Pharmacy Face-Off

Why BCMA Should Come Before CPOE
Why BCMA first?

- BCMA:
  - More effective in avoiding errors
  - Less costly and easier to implement
  - Easier to successfully maintain
  - Generates an immediate ROI
  - Just plain common sense
BCMA: More Effective in Avoiding Errors
Where do Errors Occur in the Medication Use Process?

Errors resulting in preventable ADEs

Errors Resulting in Preventable & Potential ADEs
(Bates et al. JAMA. 1995;274:29-34.)

23% of errors intercepted

37% of errors intercepted

48% of errors intercepted

No errors intercepted!!!
BCMA Medication Administration Error Reduction

Overall medication administration error rate

87%

13,340 admin errors/year on pilot unit

1,822 admin errors/year on pilot unit

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong Dose</td>
<td>100%</td>
</tr>
<tr>
<td>Wrong Dosage Form</td>
<td>100%</td>
</tr>
<tr>
<td>Omitted doses</td>
<td>92%</td>
</tr>
<tr>
<td>Wrong time</td>
<td>77%</td>
</tr>
<tr>
<td>Wrong drug</td>
<td>51%</td>
</tr>
</tbody>
</table>
BCMA Practice Change Forcing Functions

- Forces witness for high-alert medications (MDVs and drips)
- Forces nurses to verify pharmacist order entry prior to first dose administration
- Forces patient ID band identification
- Forces documentation
- Can’t prepare medications for multiple patients at one time
BCMA: Less Costly and Easier to Implement and Maintain
<table>
<thead>
<tr>
<th></th>
<th>BCMA(^1)</th>
<th>CPOE(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial cost ($) to</td>
<td>0.4-2 million</td>
<td>8 million</td>
</tr>
<tr>
<td>implement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to implement</td>
<td>4-6 months</td>
<td>1-4 years</td>
</tr>
</tbody>
</table>

1. Roundtable meeting, 2006 HIMSS Conference.
Current Adoption of Pharmacy Informatics in US Hospitals

- BCMA = 25% (was 1.5% in 2002)
- Electronic medication administration record = 83%
- CPOE with decision support = 12% (but, 34% of respondents have < 50% of orders entered by prescribers)
- Fully implemented electronic medical record = 5.9%

350 Bed Hospital
Resource Requirements

**BCMA**
- 3 FTE repackaging technicians
- 1 FTE Nursing Project Coordinator
- 0.5 FTE pharmacist project coordinator
- 0.5 FTE inventory/formulary maintenance technician
- RF Network
- Repackaging Technology
- 4 hours new nurse orientation
- Software
- Hardware

**CPOE**
- Pharmacy informatics (13 FTE)
- ITS Systems Analysts (50 FTE)
- Nursing Informatics (9 FTE)
- Medical Informatics (4 FTE)
- Many project managers (6)
- “Redcoats”
- Public affairs
- FTEs can exceed 50!!!
- 8-16 hours new nurse, pharmacist, physician orientation
- Politics and bureaucracy
- Software
- Hardware
BCMA: Generates an Immediate ROI
## BCMA Cost-Avoiance

### Assumptions:

<table>
<thead>
<tr>
<th></th>
<th>Literature method</th>
<th>Conservative method¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual doses administered per year:</td>
<td>3,650,000</td>
<td>3,650,000</td>
</tr>
<tr>
<td>Administration error rate before BCMA in manual system</td>
<td>9.10%</td>
<td>9.10%</td>
</tr>
<tr>
<td>Total administration errors per year before BCMA in manual system</td>
<td>332,150</td>
<td>332,150</td>
</tr>
<tr>
<td>Administration error avoidance as determined via direct observation study</td>
<td>87%</td>
<td>87%</td>
</tr>
<tr>
<td>Administration errors avoided per year following BCMA implementation</td>
<td>288,971</td>
<td>288,971</td>
</tr>
<tr>
<td>% of medication errors that result in harm or a PADE (per 1995 Bates study)</td>
<td>1%</td>
<td>0.10%</td>
</tr>
<tr>
<td>Total harmful errors avoided per year at Model Hospital</td>
<td>2,890</td>
<td>289</td>
</tr>
<tr>
<td>Cost of a harmful medication error (per 1995 Bates study)</td>
<td>$4,700</td>
<td>$4,700</td>
</tr>
<tr>
<td>Total harmful error cost avoidance per year as a result of BCMA</td>
<td><strong>$13,581,614</strong></td>
<td><strong>$1,358,161</strong></td>
</tr>
</tbody>
</table>

¹ Assumes only 1 in 1000 errors result in harm that add cost to the organization; lowers estimates from 1995 Bates et al research by 10-fold.
Some thoughts on CPOE
Computerized Prescriber Order Entry (CPOE)

Overall medication error rates: 10.7
Preventable ADEs (not statistically significant): 4.86
Non-intercepted potential ADEs: 4.69

Impact on Potential ADEs

- Review of 10,778 pediatric inpatient medication orders

- Preventable by CPOE: 93%
- Preventable by decentral clinical pharmacists: 94%

Clinical Pharmacy Services

“Highest Return on Investment in Healthcare”¹, ²

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Lowest</strong></td>
<td>$1.08 : $1</td>
<td>$1.70 : $1</td>
</tr>
<tr>
<td><strong>Highest</strong></td>
<td>$75.84 : $1</td>
<td>$17.01 : $1</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>$4.09 : $1</td>
<td>$4.68 : $1</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>$16.70 : $1</td>
<td>$5.54 : $1</td>
</tr>
</tbody>
</table>

Decline in ADE for ICU patients with clinical pharmacists on rounds (Preventable ADEs per 1,000 patient days)

Baseline: 10.4
9-Month Follow-up: 3.5
66% decline

Estimated annual savings in this single unit: $270,000

Clinical RPh Impact, Cincinnati Hospital and Medical Center

Take-Home Points About CPOE

- Improving the safety of the ordering phase of the medication use process has the largest potential to improve patient safety
- Clinical decision support must maximize sensitivity and specificity so as not to inundate physicians with bogus alerts (eliminate the false positives)
- A “shrink-wrapped” CPOE system does not exist
- Pharmacists are more effective than CPOE at reducing errors and expense
- Pharmacists must play an active role in CPOE system selection and implementation
Workarounds and New Sources of Error

- **BCMA**
  - Printing extra wristbands
  - Photocopying common medication bar code labels
  - Scanning after administration to avoid waking the patient
  - Deciding to bypass scanning altogether
  - Alert fatigue
  - Complacency
    - People assume that because it is automated, it must be safe and accurate

- **CPOE**
  - Alert fatigue, often alerts turned off
  - Wrong patient and drug selection
  - Use of comment fields to convey order intent
  - Verbal orders
  - Pharmacists turn into HUCs
  - Commercial systems have very limited decision support
  - Complex orders still written on paper
To Be Fair about BCMA Systems....

**Advantages**
- Safety and accuracy of medication administration
- Accuracy of documentation
- Improve nurse efficiency resulting in time savings
- Improve charge capture/accuracy
- Patient confidence in care

**Limitations**
- “Vaporware”
- Safety advantage requires that all medications are bar coded
- If want pure unit dose, can’t use many manufacturer supplied doses
- Interface requirements
- Radio frequency demands
- Personnel required to manage
- New sources of error and workaround
To be Fair to CPOE…

- Can free a lot of pharmacist time for patient care
- Eliminates error prone abbreviations
- Orders are legible
- Long-term upside when integrated with decision support is extraordinary
BCMA References

- Published studies (observational) since January 2008 demonstrating improved accuracy of medication administration and successful BMCA implementation
  - Fitzhenry F. AMIA Annu Symp Proc.
CPOE v BCMA
What to do first?

John Poikonen, Pharm.D.
http://RxInformatic.com
http://RxInformatics.wordpress.com
Resources

- [http://friendfeed.com/pharmacy-informatics](http://friendfeed.com/pharmacy-informatics)
- Disclaimer, Disclaimer, Disclaimer
  - I have no conflict of interest with any CPOE or BCMA vendor or consultant.
  - The views expressed here do NOT represent any former, current or future employer.
  - These views may not even necessarily represent my own views. This position is taken solely and hopefully for your intellectual stimulation.
CPOE v BCMA

• Evidence Based Practice
• Meaningful Use
• Government, Purchasers and Experts
Evidence Based Practice?

<table>
<thead>
<tr>
<th>Medication safety</th>
<th>Qualitative Metric Scores&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Selected References</th>
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<tbody>
<tr>
<td>Machine-readable coding in medication administration</td>
<td>XXXX</td>
<td>$$$$</td>
</tr>
<tr>
<td>Use of order sets</td>
<td>XX</td>
<td>$$$$</td>
</tr>
<tr>
<td>Computerized prescriber-order entry</td>
<td>XXXX</td>
<td>$$</td>
</tr>
<tr>
<td>Pharmacy computer decision support</td>
<td>XXXX</td>
<td>$$$</td>
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“The identified evidence base consists mainly of case studies and anecdotal reports.”

Strategic approach for improving the medication-use process in health systems: The high-performance pharmacy practice framework
**Evidence Based Practice**

<table>
<thead>
<tr>
<th>Medication safety</th>
<th>Feasibility</th>
<th>Financial Return</th>
<th>Quality and Safety Return</th>
<th>Selected References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine-readable coding in medication administration</td>
<td>XXXX</td>
<td>$$$$</td>
<td>+++</td>
<td>61, 62</td>
</tr>
<tr>
<td>Use of order sets</td>
<td>XX</td>
<td>$$$$</td>
<td>++</td>
<td>68-70</td>
</tr>
<tr>
<td>Computerized prescriber-order entry</td>
<td>XXXX</td>
<td>$$</td>
<td>+++</td>
<td>71-75</td>
</tr>
<tr>
<td>Pharmacy computer decision support</td>
<td>XXXX</td>
<td>$$$$</td>
<td>+++</td>
<td>76-79</td>
</tr>
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</table>

“Prospective time series analysis, with four periods.”

“Medication errors (those with the potential to cause injury) fell 86 percent from baseline”

Strategic approach for improving the medication-use process in health systems: The high-performance pharmacy practice framework

Evidence Based Practice?

• AHRQ Paper BCMA
  [Link](http://healthit.ahrq.gov/images/dec08bcmareport/bcma_issue_paper.htm)

• “Research has demonstrated successful reductions in the rate of *medication administration* and dispensing errors after the implementation of barcoding systems (8 - 16)”
  
  – Reference 8 and 9 are on the dispensing process that are elegant and very convincing for the dispensing process not BCMA.
  
  – Reference 10-16 are not research studies showing reduction in errors but opinion pieces.
    
    • They assume that BCMA will decrease errors and give commentary from that perspective.
    
    • None of the references are research to show decrease medication errors.
Evidence Based Practice?

  
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Evidence Based Practice

• AHRQ Paper CPOE
  http://healthit.ahrq.gov/images/jan09cpoereport/cpoe_issue_paper.htm

• CPOE systems and CDS can improve medication safety (8-11), quality of care (12-15) and reduce costs of care. (16) They can also improve compliance with provider guidelines, (17-18) as well as the efficiency of hospital workflow. (19-20)
  – Prospective, Comparative Studies
  – Randomized Trials
  – Meta Analysis
Evidence Based Practice

• AHRQ Paper CPOE
  http://healthit.ahrq.gov/images/jan09cpoereport/cpoe_issue_paper.htm

Observational Studies on BCMA

- AJHP Vol. 64, Issue 5, 536-543. 2007
  - Paper to BCMA, eMAR value unclear
  - Majority of errors detected by a BCMA system were judged to be benign and pose minimal safety risks
  - MICU decrease in wrong time errors
  - No change in errors for Med/Surg units
  - Better charting in ICU
- J Pediatr 2009;154:363-8
  - Neonatal ICU – generalizable?
May not be the technology

• UCSF Integrated Nurse Leadership Program 7 Hospitals comparison
  – 56.8% reduction in medication administration errors
  – achieved through adherence to a set of six "best practice" procedures
• Kaiser Permanente (KP) MedRite is a comprehensive program focused on improving the safety and reliability of medication administration in the hospital setting.
• Conclusion: Improve the process before you implement technology.
Observational Study Conclusions

• eMAR to BCMA gap in knowledge
• eMAR to best practice gap.
• It is the process not the technology with medication administration.
Evidence Base Practice

REVIEW ARTICLE

The Effect of Computerized Physician Order Entry on Medication Prescription Errors and Clinical Outcome in Pediatric and Intensive Care: A Systematic Review

Floor van Rosse, MSc\textsuperscript{a}, Barbara Maat, PharmD\textsuperscript{b}, Carin M. A. Rademaker, PharmD, PhD\textsuperscript{b}, Adrianus J. van Vught, MD, PhD\textsuperscript{a}, Antoine C. G. Egberts, PharmD, PhD\textsuperscript{c}, Casper W. Bollen, MD, PhD\textsuperscript{a}

• Conclusion: Introduction of computerized physician order entry systems clearly reduces medication prescription errors
Evidenced Based Practice

Improvements in MD performance resulting from computerized prompting systems are so striking and consistent that further randomized trials could be considered unethical.

Evidence Based Practice

Doing what matters

• Mortality Improvements with CPOE
  – One Study showed increase in Mortality
  – Other follow ups showing no change to slight decrease.
  – 50% decrease (Children's Hospital of Pittsburg)
  – 2.49% versus Medicare Average 4.41% (Methodist Peoria)

• Hospitals with automated notes and records, order entry, and clinical decision support had fewer complications, lower mortality rates, and lower cost

• BCMA evidence of better outcome?
Evidence Based Practice?

BCMA Studies

• Weak Study designs
  – Compare to Unit Dose studies
  – More observational studies appearing
• General decrease to no change in errors (with wrong time filtered out)
• Mostly timing improvements
• No Outcome or mortality results
• No Comparison with eMAR to BCMA
• Non-Tech interventions similar result
Evidence Based Practice
CPOE Studies

• Several prospective comparatives
• Numerous Systematic Reviews
• Strong Study designs
• Strong evidence of decrease in errors
• Moderate evidence of decrease in mortality, costs and complications
Meaningful Use – Initial Statement

Meaningful Use Matrix of June 16

• “Conduct medication administration using bar coding”

Comment Period
Comment

• Conduct medication administration using bar coding – This objective should not be included until the benefit of bar-code medication administration (BCMA) technology is proven to promote safe and efficient care to patients. The Committee should consider replacing this 2013 objective with “documenting medication administration with an electronic medication administration record (eMar).”
Meaningful Use
Final August 2009

• “Conduct closed loop medication management, including eMAR and Computer-assisted administration”. (2013)
• Use CPOE for all orders (2011)
  – Hospitals must show 10% (2011)
• Use CPOE for all orders (2013)
• Use CDS at point of care (2011 & 13)
Government, Purchasers and Experts

• Massachusetts Mandate
• Leapfrog Group
• National Quality Forum
Massachusetts Law

- Massachusetts Bill 2863
- CPOE by October 1, 2012
- BCBS Requirement
- MA Report
  - ADE’s
  - Renal Dosing
  - Guidelines

Saving Lives, Saving Money:
The Imperative for Computerized Physician Order Entry in Massachusetts Hospitals
Leapfrog Group for Patient Safety

• Consortium of major companies and other large private and public healthcare purchasers provide health benefits to more than 37 million Americans.

• Mission: Promote High Value Healthcare
  – Evidenced based Hospital Referral
  – ICU Physician Staffing

• Adoption of CPOE!
National Quality Forum

• 34 Safe Practices for Better Healthcare 2009
• Only practices that have been demonstrated to be effective in reducing adverse events
• Examples:
  – Hand Hygiene
  – Influenza Prevention
  – Venous Thrombosis Prevention
  – Pharmacist Leadership Structures

• Adoption of CPOE!
CPOE Isn’t Easy, but Worth It…

From the Iliad, when Odysseus finds himself alone and on enemy territory:

“Be strong saith my heart; I am a soldier; I have seen sights worse than this”
• The following are anticipated arguments in light of spotty and incomplete evidence that we still should implement BCMA.
• Each side of the argument has legitimate reasons
• The right hand column supports CPOE over BCMA
The Arguments

• Argument 1: We Cannot Wait
• Argument 2: Any Effort to Improve Is Better Than the Current State of Affairs
• Argument 3: Emulating Successful Organizations Can Speed Improvement
• Argument 4: The Effectiveness of Some Quality-Improvement Strategies Is Obvious
• Argument 5: Promising but Unproven Strategies Can Catalyze Innovation
• Argument 6: The Framework of Evidence-Based Medicine Does Not Apply to Quality Improvement
• Argument 7: Developing Evidence in Quality Improvement Is Too Costly
We cannot wait — the need to improve the quality of care is urgent.

Why proceeding quickly is critical

Thousands of patients are injured or killed each year by medical errors.

Why evaluation is critical

The need to improve the treatment of many diseases is equally urgent, yet we demand rigorous evidence that a therapy works before recommending it widely.

New England Journal of Medicine Sounding Board 357;6
Any effort to improve quality is better than the current state of affairs.

Why proceeding quickly is critical

- On balance, the harms of quality improvement are likely to be far less than those of the status quo.

Why evaluation is critical

- Knowledge of the harms and opportunity costs of quality improvement is important for an understanding of the net benefit to patients and health care systems, which is often small.

New England Journal of Medicine Sounding Board 357;6
Emulating successful organizations can speed effective improvement.

**Why proceeding quickly is critical**

- Emulation and collaboration provide an efficient means of disseminating potentially effective solutions.

**Why evaluation is critical**

- Emulation and collaboration can incorrectly promote or even overlook interventions that have not worked.

New England Journal of Medicine Sounding Board 357;6
The effectiveness of some quality improvement strategies is obvious.

**Why proceeding quickly is critical**

- Insistence on evidence may lead us to underuse interventions that are obviously effective.

**Why evaluation is critical**

- Even though many quality improvement practices have a simple rationale, they may be less effective than expected and can be difficult to implement fully.

New England Journal of Medicine Sounding Board 357;6
Innovation can be catalyzed by dissemination of strategies that have promise but are unproven.

<table>
<thead>
<tr>
<th>Why proceeding quickly is critical</th>
<th>Why evaluation is critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Preliminary data provide an important opportunity to speed innovation and improve care rapidly.</td>
<td>• Flawed, biased, or incomplete data may lead to adoption of interventions that are ineffective or harmful.</td>
</tr>
</tbody>
</table>
The framework of evidence-based medicine does not apply to quality improvement.

**Why proceeding quickly is critical**

- The nature of quality improvement exempts it from the usual strategies of assessment.

**Why evaluation is critical**

- Given the complexity of quality and safety problems, the complexity of their causes, and how little we understand them, we should use rigorous study designs to evaluate them.

New England Journal of Medicine Sounding Board 357;6
Developing evidence in quality improvement is too costly.

**Why proceeding quickly is critical**

- The resources and expertise required to evaluate quality and safety interventions rigorously make trials impractical, particularly when the field is moving so quickly.

**Why evaluation is critical**

- As compared with the large opportunity costs incurred by wide implementation of ineffective quality and safety strategies, investments in better evaluation would be small.

New England Journal of Medicine Sounding Board 357;6