The Evolution of Medication-related Decision Support in the Era of Opiate Abuse

David W. Bates, MD, MSc
Chief, Division of General Medicine, Brigham and Women’s Hospital
Medical Director of Clinical and Quality Analysis, Partners Healthcare
Overview

- Prevalence of medication-related harm
- Medication-related decision support
  - Early evidence
- Evolution over time
- Current state, cautionary tales
- Making it patient-centered
- Best practices
- Role in opiate use/abuse
- Conclusions
EARLY RESULTS
ADE Prevention Study: Key Results

- 6.5 ADEs/100 admissions
  - 28% preventable
  - 3 potential ADEs for every preventable ADE
  - 62% of errors at ordering and transcription stages

*Bates et al, JAMA 1995;274:29-43*
# ADE Rate By Site in Massachusetts Community Hospitals

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
<th>Site 5</th>
<th>Site 6</th>
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</thead>
<tbody>
<tr>
<td>ADE Rate*</td>
<td>15</td>
<td>19.5</td>
<td>11</td>
<td>15.5</td>
<td>17</td>
<td>15</td>
<td>12.5</td>
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<tr>
<td>% Prev</td>
<td>75</td>
<td>72</td>
<td>82</td>
<td>71</td>
<td>85</td>
<td>73</td>
<td>68</td>
</tr>
</tbody>
</table>

*Per 100 admissions*

Range: 11-19.5 for rate
68-85 for percent preventable
CORE PRINCIPLES
Types of Decision Support

- Structuring
- Information display
  - Generic across patients
  - Patient-specific
- Calculations
- Reminders
- Alerts
- Guidelines/Algorithms
Functions of CDSSs

- Alerting--high lab value
- Reminding--mammogram
- Critiquing--rejecting an order
- Interpreting--interpreting an ECG
- Predicting--risk of mortality using severity score
- Assisting--tailoring antibiotic choices
- Diagnosing--ddx in CP
- Suggesting--for adjusting mechanical ventilator

Randolph et al, JAMA 1999, from Pryor, 1990
Underpinnings

- Alerts, reminders, critiques often simple if-then rules
  - (sometimes other Boolean operators)
  - Alerts use event monitors, evaluate streams of data
    - Finding right person hard
  - Reminders notify patients of tasks to be done before event occurs
  - Critiques--alternative suggestions, evaluate plan after started
- Interpreting/predicting/diagnosing/assisting and suggesting are higher order
  - Harder to program, require more data
Key Infrastructure

- Event monitor
- Rules editor
- Tool for determining who is responsible
  - “Coverage list”
- Tools for contacting providers
EVOLUTION, KEY LEARNINGS
Impact of CPOE and Bar-Coding on Serious Med Errors

**Order Entry & decision support**
- 55% reduction

**Pharmacy Barcoding**
- 67% reduction

**-eMAR/barcoding at bedside**
- 51% reduction

**Ordering Errors (49%)**

**Dispensing Errors (14%)**

**Administration Errors (26%)**
Medication Safety: Refining the Rules

- In most systems most alerts get overridden
- We identified a highly selected set of drug alerts for the outpatient setting
- Over 6 months, 18,115 alerts
  - 12,933 (71%) non-interruptive
  - 5,182 (29%) interruptive
    - Of interruptive, 67% were accepted

Shah, JAMIA 2006
Impact of Tiering on Inpatient DDI Alerts

- Two academic medical centers
- Same knowledge base
  - Site A used 3 tiers
  - Site B had all of the alerts as interruptive (Level 2)

- Results
  - 100% of most severe vs. 34% at non-tiered
  - Overall alert acceptance higher at tiered site (29% vs 10%, p<.001)

Paterno, et al, JAMIA 2009
High-Priority DDIs

▪ 15 drug-class pairs endorsed as highly clinically significant DDIs
  – Should never be co-prescribed
  – Candidates for “hard-stop” alerts
  – Checking completeness would require further research, but represents best available consensus

▪ Less-significant DDIs are still significant
  – *Much more prevalent* and probably cause much more harm
  – Tend to depend on patient characteristics, drug dosages and timing, concomitant conditions such as hypokalemia, etc.

▪ To improve sensitivity and specificity of DDI warnings:
  – Need much more investment in evidence review and generation
  – Methods to make DDI alerts conditional on other patient data

*Phansalkar et al, JAMIA 2012*
Low-Priority DDIs

- Alert fatigue is a serious problem
- Used consensus approach to identify low-yield DDIs
  - Used data from several sources to identify potential candidates
- Created a list of 33 DDIs that do not warrant interruptive status
  - Account for many of the DDIs displayed in some systems
- A consortium to maintain this list would be helpful

Phansalkar, JAMIA, 2013
CURRENT STATUS
Medication-related Decision Support at BWH

- Have implemented Epic
- Getting one alert for every two medication orders
  - Over 95% are overridden (appropriately)
  - Serious warnings being overridden at same rate as less important
  - Can’t deliver some of the clinically most important suggestions for technical reasons
    - Renal dosing, age-related dosing
Reduced Effectiveness of DDI Alerts After Conversion to Commercial EHR

- 3,277 clinicians getting a DDI alert in outpatient setting
- Overall alert burden increased by a factor of 6
  - Acceptance for most severe fell from 100% to 8.4%
  - From 29.3% to 7.5% for medium (p<0.01)
- After disabling least severe alerts fell 50.5% but acceptance for most severe increased only from 9.1 to 12.7%
- Text is in 20 point Verdana

Wright A, J Gen Int Med 2018
Safety Results of CPOE Decision Support Among Hospitals

- 62 hospitals voluntarily participated
- Simulation detection only 53% of orders which would have been fatal
- Detected only 10-82% of orders which would have caused serious ADEs
- Almost no relationship with vendor

*Metzger et al, Health Affairs 2010*
Jane Metzger, Emily Welebob, David W. Bates, Stuart Lipsitz, and David C. Classen,
Mixed Results In The Safety Performance Of Computerized Physician Order Entry,
Health Affairs, Vol 29, Issue 4, 655-663
Copyright ©2010 by Project HOPE, all rights reserved.
43% relative reduction for every 5% increase in Leapfrog score (p=0.01)
4 fewer preventable ADEs/100 admissions for every 5% increase in score

Leung et al, JAMIA 2013
Number of Hospitals Taking Test

Number (N) of Hospitals

![Chart showing the number of hospitals taking a test from 2010 to 2017]

- 2010: 214
- 2011: 288
- 2012: 455
- 2013: 931
- 2014: 1238
- 2015: 1580
- 2016: 1689
- 2017: 1691

The number of hospitals taking the test has increased steadily from 2010 to 2017.
Average Percent Correct

Average % Correct

51.8 56.1 55.9 57.5 57 58.6 59.9 57.9
MAKING PATIENT-CENTERED
NEPHROS Study

- Effect of real-time decision support for patients with renal insufficiency
- Of 17,828 patients, 42% had some degree of renal insufficiency

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<th>Control</th>
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<tbody>
<tr>
<td>Dose</td>
<td>67%</td>
<td>54%</td>
</tr>
<tr>
<td>Frequency</td>
<td>59%</td>
<td>35%</td>
</tr>
</tbody>
</table>

- LOS 0.5 days shorter

_chertow et al, JAMA 2001_
Future in Patient-Centeredness

- Considering more data, including genetic information, patient preferences
- Sharing information with patients, making joint decisions about therapy of choice
- Enroll patients in portals, make it easy to contact practices
- Consider sending some directions directly to patients—has worked very well for health maintenance
BEST PRACTICES
Content—Which Alerts

- Interrupt with only most important warnings and tier
  - Jury still out regarding non-interruptive warnings
- Have regular review
- Track how providers are responding as practices change
- Sharing regarding this would help
  - Would be a common good
  - Could be international

Kesselheim et al, Health Affairs, 2011
Follow human factors principles

- Tier
- Uniform
- Placement
- Different levels of warning should appear different
- Use color wisely
- Succinct textual information
Which Is More Important, Content or Management

- Content is more generalizable
- Management may have an even bigger impact
  - Can have great content and no impact
  - Management has at least two dimensions
    - Attention to human factors issues in delivery, display
    - Implementation
- Have to get good score on all of these right to get benefit!
Ten Commandments for Effective Clinical Decision Support

1. Speed is everything
2. Anticipate needs and deliver in real time
3. Fit into the user’s workflow
4. Little things can make a big difference
5. Physicians resist stopping

6. Changing direction is fine
7. Simple interventions work best
8. Asking for information is OK—but be sure you really need it
9. Monitor impact, get feedback, and respond.
10. Knowledge-based systems must be managed and maintained.

*Bates DW et al, JAMIA 2003*
Improving Antibiotic Prescribing for Acute Respiratory Infections using Behavioral Economic Principles: A Randomized Trial

*Society of General Internal Medicine*

*April 26, 2014*

Jeffrey A. Linder, Daniella Meeker, Mark W. Friedberg, Stephen D. Persell, Craig R. Fox, Noah J. Goldstein, Alan F. Rothfeld, Joel Hay, Jason N. Doctor
Background: Changing Behavior

- **Implicit model**: clinicians reflective, rational, and deliberate
  - Informational interventions

- **Behavioral model**: decisions fast, automatic, influenced by emotion and social factors
  - Nudges
  - Social motivation
Interventions

1. Suggested Alternatives
2. Accountable Justification
3. Peer Comparison
# Intervention 1: Suggested Alternatives

A warning message is displayed indicating that the patient is being ordered AMOXICILLIN, which is not generally indicated for non-specific upper respiratory infections. The system suggests considering the following alternative prescriptions, treatments, and materials to help the patient.

## Alternatives

### Over-the-counter medications

#### Decongestants
- **Oxymetazoline HCL (0.05% SPRAY)**
  - 2 SPRAY (0.05% SPRAY) NAS BID or PRN but no more frequently than every 6 hours. Do not use more than 3 days. Dispense: 1 Bottle(s) Refills: 0
- **Pseudoephedrine (30 MG TABLET)**
  - 60 MG (30 MG TABLET Take 2) PO Q6H PRN as needed for nasal congestion. Dispense: 50 Tablet(s) Refills: 0

#### Antihistamines
- **Diphenhydramine ORAL (25 MG TABLET)**
  - 25 MG (25 MG TABLET Take 1) PO Q6H PRN not to exceed 6 doses in 24 hours. Dispense: 24 Tablet(s) Refills: 0
- **Loratadine (10 MG TABLET)**
  - 10 MG (10 MG TABLET Take 1) PO QD PRN Dispense: 30 Tablet(s) Refills: 0
Patient has asthma.
"You are a Top Performer"
You are in the top 10% of clinicians. You wrote 0 prescriptions out of 21 acute respiratory infection cases that did not warrant antibiotics.

"You are not a Top Performer"
Your inappropriate antibiotic prescribing rate is 15%. Top performers' rate is 0%. You wrote 3 prescriptions out of 20 acute respiratory infection cases that did not warrant antibiotics.
ROLES OF CDS IN OPIATE MANAGEMENT
Roles of CDS in Opiate Management

- Even before crisis opiates were a leading cause of ADEs
- Make it easy to get to state data (PMPs)
  - We have direct link
- Encourage prescribing of small amounts
- Identify people who are at risk of dependency
- Make it easy to access opiate-related resources
CONCLUSIONS
The Future of Decision Support

- Should be able to implement much more complex rules
  - Take into account wide array of factors
  - Leverage analytics
- “Think along” with provider, interrupt ONLY when really helpful
- Eventually be more directive in certain situations
  - E.g. considering an antibiotic for pneumonia treatment
- Get patients involved!
- May be collective repositories to draw from
  - Treat as web services
Conclusions

▪ Medication-related decision support can deliver great value, improve safety/efficiency

▪ Getting benefit requires picking good rules, delivering well, and maintaining the CDS

▪ Not doing well at all now—need to implement what has been learned previously

▪ Should also learn from behavioral economics

▪ Should be able to do much more downstream, considering patient factors

▪ CDS is very appropriate for opiate management but has to be done well
“I don’t want to make the wrong mistake.”

Yogi Berra