Digital Drugs Delivering Benefits
By Connecting Care

Professor Johanna Westbrook
Centre for Health Systems and Safety Research
Macquarie University, Australia
Australian Institute of Health Innovation
Australian Institute of Health Innovation (AIHI)

Professor Jeffrey Braithwaite
Foundation Director, AIHI
Centre for Healthcare Resilience & Implementation Science

Professor Enrico Coiera
Centre for Health Informatics

Professor Johanna Westbrook
Centre for Health Systems and Safety Research
Centre for Health Systems and Safety Research

Programs of Research

- Medication Safety and e-Health
- Communication and Work Innovation
- Human Factors Evaluation and Design
- Pathology and Imaging Informatics
- Safety & Integration of Aged and Community Care Services
- Primary Care Safety and eHealth
Digital Drugs Delivering Benefits
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Within an organisation
Across organisations
Across a country
Medication errors – single most preventable cause of patient harm

5.8 prescribing errors/adm

25% of all medications administered had at least one error

2-3% of admissions are medication related

Plan to rollout Cerner in 241 hospitals in NSW (pop 7.5M)
Controlled Before & After study to assess if commercial e-MMS are effective at reducing medication errors.

2 Hospitals  2 Systems  6 wards
Sample: 3200 patient admissions; 17,000 prescribing errors

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

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

25/100 admissions $\rightarrow$ 14/100 admissions

(95%CI 21-29) $\rightarrow$ (95%CI 10-18)

No significant change on the control wards ($p=0.4$)
Effects of eMM on medication administration error rates

- Controlled pre post study
- 226 nurses administering 7451 medications on 6 wards
- Observe & record drug details- compare with charts
Data Collection Tool

- Compliance with procedures
- Details of drug administered
- Time drug was given
- Record the number of Interruptions
Significant reduction on the intervention wards of 4.24 errors/100 administrations (95%CI: 0.15-8.32, \( p=0.04 \)) compared to control wards.

Wrong timing errors had the greatest decline by 3.35 /100 administrations (95%CI: 0.01-6.69, \( p<0.05 \)) compared with control wards.
Change in serious medication administration errors

Significant reduction in serious (ie potential ADEs) MAEs on intervention compared to control wards

Pre: 4.20% (95%CI 3.25, 5.15%)  
Post: 1.83% (95%CI 1.20, 2.46%)
A simple decision tree was designed to estimate Incremental Cost Effectiveness Ratio (ICER).
Data relates to cardiology ward in one hospital

Admitted patient

- eMMS prescribing
  - Potential ADE (moderate, major or serious error)
    - Interception
      - Error causes harm
      - Significant ADE
      - Serious ADE
      - Severe ADE
    - Not intercepted
      - Error causes no harm
      - Severe ADE
  - No potential ADE (insignificant or minor error)

- Paper-based prescribing
  - Potential ADE (moderate, major or serious error)
    - Interception
      - Error causes harm
      - Significant ADE
      - Serious ADE
      - Severe ADE
    - Not intercepted
      - Error causes no harm
      - Severe ADE
  - No potential ADE (insignificant or minor error)
  - No medication error
Results

- eMM – resulted in a reduction of $63-66 (£32) per admission

- Cardiology ward = ~$100,000 savings p.a. due to a reduction ~ 80 ADEs p.a.

- Entire hospital with 39,000 annual admissions = releasing $2.5M each year
New Errors!

The safety of electronic prescribing: manifestations, mechanisms, and rates of system-related errors associated with two commercial systems in hospitals

Johanna I. Westbrook, Melissa T. Baysari, Ling Li, Rosemary Burke, Katrina L. Richardson, Richard O. Day

J Am Med Inform Assoc 2013;

- Occurred frequently, but low risk of patient harm
- Most frequent type
  Incorrect selection from drop-down menus = 43%
How will digital drug information transform health care decision-making and work practices?

Success reliant upon systems integrating and supporting work and communication processes.
Who do you seek medication advice from at least weekly on your ward?

9.0/100 patient days
Prescribing error rate
N=428 admissions

19.4 / 100 patient days
Prescribing error rate
N=240 admissions

84% of staff agreed that if doctors and nurses talked more frequently there would be fewer medication errors

54% agree that if doctors and nurses talked more frequently there would be fewer medication errors

Significantly lower agreement than Ward A P=(.027)
Who Do Hospital Physicians and Nurses Go to for Advice About Medications? A Social Network Analysis and Examination of Prescribing Error Rates

Nerida Creswick, PhD* and Johanna Irene Westbrook, PhD†

* J Patient Saf • Volume 11, Number 3, September 2015
How will eMM systems impact communication and workflow?
AIM: To measure changes in how nurses and doctors distributed their time across work tasks pre and post eMMS

70 nurses observed for 276.9 hours
59 doctors observed for 356.3 hours
Work Observation Method By Activity Timing -

What task?
With whom?
With what?
Where?
Interruptions
Nurses and Doctors with eMM experienced **no significant changes** in % of time spent on:

- Medication Tasks;
- Direct Care;
- Professional Communication

Compared to those without eMM

Doctors with eMM spent 6% **more time** with other doctors (p=0.003) and patients (p=.009) compared to control ward doctors.

Nurses with eMM spent **less time** with doctors (p=0.0001). Both fewer (tasks per hour) and **shorter** interactions (mean task time)
Influence on team and individual decision-making processes
What impact does eMMS decision support have during ward rounds?

- 48% of medication orders triggered alerts
- 17% read
- No prescriptions changed

Research and applications

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 Day⁴,⁵
Junior doctors at night
16:30-22:30

Observational study - 65 hours

78% of those alerts were read

5% resulted in a change in prescribing

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

Samantha L. Jaensch\textsuperscript{a,b}, Melissa T. Baysari\textsuperscript{b,c,*}, Richard O. Day\textsuperscript{a,b}, Johanna I. Westbrook\textsuperscript{d}  
\textit{International Journal of Medical Informatics} 82 (2013) 980–986
Paediatric patients
Delivering safe and effective care for children in hospital with eHealth systems

Aim – Assess the impact of eMM in paediatrics

Design: Stepped wedge cluster randomised controlled trial
Impact on medication errors and harm
Use evidence to make changes prior to site 2 implementation

Cost effectiveness
Stepped-wedge cluster randomised controlled trial (SWCRCT)

- 8 Wards will be included in the study at Site 1
- The order of wards (clusters) receiving the eMM has been randomised
- Collect data at baseline and the next 10 weeks
- By the end of the study all clusters will have the intervention.
Stepped Wedge Cluster Randomised Controlled Trial at Site 1

Prescribing errors: Measured at baseline and at each of 10 steps, totalling n=1232 admissions at end of study

Medication administrations Measured at baseline and at each of the 10 steps totalling n=2640 administrations

Clinical review to assess potential and actual harm
Role of parents/caregivers
Digital Drugs Delivering Benefits

Across organisations
Enabling seamless information exchange
Lessons from implementation of electronic medication administration records in residential aged care facilities

Amina Tariq
Andrew Georgiou
Johanna Westbrook
Medication Management in RACFs

- Examination
- Clinical history
- Production of Scripts

• Coordination with pharmacies & GPs
• Administration of medication
• Medication Charts

- Preparation of medications
- Pharmaceutical information record

All actors have different paper/digital views
Going Digital - Interoperability Issues

1. Pharmacy Computer View
2. RACF Computer View (administration)
3. Printed Chart View
Suboptimal integration with work

Data entry for patches at the pharmacy

How it appears in the resident’s medications data
Enormous potential to obtain population data regarding the medication profiles of residents

Data sources represent different meanings and language
Area size comparison of Australia and Europe

Australia's area = 7,706,168 sq km
Europe's area as shown = 3,483,066 sq km
23.9 Million
2% of Australia’s population lives in the yellow area
Personally Controlled Electronic Health Record PCEHR -

Population uptake

Electronic Health Record for every Australian went live July 2012

As at 2 October 2015

2,419,577 Australians with an active eHealth record
PCEHR uptake by age and region

Age and gender-specific registration rates at 21-Jan-2015

Estimated % of the population registered by remoteness area classification at 14-Jan-15
### Medical Information

**Patient Information**
- **Name:** Lindsay Banton
- **DOB:** 01/10/1991
- **Occupation:** Trade
- **Record No.:** 8003 8086 6867 0969
- **ATSI:** Neither Aboriginal nor Torres Strait Islander

**Allergies:** ELASTOPLAST, GLUTEN, HAY FEVER, NITRATES, SHELLFISH, SULFONAMIDES, TRIMETHOPRIM

**Warnings:**

### Family History
- No known issues

### Social History
- Long working hours, active socially, poor eating habits

### Past History

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Condition</th>
<th>Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>05/1986</td>
<td>Throat infection</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>1/12/1990</td>
<td>Asthma</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>AUG 1999</td>
<td>Asthma - Frequent Episodic</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td>Dizziness - industrial</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>NOV10</td>
<td>Atypical Pneumonia</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1/2/11</td>
<td>Hypercholesterolaemia</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>02/01/2012</td>
<td>Ischemic heart disease</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>17/05/2013</td>
<td>Tonsillitis</td>
<td></td>
</tr>
</tbody>
</table>

### Immunizations

<table>
<thead>
<tr>
<th>Date</th>
<th>Immunization</th>
</tr>
</thead>
<tbody>
<tr>
<td>16/05/2007</td>
<td>HEP-VAX II (ADULT)</td>
</tr>
<tr>
<td>04/06/2007</td>
<td>RABIES</td>
</tr>
<tr>
<td>08/06/2010</td>
<td>DIPHTHERIA</td>
</tr>
<tr>
<td>05/05/2012</td>
<td>BOOSTRIX</td>
</tr>
<tr>
<td>15/02/2013</td>
<td>DTPA</td>
</tr>
</tbody>
</table>

### Medications

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Strength</th>
<th>Dose</th>
<th>Freq</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMOXIL CAPSULE</td>
<td>250mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPRATROPION BROMIDE</td>
<td>21mcg/spray</td>
<td>2-4 Sprays</td>
<td>t.d.</td>
<td>m.o.u.</td>
</tr>
<tr>
<td>VENTOLIN CFC-FREE INHALER</td>
<td>100mcg/500mg</td>
<td>1-2 puffs</td>
<td>q.4h</td>
<td>m.o.u.</td>
</tr>
</tbody>
</table>

### Preventive Health
- Counselling re: Smoking Cessation should be considered!
- Pneumococcal Disease vaccination is recommended!
- Diphtheria and tetanus containing vaccination is recommended!
### Adverse Reactions

<table>
<thead>
<tr>
<th>Substance/Agent</th>
<th>Manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SULFONAMIDES</td>
<td>Not stated</td>
</tr>
<tr>
<td>NITRATES</td>
<td>Hives, Rhinitis, Asthma complications</td>
</tr>
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</table>

### Clinical Indications

<table>
<thead>
<tr>
<th>Medication</th>
<th>Directions</th>
<th>Clinical Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPRATROPIUM BROMIDE (ANHYDROUS) Nasal Spray 21mcg/spray</td>
<td>2-4 Sprays t.i.d. m.d.u.</td>
<td>Hay fever</td>
</tr>
<tr>
<td>VENTOLIN CFC-FREE Inhaler 100mcg/dose</td>
<td>1-2 Puffs q.4.h. m.d.u.</td>
<td>Asthma</td>
</tr>
</tbody>
</table>

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<td>1-2 Puffs q.4.h. m.d.u.</td>
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Concluding Thoughts

• Moving from paper-based medication information can produce many benefits - reduced errors and improved medication management.

• Challenges in terms of the representation of information and associated meanings, with implications for the exchange of information and interoperability of systems and also ‘trust’.

• Medication decision making processes are complex, dynamic and influenced by multiple contextual factors