

Evaluating the effects of health information technology on patient safety

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How can health IT be used to improve care delivery and patient outcomes?



**Generate high quality
evidence of effects**

Do eMM systems reduce medication errors?

Controlled before/after study



2 Hospitals 2 Systems 6 wards

Effects of Two Commercial Electronic Prescribing Systems on Prescribing Error Rates in Hospital In-Patients: A Before and After Study

Johanna I. Westbrook^{1*}, Margaret Reckmann¹, Ling Li¹, William B. Runciman², Rosemary Burke³, Connie Lo^{1†}, Melissa T. Baysari⁴, Jeffrey Braithwaite⁵, Richard O. Day⁶

January 2012 | Volume 9 | Issue 1 | e1001164



Sample: 3200 patient records; >12,000 prescribing errors

Prescribing errors declined by **>50% (p<0.0001)**

44% (p=0.0002) reduction in serious prescribing error rate

25/100 admissions **→** **14/100** admissions

(95%CI 21-29)

(95%CI 10-18)

No significant change on the control wards (p=0.4)

Cost-effectiveness analysis of a hospital electronic medication management system

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REVISED 16 October 2014
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Johanna I Westbrook¹, Elena Gospodarevskaya², Ling Li³, Katrina L Richardson⁴,
David Roffe⁵, Maureen Heywood⁶, Richard O Day⁷, Nicholas Graves⁸



OXFORD
UNIVERSITY PRESS

J Am Med Inform Assoc 2015

- eMM – resulted in a reduction of \$63-66 AUD per admission in cardiology ward preventing ~ 80 ADEs p.a (~5340 JPY; \$50 USD)
- Entire hospital with 39,000 annual admissions = releasing \$2.5M each year (\$205M JPY; \$2M USD)

Current Evidence of eMM

- ❖ Current systematic review –15 studies (2000-2017) that measured changes in medication errors and harm pre and post IT system. 7 US studies; only 3 in paediatrics.
- ❖ Overall good evidence that eMM systems reduce medication errors
- ❖ Less evidence of harm reduction
- ❖ Very limited evidence of cost-effectiveness
- ❖ Limited evidence from developing countries



Keeping children safe from harm in hospital

❖ Complex and high risk

Is eMM
the
Solution?

eMM
admissions, 100
orders.

❖ Most studies measure errors but not harm

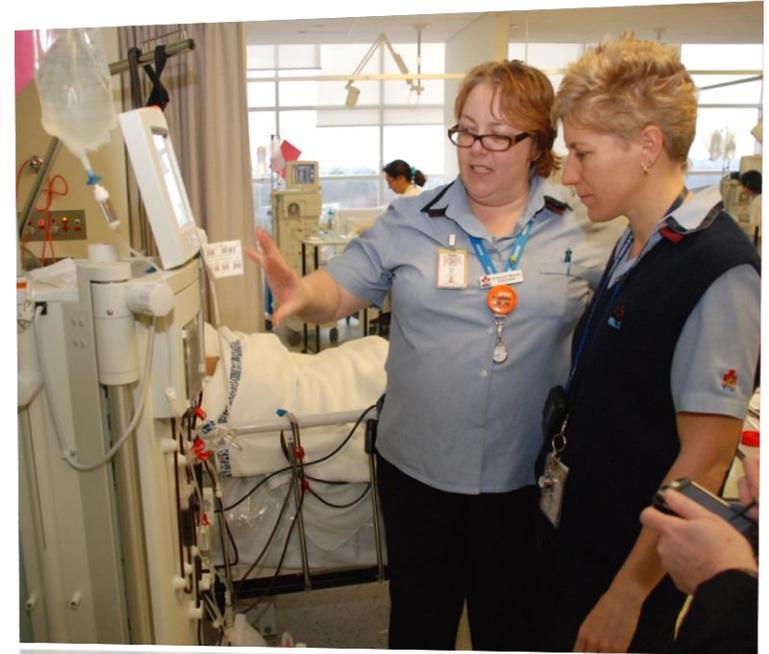
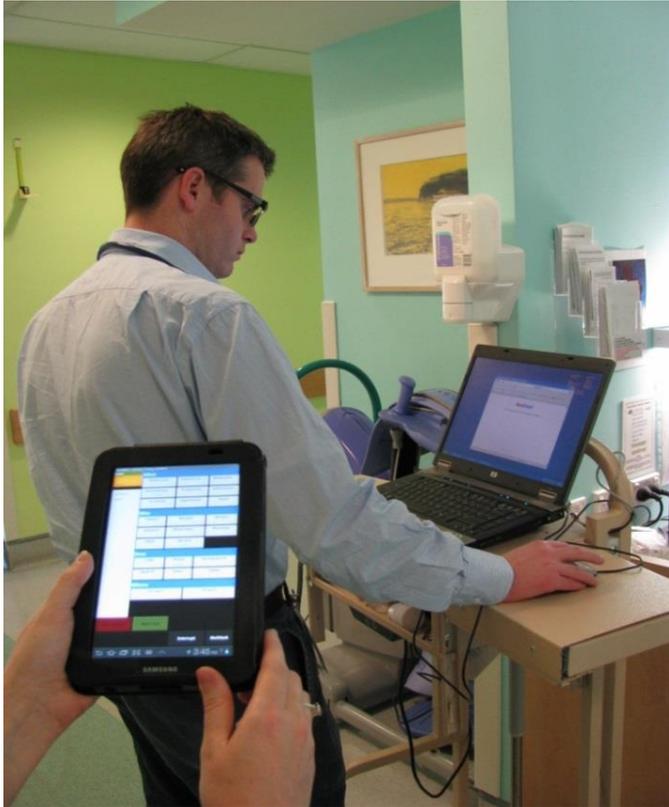
Stepped wedge cluster randomized controlled trial
Aim – Assess the impact of eMM in paediatrics
including harm & cost-effectiveness



Integrating systems into clinical work

Will I spend my life on a computer?

AIM: To measure changes in how nurses and doctors distributed their time across work tasks in a controlled pre and post eMMS studies



70 nurses observed for 276.9 hours
59 doctors observed for 356.3 hours

WOMBAT - Activity Timing (DUMMY)

Active

Active

15:12:37

Pager

15:12:24

What

Medication Direct care.. Indirect ca..

Document Prof. Comm Administrat..

In transit In transit Superv/Educ..

Social Pager

Who

Patient Nurse/s Doctor/s

Pharm Relative AH

Other No One

How

COW Phone Perm Rec

Dsk-PC Paper Tablet

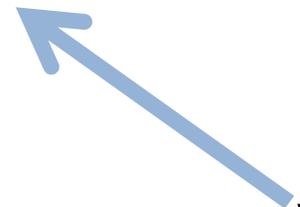
Where

On Ward Off Ward

End Session Next Task

Interrupt Multitask

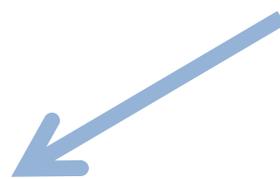
Work Observation Method By Activity Timing -



What task?



With whom?



With what?



Where?



Interruptions
Multitasking

<http://aihi.mq.edu.au/project/wombat-work-observation-method-activity-timing>



© Tam Dempsey / Photoseek.com

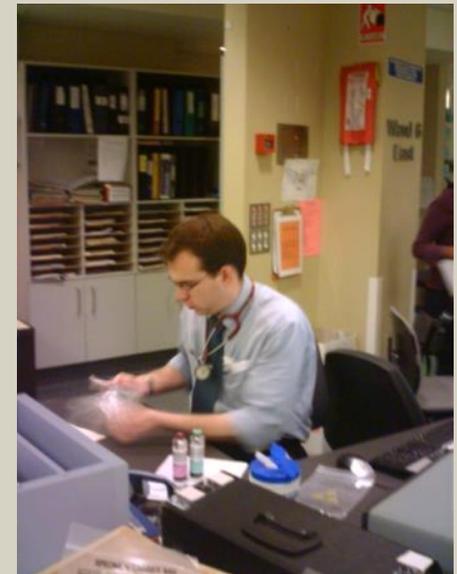
Results

- Nurses and Doctors with eMM experienced **no significant changes** in % of time spent on:

- ❖ Medication Tasks;
- ❖ Direct Care;
- ❖ Professional Communication

Compared to control wards without eMM

Achieved significant reductions in errors



Research and applications



Impact of an electronic medication management system on hospital doctors' and nurses' work: a controlled pre-post, time and motion study

Johanna I Westbrook,¹ Ling Li,¹ Andrew Georgiou,¹ Richard Paoloni,² John Cullen³

J Am Med Inform Assoc 2013;

Continued discord between IT systems & clinical work processes

Island Health CEO apologizes in wake of report on IHealth system



A report into the \$174-million electronic health record system in Nanaimo validates safety risks raised by doctors, and suggests Island Health should have spent more time tailoring the software to the needs of front-line workers before introducing it.

Cindy E. Harnett / Times Colonist
November 17, 2016

Recognising that clinical work is dynamic and ICT systems must be adaptable

Work and communication patterns of junior doctors during the day, night and weekends substantially differ.



Junior Doctors' Work (> 400 hours)

Direct observational studies
to capture time spent in
different work tasks

Day time 08:30-19:00

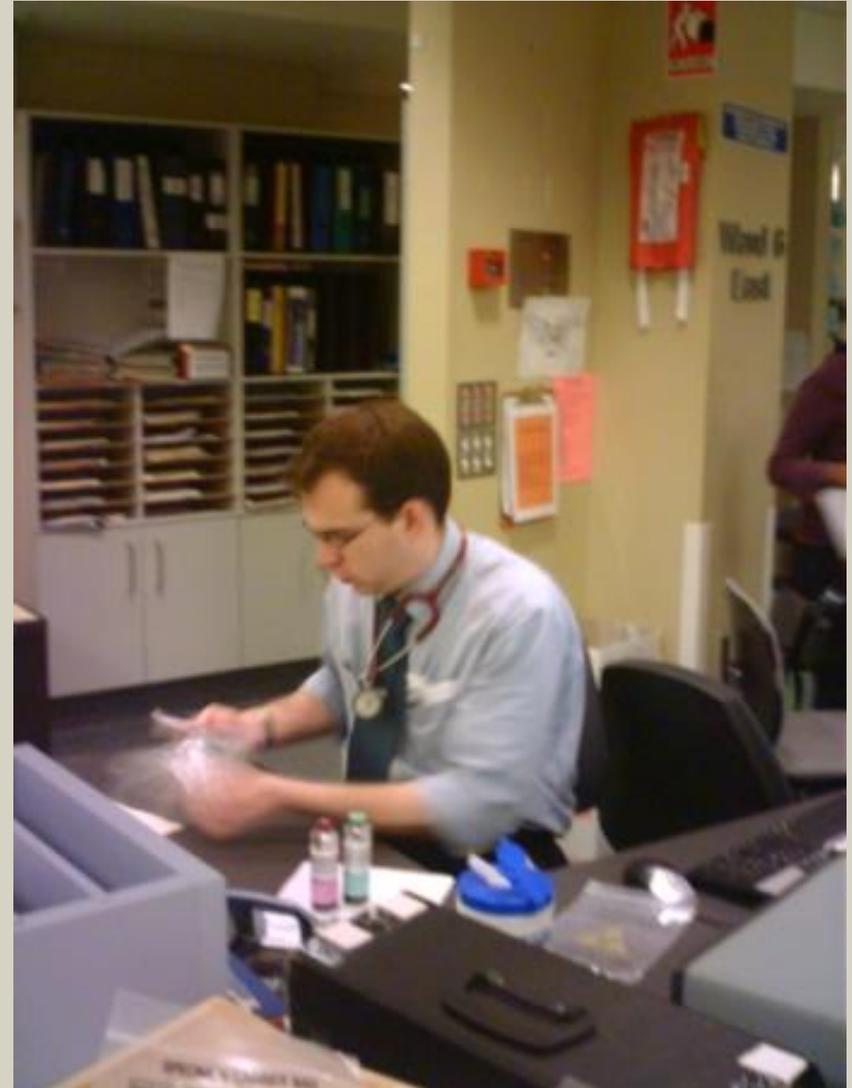
12 junior doctors, 151 hours

Night time 22:00-08:00

8 junior doctors, 96 hours

Weekend 08:00-19:00

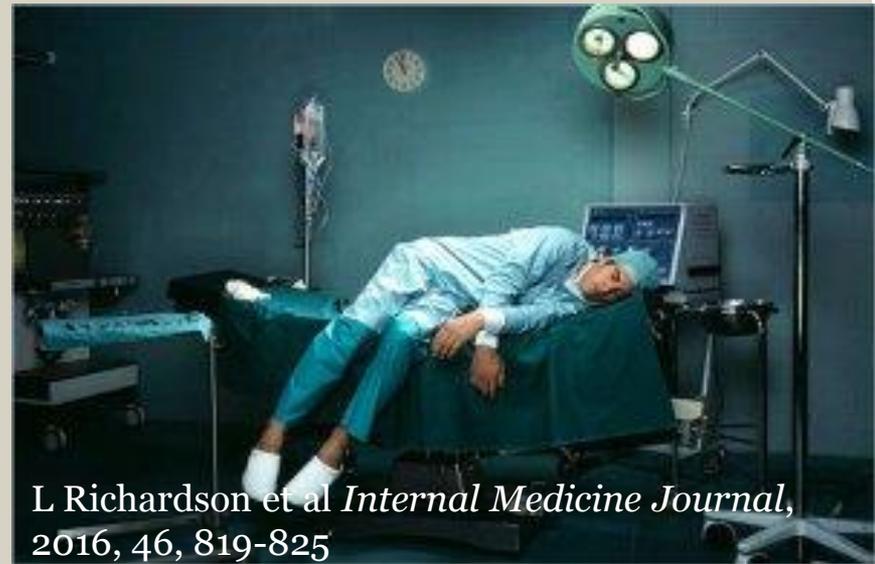
16 junior doctors, 160 hours



Implications for HIT Design

Weekend Work

- Highest % of time providing clinical care
- Interrupted frequently
- Multi-tasking
- Inadequate rest breaks



Percentage of Time

* significant difference $P < 0.001$

Task	Weekend	Dayshift	Night shift
Indirect care	32	24*	16*
Direct care	23	13*	14*
Social	9	16*	28*
Supervision/ education	1	7*	2*
Multi-tasking	21	19	6*
Interruption rate (per hr)	6.6	2.2*	1.3*

Health Information Technology which supports the dynamic nature of clinical work



MACQUARIE
University

Keeping track of multiple tasks

Reducing cognitive load

Supporting fatigued users

Systems which can adapt to users' needs



Evidence that targeted decision support can be highly effective

Dicloxacillin Capsule

Drug to Allergy/Intolerance Interactions

 Class Allergy to Penicillins  (facial swelling)

Dicloxacillin Capsule contains Dicloxacillin which is in the class Penicillins to which the patient is allergic.

Action

Comment

- Override
- Remove

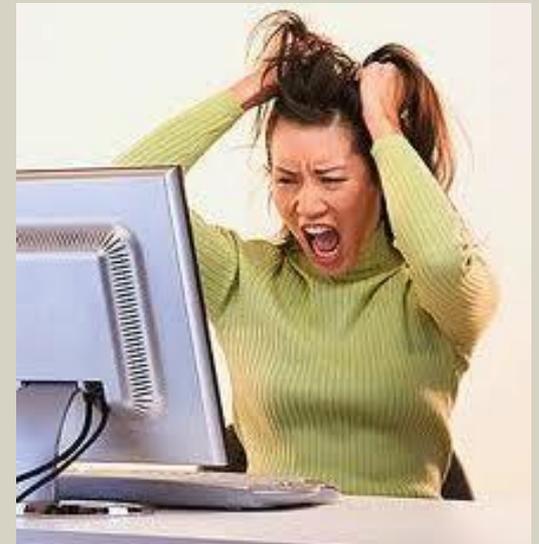
But.....

A large body of work demonstrating that doctors override alerts (i.e. click past alerts without following recommendations), up to **95%** of alerts

 Alert fatigue - mental state resulting from excessive numbers of alerts being triggered

Leads to:

- User frustration and annoyance
- Prescribers overwhelmed by alerts
- Learn to ignore all alerts



When and why decision support may be effective?



What impact does eMMS decision support have during ward rounds?

- 58.5 hrs, 14 teams, 96 orders
- 48% of medication orders triggered alerts
- 17% read
- No orders changed



Research and applications

J Am Med Inform Assoc 2011;**18**:754–759.

The influence of computerized decision support on prescribing during ward-rounds: are the decision-makers targeted?

Melissa T Baysari,¹ Johanna I Westbrook,² Katrina L Richardson,³ Richard O Day^{4,5}

Junior doctors' response to computerised alerts at night 16:30-22:30

- Observational study - 65 hours
- 78% of alerts were read
- 5% resulted in a change in prescribing



Junior doctors' prescribing work after-hours and the impact of computerized decision support

INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS 82 (2013) 980-986

Samantha L. Jaensch^{a,b}, Melissa T. Baysari^{b,c,*}, Richard O. Day^{a,b},
Johanna I. Westbrook^d



Review article

A systematic review of the effectiveness of interruptive medication prescribing alerts in hospital CPOE systems to change prescriber behavior and improve patient safety

N. Page^{a,*}, M.T. Baysari^{a,b}, J.I. Westbrook^a

International Journal of Medical Informatics 105 (2017) 22–30

- ❖ Drug-condition – 5/6 studies showed positive effects
- ❖ Drug-drug – 2/6 studies
- ❖ Corollary order alerts – 1/6 studies

- ❖ No one studied the combined effects of multiple alert types

Drug-drug Interaction (DDI) Alerts



Large potential number – 100s - >15,000 alerts

Eur J Clin Pharmacol (2018) 74:15–27
<https://doi.org/10.1007/s00228-017-2357-5>



REVIEW

Drug-drug interactions and their harmful effects in hospitalised patients: a systematic review and meta-analysis

Wu Yi Zheng¹ • L. C. Richardson¹ • L. Li¹ • R. O. Day^{2,3} • J. I. Westbrook¹ •
M. T. Baysari^{1,3}

Eur J Clin Pharmacol (2018) 74:15–27

Does the size of the problem warrant the solution?

Require an evidence-based approach to decision support

Conclusions

- ❖ Digital systems have enormous potential to improve the quality, safety and efficiency of health care
- ❖ Securing benefits relies upon high quality evidence to inform design and better integration and use of systems
- ❖ Evaluation and monitoring of both expected and unexpected changes is critical using robust measurement approaches