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Human Factors

Dr Melissa Baysari & Dr Robyn Clay-Williams

What is human factors (HF)?

- Applies evidence-based methods and knowledge about people to design and improve the interaction between people, systems, and organisations
- Achieved by ensuring there is a **good fit** between people and their environment
- Good fit = happy, healthy and productive workers

Good vs. bad design

Think about the fit!

Human factors methods

To understand how good the fit is between people and their working environment, we apply a range of human factors methods, such as

- Interviews
- Focus groups
- Observation (and video recording) in situ and in the lab
- Physical measurement of the workplace

These methods can tell us a lot about how people *think* they work (and how they *actually* work)

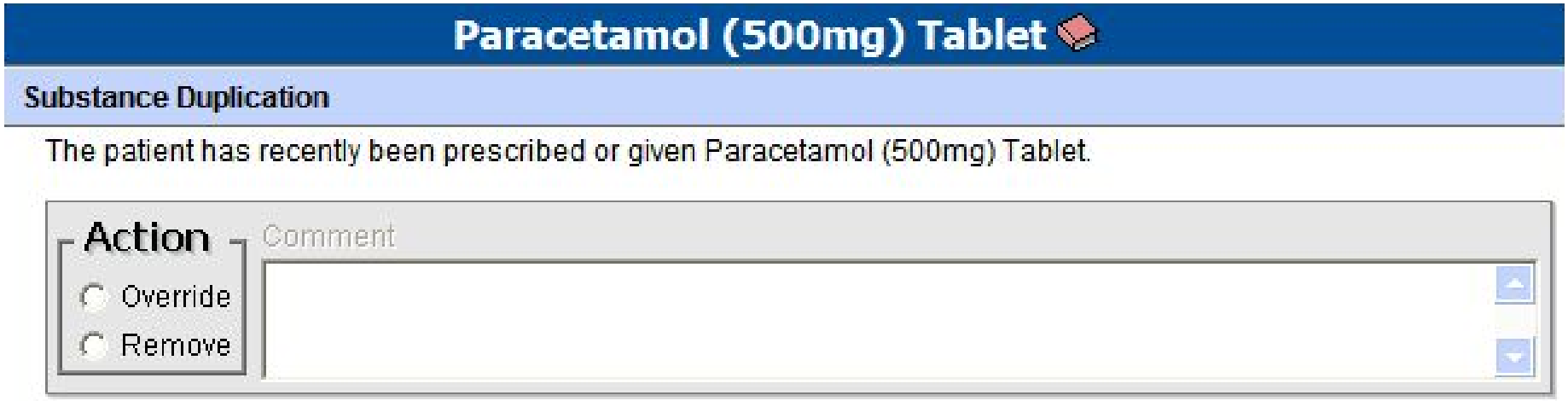
The fit between doctors & IT

Computerised decision support (DS) = information & guidance at the time decisions are being made

Includes: Computerised alerts
Access to on-line reference material
Pre-populated orders

Evidence that well designed DS can impact on prescribing behaviour **BUT** DS is a deceptively simple concept

Design and execution are extremely difficult


Paracetamol (500mg) Tablet
Substance Duplication
The patient has recently been prescribed or given Paracetamol (500mg) Tablet.
Action
Override
Remove
Comment

The fit between doctors & alerts

- 14 specialty teams observed on 1-3 ward rounds (58.5 h)
- Observer noted:
  - All interactions with prescribing system
  - Alerts generated
  - Prescriber responses to alerts
  - Any changes to orders following alerts
- Prescribers interviewed about system & alerts

Decision-makers on ward-rounds

- Senior doctors made the prescribing decisions
- Senior doctors were seen to:
  - tell junior doctors what medications to order
  - call medications out to junior doctors who stood at computers in the hallway
  - leave junior doctors to enter medication orders into the system while the rest of the team moved onto the next patient case
- Senior doctors rarely used the prescribing system

Impact of alerts?

- Nearly ½ medication orders triggered an alert
- Only 17% of alerts were read
- No prescriptions were changed following an alert
- No junior doctor mentioned an alert to his/her team
- No junior doctor questioned a senior doctor's decision to prescribe a medication following an alert

Opinions of alerts

Registrar 1: “I find them to be irritating because often I don’t feel they inform me of something which I’m interested in…I haven’t yet had a warning where I thought oh good, thank you for that”

Registrar 2: “It pops up so often which can be a very bad thing because you’re dismissing it so often that you develop this sort of mechanism so it can be bad in a sense that sometimes you might miss some important things”

Alert fatigue

- A consequence of too many alerts being presented
- A significant problem because it results in user frustration & annoyance
- Leads to prescribers learning to ignore all alerts, even those that present useful & sometimes safety critical information

Good fit between alerts and doctors?

- No!
- Users of the system are not the decision-makers on ward-rounds
- Greatest value of alerts is on non-ward-round settings where senior doctors are less influential

  Our after-hours research has confirmed this
- Should we switch alerts off during ward-rounds??

Designing effective DS

Current work: Using a lab environment to identify the features of **effective DS**

Alert rate

Alert design

Alert relevance

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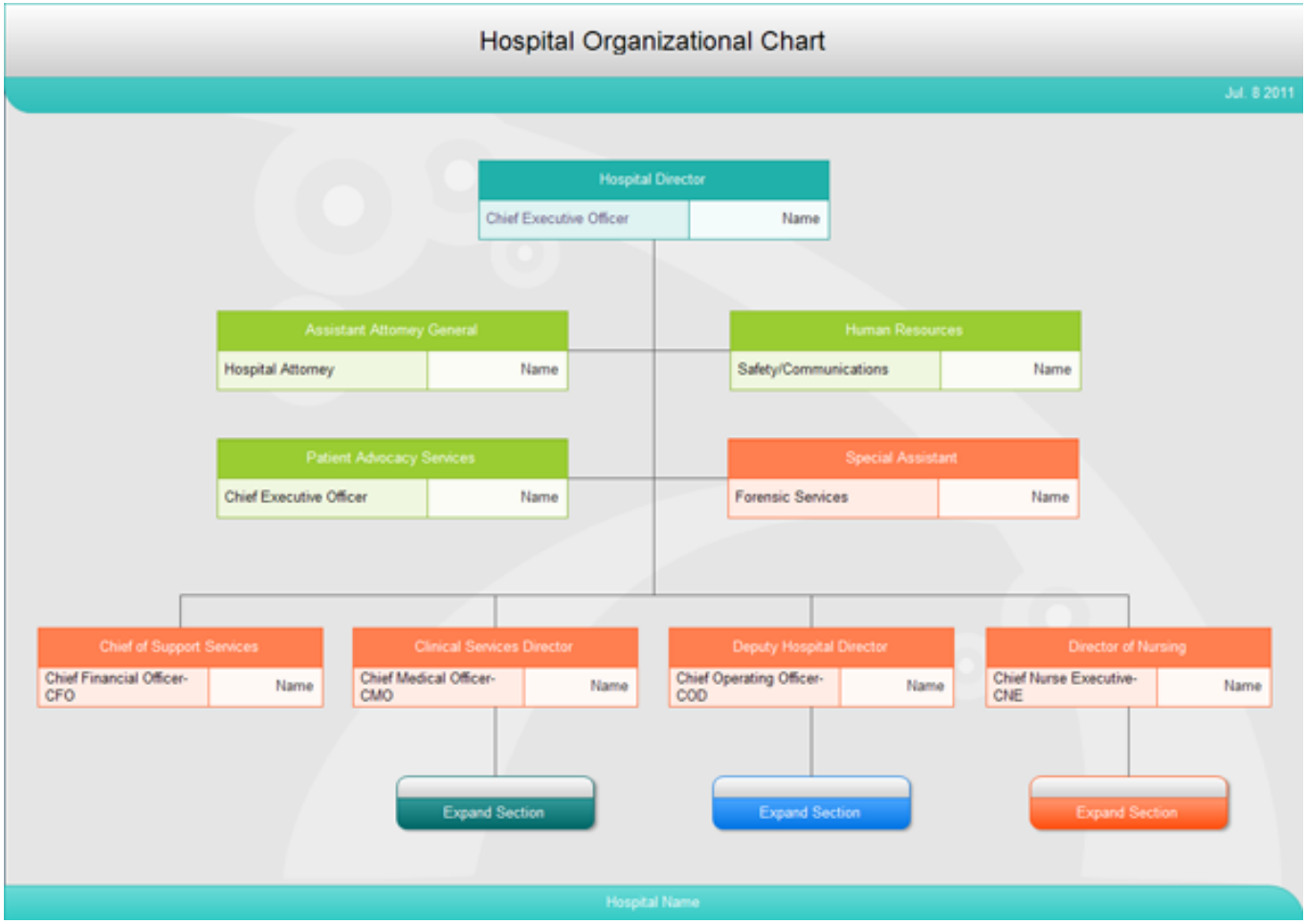
Is this your mental model?



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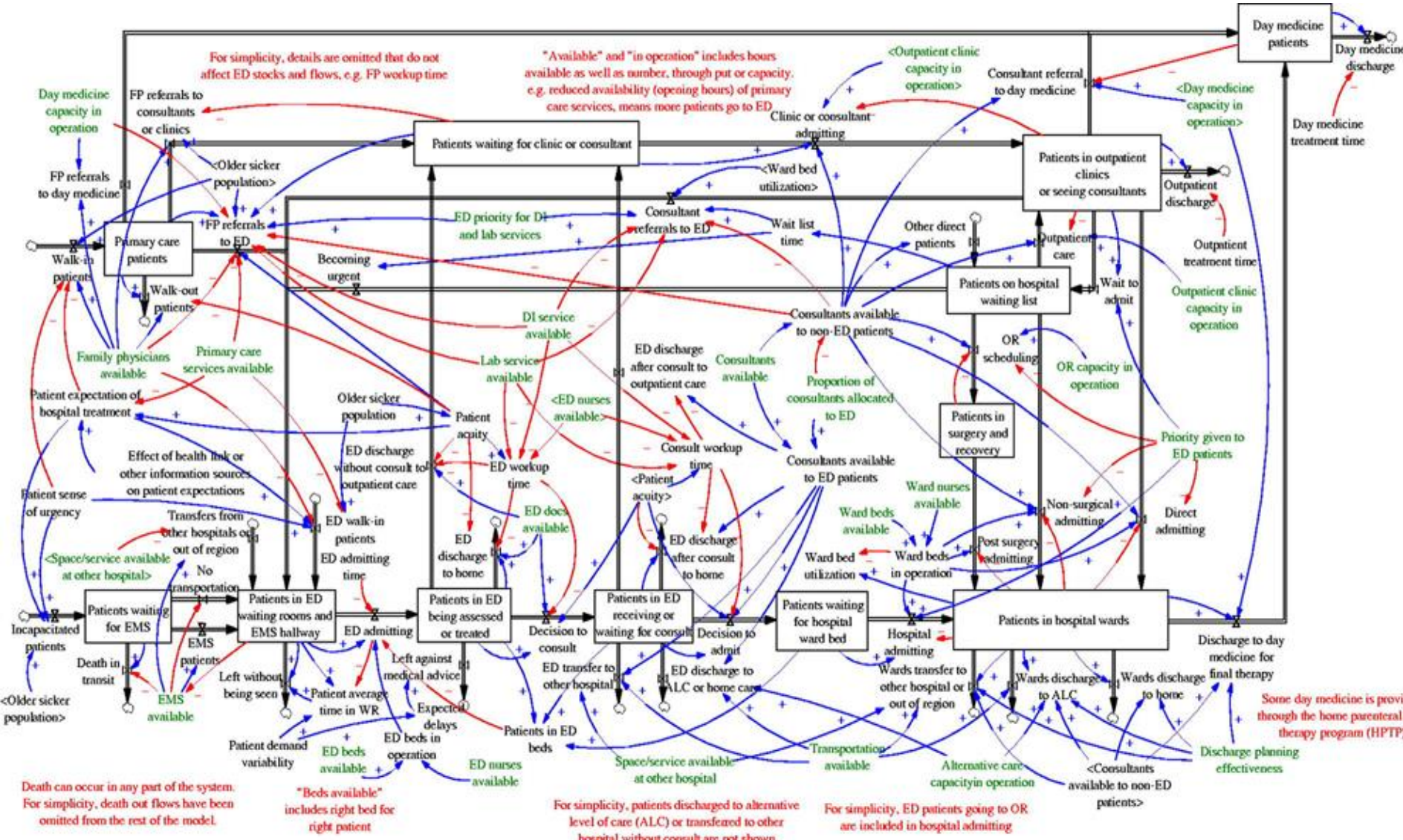
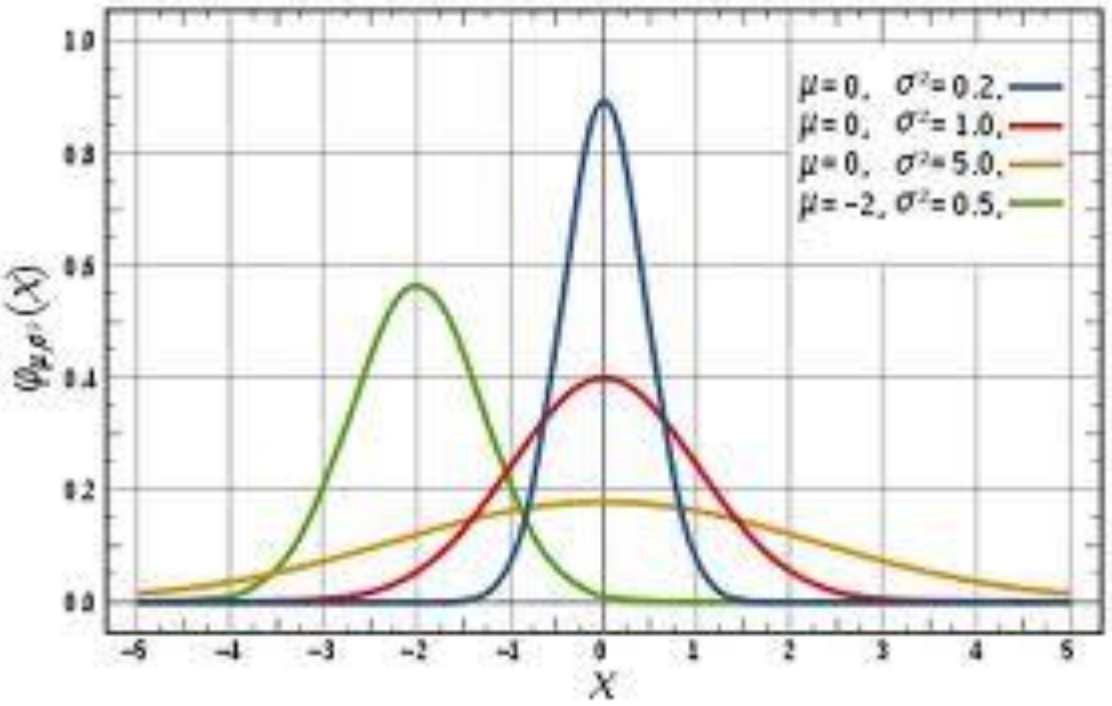
But healthcare really looks like this …



Human performance



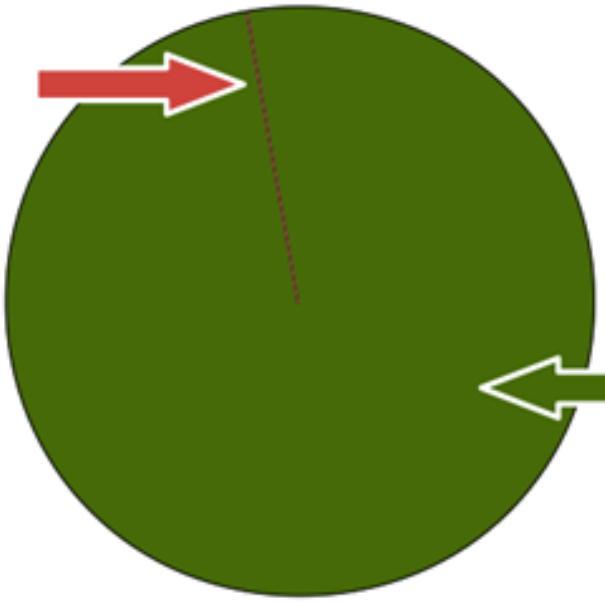
Safety I and Safety II thinking

Safety-I = Reduced number of adverse events.

Focus is on what goes wrong. Look for failures and malfunctions. Try to eliminate causes and improve barriers.

Safety and core business compete for resources. Learning only uses a fraction of the data available

10^{-4} := 1 failure in 10.000 events



1 - 10^{-4} := 9.999 non-failures in 10.000 events

Safety-II = Ability to succeed under varying conditions.

Focus is on what goes right. Use that to understand everyday performance, to do better and to be safer.

Safety and core business help each other. Learning uses most of the data available

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Resilience is...

For an Object	For a System	For an Adaptive System
…Bouncing back faster after stress, enduring greater stresses, and being disturbed less by a given amount of stress…	…Maintaining system function in the event of a disturbance…	…The ability to withstand, recover from, and reorganize in response to crises...

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[Martin-Breen P, et. al,2011]

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work as imagined
vs.
work as done

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We tend to figure out solutions and ‘fix’ work-as-imagined rather than work-as-done

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Using Functional Resonance Analysis Method (FRAM) to improve and implement guidelines

- Uptake of clinical guidelines/protocols is poor

(e.g. as few as 24% ICU patients receive

full recommended care)[1]

- Why?

Compliance? Behaviour change !

[1][Leone M, et. al, 2012]

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~~Compliance?~~ Behaviour change !

Resilient thinking would suggest there is more to the story …

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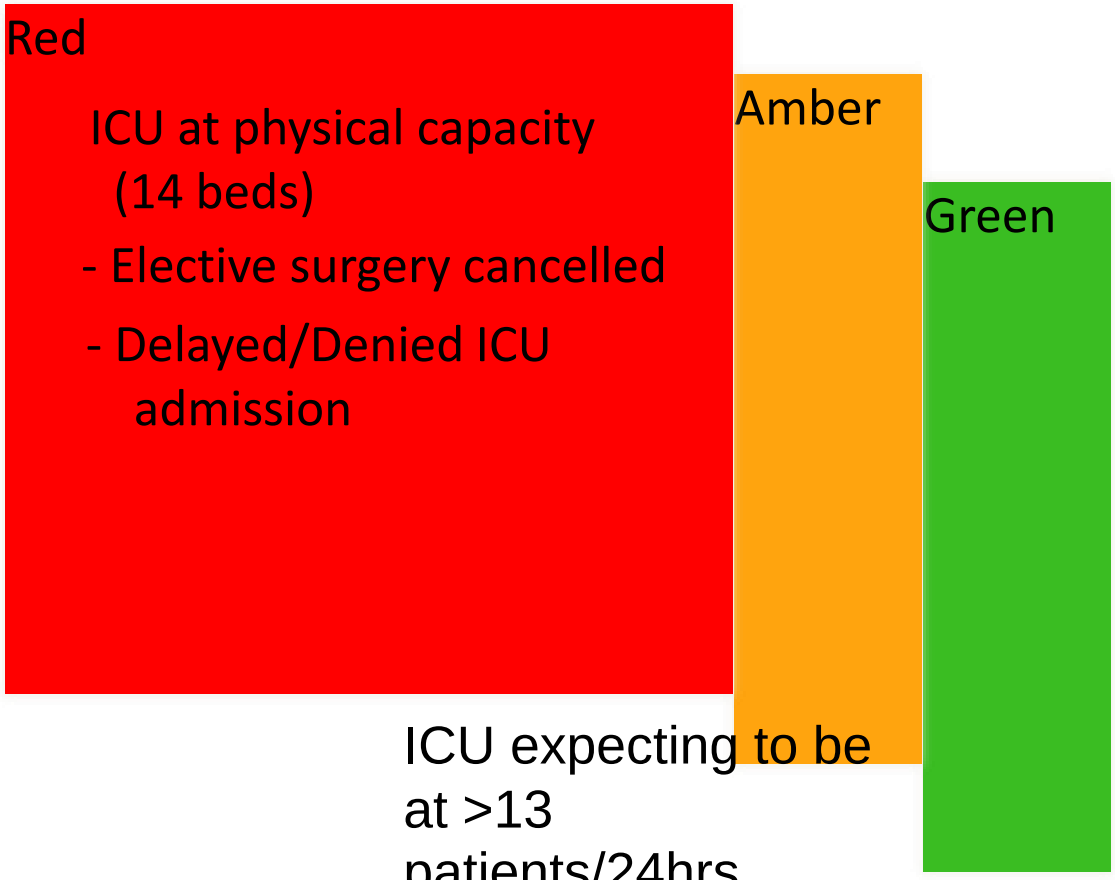
An ICU Escalation Protocol – the problem

- Townsville Hospital
  - 600 beds, 12-14 ICU beds
- Patients come to the ICU from ED, Wards, Surgery (especially elective surgery)
- ICU usage unpredictable, highly variable
- No alternate ICU close by

An ICU Escalation Protocol



The Plan

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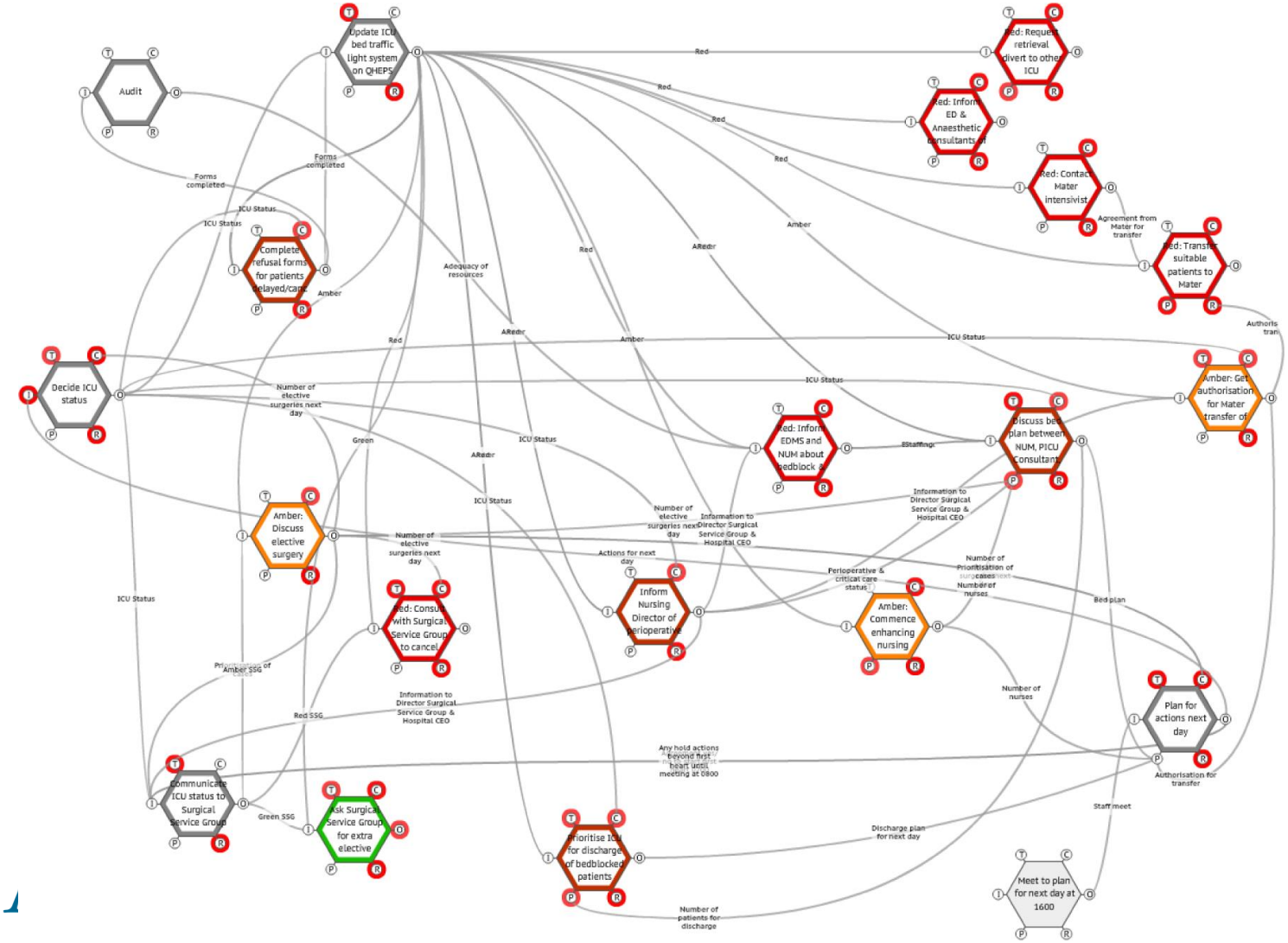
‘FRAMing’ the ICU Escalation Plan



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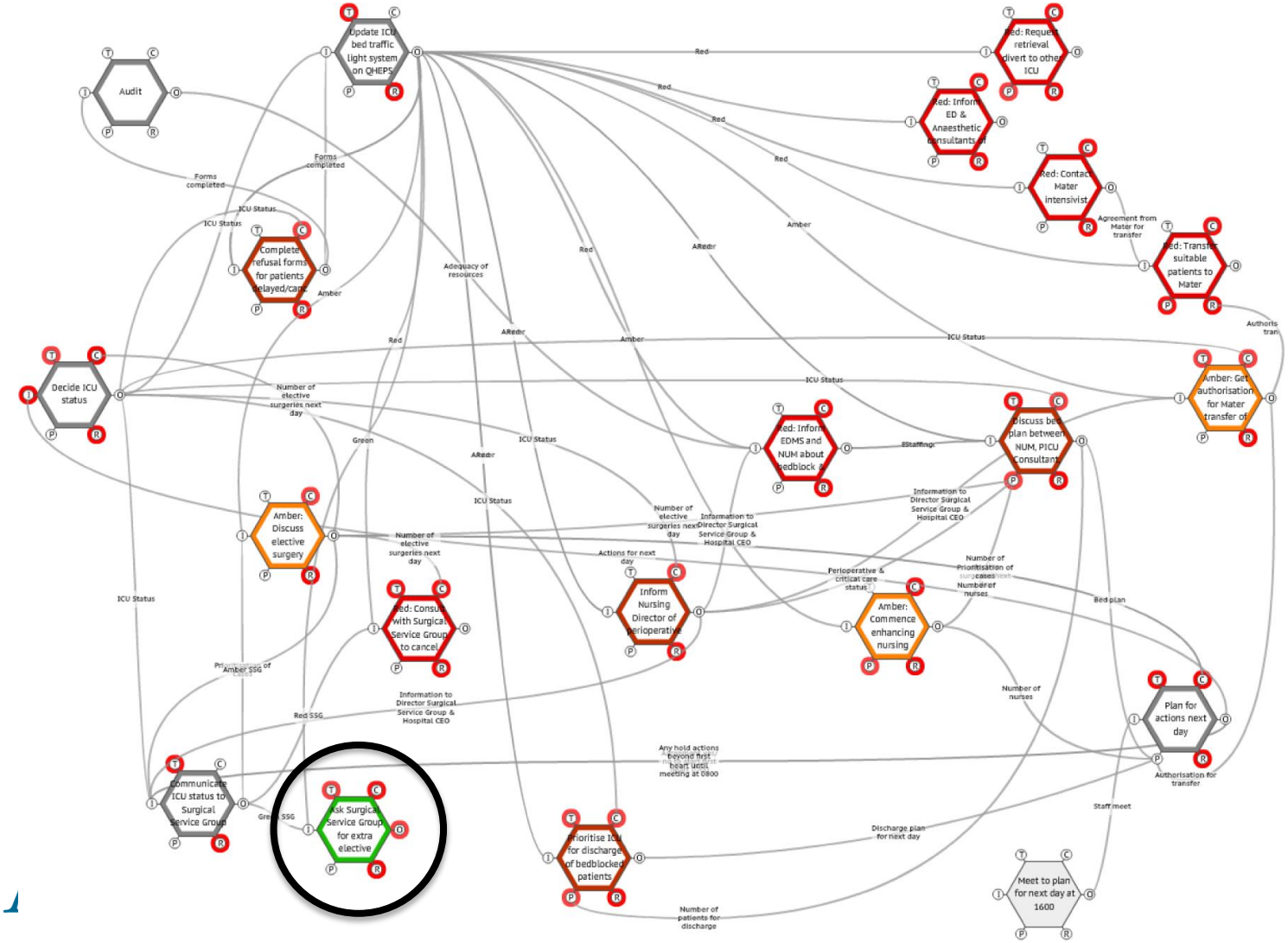
‘FRAMing’ the ICU Escalation Plan



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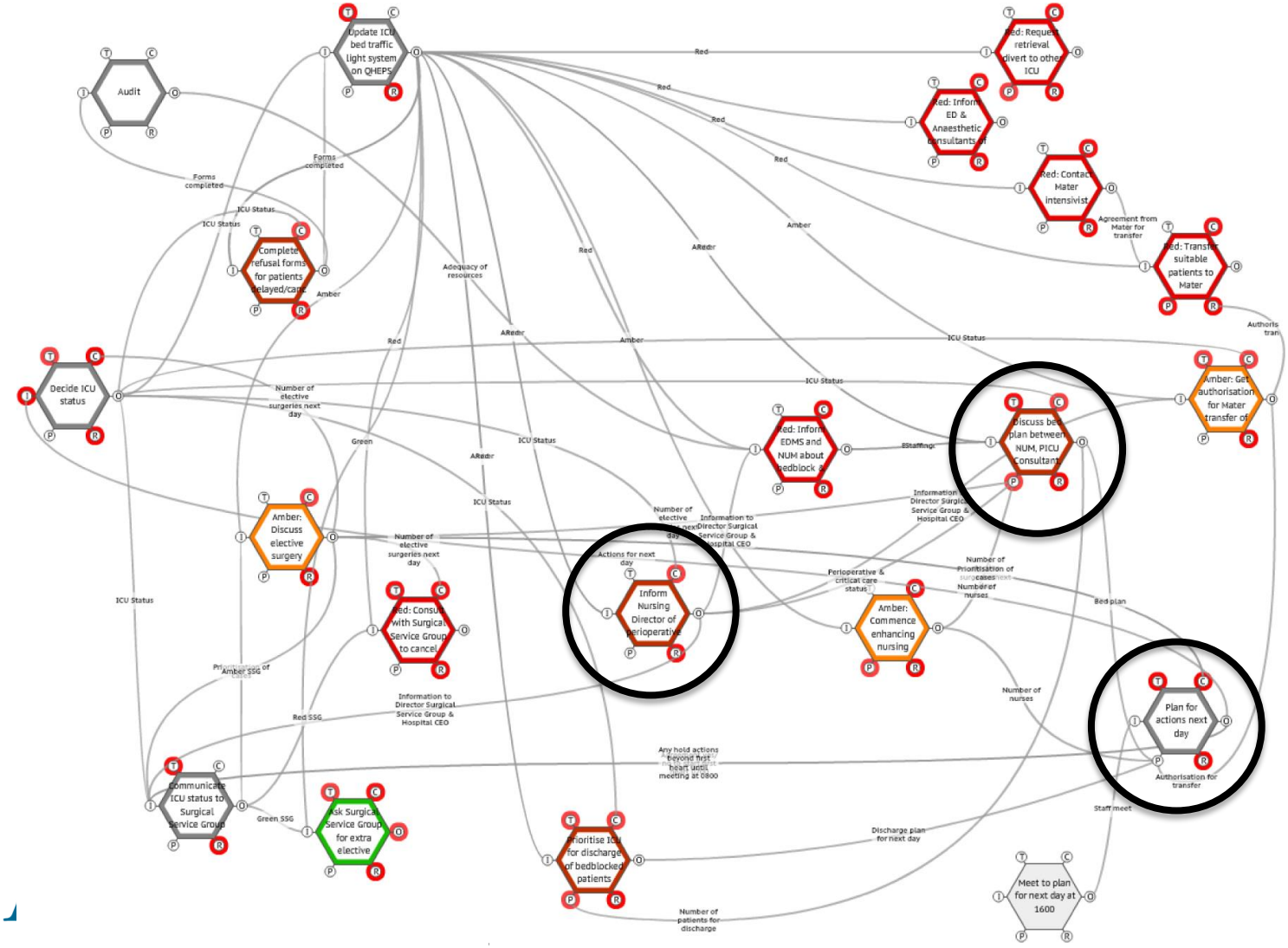

The value of human factors

- Important to consider HF when implementing any change to practice, such as
  - Equipment
  - IT systems
  - Guidelines or protocols
- By doing so, we improve usability: Effectiveness, efficiency & user satisfaction

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Thank you

END

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How eHealth, data and improvement science can drive systems innovation

A/Prof Rebecca Mitchell, Dr Natalie Taylor, A/Prof David Greenfield

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Health outcomes and patient safety

Associate Professor Rebecca Mitchell

Key areas of research

- Large scale injury epidemiological research across the lifespan e.g.
  - Paediatric – survival and health outcomes post-injury; trauma care
  - Adult – national matched case-control study of health service use
  - Older people - dementia and injury rehabilitation
- Often use data linkage techniques
- Better understanding of the determinants of injury risk
- Inform public health policy, delivery of health services, and injury prevention practice

Hip fracture and health outcomes

- Hip fracture serious injury for older people
- About 17,000 hip fractures in Australia each year, costing $272 million
- 45% decrease in death/ major complications if patients were treated jointly by orthopaedic and geriatric teams – an orthogeriatric model of care
- Examined 30-day mortality post hip fracture surgery in NSW for individuals 65+ years

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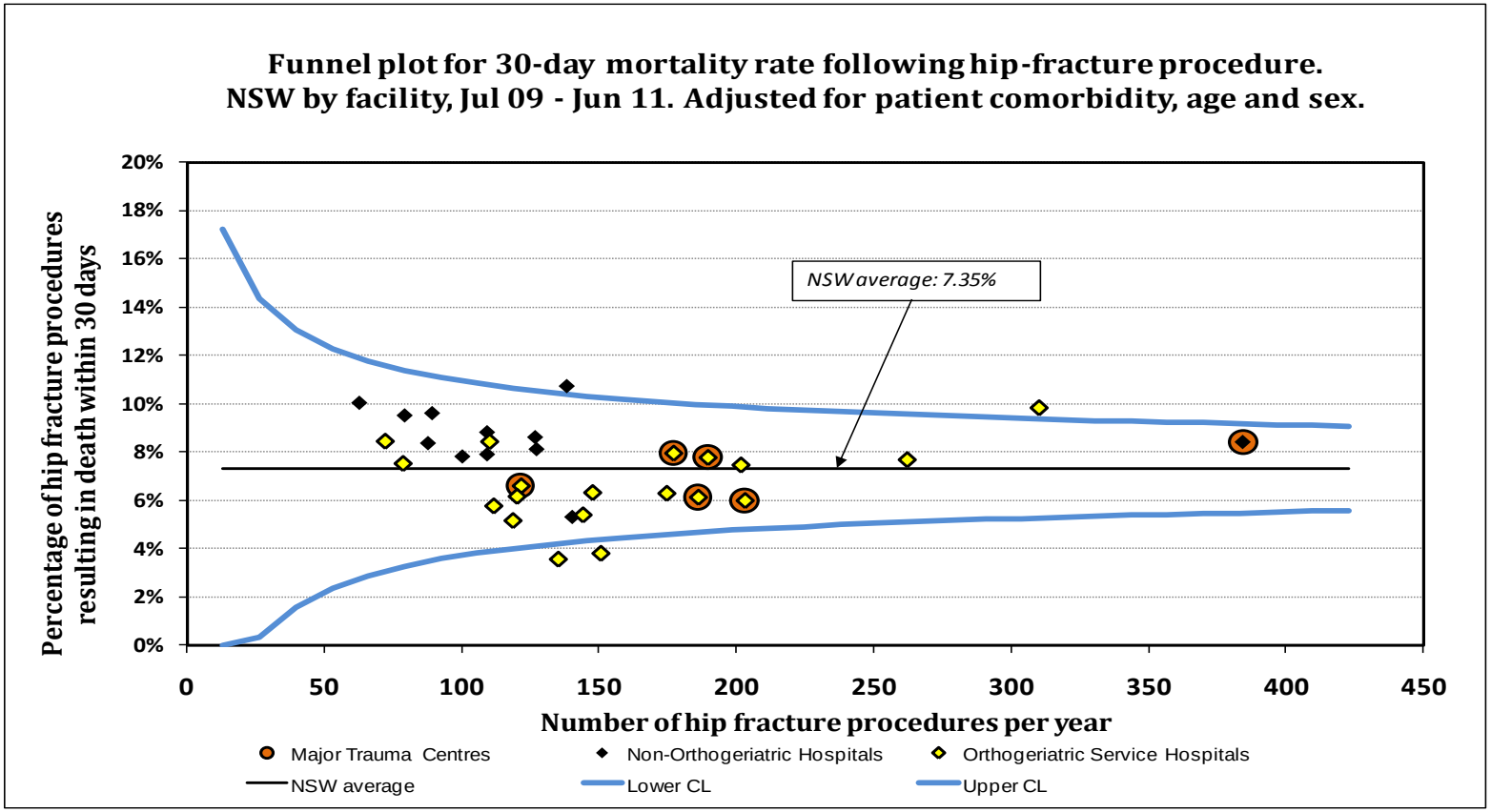
Hip fracture and health outcomes

Median adjusted 30-day mortality lower for hospitals with orthogeriatric services (6.2% vs 9.4%, p<0.002)



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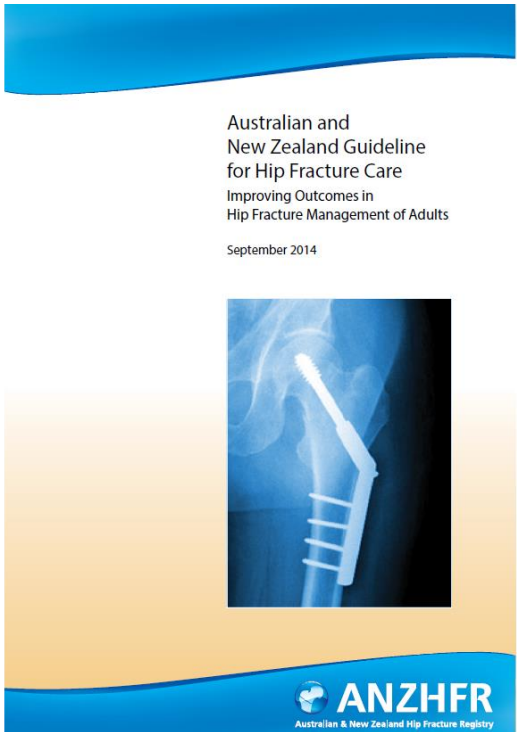
Zeltzer J. Mitchell R. Toson B. Harris I. Ahmad L. Close J. (2014) MJA 201 (7) 409-411.

Hip fracture and health outcomes

- NSW Agency of Clinical Innovation developed Orthogeriatric Model of Care: Clinical Practice Guide
- Bupa Health Foundation grant:
  - NHMRC Clinical Guidelines for Hip Fracture Care
  - Australian and New Zealand Hip fracture Registry established
- ACSQHC: Hip Fracture Clinical Care Standard (in-progress)



Future areas of research

- Paediatrics
  - International comparison of health outcomes of injured children
  - Longitudinal cohort study using eHealth records
- Adults
  - Healthy lifestyles in Australia: impact of chronic comorbidities on injury
  - Work safety: relationships between measures of OHS performance
- Dementia and injury
  - Trial of interventions to maximise function outcomes following injury for people with dementia
  - Naturalistic prospective study of carer's of people with dementia

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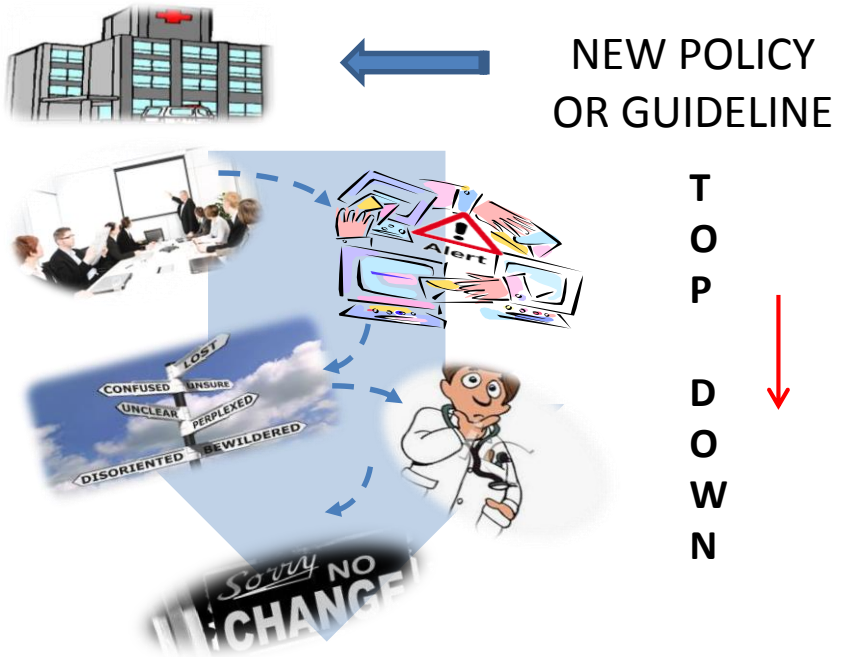
Healthcare professional behaviour change

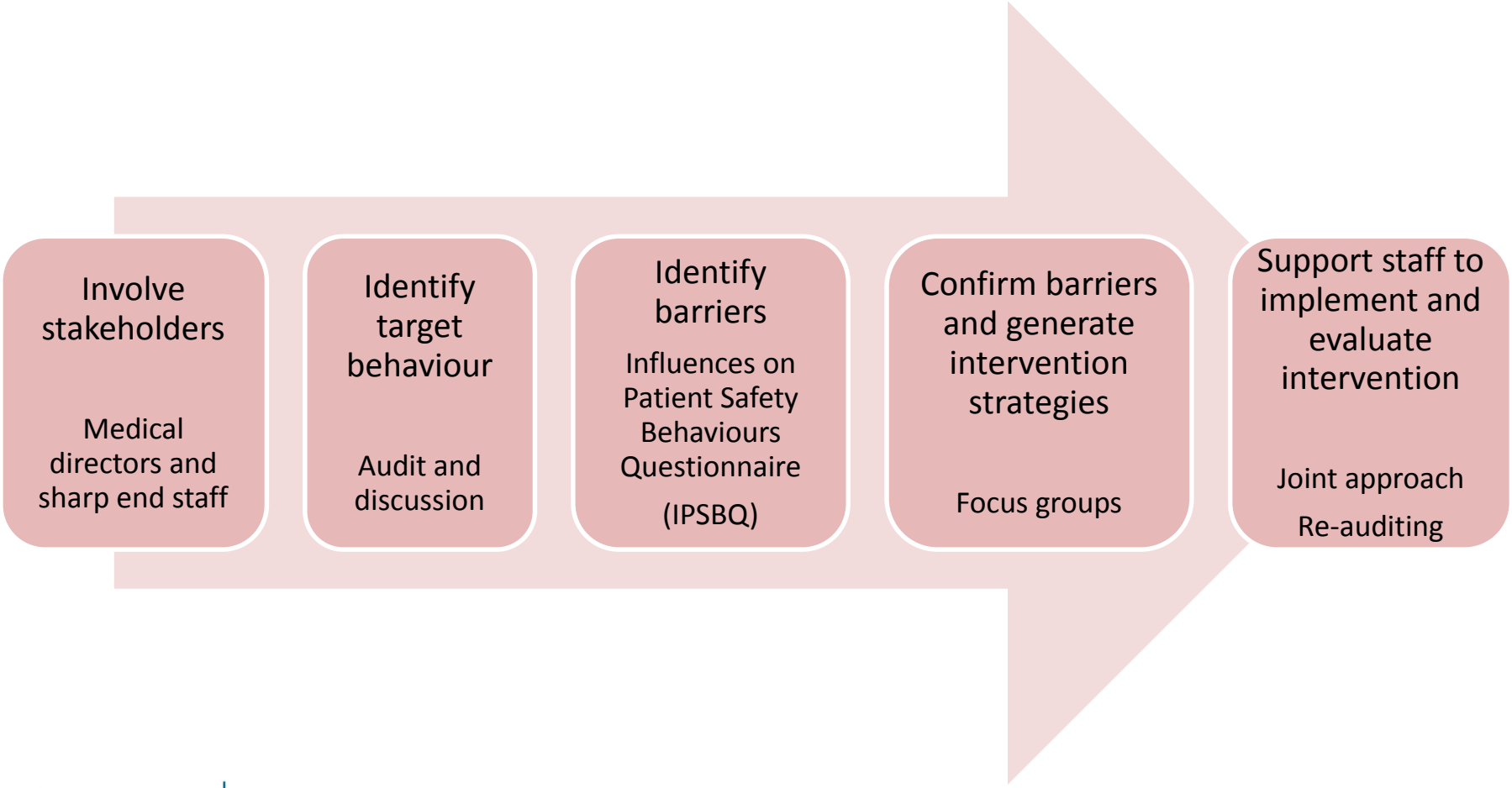
Dr Natalie Taylor

Key areas of research

- **Healthcare professional behaviour change**
- Consumer health behaviour change
- Implementation science
- Innovation in healthcare
- Meta-analyses



The Theoretical Domains Framework Implementation (TDFI) approach



Results

Target behaviour: Using pH as the first line method for checking tube position

Audit information	Hospital 1		Hospital 2		Hospital 3		*Hospital 4(c)*	
	Pre	Post	Pre	Post	Pre	Post	*Pre*	*Post*
Number of sets of notes audited	49	48	43	44	44	40	*53*	*46*
pH of aspirate from stomach	18%	**63%****	12%	**73%****	14%	**33%***	*45%*	*46%*
Patient sent for X-ray	49%	23%	77%	9%	41%	40%	*25%*	*20%*
Tube placed in radiology	0	0	0	0	36%	10%	*0*	*0*
Information not documented	33%	15%	9%	18%	9%	18%	*30%*	*46%*

Practice change: use of pH first line increased significantly across intervention hospitals compared to the control (***p < .001; *p < .05;* Taylor et al., 2014)

Cost-effectiveness: estimated savings of £2.56million across 34 hospitals

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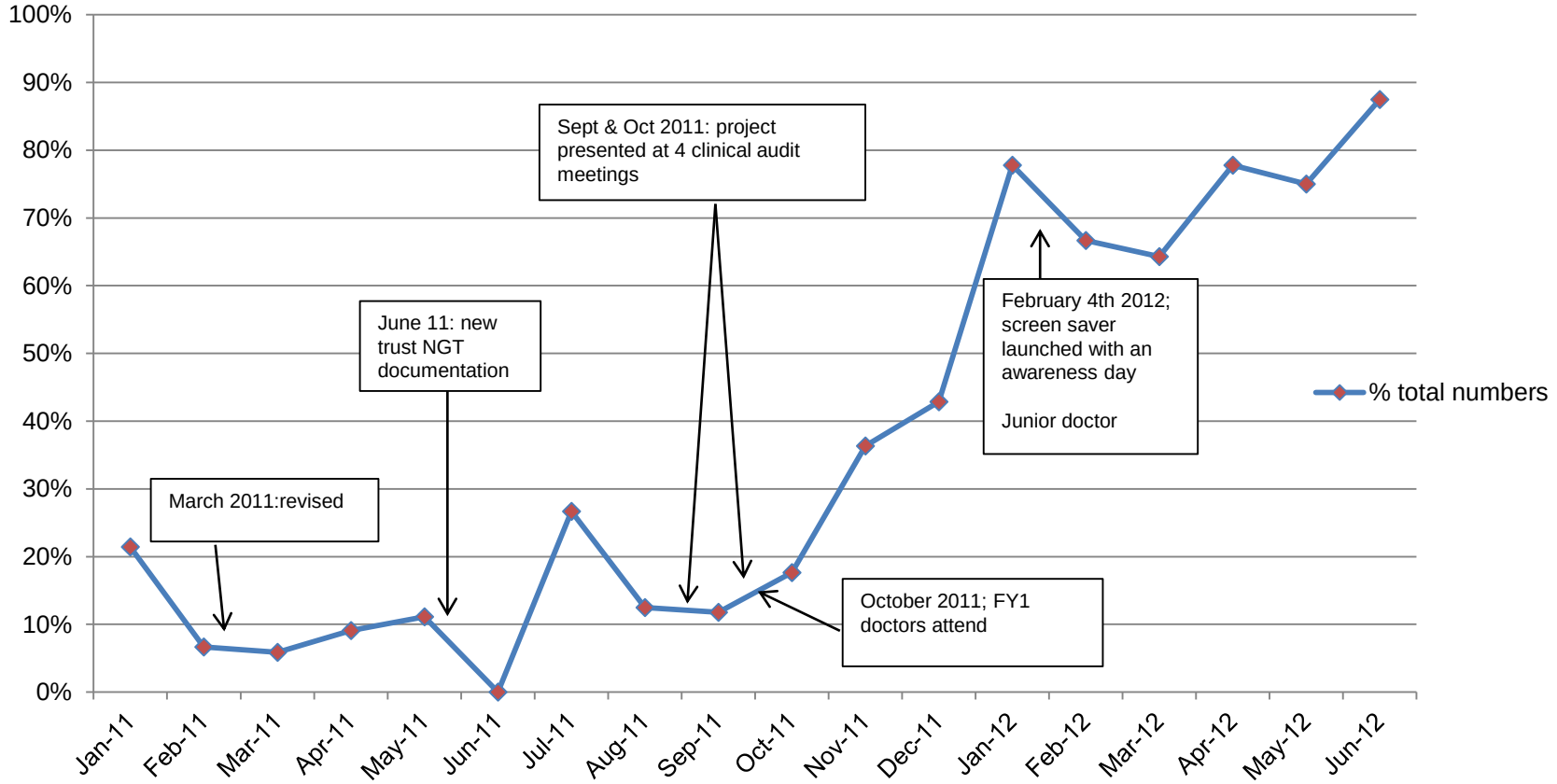
Results

% of patients with NG feeding tubes who had pH testing as the first line test method following insertion (*n* = 290)



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Future areas of research

- Healthcare professional behaviour change
  - Cancer
  - Female heart attacks
  - Positive deviance
- Consumer behaviour change
  - Medication adherence
  - Childhood obesity
- Implementation science
  - DUQuA

- Innovation

- Meta-analyses
  - Predicting health behaviours

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Healthcare complex adaptive systems, and the organisation of clinical practice

Associate Professor David Greenfield

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So, are you an optimist or pessimist?

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The problem

Expert based quality improvement models advocate:

- Recognition of healthcare as a complex system
- Acknowledgment of the importance of coordination of healthcare processes
- Positive attitude to disclosure of error
- Adherence to the concept of continuous improvement
- Central preoccupation with patient-centred care

Frontline clinicians perceive quality determined by:

- Primary responsibility of individual
- Dependent on the individual's mastery of technical and interpersonal aspects of care
- Mistrust re disclosure policy
- Ability to negotiate a system of obstacles with insufficient resources
- Avoiding administrative and bureaucratic impositions

The healthcare revolution

- Medical technology

For example:

CT SCANNER

Developed in 1972

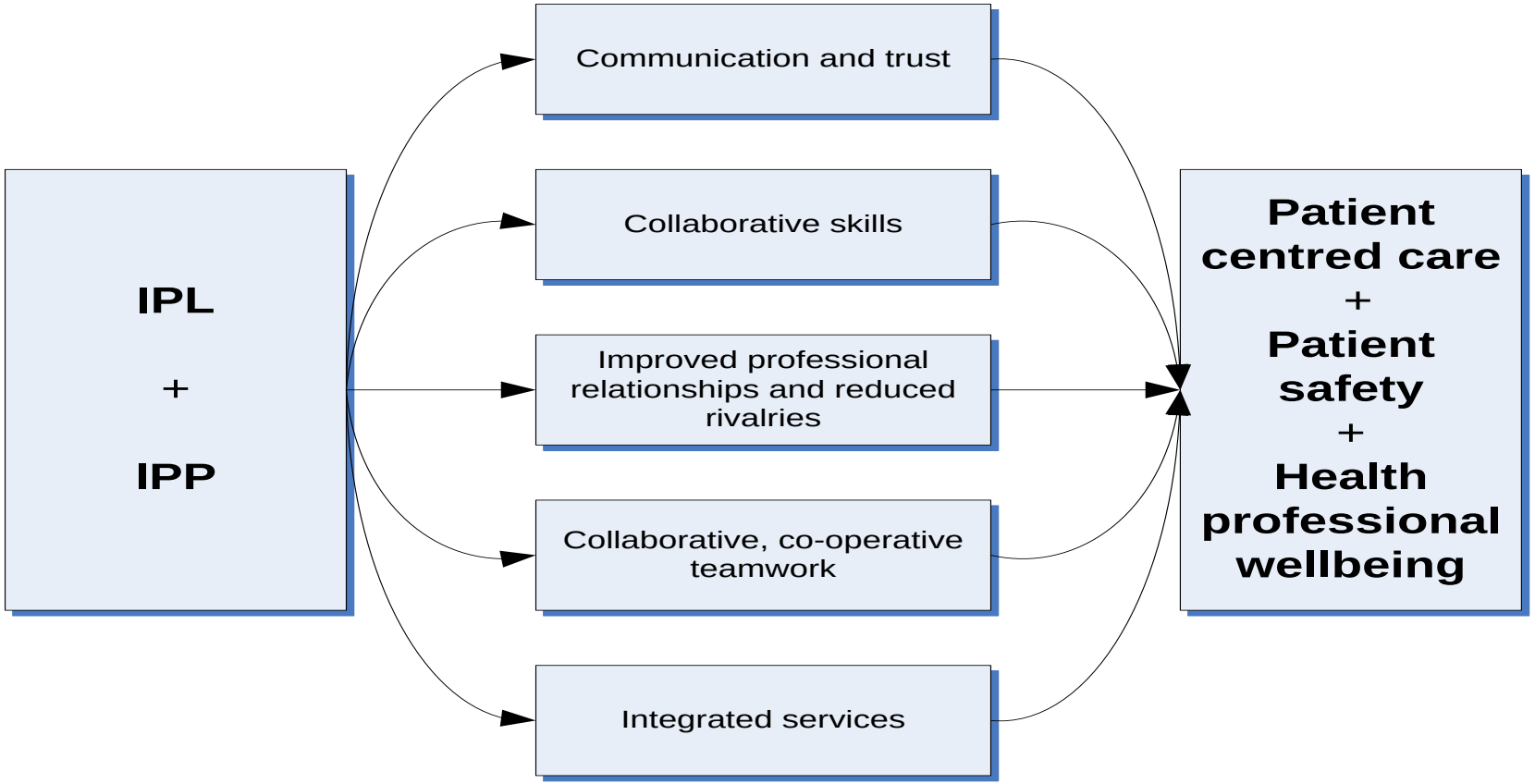
Godfrey Hounsfield, England

and independently by

Allan Cormack, Masschusetts

US 1980 to 2007: 3 to 72 million scans

A key to improvement: interprofessional collaboration



A key to improvement: multi-team systems

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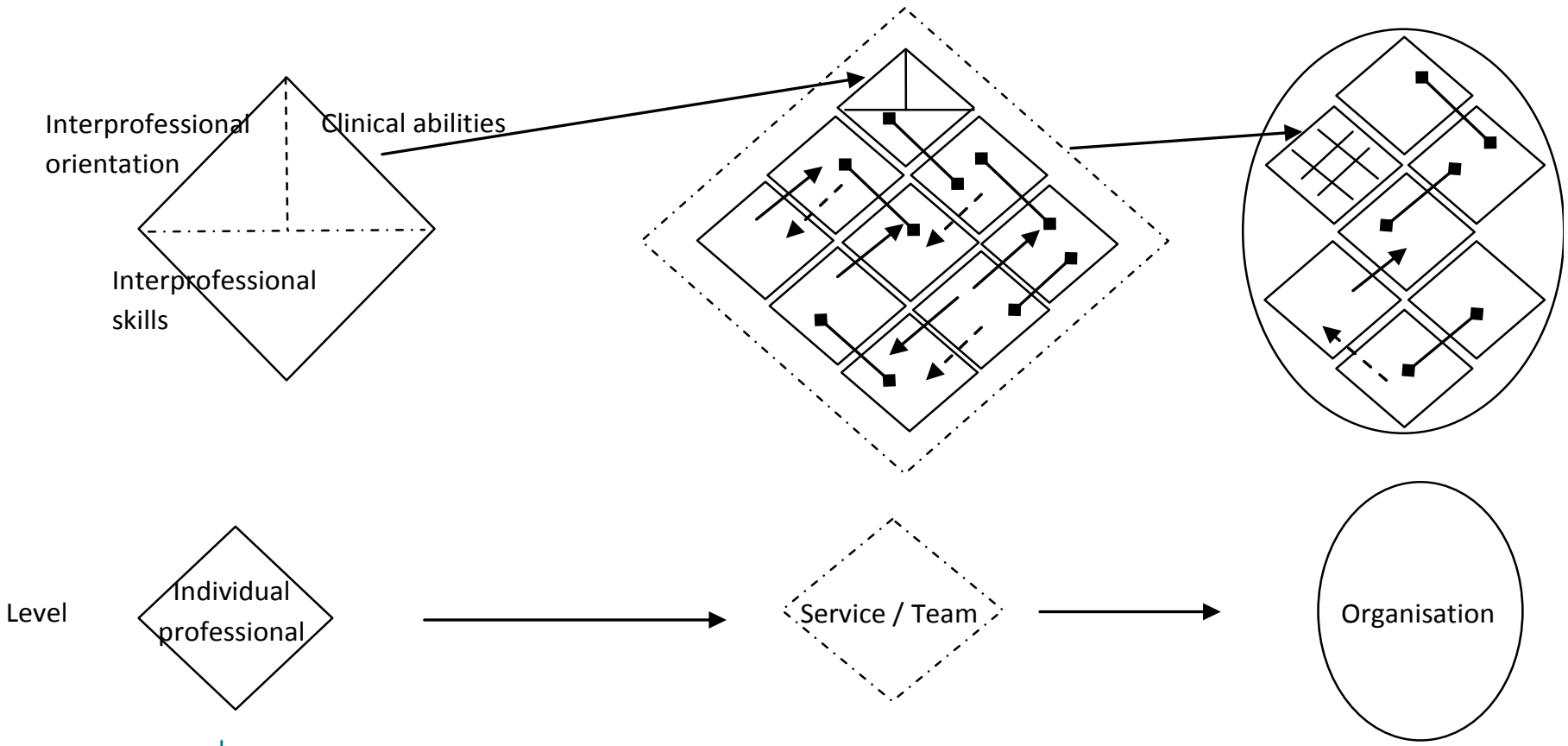
Figure 1 Organisational model of interprofessional collaboration (OMIC)



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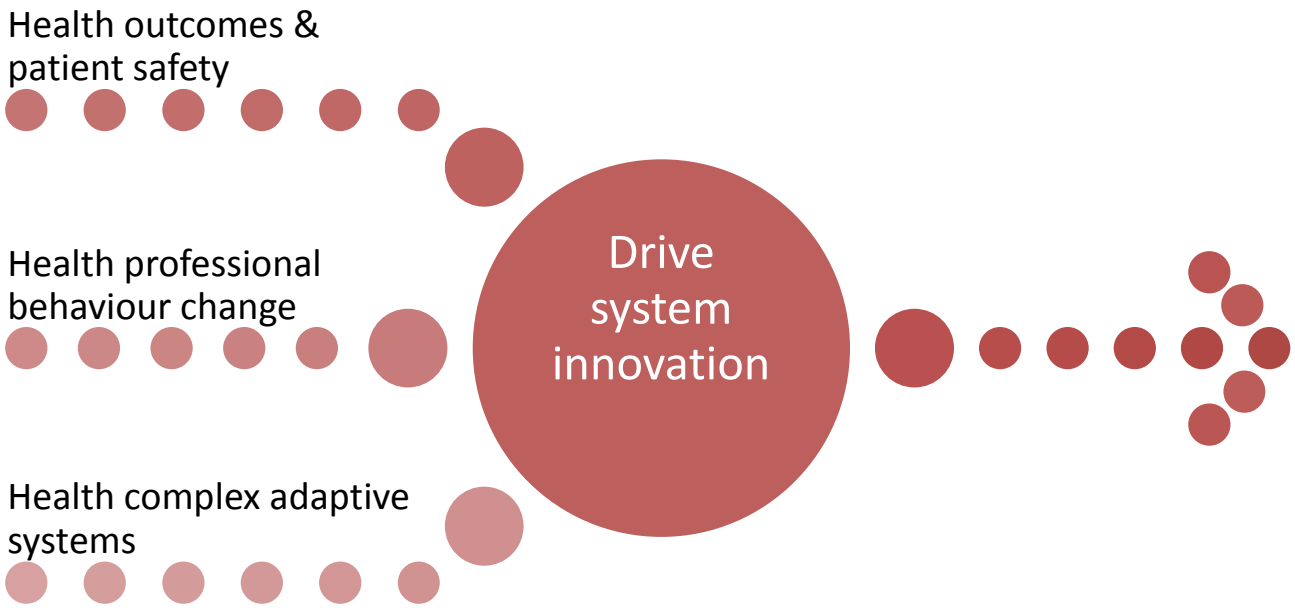
Future opportunities



What are the future opportunities for research and industry?

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Thank you and questions

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Reinvention – what will the health system need in 20 years?

A/Prof Andrew Georgiou PhD

Centre for Health Systems & Safety Research

ECRI Institute's Top 10 Patient Safety Concerns for 2014

1. Data integrity failures with health information technology systems*
2. Poor care coordination with patient's next level of care
3. Test results reporting errors
4. Drug shortages
5. Failure to adequately manage behavioral health patients in acute care settings
6. Mislabeled specimens
7. Retained devices and unretrieved fragments*
8. Patient falls while toileting
9. Inadequate monitoring for respiratory depression in patients taking opioids
10. Inadequate reprocessing of endoscopes and surgical instruments*

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The eHealth challenge

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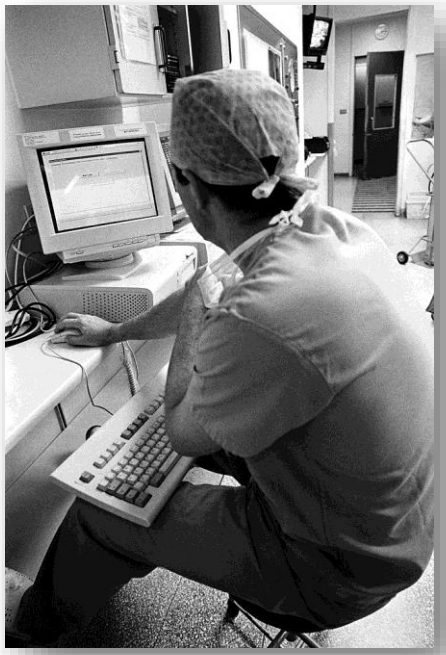
- Health IT initially developed within nichés in the hospital
- eHealth expansion has been slow and fragmented resulting in many hybrid paper/electronic systems
- Encompasses electronic health records (EHRs), patient engagement tools (e.g., PHRs) and telehealth and decision support systems
- eHealth is not one specific product just waiting to be purchased and implemented – many technical systems operating within a dynamic and complex social environment
- Impacts on mobility, coordination, effectiveness, efficiency, control, communication, safety, quality and more.



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Yesterday's world … today!

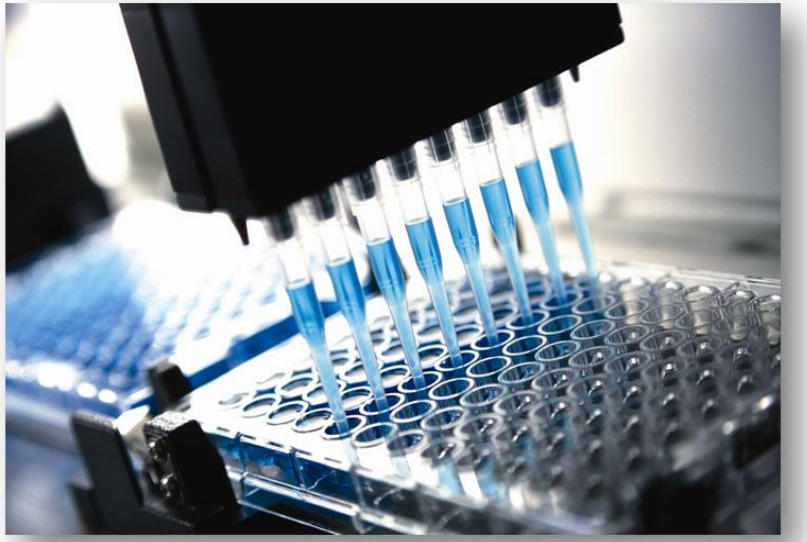
- A median of six forms completed each day per staff member
- 69% of staff spend time transferring information from paper to computer (30 mins/shift)
- Median of 3.5 faxes and 3.5 phones calls to GPs/pharmacy per day
- Only 35.4% reported that they had access to residents' hospital information after discharge

**Gaskin et al. BMC Geriatrics (2012)*

The aged care informatics challenge

- A fragmented service
- Consumer-directed care
- The delivery of “seamless” care
- Integration of services
- ICT “laggard”
- Lack of solid research evidence of the functioning and requirements of aged care

Laboratory medicine – the world of Big Data



- Medical imaging and pathology are estimated to make up some 70% of all hospital data *(Forsman 1996)*
- Contribute to 60-70% of decisions relating to patient care
- Cost of diagnostic test services rose to $5.25 billion in 2013 *(SMH Jan 2015)*
- 81% increase for pathology over a decade *(SMH Jan 2015)*

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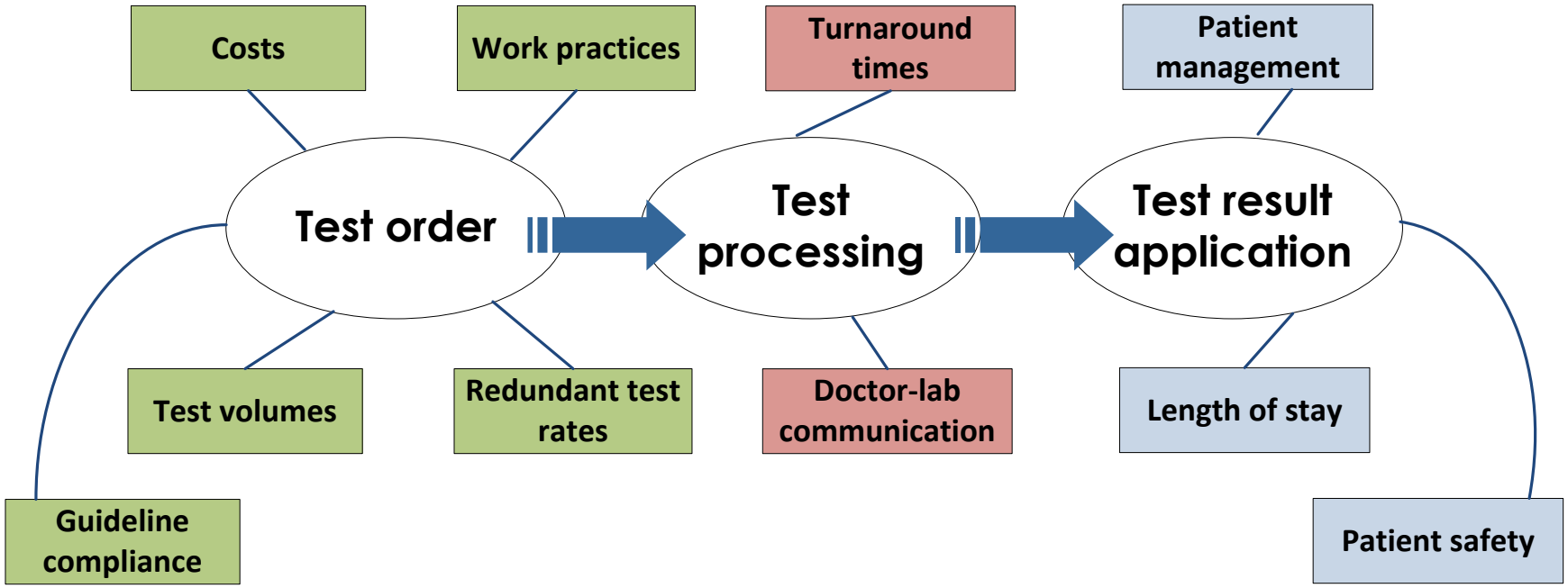
E-health benefits realisation



Georgiou et al. Int J Med Info 2006

TAT pre & post EMR in four hospitals

	2005 Before	2006 After	2007 After	Kruskal-Wallis
Hospital A - Median TAT	77	68	66	P<0.001
% tests using EMR		75%	80%	
Hospital B - Median TAT	145	129	108	P<0.001
% tests using EMR		0-44%	57%	
Hospital C- Median TAT	138	135	113	P<0.001
% tests using EMR		29-38%	53%	
Hospital D- Median TAT	141	139	128	P<0.001
% tests using EMR		56-71%	74%	

Median TAT in minutes

Westbrook et al. MIE 2009

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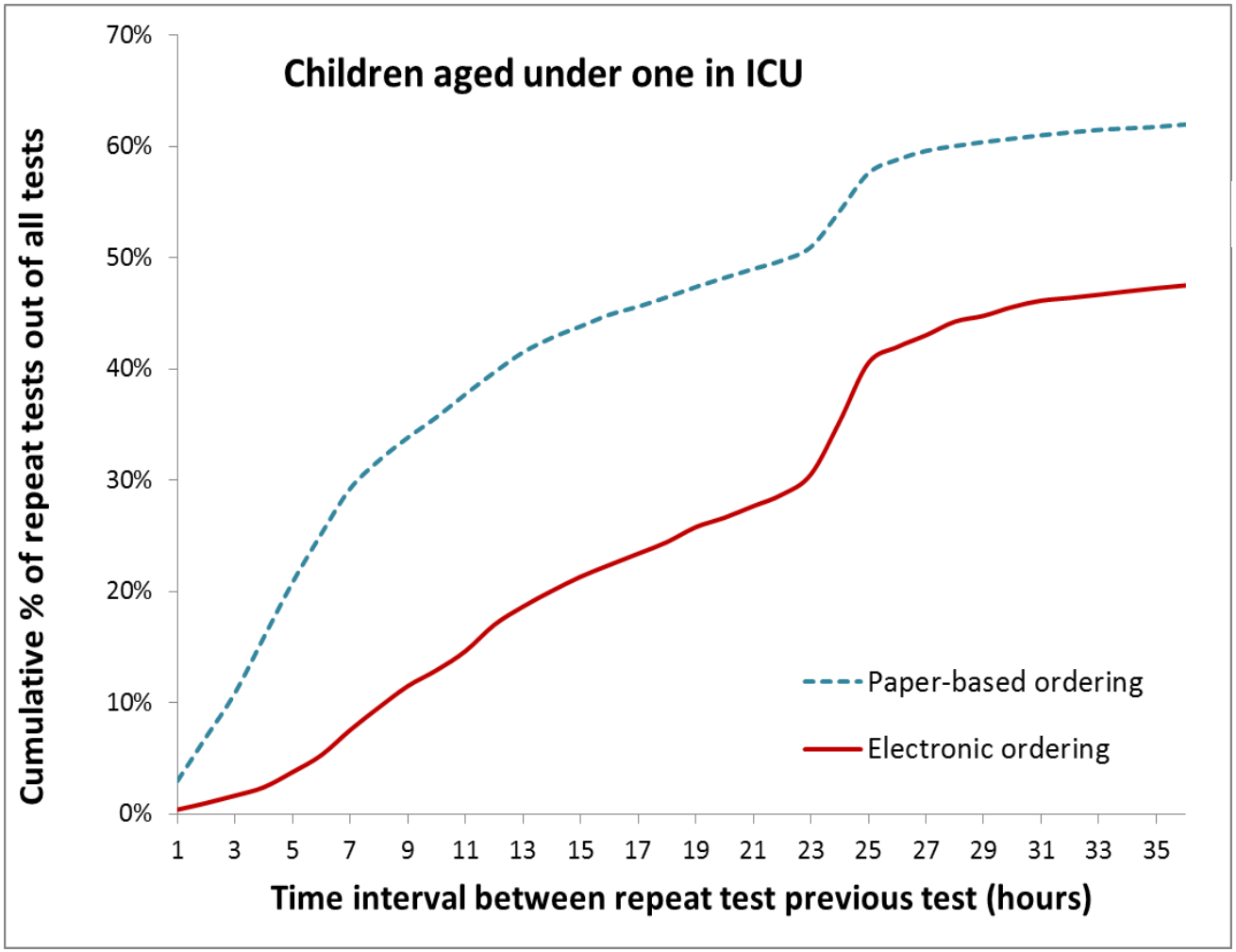

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•Cumulative percentages of repeat testing, as a proportion of all tests ordered, within one-hour to 35-hours of the previous test, for tests orders using the paper-based (dashed line) and electronic ordering system (solid line).

•*(Georgiou et al. Impact of the implementation of electronic ordering on hospital pathology services, 2012)*

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Incident Information Management System (IIMS) reported errors

	EMR	Paper	
Mislabelled specimen	0.1 (n=39)	0.31 (n=56)	p<.001
Mismatched specimen	0.49 (n=200)	1.42 (n=255)	p<.001
Unlabelled specimen	1.37 (n=559)	1.65 (n=296)	p<.01

Georgiou et al. Impact of the implementation of electronic ordering on hospital pathology services, 2012

An electronic safety net to enhance test result management

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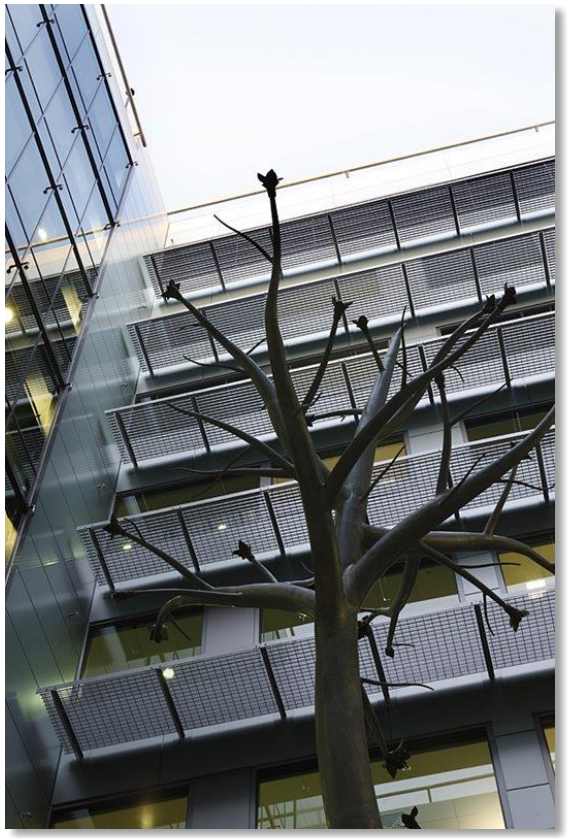
- Mater Mothers' Hospital (Brisbane) -249 beds
- IP Health Verdi software
- Clinicians to electronically review and acknowledge of test results (2010)



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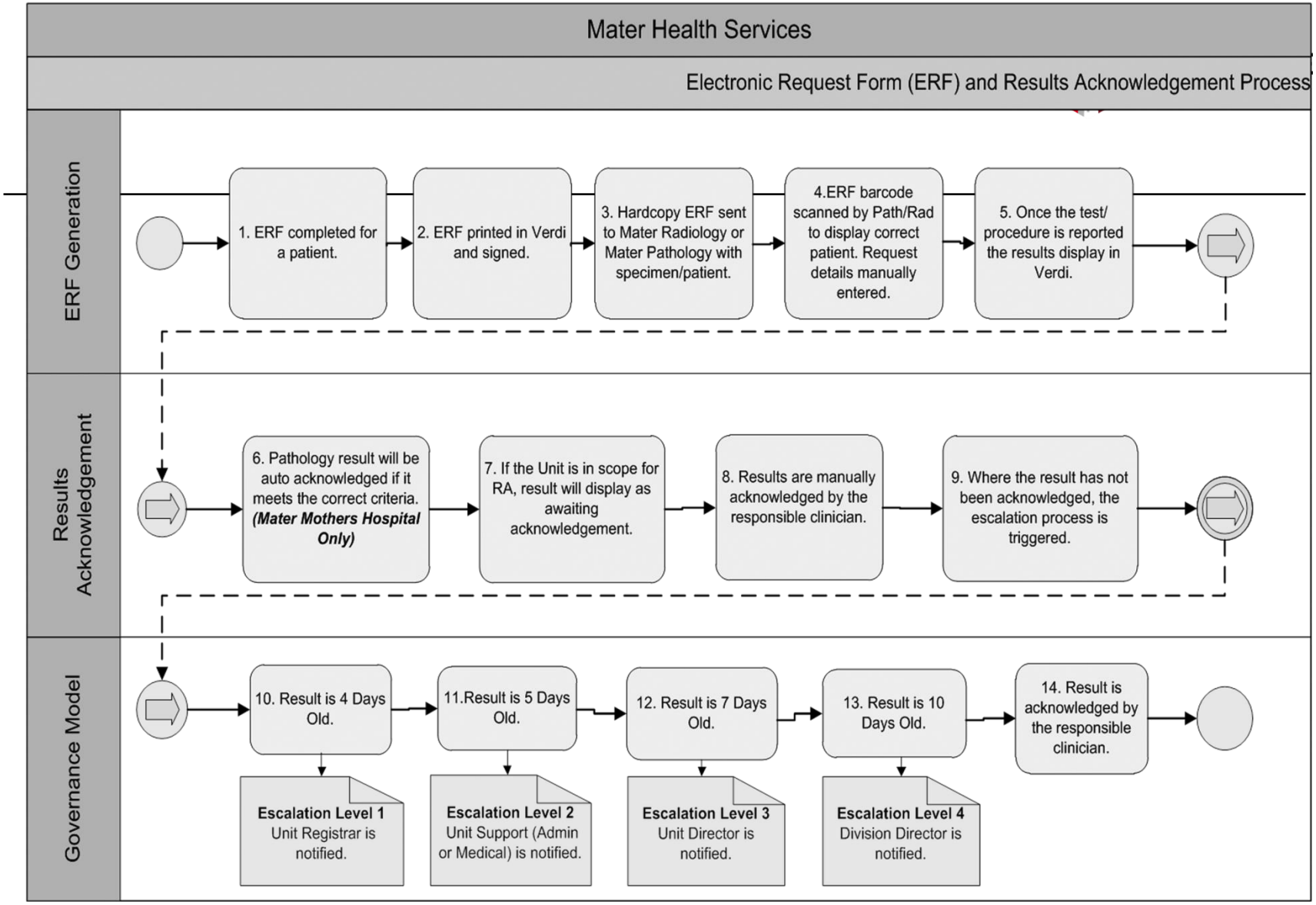
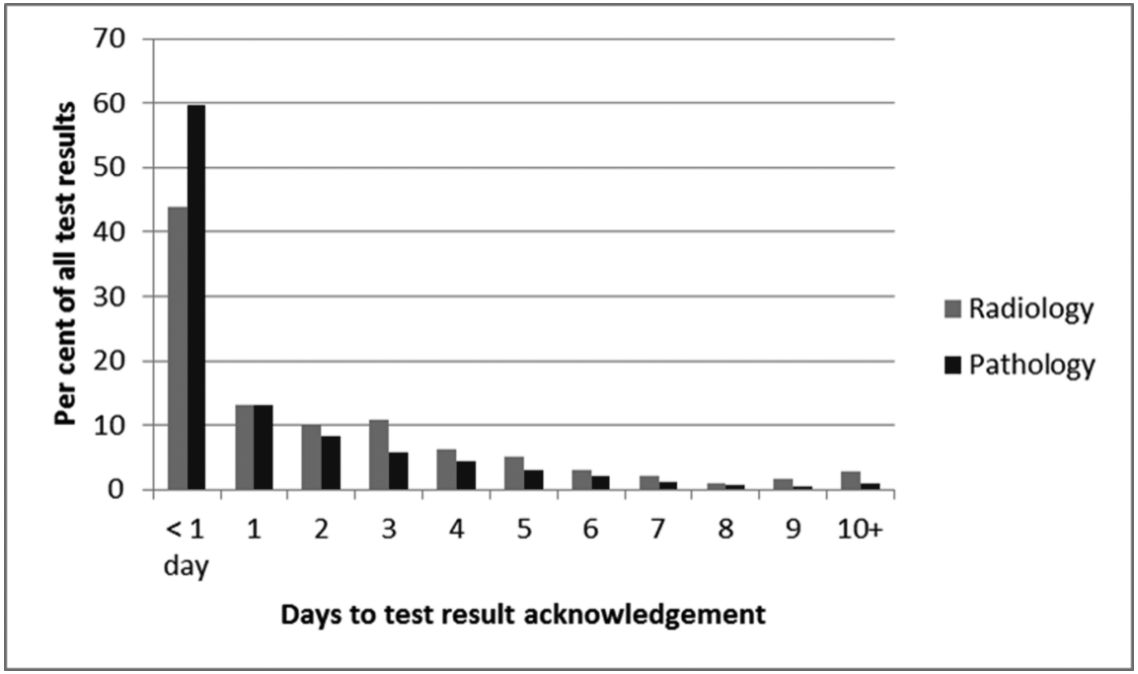

Mater Health Services
Electronic Request Form (ERF) and Results Acknowledgement Process
ERF Generation
1. ERF completed for a patient.
2. ERF printed in Verdi and signed.
3. Hardcopy ERF sent to Mater Radiology or Mater Pathology with specimen/patient.
4.ERF barcode scanned by Path/Rad to display correct patient. Request details manually entered.
5. Once the test/ procedure is reported the results display in Verdi.
Results Acknowledgement
6. Pathology result will be auto acknowledged if it meets the correct criteria. (Mater Mothers Hospital Only)
7. If the Unit is in scope for RA, result will display as awaiting acknowledgement.
8. Results are manually acknowledged by the responsible clinician.
9. Where the result has not been acknowledged, the escalation process is triggered.
Governance Model
10. Result is 4 Days Old.
11.Result is 5 Days Old.
12. Result is 7 Days Old.
13. Result is 10 Days Old.
14. Result is acknowledged by the responsible clinician.
Escalation Level 1 Unit Registrar is notified.
Escalation Level 2 Unit Support (Admin or Medical) is notified.
Escalation Level 3 Unit Director is notified.
Escalation Level 4 Division Director is notified.

Test result acknowledgement

- All test results acknowledged
- 60% of lab and 44% of imaging results acknowledged within 24h



•*Georgiou et al. JAMIA 2014*

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Patient access to information

- Patient access to information – essential element of effective health care (Al-Shorbaji 2013)
- Electronic patient portals connected to the hospital EMR
- Secure on-line access
- Access to appointments, test results, clinical information and to clinicians

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Evidence about the use of patient portals

- Positive examples related to patients with chronic diseases e.g., diabetes, hypertension and depression involving case management
- Very few studies have evaluated key performance indicators such as re-admissions, hospitalisations, length of stay.
- We have only just begun to engage and understand this technology its effect on care delivery, outcomes and patient engagement

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Thank you

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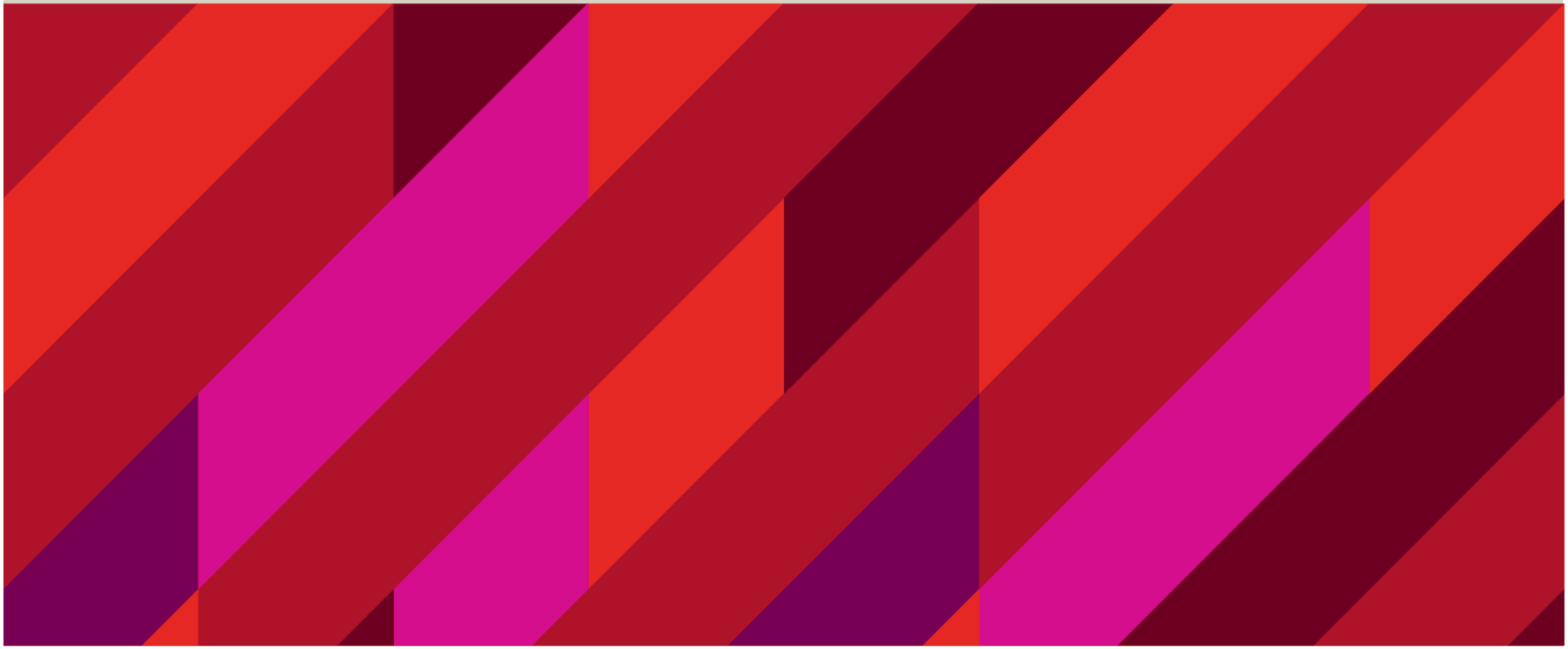
A learning health system in 20 years

A/Prof. Farah Magrabi



Safety of Health IT

Fiona Stanley Hospital systems crash

The Western Australian 15 Feb 2015

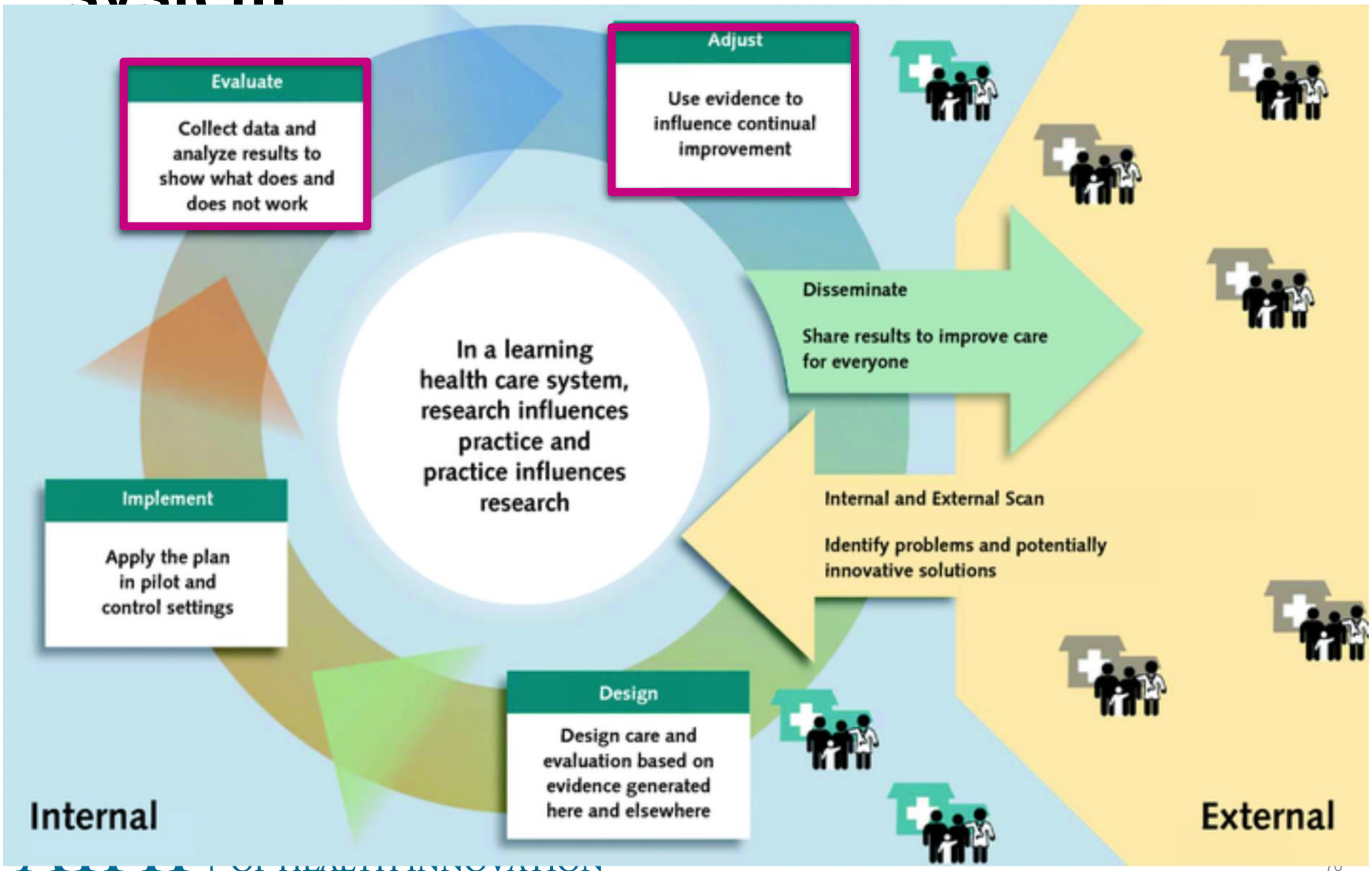
Data centre outage hits all Queensland hospitals

Pulse+IT 10 Dec 2014

EHR failure closes California hospital ED, nurses ask for investigation

Health IT Review 6 Mar 2015

By 2035: a learning health system



Ann Intern Med. 2012;157(3):207

Goal: To ensure safety & effectiveness of clinical processes

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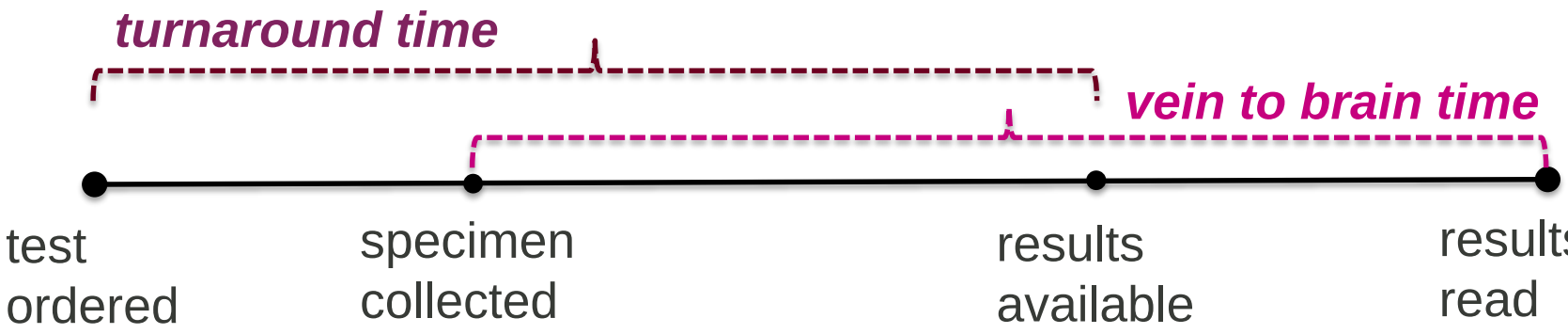
time: delays
events: errors



Pathology testing

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Evaluation and adjustment can be automated

Adjust

Disturbance

Clinical process

Monitor

Surveillance system

Alert

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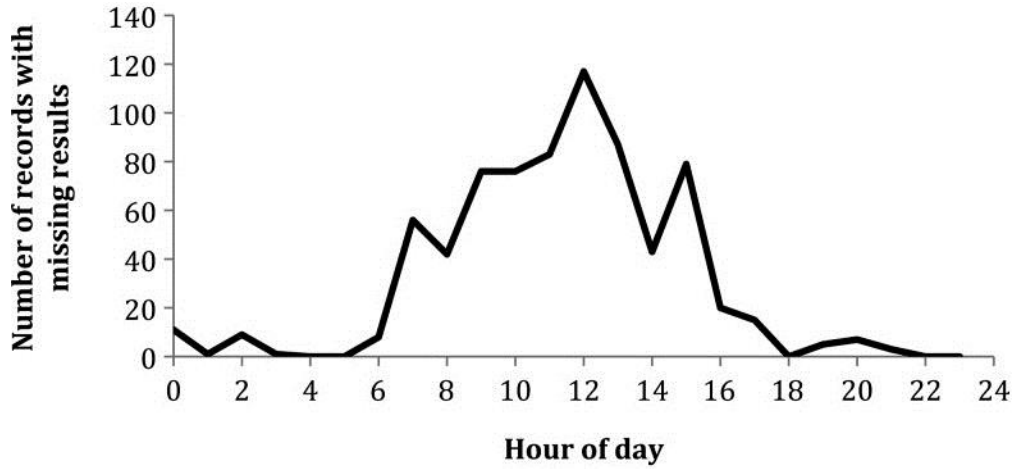
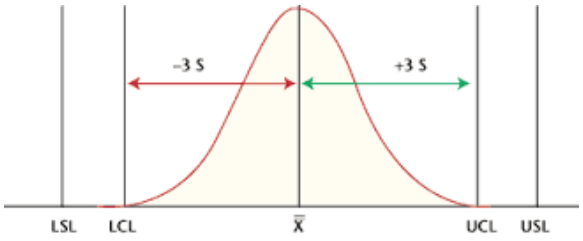
Building a surveillance system



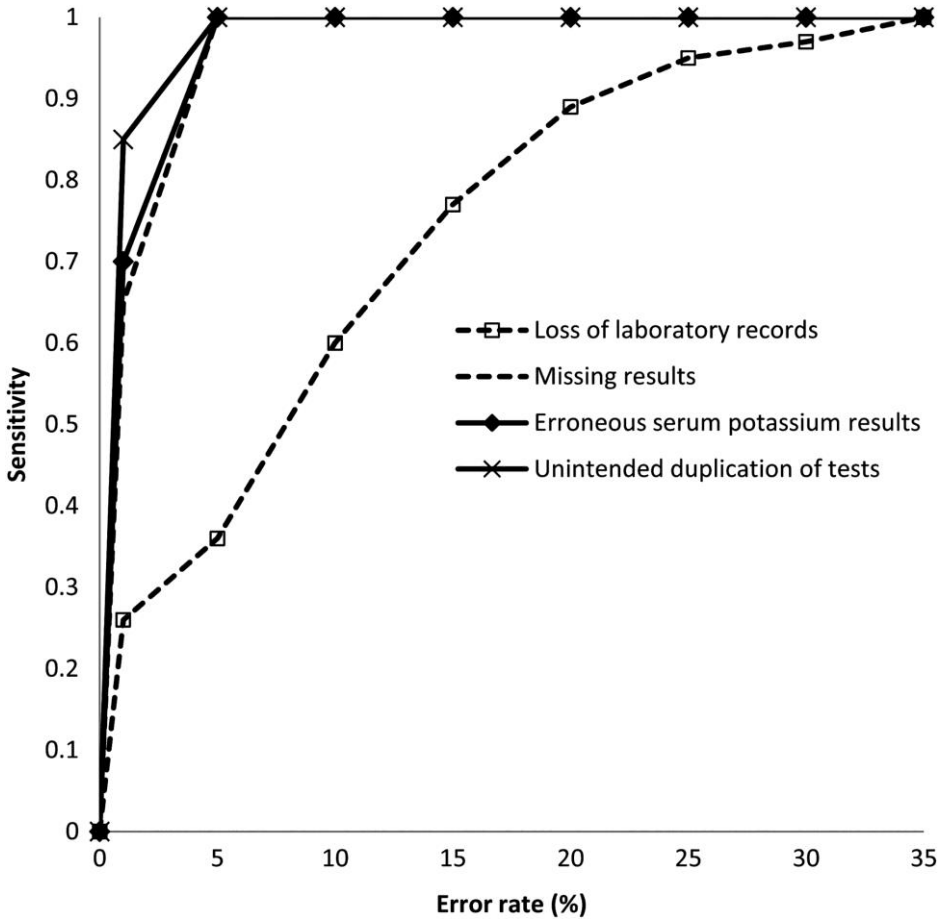
1. Define metrics
2. Model baseline profile
3. Set control limits
4. Validate model

- process time
- event rates
  - tests per hour
  - tests with missing results
- biomed & physiological variables
  - average value e.g. potassium



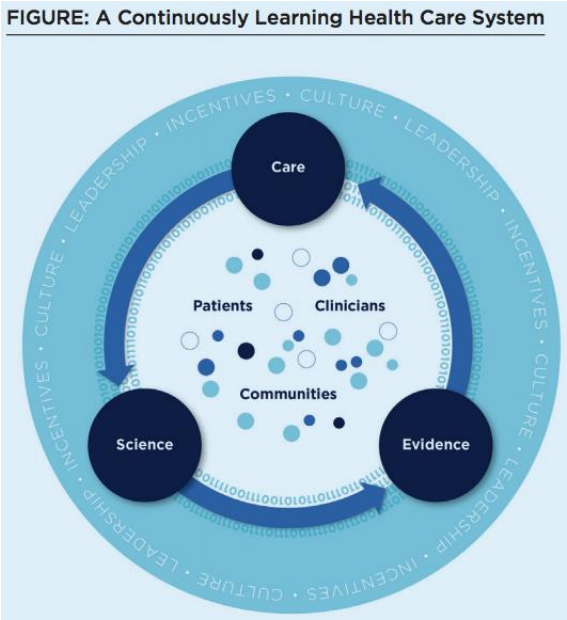
- sensitivity
- specificity
- timeliness

Model sensitivity



Other areas for learning health systems

- Computable evidence
- Health analytics
- Evidence surveillance



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MUH a learning health system?

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Thank you

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