“Preventing Adverse Drug Events and Harm”

Frank Federico, RPh, IHI Executive Director
Steve Meisel, PharmD, IHI Faculty

March 27th, 2012
12:00 - 1:00pm ET
Beth O’Donnell, MPH, Institute for Healthcare Improvement (IHI), is responsible for managing and coordinating strategic partnerships. Ms. O’Donnell received her undergraduate degree at St. Lawrence University and her graduate degree from The Dartmouth Institute for Health Policy and Clinical Practice. She joined IHI in August.
Welcome to today’s session!

Please use Chat to “All Participants” for questions

For technology issues only, please Chat to “Host”

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When Chatting...

Please send your message to All Participants
Let’s Practice Using “Chat”

Please take a moment to chat in your organization name and the number of people on the call with you.

Ex. “Institute for Healthcare Improvement – 2”
Overall Objectives

Participants will be able to:

• Identify opportunities to decrease Adverse Drug Events (ADEs)

• Describe three process changes needed to reduce ADEs

• Discuss what measures are needed to determine the impact of interventions
Frank Federico, RPh, Executive Director, Strategic Partners, Institute for Healthcare Improvement (IHI), works in the areas of patient safety, application of reliability principles in health care, preventing surgical complications, and improving perinatal care. He is faculty for the IHI Patient Safety Executive Training Program and co-chaired a number of Patient Safety Collaboratives. Prior to joining IHI, Mr. Federico was the Program Director of the Office Practice Evaluation Program and a Loss Prevention/Patient Safety Specialist at Risk Management Foundation of the Harvard Affiliated Institutions, and Director of Pharmacy at Children’s Hospital, Boston. He has authored numerous patient safety articles, co-authored a book chapter in *Achieving Safe and Reliable Healthcare: Strategies and Solutions*, and is an Executive Producer of "First, Do No Harm, Part 2: Taking the Lead." Mr. Federico serves as Vice Chair of the National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP). He coaches teams and lectures extensively, nationally and internationally, on patient safety.
Steven Meisel, Pharm.D., Director of Patient Safety for Fairview Health Services, an integrated health system based in Minneapolis, Minnesota. In this role he is responsible for all aspects of patient safety improvement, as well as related measurement, reporting, educational and cultural initiatives. Dr. Meisel has served as faculty for the Institute for Healthcare Improvement safety since 1997. Dr. Meisel is the recipient of numerous awards, including the 2005 University Health-System Consortium Excellence in Quality and Safety Award. He is the author of several publications.
Session Agenda

• Homework – What did you learn?
• Health Information Technology & Medical Education
  o Preventing ADEs Using IT
  o Improving Quality of Drug Ordering Using CPOE
  o Alerting
  o Barcoding
  o IV Medication Safety
  o HIT
• Looking Back on Your Journey
• Q&A
Review of Homework

• Review your system related to medication reconciliation and health literacy.

• Examine standardized processes around medication reconciliation. If in place, are processes used as designed?

• Identify one change you will test to improve either medication reconciliation and/or health literacy.

• What outcome and process measures are you using, or will use?
Tejel Gandhi, M.D., M.P.H., is a board certified internist and Associate Professor of Medicine at Harvard Medical School. She received her MD and MPH from Harvard Medical School and the Harvard School of Public Health, and trained at Duke University Medical Center. Her undergraduate training at Cornell University was in biochemistry.

Dr. Gandhi’s research interests focus on patient safety and reducing error using information systems. She won the 2009 John Eisenberg award for her contributions to understanding the epidemiology and possible prevention strategies for medical errors in the outpatient setting. Dr. Gandhi was the Executive Director of Quality and Safety at Brigham and Women’s Hospital for 10 years, and in that role, she worked to redesign systems to reduce medical errors and improve quality. Currently, Dr. Gandhi is Chief Quality and Safety Officer at Partners Healthcare. In this role, she is helping to lead the efforts to standardize and implement patient safety best practices across the system.
Health Information Technology and Medication Safety

Tejal Gandhi, M.D., M.P.H.
Chief Quality and Safety Officer, Partners Healthcare
Associate Professor of Medicine
Harvard Medical School
Objectives

• Describe HIT innovations and their impact on medication safety

• Highlight strategies for success when designing HIT initiatives
Handwriting Example

[Handwritten text]
Medication Safety

• The typical hospital medication process has several steps:
  – Ordering- MD orders medication
  – Transcribing- nurse copies order onto a paper medication administration record (MAR)
  – Dispensing- pharmacy sends medication to the floor
  – Administering- nurse gives medication to patient and documents this on the MAR

• Medication errors in hospitals are common and can have serious consequences
  – Errors can occur at any stage
Main Strategies for Preventing Errors Using IT

- Tools to improve communication
- Making knowledge more readily accessible
- Requiring key pieces of information
- Assisting with calculations
- Performing checks in real time
- Assisting with monitoring
- Providing decision support

_Bates and Gawande, NEJM 2003_
Potential IT Solutions

• Computerized physician order entry (CPOE) tackles ordering errors
  — Computerized writing of orders
  — 55% reduction in serious med errors

• Barcoding, electronic medication administration records (eMAR), and smart pumps can tackle transcription, dispensing and administration errors
Improving the Quality of Drug Ordering with CPOE

- Streamline, structure process
  - Doses from menus
  - Decreased transcription
  - Complete orders required
- Give information at the time needed
  - Show relevant laboratories
  - Guidelines
  - Guided dose algorithms
- Perform checks in background
  - Drug-allergy
  - Dose ceiling
  - Drug-lab
  - Drug-patient
  - Drug-drug
Allergy to Medication

Current Order:
DICLOX PO

Warnings:

POSSIBLE ALLERGY
POSSIBLE ALLERGY

Message:
Pt. has a POSSIBLE allergy to PENICILLINS.
<Documented allergy to CEPHALOSPORINS --> HIVES.>

(*) C Cancel order
( ) K Keep (override) order

Use up & down arrow keys to read warning messages.
High Chemotherapy Dose Warning

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**WARNING -- HIGH CHEMOTHERAPY DOSE**

39mg/m² Q4H exceeds the daily maximum dose limit of 60mg/m² for DOXORUBICIN
Are you sure about this order?

<No, return to template to change dose.>

<Yes, Continue order with current dose.>
Impact of CPOE on Medication Errors

- CPOE reduced medication errors by 80%
- CPOE reduced serious medication errors by 55%

Bates DW et al. JAMA 1998
Overriding of Alerts

- Studies have shown that MDs override clinical decision support alerts a large percent of the time
  - 88% of inpatient DDI alerts overridden (Payne et al. Proc AMIA 2002)
  - 83% of inpatient drug-allergy alerts (Abookire et al. Proc AMIA 2000)
  - 89% of outpatient high severity DDI alerts and 91% of outpatient drug-allergy alerts (Weingart et al. Arch Intern Med 2003)

- Over alerting has led to major boycotts of CPOE systems (e.g. Cedars Sinai)
Potential Strategies to Improve Alerting

- Creation of streamlined knowledge bases
  - Only essential content
  - Balance between sensitivity and specificity
- Tiering of alerts is also a possibility
  - Hard stop
  - Interruptive
  - Non-interruptive
- Minimizing interruptions
- Did this in EMR
  - 67% of alerts accepted vs. 20% from most studies
Alerting Summary

• Streamlined knowledge bases and tiered alerting have higher acceptance rates
  — Especially for very high risk alerts

• What is our ideal acceptance rate?? Sensitivity/specificity? Best way to display?

• More work needs to be done to maximize the clinical benefits

• Sharing of streamlined knowledge should be widespread
  — No need to reinvent the wheel
Epidemiology of Dispensing Errors

- Dispensing errors are relatively common in hospital pharmacies because of the high volume of medications dispensed
  - 44,000 errors/year in a 735-bed hospital (6 million doses/yr)

- Many dispensing errors have potential for harm
  - More than 9500 errors with potential to harm patients occur per year in a 735-bed hospital
  - Only 1/3 of these serious errors intercepted prior to administration

Pharmacy Barcoding

- Pharmacy technicians use barcode scanning to verify that the drug they are dispensing matches the physicians’ orders.
Dispensing Errors and Potential ADEs: Measurement/Evaluation

* p<0.0001 (Chi-squared test)

Effect of Barcode Technology on Target Potential ADEs

* p<0.001 (Chi-squared test)
Projected Impact at Brigham & Women’s Hospital

• As we speak, the barcode pharmacy system is preventing per year:
  — >13,500 medication dispensing errors (31% reduction)
  — >6,000 errors with potential for harm (63% reduction)
Benefits of Barcode Technology in the Pharmacy

- Medical costs saved through adverse drug event reduction, *per year*
- Increased on-time medication availability on nursing units
- Improved inventory control
- Formal cost benefit analysis showed break-even within first year after go-live
  - 5-year cumulative net benefit = $3.3M

*Maviglia, S et al. Archives of Internal Medicine 2007*
EMAR/Barcoding

• After CPOE and pharmacy barcoding, most common error type at BWH was administration errors
  — Based on safety reporting
  — Research studies from other groups highlighted the frequency of these kinds of errors
Barcode/EMAR at the Bedside

- Orders flow electronically from CPOE to an electronic medication administration record (eMAR)
  - Eliminates transcription entirely
  - Nurses have laptops with eMAR and use this to track what medications need to be given (administered)
- Nurses use barcode scanning of the medication and the patient to verify that the drug they are administering matches the physicians’ orders
  - Right drug, right patient, right dose, right time
  - eMAR alerts if any of these is incorrect
  - Potentially reduces administration errors
Intervention Design/Implementation

• 2D Imagers
  — Both 1 and 2 dimensional bar codes
  — Wireless blue tooth compatible

• Computer Hardware
  — Full size laptop
  — Complete desktop functionality
  — Mobile carts
Scheduling of Medications
Wrong Medication Alert

Wrong Medication
Medication is not part of patient's active medication profile.

Product Scanned:
SODIUM BICARB 650 MG TABLET

Please zoom the order to verify Pharmacy approved packages
Wrong Patient Alert

Wrong Patient

The scanned wristband is either the wrong patient's or the wristband was unreadable. Please check to see if this is the correct patient's wristband and re-scan. If this is the correct patient and this continues then select "Manual Patient Entry" on the To Do Screen to record the administrations.

Patient Scanned:
EMARTEST, MAGGIE MRN: 18919027
# Impact of Barcode Scanning Technology on Administration Errors

<table>
<thead>
<tr>
<th></th>
<th>No Barcode Scanning (n=6712)</th>
<th>Barcode Scanning (n=7314)</th>
<th>Relative Reduction (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication Administration Errors</td>
<td>11.5%</td>
<td>6.7%</td>
<td>41% (p&lt;0.001)</td>
</tr>
<tr>
<td>Potential Adverse Drug Events</td>
<td>3.1%</td>
<td>1.6%</td>
<td>50.8% (p&lt;0.001)</td>
</tr>
</tbody>
</table>

Poon et al. NEJM 2010
Impact of EMAR on Nurse Satisfaction

- Pre and post surveys
- Main Results: Nurses feel medication administration is safer and more efficient after implementation of barcode technology

*Hurley, A et al. Journal of Nursing Administration 2007*
Impact on Nurse Workflow

- 232 2-hour observation sessions before and after barcode/eMAR implementation

- **Primary Result:** Proportion of time spent on medication administration did not change after barcode/eMAR implementation

- **Secondary Result:** Proportion of time spent in presence of patient increased

*Poon, et al. Journal of Nursing Administration 2008*
Barcode Summary

• Barcode technology significantly reduces dispensing, transcription, and administration errors
• Benefits of the technology outweigh its costs in the hospital pharmacy
• A well-designed and fully-supported system did not increase the proportion of time nurses spend on medication administration
• The technology does not appear to compromise the amount of time nurses spend with patients.
• Key is involvement of end users from the beginning in design, hardware selection, and piloting
IV Medication Safety

• Several studies show that IV medications are responsible for 54-61% of the most serious and life threatening potential adverse drug events.

• Almost all “high risk” drugs (heparin, insulin, morphine, potassium chloride) are administered via the IV route.
Smart Pumps and Medication Safety

- Barcoding helps ensure right drug, time, etc.
- However, for IV medications, the biggest error involves programming the infusion pump
  - Manual nursing step
  - Barcoding does not address this (yet...)
    - Work in progress to automatically program pumps via wireless communication or barcode scanning
Features of the “Smart” Pumps

• “Smart” pumps share safety features of older pumps

• “Smart” pumps also equipped with a drug library
  – Provide dose and rate limits on commonly used medications
  – Provide users with overdose and under dose alerts
Case Examples: Decision Support Near Miss Intercepts

- Dopamine
  - entered at 70 mcg/kg/min instead of 7
- Epinephrine
  - entered at 32 mcg/min instead of 2
- Heparin
  - entered [ ] of 5 units/250 cc rather than 25,000/250 cc
Summary: Impact on Serious Medication Errors

- **Order Entry & decision support**: 55% reduction
- **Pharmacy Barcoding**: 67% reduction
- **-eMAR/barcoding at bedside**: 51% reduction
- **Transcription Errors**: 11%
- **eMAR**: 100% reduction
- **Dispensing Errors**: 14%
- **Administration Errors**: 26%

Flowchart:
- MD → Med Orders
- Med Orders → Pharmacist
- Pharmacist → Dispensing
- Dispensing → Medication on Wards
- Medication on Wards → RN
- RN → Administration
- Administration → Patient
Outpatient Adverse Drug Events

- 25% (162/661) primary care patients had an adverse drug event (ADE)
  - 13% (24) serious
  - 11% (20) preventable
  - 28% (51) ameliorable
  - 6% (n=13) both serious and preventable or ameliorable

Outpatient Prescribing Errors

1879 prescriptions reviewed

- Medication errors 143 (7.6%)
  - Potential ADEs 62 (3%)
    - Life threatening 1 (2%)
    - Serious 15 (24%)
    - Significant 46 (74%)
Prevention

• More advanced computer prescribing checks with decision support would have prevented 95% of potential ADEs
  ─ Majority of prevention from complete prescriptions, drug-dose, and drug-frequency checking
Eprescribing Impact

• One study of 15 providers before and after implementation of eprescribing
  —Error rates reduced from 42/100 prescriptions to 6/100 prescriptions

Kaushal, R. et al. JGIM 2010
Impact on multispecialty group practice

- Pre-post study
- Prescription errors decreased from 18% to 8%
- Largest reductions:
  - Illegibility
  - Inappropriate abbreviations
  - Missing information
- No reduction in errors with potential for harm (likely power issue)

Devine, E et al. JAMIA 2010
Medication Reconciliation

- Designed a tool to display patients home meds electronically, pulled from EMR, prior discharge summaries
- Residents use that to create Pre-admission medication list and subsequent admission orders

Schnipper, J. Arch Intern Med 2009
Intervention I: PAML Builder
PAML Builder: Action on Admission

![Image of PAML Builder interface showing a medication list]

<table>
<thead>
<tr>
<th>Source</th>
<th>Medication</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMR</td>
<td>Acetaminophen</td>
<td>03/07/06</td>
</tr>
<tr>
<td>LMR</td>
<td>Chlorzepate Capsules</td>
<td>07/05/05</td>
</tr>
<tr>
<td>LMR</td>
<td>Diclofenac</td>
<td>05/05/06</td>
</tr>
<tr>
<td>LMR</td>
<td>Flec Seed Oil</td>
<td>05/05/06</td>
</tr>
<tr>
<td>LMR</td>
<td>Nifedipine XI</td>
<td>12/05/05</td>
</tr>
<tr>
<td>LMR</td>
<td>Rosuvastatin</td>
<td>05/05/06</td>
</tr>
<tr>
<td>LMR</td>
<td>Therapeutic Multi-Minerals</td>
<td>05/05/06</td>
</tr>
<tr>
<td>LMR</td>
<td>Trazodone</td>
<td>05/05/06</td>
</tr>
</tbody>
</table>

**Pre-Admission Medication List (PAML)**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Date</th>
<th>Need for Clarification</th>
<th>Planned Action on Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digoxin</td>
<td>06/01/06</td>
<td>05:15</td>
<td>Curt diff</td>
</tr>
<tr>
<td>Nitroline XI</td>
<td>33mg SR qid</td>
<td></td>
<td>Substitute with different med</td>
</tr>
<tr>
<td>White Water</td>
<td>PO 10</td>
<td>Unknown</td>
<td>Hold on Admission</td>
</tr>
</tbody>
</table>

Continue at pre-admission dose/frequency and route.
Continue at different dose/frequency and route.
Continue at pre-admission dose/frequency and route.

Continue at different dose/frequency and route.

Substitute with different med.

H. Institute for Healthcare Improvement
## Discharge Medication Ordering Screen

### 1 Medication(s) to be Reconciled

<table>
<thead>
<tr>
<th>Preadmission Medications</th>
<th>Current Inpatient Medications</th>
<th>Discharge Medications</th>
<th>Select</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drug</strong></td>
<td><strong>Dose</strong></td>
<td><strong>Route</strong></td>
<td><strong>Freq</strong></td>
<td><strong>PRN</strong></td>
</tr>
<tr>
<td>DIGOXIN</td>
<td>0.125 MG</td>
<td>PO</td>
<td>QD</td>
<td>✔</td>
</tr>
<tr>
<td>FUROSEMIDE (LASIX)</td>
<td>40 MG</td>
<td>PO</td>
<td>QD</td>
<td>✔</td>
</tr>
<tr>
<td>DIPHENHYDRAMINE</td>
<td>25-50 MG</td>
<td>IV</td>
<td>BID</td>
<td>✔</td>
</tr>
<tr>
<td>MAGNESIUM HYDROXIDE</td>
<td>30 ML</td>
<td>PO</td>
<td>QD</td>
<td>✔</td>
</tr>
<tr>
<td>ACETYLSALICYLIC ACID</td>
<td>325 MG</td>
<td>PO</td>
<td>QD</td>
<td>✔</td>
</tr>
<tr>
<td>ACETAMINOPHEN (TYLENOL)</td>
<td>650 MG</td>
<td>PO</td>
<td>QID</td>
<td>✔</td>
</tr>
<tr>
<td>PENICILLIN V POTASSIUM</td>
<td>500 MG</td>
<td>PO</td>
<td>QID</td>
<td>✔</td>
</tr>
<tr>
<td>MULTIVITAMIN</td>
<td>1 TAB</td>
<td>PO</td>
<td>QD</td>
<td>✔</td>
</tr>
<tr>
<td>VITAMIN HAZEL PADS (TUCKS)</td>
<td>TOPICAL</td>
<td>TP</td>
<td>QID</td>
<td>✔</td>
</tr>
</tbody>
</table>

- **Launch PAML Builder**
- **Add New Discharge Med**
- **Edit**
- **Remove**
- **Key Medication Information**
  - Select One
  - Warfarin eMAR & Lab Results

**Institute for Healthcare Improvement**

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## Patient Discharge Medication Education

### Your Discharge Medication List

**Medications that are new:**
- PENICILLIN V POTASSIUM 500 MG by mouth 4 times a day
- COLACE 100 MG by mouth 2 times a day
- NICOTINE 14 MG/DAY on top of skin 1 time a day

**Medications that have changed:**
- FLUTICASONE PROPIONATE/SALMETEROL 100/50 1 PUFF inhaled 2 times a day

**Medications that stay the same:**
- DIGOXIN 0.25 MG by mouth 2 times a day
- MULTIVITAMIN 1 TAB by mouth 1 time a day

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![Red stop sign]

**STOP taking the following medications:**
- LISINOPRIL 10 MG by mouth 1 time a day
- COSOPT 1 DROP in both eyes 2 times a day
Medication Reconciliation

• Demonstrated 55% reduction in medication discrepancies with potential for harm

• Similar application built for post-discharge medication reconciliation
  — Displays hospital discharge meds side by side with EMR meds
  — Impact being studied

Schnipper, J. [unpub data]
LMR Medication Reconciliation Screen
Key Elements for HIT Success

• Senior leadership support for IT resources and patient safety
  — Emphasize safety benefits/stories/data

• Clinical staff champions to support use of technology
  — Key to demonstrate/measure benefit
  — Key to involve clinical users in design process and get their feedback
    ➢ User groups
    — Key to understand workflow and speed
    — Key during rollouts to emphasize safety benefits

• Be ready to uncover unknown processes that have been supporting the existing process
Key Elements for HIT Success (cont.)

- Avoid over engineering functionality
  - Keep it Simple
  - Make it Easy to Do the Right Thing
- Implement well
  - 24/7 support and super-users
  - Training is most successful when clinicians teach clinicians
- Measure impact
  - Unintended consequences
- Continually seek user feedback for improvements
  - Electronic
  - Face-to-face
  - Override data
- The work never ends!
HIT and Medication Safety Summary

• Non-technology and technology solutions are both important for improving medication safety

  — Creating a culture of safety and ensuring action based on events identified is critical

• Technology can provide the high reliability infrastructure to reduce human error

• HIT can have large impact on physician decision making and improved communication between systems, providers and patients

• Studying the impact of these interventions is essential
"It was done by a doctor – it's called 'Orders.'"
Looking Back…

- **Kick Off Session**, Jan. 17th: Introduction to Contributing Factors for ADEs
- **Session 2**, Jan. 31st: Improving Narcotics & Opiate Management
- **Session 3**, Feb. 14th: Improving Insulin Management
- **Session 4**, Feb. 28th: Improving Anticoagulation Management
- **Session 5**, March 13th: Medication Reconciliation & Health Literacy
- **Session 6**, March 27th: Technology Solutions
Follow Up Items

- Listserv will remain active, so please continue to share and ask questions!
- Along with the recording, the follow up email will contain a Continuing Education Handbook to help guide you through the CEU process. It will also contain a program Evaluation.
Thank You!