Optimizing Evidence-Based Practice by Improving Training Licensure and Developing and Evaluating Computerized Healthcare Interventions

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Disclosure

None of the above speakers have any conflicts of interest to report
Variations in Medical Practice: Canada

Rates for all procedures by health region, Canada, 2010

(OECD 2014) Geographic Variations in Health Care: What Do We Know and What Can Be Done to Improve Health System Performance?
Variations in Medical Practice: UK

% of people with type 1 and type 2 Diabetes who received guideline-recommended care processes
% of diabetic Medicare enrollees receiving appropriate management
Variations in Medical Practice

- Unexplained by differences in illness
- Unexplained by patient preference
- Unexplained by lack of resources
- A function of physician ability and decision making
- Identifying variations and reducing them should be a priority
Is there an association between licensing exam scores and primary care practice?
Study cohort: 984 physicians followed over 4–7 years in Quebec after passing Quebec family medicine certification examination between 1990 and 1993.
Physician scores on a National Clinical Skills Examination as predictors of complaints to medical regulatory authorities in Ontario and Quebec

For every 2 SD decline in the communication score, there is a 38% increase in the rate of complaints.
Conclusions:

- Licensing examination scores are significant independent predictors of resource use and the quality of care in practice.

- Training and licensure are one potential target in optimizing evidence-based healthcare.
Once physicians enter practice, a multitude of systemic, organizational, and individual factors affect their performance.
Multiple prescribing physicians: increase the risk of inappropriate prescriptions

MOXXI: 198,051 eligible patients insured by the RAMQ drug insurance from Jan. 2006 to Jan. 2007
Handwritten prescriptions: increase the risk of transcription errors

1.6% of these errors are potentially dangerous

Kistner et al. (1994)
MOXXI: Medical Office of the XXIst Century

- Electronic medical record
- Computerized drug management system
- Electronic prescriber
- Platform for clinical decision support
MOXXI: Medical Office of the XXIst Century

1,800 Quebec pharmacies

Public Insurer

Complete record of all drugs dispensed – updated in real-time

Online payment & adjudication
Practice-Based Interventions for System Problems (MOXXI)

Integrated drug profiler: retrieves a complete drug profile from an integrated drug management system.
Computerized Prescribing: reduces prescribing potential errors by providing menus for dose selection
Practice-Based Interventions for Systemic Problems (MOXXI)

**Computerized Prescribing:** handwritten vs. computer-generated prescriptions
Developing & Evaluating Practice-Based Systemic Interventions (MOXXI)

Computerized Prescribing: typed prescriptions reduce prescribing and transcription errors
Systemic Problems: Care Transitions and Medication Errors

- 67% of inpatients have at least 1 error in their medication history at admission

- 12% of medication discrepancies are unintentional, but have potential for harm. Of these, 72% were due to admission errors, while 26% were due to lack of reconciliation at discharge

- 19% to 23% of patients will have an adverse drug event within 30 days of hospital discharge and 14.3% will be readmitted

- Adverse drug events are preventable in 58% of the cases

- Adverse drug events are the 6th leading cause of death at a cost over $5.6 million per hospital per year

We were lucky to engage with Bernard the patient representative.

East Lancashire

Acute Care

Reconciliation Issues

Variation is huge

Primary Care

How many days till someone looks at discharge letter?

Who will deal with it?

Receptionist, GP

Must be clear

What changes to medication?

Reason for stopping

How do we standardise communication?

Increase discharge completion rates

Improving medicines safety

Drawn by www.moretthanminutes.co.uk
Optimizing Evidence-Based Healthcare: Practice-Based Interventions for Systemic Problems

**RightRx:** Electronic Process for Medication Reconciliation – targeting transitions in care
Practice-Based Interventions for Systemic Problems (RightRx)

RightRx: Discharge

✓ Clear community medication list available for discharge prescription

✓ Alignment of medications

✓ User forced to act on each medication
RightRx: Discharge

- Legible discharge prescription, including all medications to be stopped
- Reasons for changes displayed under each medication
- Number of renewals can be pre-set to user’s choice
- Discharge physician’s name and license number printed
Practice-Based Interventions for Systemic Problems (RightRx)

Time for Medication Reconciliation Form Completion in Medicine

<table>
<thead>
<tr>
<th></th>
<th>Usual care</th>
<th>RightRx</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDL</td>
<td>3.33</td>
<td>2.43</td>
</tr>
<tr>
<td>DISCHARGE</td>
<td>2.37</td>
<td>1.63</td>
</tr>
</tbody>
</table>

Tamblyn et al. *JAMIA* (2017)
Practice-Based Interventions for Systemic Problems (RightRx)

**Medication Reconciliation Completion Rates in the RightRx and Usual Care Units**

<table>
<thead>
<tr>
<th>Completion Status</th>
<th>RightRx</th>
<th>Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td>88.1</td>
<td>46.3</td>
</tr>
<tr>
<td>Major Incomplete</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>Minor Incomplete</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>Not Attempted</td>
<td>0.2</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Tamblyn et al. JAMIA (2017)
Practice-Based Interventions for Systemic Problems (RightRx)

Potential Adverse Drug Event Rates Related to Incomplete Medication Reconciliation in the Intervention and Control Groups

<table>
<thead>
<tr>
<th>Error Type</th>
<th>RightRx Group (%)</th>
<th>Usual Care Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors of omission</td>
<td>21</td>
<td>42.3</td>
</tr>
<tr>
<td>Therapy duplications</td>
<td>9.9</td>
<td>2.3</td>
</tr>
</tbody>
</table>
### Computerized Decision Support: providing automated alerts for prescribing problems

<table>
<thead>
<tr>
<th>Type</th>
<th>Drug(s)</th>
<th>Level</th>
<th>Suppress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes: use with caution, may mask some symptoms</td>
<td><strong>METOPROLOL 24H-TABLET 200MG</strong></td>
<td><img src="https://via.placeholder.com/15" alt="Moderate" /></td>
<td><img src="https://via.placeholder.com/15" alt="Suppress for this patient only" /> <img src="https://via.placeholder.com/15" alt="Suppress for all patients" /></td>
</tr>
<tr>
<td>antagonism</td>
<td><strong>METOPROLOL 24H-TABLET 200MG</strong> <strong>VENTOLIN HFA METERED INH. 100MCG</strong></td>
<td><img src="https://via.placeholder.com/15" alt="Serious" /></td>
<td><img src="https://via.placeholder.com/15" alt="Suppress for this patient only" /> <img src="https://via.placeholder.com/15" alt="Suppress for all patients" /></td>
</tr>
</tbody>
</table>
## Computerized Decision Support: on-demand vs automated drug alerts

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>On Demand Alerts</th>
<th>Automated Alerts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients</td>
<td>1,550</td>
<td>1,899</td>
</tr>
<tr>
<td>Number of Alerts</td>
<td>4,445</td>
<td>6,506</td>
</tr>
<tr>
<td>% Seen</td>
<td>0.9%</td>
<td>10.3%</td>
</tr>
<tr>
<td>% Revised that were Seen</td>
<td>75.6%</td>
<td>12.1%</td>
</tr>
</tbody>
</table>

Practice-Based Interventions for Optimizing Clinical Decision-Making: Potentially Inappropriate Prescribing (MOXXI)

**Computerized Decision Support**: most drug alerts from commercial systems are ignored

- Physicians override 49% to 96% of alerts for drug-allergy, drug-drug, and drug-disease contraindications
- Experienced physicians more likely to override alerts than trainees
- Incorrect data explains most allergy and pregnancy alerts
- “Benefit great than risk” reason for most overrides
Developing & Evaluating Practice-Based Interventions to Optimize Clinical Decision-Making (MOXXI)

Computerized Decision Support: incorporating epidemiological science into risk–benefit assessment

UKPDS Risk Engine
Home page

**Background**
Risk calculators based on equations from the Framingham Heart Study tend to underestimate risks for people with diabetes as this study included relatively few diabetic subjects. The UKPDS Risk Engine is a type 2 diabetes specific risk calculator based on 53,000 patients years of data from the UK Prospective Diabetes Study, which also provides an approximate 'margin of error' for each estimate.
Practice-Based Interventions to Optimize Clinical Decision-Making by Personalizing Information by Patient Profile (MOXXI)

Computerized Decision Support: designing new smart alerts that provide person-specific risk assessment

\[
hazard_{total} = hazard_{nm} \times \exp(0.304 \times \text{class}_2 + 0.035 \times \text{class}_3 + 0.253 \times \text{class}_4 + 0.105 \times \text{class}_5 + 0.088 \times \text{class}_6 + 0.088 \times \text{class}_7 + 0.225 \times \text{class}_9 + 0.056 \times \text{class}_{11} + 0.008 \times \text{class}_{13} + 0.106 \times \text{class}_{15} + 0.099 \times \text{class}_{16} + 0.047 \times \text{class}_{17} + 0.147 \times \text{class}_{18} + 0.07 \times \text{class}_{23})
\]

\[
risk_{total} = 100 \times \left(1 - \left(1 - \frac{\text{baseline}}{100}\right)^{hazard_{total}}\right)
\]
Computerized Decision Support: RCT quantifies risk reduction

Change of $-0.17 (-0.32$ to $-0.02)$ in risk of injury per 1000

Greatest change for patients at highest risk

N=2,741  N=2,887

Tamblyn et al. The effectiveness of a new generation of computerized drug alerts in reducing the risk of injury from drug side effects; a cluster randomized trial. JAMIA (2012)
Nonadherence: to anti-hypertensive treatment reduces the benefits of treatment for stroke and MI prevention and is significantly associated with knowledge and decision making scores on licensing exams.
Nonadherence: user fees related to drug costs and adverse effects are the most common causes of nonadherence.
Practice-Based Interventions to Optimize Clinical Decision-Making re: Medication Adherence (MOXXI)

**Computerized Decision Support:** providing physicians with information on treatment adherence
Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Medication Non-Adherence

**Computerized Decision Support:** Increasing the detection and response to adherence problems with cardiovascular medication in primary care through computerized drug management systems: A randomized controlled trial

30 primary care physicians (2329 patients prescribed cardiovascular drugs with follow-up visit)

**Control Group**

**Intervention Group**

Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Medication Non-Adherence

**Computerized Decision Support:** helps identify side-effects as a cause of non-adherence

![Bar chart showing % of CV stop/changes](chart.png)

- **Ineffective treatment**
- **Intolerance to drug or side-effect(s)**
- **Other**

**Profile Blocked** vs. **Profile Available**

Physicians are more likely to identify side effects as cause for non-adherence.
Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Medication Non-Adherence

Computerized Decision Support: showing comparative patient out-of-pocket costs for antihypertensives
Computerized Decision Support: showing comparative patient out-of-pocket costs for antihypertensives

Higher Out-of-Pocket Expense (OoPE) is associated with decreased compliance. Diuretics are equally effective, and can reduce Patient's OoPE by 50%.

<table>
<thead>
<tr>
<th>Rx</th>
<th>Drug name</th>
<th>Patient Annual OoPE</th>
<th>Total Annual Cost</th>
<th>Total Out-Of-Pocket Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DILTIAZEM 12H. CAPSULE 60MG</td>
<td>$165.00</td>
<td>$220.80</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>HYDROCHLOROTHIAZIDE TABLET 25MG</td>
<td>$14.40</td>
<td>$14.40</td>
<td>$150.60</td>
</tr>
<tr>
<td></td>
<td>HYDROCHLOROTHIAZIDE TABLET 50MG</td>
<td>$20.40</td>
<td>$20.40</td>
<td>$144.00</td>
</tr>
</tbody>
</table>

To change prescription, select drug and then click “Apply Changes”. To keep the current prescription, please select a reason below.

- Keep original prescription
- Reason: [ ]
Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Medication Non-Adherence

Computerized Decision Support: showing comparative patient out-of-pocket costs for antihypertensives

% increase in patients newly started on diuretics in out-of-pocket module and usual care groups

RR 1.65, 95% CI 1.17–2.33

56 physicians, 3592 patients

38 physicians, 1914 patients in Out-of-Pocket Expenditure Module

38 physicians, 1678 patients in Usual Care (basic MOXXI system)

26.6%

19.8%

Out of Pocket Expenditure Module

Usual Care

Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Chronic Disease Management: Asthma

**Computerized Decision Support:** for evidence-based asthma management – daily surveillance of ER visits and rescue medication to assess asthma control
Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Chronic Disease Management: Asthma

Computerized Decision Support: for evidence-based asthma management – daily surveillance of ER visits and rescue medication to assess asthma control
Evaluating Practice-Based Interventions to Optimize Clinical Decision-making for Chronic Disease Management: Asthma

**Computerized Decision Support:** for evidence-based asthma management – daily surveillance of ER visits and rescue medication to assess asthma control

- **Out-of-Control at First Visit:** 704 (15.8%)
  - RR: 0.87
  - 95% CI: 0.77, 0.99

- **In-Control at First Visit:** 3,743 (84.2%)
  - RR: 1.00
  - 95% CI: 0.74, 1.36
To Sum Up...

- Observational studies help identify modifiable determinants of adverse events and health outcomes
  - e.g. training and licensure, multiple prescribers, off-label prescribing, non-adherence

- Interventions targeting those determinants should be developed based on an understanding of healthcare problems and their causes
  - e.g. MOXXI, RightRx

- The future of practice-based interventions lies in tailoring interventions to particular physician profiles and preferences
Off-label Prescribing

Percent of Prescriptions for On-Label and Off-Label Uses

- On-Label Use
- Off-Label Use with Strong evidence
- Off-Label Use without Strong evidence

Percentage of Antidepressants being Prescribed Off-Label

- SSRI: 21.80%
- SNRI: 6.10%
- TCA: 8.14%
- Other: 42.40%
- All Classes: 29.30%
Optimizing Evidence-Based Healthcare: Factors Affecting Prescription Medication Use

Off-label Prescribing: associated with adverse drug events in adult population

![Graph showing cumulative HRs of ADEs over time for different types of prescribing (off-label without evidence, off-label with evidence, and on-label).]

<table>
<thead>
<tr>
<th>Description</th>
<th>No. at risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-label drug use without evidence</td>
<td>14,431</td>
</tr>
<tr>
<td>Off-label drug use with evidence</td>
<td>3,416</td>
</tr>
<tr>
<td>On-label drug use</td>
<td>133,458</td>
</tr>
</tbody>
</table>

Eguale et al. *JAMA Internal Medicine* (2016)