are affected more than efficacy outcomes.

40-62%

25285542

17% v 88%

When reviewers and systematic reviewers synthesise the results from many clinical studies, those with financial conflicts of interest are more likely to report favourably.

New ways to measure biases

10,086 citations to 4,574 unique articles among 152 reviews about the clinical use of neuraminidase inhibitors.

93 (61%) of reviews were unanimously graded as favourable.

Table 1. The classification results for different classifiers predicting the conclusions of reviews

Classifier	Precision	Recall	F ₁	Accuracy (%) (95% CI)
Naive Bayes				
Including all citations	0.93	0.99	0.96	94.2 (90.5, 97.9)
Articles cited more than once	0.95	0.99	0.97	95.5 (92.2, 98.8)
KNN (k = 1)				
Including all citations	0.91	0.99	0.95	93.0 (88.9, 97.1)
Articles cited more than once	0.93	0.99	0.96	94.2 (90.5, 97.9)
KNN (k = 3)				
Including all citations	0.92	0.96	0.94	91.7 (87.3, 96.1)
Articles cited more than once	0.87	0.98	0.92	89.6 (84.7, 94.5)
KNN (k = 5)				
Including all citations	0.97	0.96	0.96	95.5 (92.2, 98.8)
Articles cited more than once	0.96	0.98	0.97	96.2 (93.2, 99.2)
SVM RBF				
Including all citations	0.94	0.95	0.75	93.0 (88.9, 97.1)
Articles cited more than twice (F = 1.0)	0.94	0.95	0.75	93.0 (88.9, 97.1)

Abbreviations: CI, confidence interval; KNN, k nearest neighbor; SVM, support vector machine; RBF, radial basis function.

Problem 3: People often believe strange things

Computational epidemiology

Misinformed health behaviours



33%* of US adults believe that there is a lot of disagreement among scientists about global warming.

31% of Norwegians believe that there is some disagreement between experts on the safety of vaccines.

Misinformed health behaviours



33%* of US adults believe that there is a lot of disagreement among scientists about global warming.

31% of Norwegians believe that there is some disagreement between experts on the safety of vaccines.

37%* of US adults believe the FDA is deliberately preventing the public from getting natural cures for cancer and other diseases because of pressure from drug companies.

20%* of US adults believe that health officials know that cell phones cause cancer but are doing nothing to stop it because large corporations won't let them.

12%* of US adults believe that public water fluoridation is really just a secret way for chemical companies to dump the dangerous byproducts of phosphate mines into the environment.

*of those who have heard of the topic

Opinion surveillance

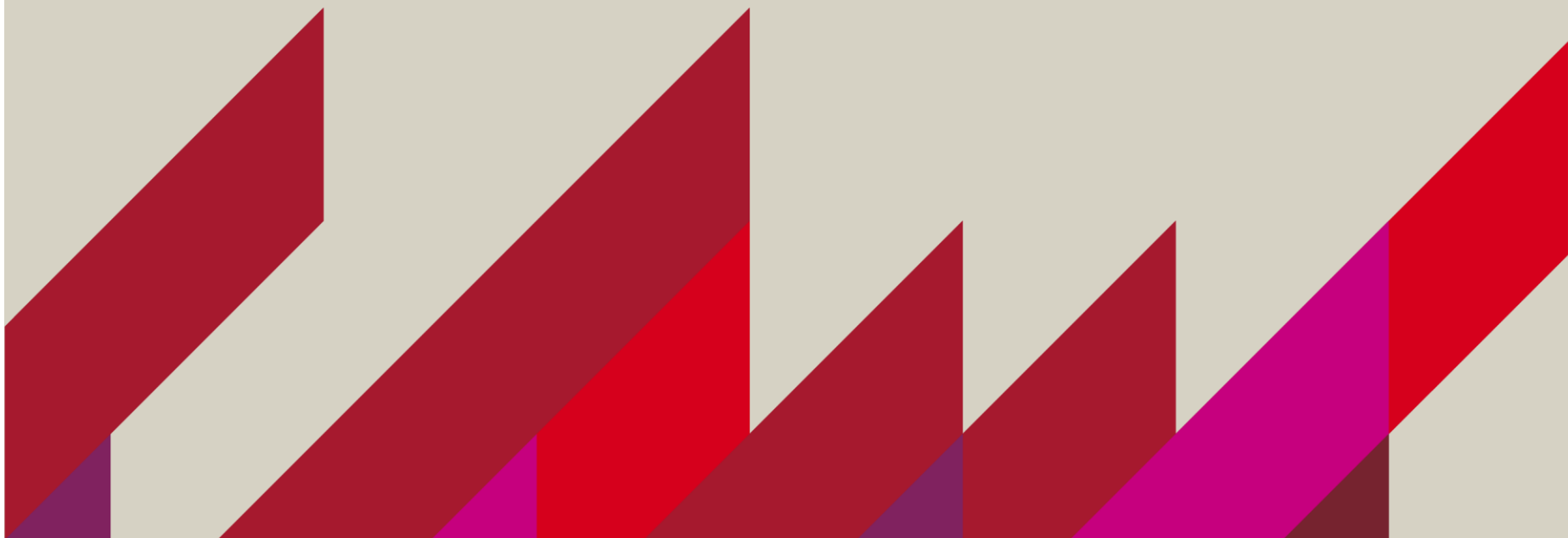
After being exposed to mostly negative tweets about HPV vaccines, the odds ratio of subsequently tweeting an anti-vaccine opinion was: **3.46** [95%CI 3.25-3.67].

(among the 30,621 users who tweeted about HPV vaccines at least once following exposure to several tweets about HPV vaccines, covering 83,551 tweets over 6 months).



Thank you

@adamgdunn



Health Analytics for a Learning Health Care System

AIHI Symposium, 31st March 2015



Dr Blanca Gallego Luxan
Australian Institute of Health Innovation
Macquarie University

Context

Towards a Learning Health Care System

Traditional Health
Care System



Learning Health
Care System

**New
Methods**

- Patient care is integrated with medical research
FACILITATING
Clinical practice continuously monitored, updated and improved
- Medical research is integrated with patient care
FACILITATING
Research continuously informed and guided by clinical practice

Our Research

Building Models to Support Decision Making at the point-of-care

Automated Tools

Computed in real-time
Updated in real-time

**Decision
Support at
the point-
of-care**

Prediction

Prognosis
Risk

Evaluation

Comparative
effectiveness

Forecasting patient trajectories

Will a patient be: in hospital, at home or dead in the next week?

➤ Early accurate estimates of remaining days of hospitalisation, risk of readmission, and death ->

Discharge planning strategies ->

Improve continuity of care

Prevent readmissions and post-discharge deaths

➤ Early accurate estimates of high risk of death ->

Prevent deterioration and death

Initiate counseling about end-of-life-care

➤ Typical predictive model->

Predict single outcome

Given time period

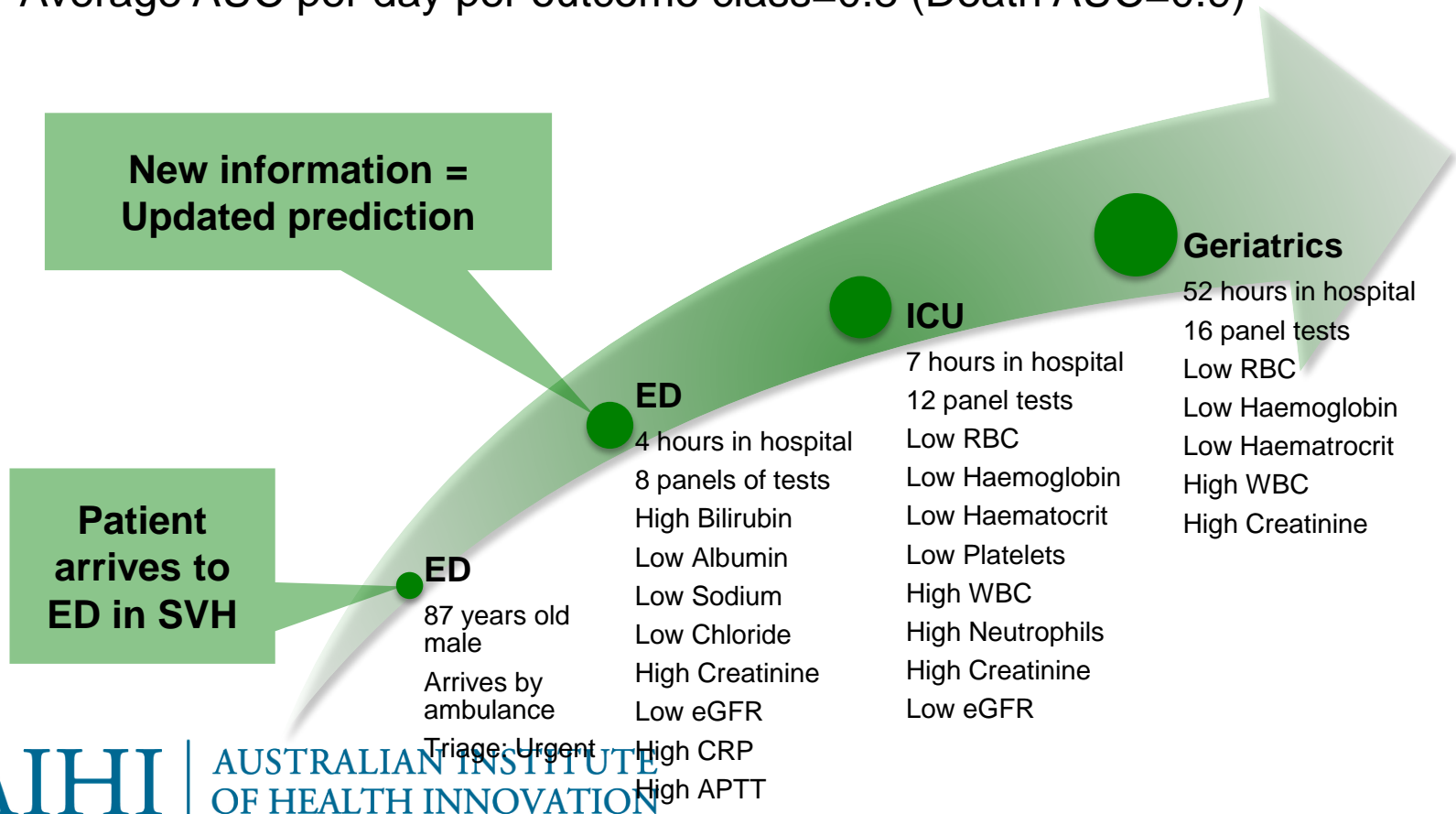
Given forecasting time

Forecasting patient trajectories

Will a patient be: in hospital, at home or dead in the next week?

We **simultaneously** predict the probability of discharge, readmission and death **for each of the next 7 days**, throughout the patient's hospitalisation.

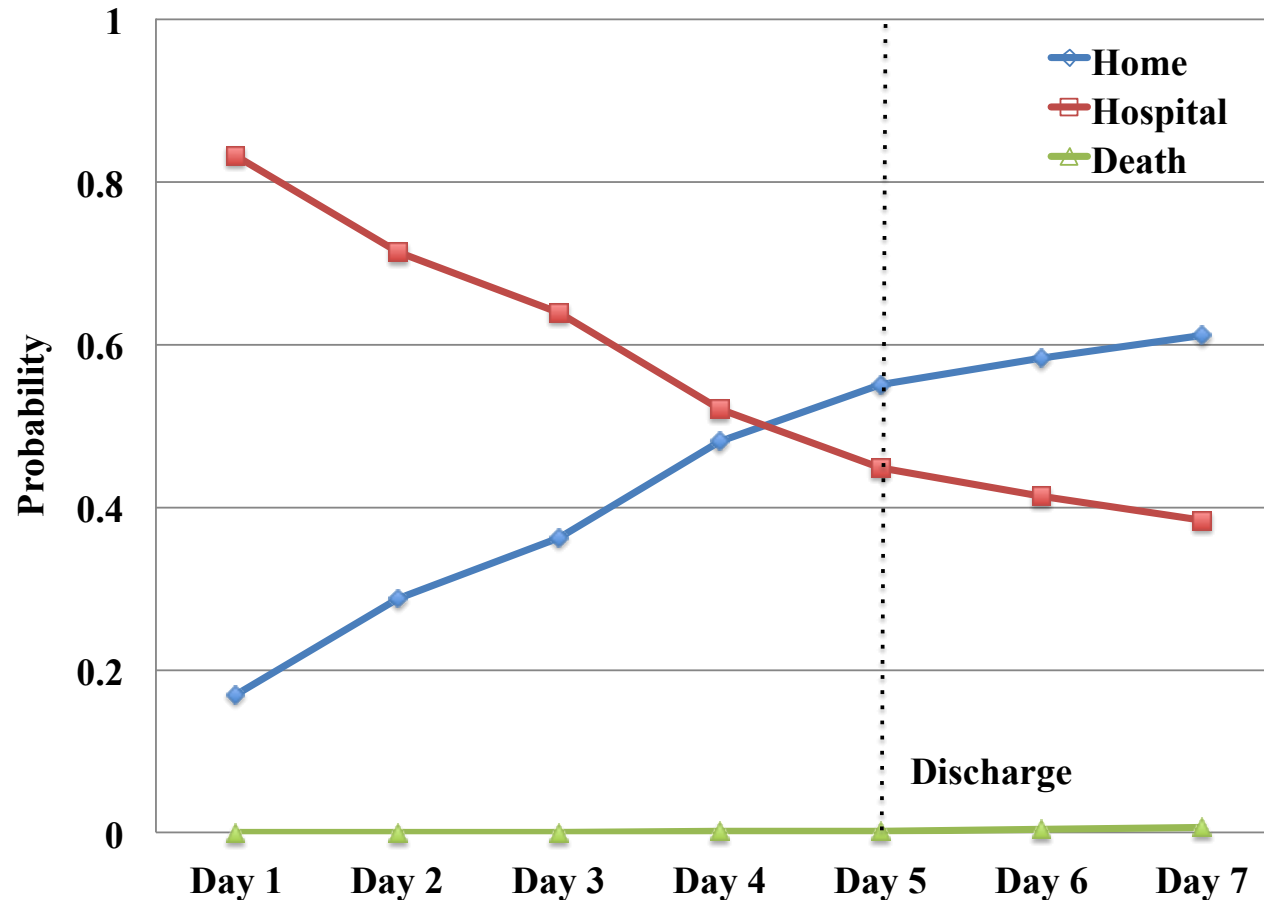
Average AUC per day per outcome class=0.8 (Death AUC=0.9)



Forecasting patient trajectories

Will a patient be: in hospital, at home or dead in the next week?

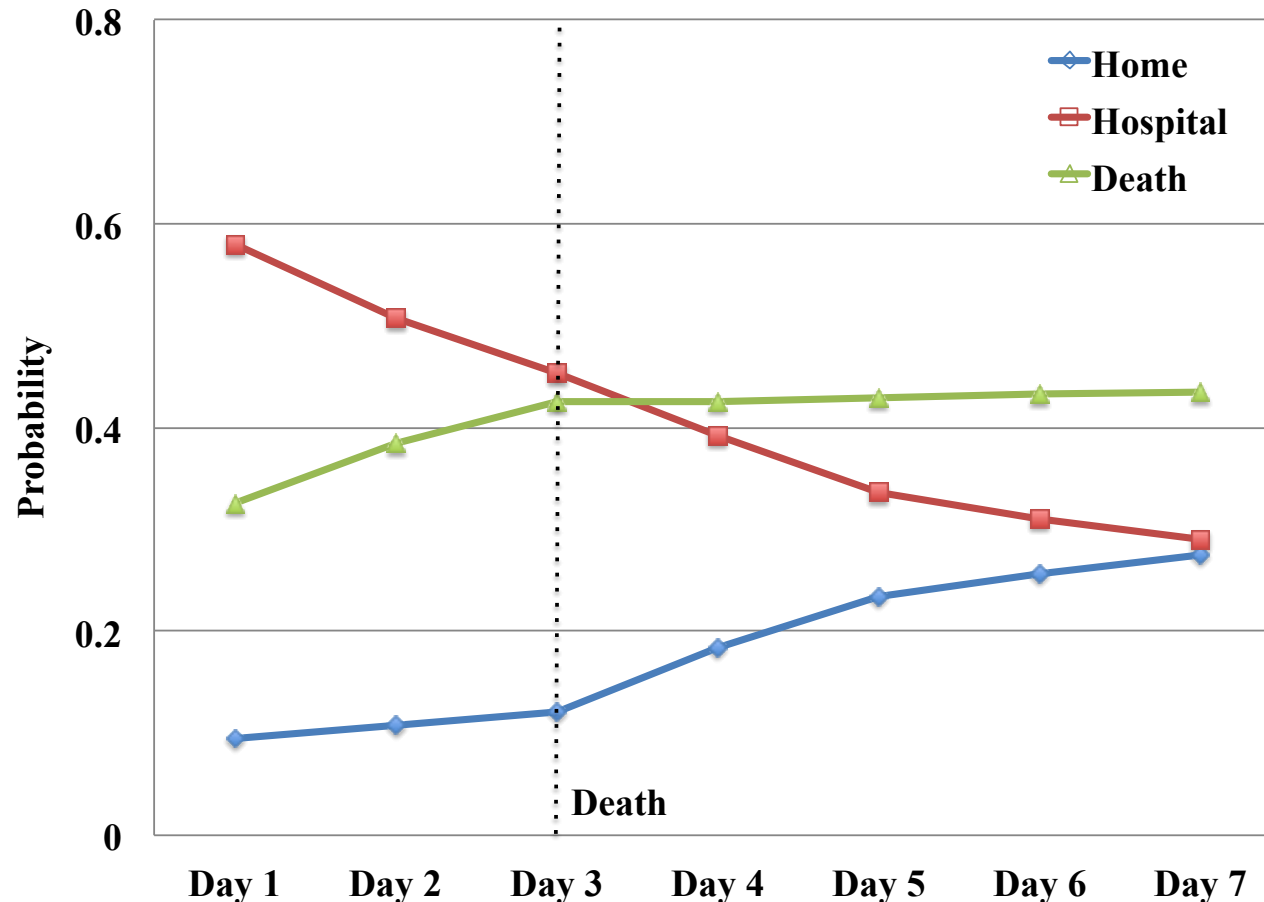
B. Expected Discharge



Forecasting patient trajectories

Will a patient be: in hospital, at home or dead in the next week?

D. Expected Death



Bringing cohort studies to the bedside



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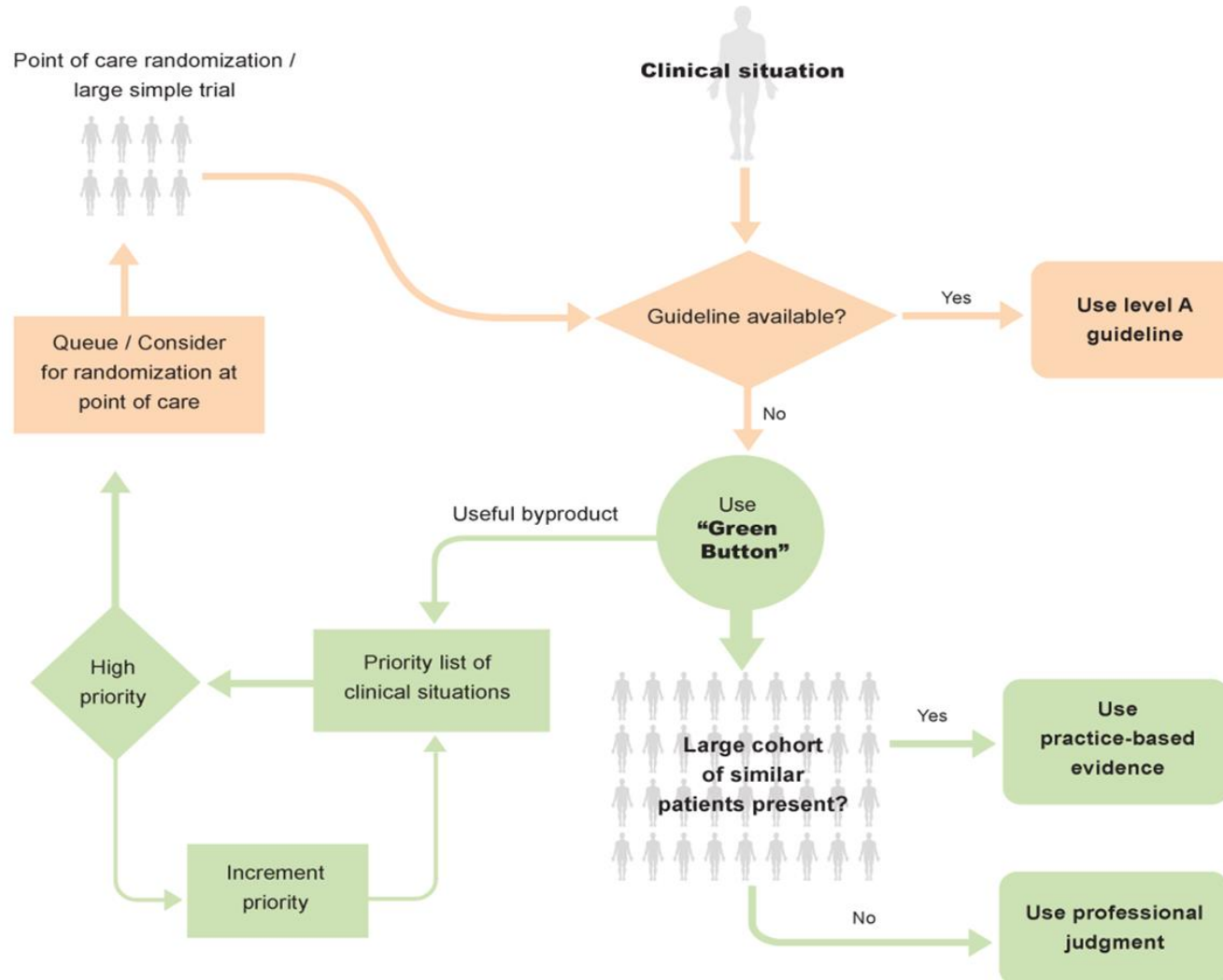
Framework for a 'green button' to support clinical decision-making



Capability in the EHR system that resolves the tension between
'evidence-based medicine' AND ***'practice-based evidence'***

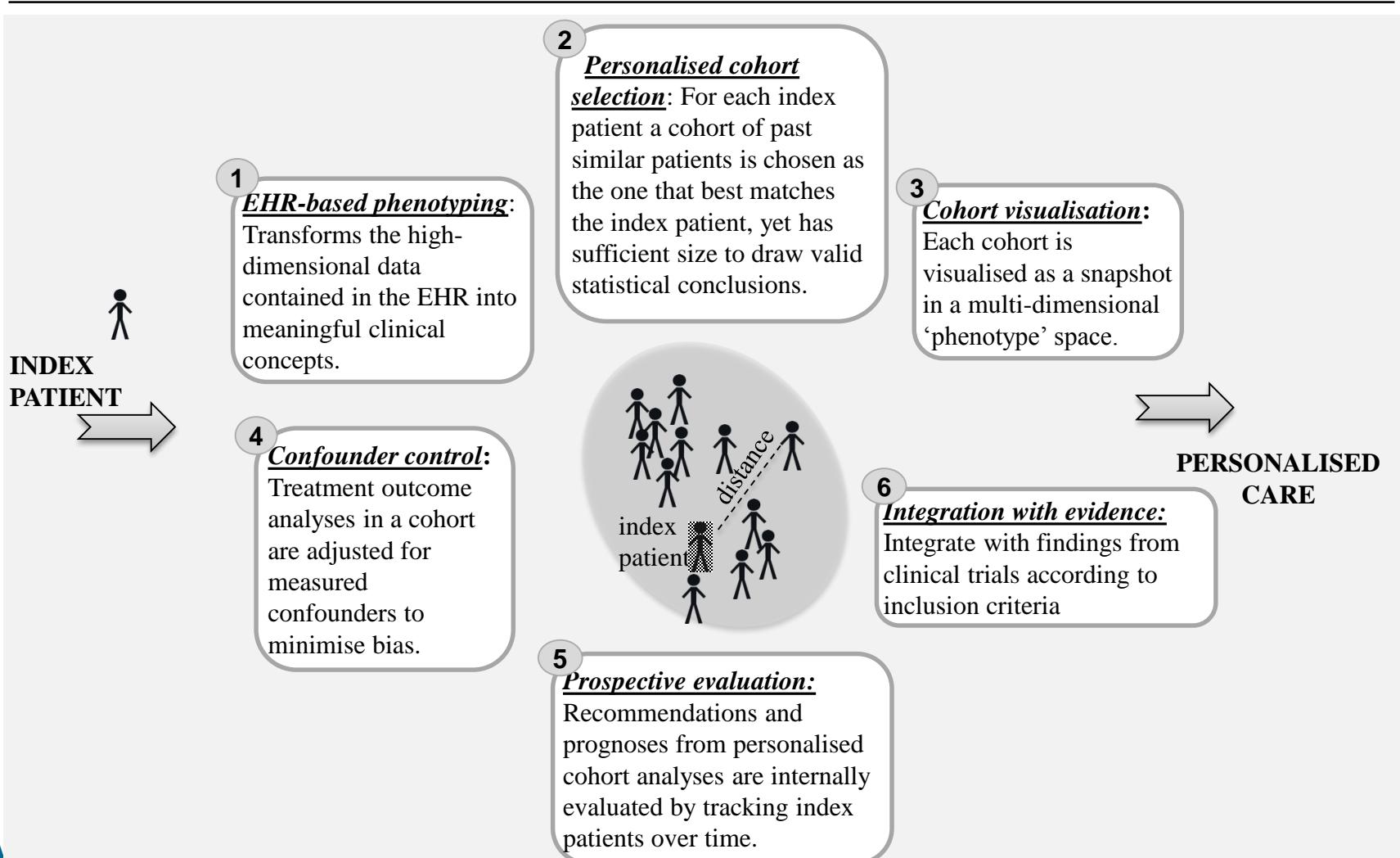
Bringing cohort studies to the bedside

Framework for a 'green button' to support clinical decision-making



Bringing cohort studies to the bedside

Framework for a 'green button' to support clinical decision-making



Thank you for listening

Questions are welcome

Work in collaboration with:

Dr Oscar Perez-Concha (MQU)

Prof. Coiera (MQU)

A\Prof. Nigam Shah (Stanford)

A\Prof. Chris Longhurst (Stanford)

Prof. Ric Day (UNSW, SVH)

Prof. Teng Liaw (UNSW)

Dr Xiong Cai (UNSW)

Prof. Martin-Sanchez (Melbourne)

Dr James Sheppard (Oxford)

David Roffe (SVH)

The management of diagnostic tests

A/Prof Joanne Callen PhD

Centre for Health Systems & Safety
Research



Collaborators



A/Professor Andrew Georgiou, Dr Ling Li
Professors Bill Runciman and Johanna
Westbrook
**Centre for Health Systems and Safety
Research**

Associate Professors Richard Paoloni, Kathy
Gibson
Louise Robertson
Sydney LHD and South Western Sydney LHD

Case study: Failure in communication



MACQUARIE
University

*A 50 year old woman was admitted to hospital to have her gall bladder removed. A CT scan of the abdomen showed a large pelvic mass. The patient had her gall bladder removed; however **the pelvic mass was not followed up**. Health care organisations all over the world are unable to prevent cases such as this.*

How many results are missed for hospital patients?

Hospital inpatients

20.04% - 61.6% of tests are missed

Callen et al. BMJ Qual Saf 2011;20;194-199

ED patients (discharged from ED)

1.0% - 75% of tests are missed

Callen et al. BMJ Qual Saf 2011;20;194-199



How many results are missed for patients in ambulatory settings?

Ambulatory patients

6.8% - 62% laboratory tests missed

1.0% - 35.7% imaging tests missed

Callen et al. JGIM, 2012

11% AND 35.7% - NO EVIDENCE OF FOLLOW-UP OF MAMMOGRAMS

CHEN ET AL. J NATL MED ASSOC 2010

POON ET AL. JGIM 2004



Impact on patients of missed/delayed test results

Delayed diagnosis

Inappropriate antibiotics prescribed

Delayed or missed cancer diagnosis

Death



Where does communication break down in the test management process?



No standard policies or guidelines

Multidisciplinary nature of the test management process

Problems occur at the *interface* between primary and secondary care and laboratories

Use of *multiple information systems*

Focus areas for our research

Can technology assist the process?



What is the role of the patient?



Two projects - test management

1. Evaluation of an electronic test result endorsement function
2. Notification of significantly abnormal test results to patients: physicians' perspective



1. Evaluation of an electronic test result endorsement system

Does electronic test result acknowledgement **reduce the number of missed test results**

Does electronic results acknowledgement **take physicians more time?**

What do physicians think about electronic test acknowledgement in relation to **work**



Does electronic test result acknowledgement reduce the number of missed test results?



Design

Before and after study

Intervention

On-line test result acknowledgement function implemented August 2013

Population

Patients discharged from one metropolitan ED for one month

Before intervention (April 2013)– 2,513 microbiology & radiology tests ordered for ED

After intervention (April 2014) – 2,269 microbiology & radiology tests ordered for ED

Outcome measures

percentage of abnormal test results not acknowledged; not acknowledged which are ju

test results to patients: physicians' perspectives



Cross sectional survey

Primary care physicians and specialists (USA and Australia) (n=315/1417; 5 sites)

Emergency Department physicians (Australia) (n=61/89; 2 sites)

Questions

Are there policies and procedures for notification?

Who should notify the patient?

Should patients receive direct notification of results?

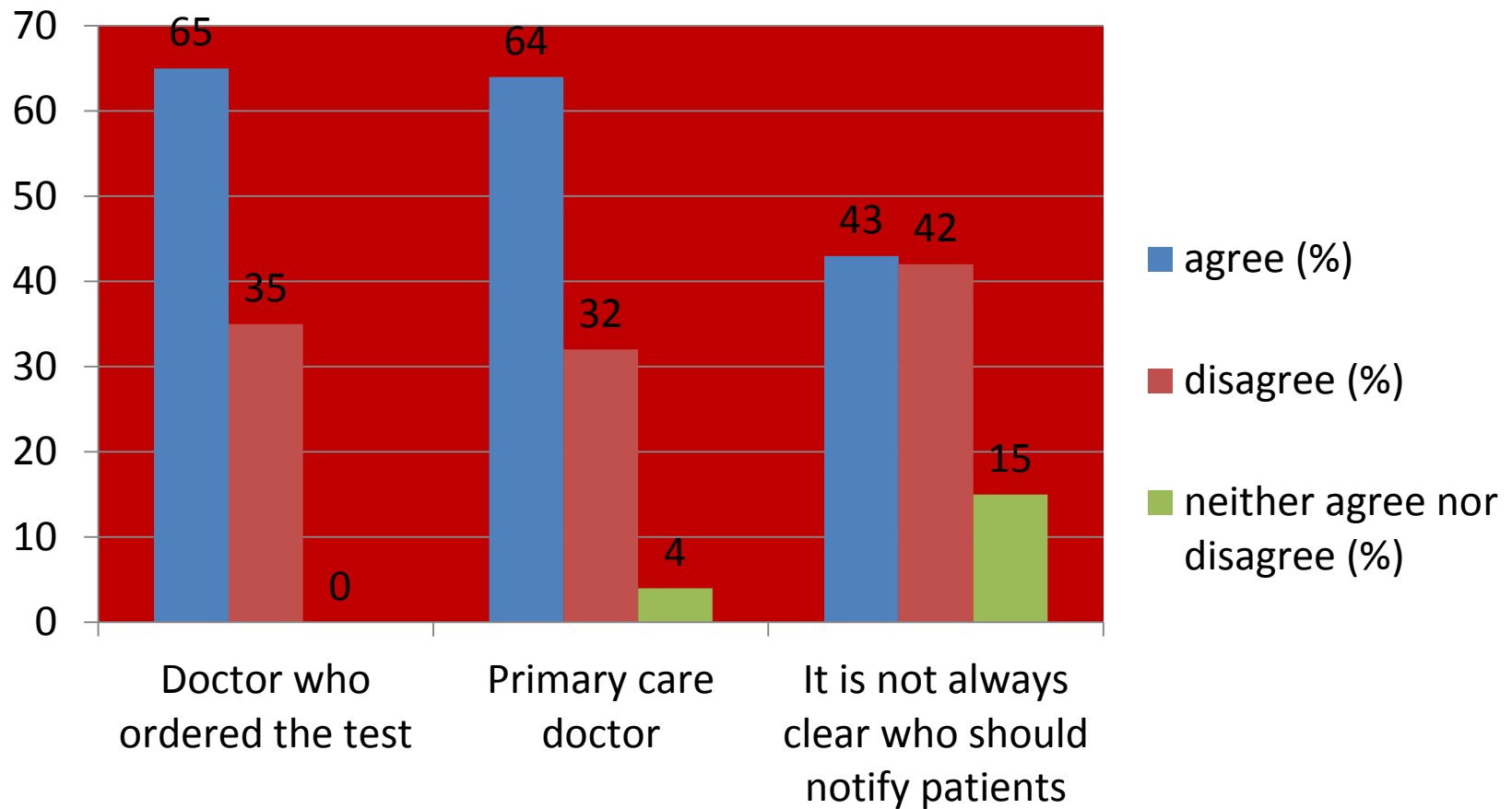
What are your concerns about notification? (patients' anxiety, patients' lack of expertise)

Callen et al. J Med Internet Research 2015

Giardina et al. Patient Education and Counselling, 2015



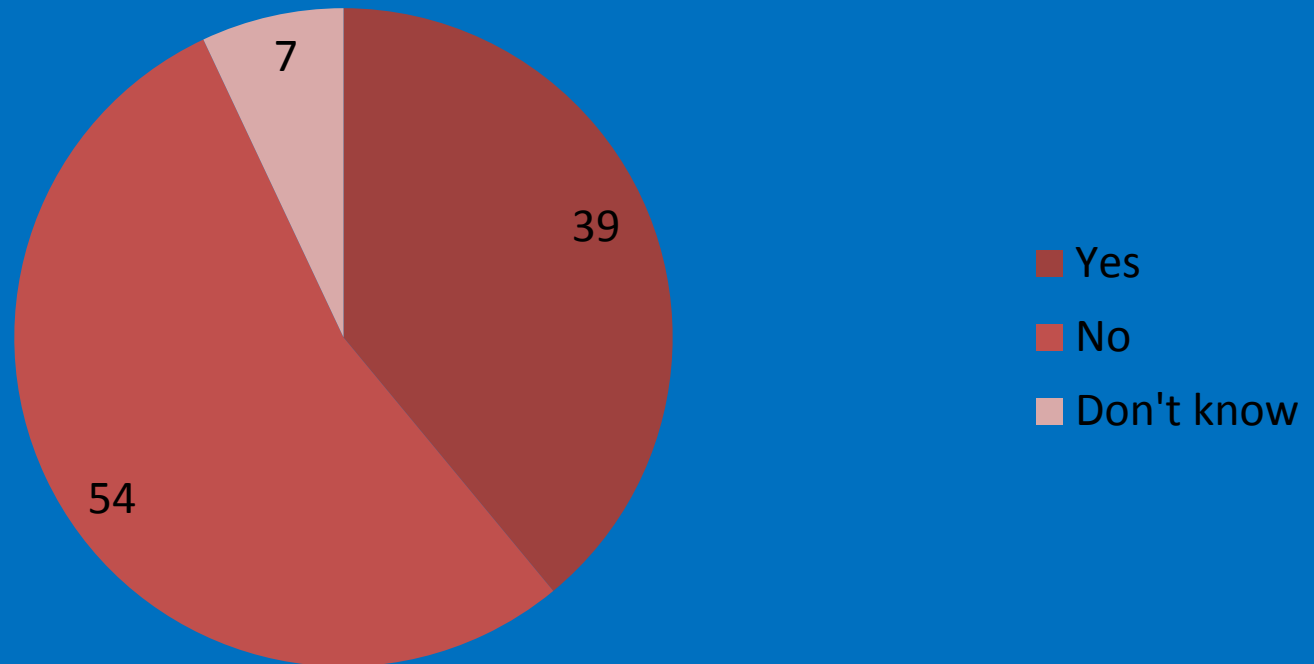
Who is responsible for notifying the patient of a test result?



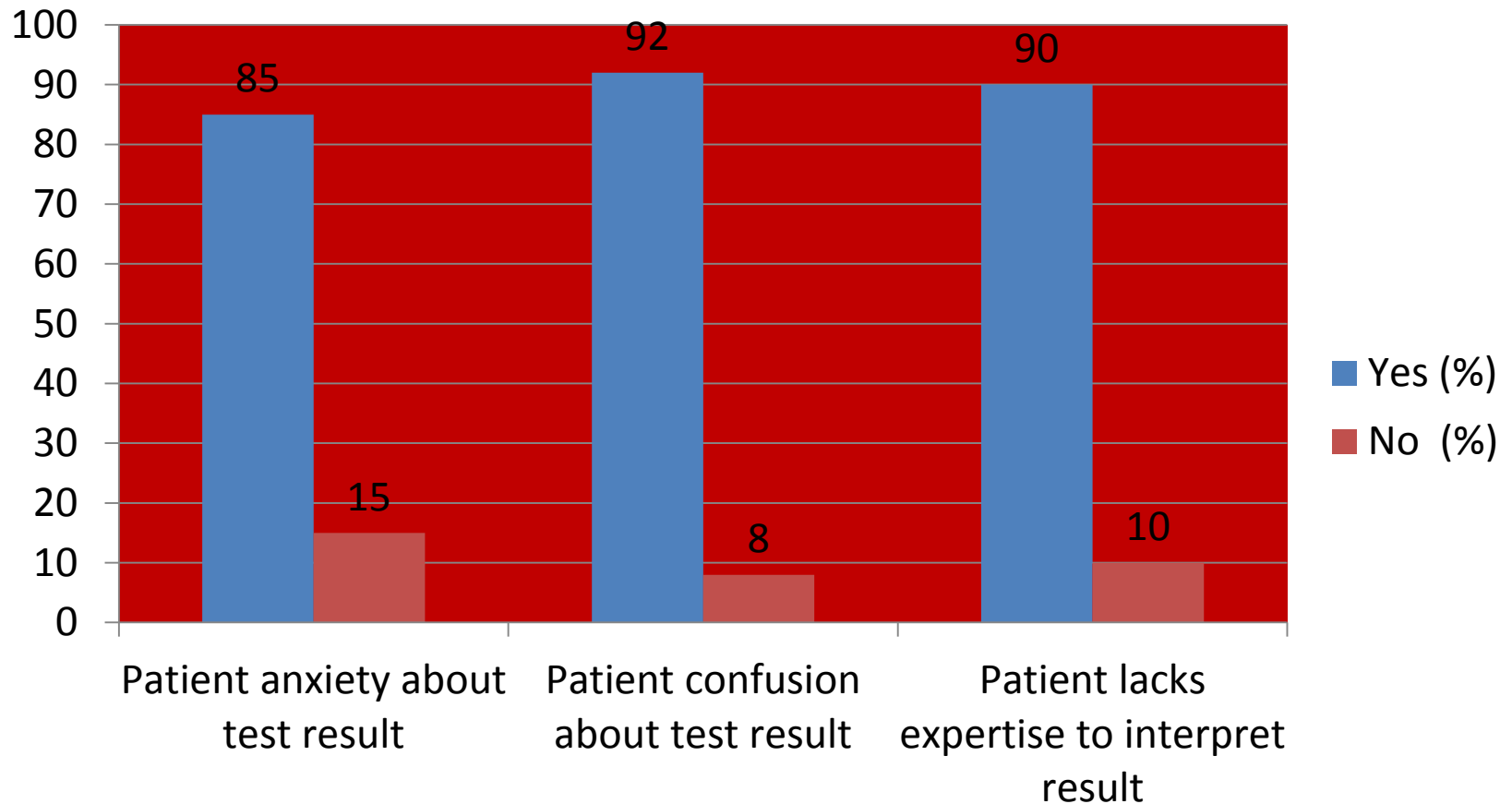
Are you comfortable with patients receiving direct notification of test abnormal results?



Direct patient notification (%)



Main concerns regarding direct notification of results to patients



Context of the problem of missed test results



Solutions need to be multipronged

Policies, procedures and responsibilities

Role of patients, doctors, nurses, clerical staff and laboratories in the follow-up process

Evaluation of **information and communication** technology (ICT) solutions

Integrate solutions with **work practices** of health professionals



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Thank you

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