National Web-Based Teleconference on Health IT
Preventing Errors and Promoting Safety Through Better Medication Management

February 16, 2011

Moderator:
Angela Lavanderos
Agency for Healthcare Research and Quality

Presenters:
Donna Horn
Andrea Wessel
Chris Lehmann
Judy Smetzer
Preventing Errors and Promoting Safety through Better Medication Management

Introduction

Donna Horn RPh, DPh

I do not have any relevant financial relationships with any commercial interests to disclose.
Definitions

• Medication errors
  – Wrong patient, drug, dose, frequency, route, dosage form, administration directions
  – Presence of contraindication
  – Inappropriate duplicative therapy
  – Important drug-drug interaction

• Adverse drug events (ADEs)
  – Injuries from drug therapy

• Preventable adverse drug events (PADEs)
  – At least a quarter of ADEs are preventable\(^1-3\)
  – Among the most common causes of harm during care
Scope and Significance

Are PADEs really that bad…?
Scope and Significance

Inpatient

− Prescription errors (PADEs)
  • 3.7 to 84.1 per 1,000 admissions\textsuperscript{3-7}

− Preparation/dispensing errors (PADEs)
  • 1.1 to 1.6 per 1,000 admissions\textsuperscript{3,7}

− Drug administration errors (PADEs)
  • 2.1 to 17.9 per 1,000 admissions\textsuperscript{3,7}

− 450,000 patients experience PADE each year\textsuperscript{3,8}
  • 4\% (1.4-15.4\%) of all hospital admissions\textsuperscript{9-15}
Scope and Significance

Outpatient

- Community pharmacies
  - 1.7% to 24% dispensing error rate\textsuperscript{16-19}
- Even with lowest error rate (1.7%)
  - 4 errors per 250 prescriptions\textsuperscript{5}
  - 60 million PADEs annually\textsuperscript{20}
- 5% ambulatory patients experience PADEs\textsuperscript{15}
  - Dosing errors highest clinical significance
- $121.5 billion for hospital admissions\textsuperscript{21}
  - 70% of total costs of drug-related problems
Scope and Significance

Other ambulatory settings

• Outpatient pediatric clinics
  – 15% wrong dose prescribing errors for 22 common drugs\textsuperscript{22}
• Ambulatory clinics
  – 21% prescribing errors\textsuperscript{23}
  – 17% samples dispensed refer to absent packaging information\textsuperscript{24}
• Hemodialysis unit
  – 97.7% patients subject to prescribing errors\textsuperscript{25}
Patients at Higher Risk for PADEs

- Patients on multiple medications
- Patients with low health literacy
- Elderly patients
- Patients with renal or liver impairment
- Pediatrics
High-Alert Medications (Ambulatory)

Drug Class/Category
- Antiretroviral agents
- Chemotherapy, oral
- Hypoglycemic agents, oral
- Immunosuppressant agents
- Insulin
- Opioids, all formulations
- Pregnancy category X drugs
- Pediatric liquid medications that require measurement

Individual Drugs
- carbamazepine
- chloral hydrate liquid
  - sedation of children
- heparin
- methotrexate
  - non-oncologic use
- midazolam liquid
  - sedation of children
- propylthiouracil
- warfarin
Error-Reduction Strategies

- Forcing functions
- Barriers and fail-safes
- Automation and computerization
- Redundancies
- Recovery
- Standardization and protocols
- Performance shaping factors (e.g., checklists, reminders)
- Rules and policies
- Education
- Information
- Make no mistake

Improve system reliability

Improve human reliability
References


Preventing Errors and Promoting Safety through Better Medication Management: The PPRNet Experience

Andrea Wessell, PharmD, BCPS, CDE
PPRNet, Medical University of South Carolina
Charleston, SC

I do not have any relevant financial relationships with any commercial interests to disclose.

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Acknowledgements

• PPRNet Research Team
  – Steven Ornstein, MD
  – Ruth Jenkins, PhD
  – Paul Nietert, PhD
  – Lynne Nemeth, PhD, RN
  – Cara Litvin, MD, MS

• PPRNet practices

• Agency for Healthcare Research and Quality Ambulatory Safety and Quality Program: Improving Quality through Clinician Use of Health IT
Learning Objectives

1. Describe the importance of health IT in preventing patient safety errors.

2. Examine successful error prevention strategies from real-world practice.
MS-TRIP: Medication Safety in Primary Care Practice – Translating Research into Practice

• 3-year demonstration project in 20 PPRNet practices

• Goals:
  1. Develop a set of medication safety indicators relevant to primary care
  2. Incorporate indicators into PPRNet quarterly reports
  3. Assess impact of PPRNet-TRIP quality improvement model on indicators
Background: PPRNet

- Nationwide primary care practice-based research network among users of a common electronic health record (EHR)
- Medication safety decision support features within EHR
  - Allergy, drug-drug and drug-disease and interaction alerts
  - Dosing calculators
  - Monitoring prompts
## MS-TRIP Practice Characteristics

<table>
<thead>
<tr>
<th>Geographic location</th>
<th>Practice count</th>
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<tbody>
<tr>
<td>South</td>
<td>9</td>
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<tr>
<td>Midwest</td>
<td>5</td>
</tr>
<tr>
<td>West</td>
<td>4</td>
</tr>
<tr>
<td>Northeast</td>
<td>2</td>
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</table>

<table>
<thead>
<tr>
<th>Number of clinicians</th>
<th>Practice count</th>
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<tr>
<td>1 or 2</td>
<td>11</td>
</tr>
<tr>
<td>3 or 4</td>
<td>7</td>
</tr>
<tr>
<td>10 or greater</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practice type</th>
<th>Practice count</th>
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</thead>
<tbody>
<tr>
<td>Physician-owned</td>
<td>14</td>
</tr>
<tr>
<td>Hospital-owned</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
</tbody>
</table>

Quality and Safety in Health Care 2010; 19:1-5.
MS-TRIP Intervention

Reports

- Quarterly

- Performance over time with benchmarks

- Lists of de-identified patients with potential errors

Site Visits

Network Meetings
<table>
<thead>
<tr>
<th>Reports</th>
<th>Site Visits</th>
<th>Network Meetings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Quarterly</td>
<td>• Annually</td>
<td></td>
</tr>
<tr>
<td>• Performance over time with benchmarks</td>
<td>• On site meeting with practice staff and clinicians</td>
<td></td>
</tr>
<tr>
<td>• Lists of de-identified patients with potential errors</td>
<td>• Academic detailing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Performance review</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improvement planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• QI implementation assistance</td>
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</table>
MS-TRIP Intervention

**Reports**
- Quarterly
- Performance over time with benchmarks
- Lists of de-identified patients with potential errors

**Site Visits**
- Annually
- On site meeting with practice staff and clinicians
- Academic detailing
- Performance review
- Improvement planning
- QI implementation assistance

**Network Meetings**
- Annually
- “Best practice” dissemination
- Small group workshops on overcoming challenges in implementation
MS-TRIP Indicator Set

- Avoiding potentially inappropriate therapy (3)
- Avoiding potentially inappropriate dosages (4)
- Avoiding potential drug-drug interactions (8)
- Avoiding potential drug-disease interactions (9)
- Monitoring of potential adverse events (20)
Median Summary Performance in Medication Safety Measures Over Time

- Avoiding Potential Drug-Drug Interactions
- Avoiding Potentially Inappropriate Dosing
- Avoiding Potential Drug-Disease Interactions
- Avoiding Potentially Inappropriate Therapy
- Monitoring/Preventing Potential Adverse Drug Events

* p < 0.05
Medication Error Prevention Strategies
Practice Strategies

• Assure the accuracy of each patient’s recorded medication list

• Integrate EHR decision support features into routine practice

• Implement a practice refill and monitoring protocol

• Utilize medication safety practice performance reports

Accurate Medication Lists

- Document all medications prescribed by practice providers

- Implement a process for patient review of EHR medication list
  - Inquire and evaluate use of nonprescription therapy and medications from outside providers

- Distribute printed medication list at the end of each visit
EHR Decision Support

- Review alerts and adjust prescribing as necessary
- Calculate doses based on renal function
- Apply medication monitoring protocols
Refill and Monitoring Protocols

- Educate staff on refill protocol and use of decision support
  - Schedule refills according to monitoring requirements
  - Limit refills if overdue for follow-up

- Empower staff to review monitoring prompts and implement standing orders
• Utilize reports to evaluate performance and guide improvement plans

• Design and execute case management for patients with potential error
  – Message providers within EHR
  – Highlight potential error on EHR medication list
  – Contact patients with adjustments or monitoring instructions

<table>
<thead>
<tr>
<th>Measure Description/Criterion</th>
<th>Description of Eligible Patients</th>
<th>Number of Eligible Patients</th>
<th>Percent Meeting Criterion</th>
<th>Number Not Meeting Criterion</th>
<th>PPRNet Median</th>
<th>PPRNet Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allopurinol: Greater than 200 mg/day; Greater than 100 mg/day</td>
<td>Pts with an active rx* and GFR* 20-60 ml/min or GFR &lt;= 20 ml/min</td>
<td>23</td>
<td>48%</td>
<td>12</td>
<td>71%</td>
<td>100%</td>
</tr>
<tr>
<td>Benzodiazepines: Greater than daily dose for alprazolam 2mg, lorazepam 3mg, oxazepam 60mg, temazepam 15mg, and triazolam 0.25mg</td>
<td>Pts &gt;= 65 years and active rx</td>
<td>87</td>
<td>94%</td>
<td>5</td>
<td>95%</td>
<td>99%</td>
</tr>
<tr>
<td>Digoxin: Greater than 0.125 mg/day</td>
<td>Pts &gt;= 65 yrs with Dx of Heart Failure and active</td>
<td>3</td>
<td>100%</td>
<td>0</td>
<td>95%</td>
<td>100%</td>
</tr>
<tr>
<td>H-2 blocker: Greater than daily dose for cimetidine 1200mg, famotidine 20mg, nizatidine 150mg, ranitidine 150mg</td>
<td>Pts with GFR &lt; 60 ml/min and an active rx</td>
<td>14</td>
<td>57%</td>
<td>6</td>
<td>50%</td>
<td>77%</td>
</tr>
</tbody>
</table>
In the context of a quality improvement intervention, PPRNet practices implemented a consistent set of safety strategies in:

- Practice redesign
- Team involvement
- Patient activation
- Enhanced use of health IT tools
Thank You!
The Road to Safer Patient Care: Leveraging IT

Christoph U. Lehmann, MD
Director, Clinical Information Technology
Johns Hopkins Children’s Medical and Surgical Center

clehmann@jhmi.edu

I do not have any relevant financial relationships with any commercial interests to disclose.
Approach to Errors

• Person approach
  – based on assigning blame
  – focuses on individuals
  – punitive in nature

• Systems approach
  – based on preventing recurrence of errors
  – focuses on system vulnerabilities
  – constructive and inclusive in nature

Reason J. Human error: models and management. BMJ. 2000 Mar 18;320(7237):768-70
System Failures

• Human fallibility is only part of the problem

• Failures at the system level
  – in disseminating pharmaceutical information
  – in checking drug dosages and patient identities
  – in making patient information available

• accounted for > 75% of adverse drug events

(Leape et al, 1995)
Injuries are not Accidents

• Distinct patterns
• Systems issues
• Risk groups-vulnerable populations
• Profiles of harmed patients
• Near misses precede many/all of these events
• The focus on the human actors detracts from an examination of the full range of factors that contribute to injuries
Narcotic RxWriter
Narcotic Prescriptions for Children on Discharge
Errors on Narcotic Prescriptions (N=314)

Severity score:

0 = No errors
1 = Insignificant error
2 = Problem
3 = Significant
4 = Serious
5 = Severe
<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Frequency</th>
<th>Route</th>
<th>Duration</th>
<th>PRN vs ATC</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen with Codeine Elixir</td>
<td>1 mg/kg/dose</td>
<td>q 4 hours</td>
<td>PO</td>
<td>10 days</td>
<td>PRN</td>
<td>Select Acetaminophen with Codeine Elixir</td>
</tr>
<tr>
<td>Acetaminophen with Codeine Tablet</td>
<td>1 mg/kg/dose</td>
<td>q 4 hours</td>
<td>PO</td>
<td>10 days</td>
<td>PRN</td>
<td>Select Acetaminophen with Codeine Tablet</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>0.05 mg/kg/dose</td>
<td>q 4 hours</td>
<td>PO</td>
<td>10 days</td>
<td>PRN</td>
<td>Select Hydromorphone</td>
</tr>
<tr>
<td>Morphine</td>
<td>0.3 mg/kg/dose</td>
<td>q 2 hours</td>
<td>PO</td>
<td>10 days</td>
<td>PRN</td>
<td>Select Morphine</td>
</tr>
</tbody>
</table>
The Johns Hopkins Hospital

600 North Wolfe Street  Baltimore, MD 21287-6180  (410) 955-5000

Hospital's Medical Assistance Number: 064822-600

Name: John Doe

Address:

Valid For Controlled Substances Only

Hydromorphone 1 mg/kg/dose =

Please select

22 mg = 22 mL of Hydromorphone (1 mg per 1 mL)
24 mg = 3 Tab of Hydromorphone (8 mg per 1 tab) [ROUNDED by 3%]

q 4 hours PO  PRN (50% of ATC dose dispensed) for 10 days

Your prescription has triggered alerts.

Please note that HARD limits can overridden only by the PAIN service.

Please go back and correct your order.

- Maximum Dose for Hydromorphone is 3 mg/dose (Hard Limit)
- Maximum Dose for Hydromorphone is 0.2 mg/kg/dose (Hard Limit)
- Maximum Dose for Hydromorphone is 0.15 mg/kg/dose (Soft Limit)
- Maximum Dose for Hydromorphone is 24 mg/day (Soft Limit)
- Maximum Dose for Hydromorphone is 0.9 mg/kg/day (Soft Limit)

Refill: 0 Times

Physician Signature

[Brand medically necessary]
The Johns Hopkins Hospital

600 North Wolfe Street, Baltimore, MD 21287-6180 * (410) 955-5000
Hospital's Medical Assistance Number: 064-872-800
Name: John Doe
Address: ________________________________

Valid For Controlled Substances Only

Hydromorphone Liquid 1 mg per 1 mL
Dispense: #30 mL (thirty)
Sig: Take 1 mL (1 mg Hydromorphone) PO q 4 hours prn pain for 10 days
(= 0.05 mg/kg/dose [Rounded by 9%])
Please dispense with measuring device.
May substitute

Refill: 0 (zero) Times
Physician Signature: ______________________ , M.D.
Physician Print Name: CHRISTOPH LEHMANN, M.D.
J.H.H. Physician ID No.: N2412
DEA No.: BL
0039 (6/03) This prescription is NOT valid as a copy. Pharmacist please check for signature indentation/imprint.

Serial No.: 1007976
10-26-2006
Age: 3 years DOB: 06/26/2003
Weight: 22 kg
Outcome of Prescription Attempts

- 4,995 Attempts
  - 4,282 Attempts Without Alerts
    - 1,340 Abandoned
    - 2,942 Prescriptions
  - 713 Attempts With Alerts
    - 297 Overridden
    - 416 Abandoned
- 3,239 Total Prescriptions
Medication Ordering to Reduce Errors
Prevention of Medication Errors in the Pediatric Inpatient Setting

• Confirm patient's weight
• Identify drug allergies
• Avoid abbr. (instructions, drug names, units)
• Avoid vague instructions
• Specify exact dosage strength
• Avoid terminal zero to right of decimal
• Use zero to left of decimal for numbers < 1
• Legibility
How does one change error rates?

- *Education*: Traditional approach
- *Incentives*: Nice if you can afford it
- *Automation*: Where computers come in
Errors

- Humans
  - erratic
  - err in unexpected ways
  - resourceful, inventive and flexible
  - more likely to recover from errors

- Machines
  - more dependable
  - little ability to adjust behaviors to correct to minor problems
Code Card Project

• One month survey in PICU:
  – 5% calculation errors on code cards
  – Outdated doses in infants (weight change)
Code Card Project

Johns Hopkins Children's Center CPR Card

Weight (in KG): *
Re-Enter Weight (in KG): *
Patient Last Name: *
Patient First Name: 
Patient MRN: 
Nurse's Name: 

* mandatory information
**Johns Hopkins Children's Center CPR Card Page 1/2**

- **Patient Weight:** 12 KG  
- **Name:** Smith, John  
- **Patient History #:** 123-45-67  
- **Date:** 12/07/2003

***These doses are intended for EMERGENCY / ARREST situations only***

<table>
<thead>
<tr>
<th>PALS DRUGS</th>
<th>CONCENTRATION</th>
<th>DOSE mL/KG</th>
<th>FINAL DOSE (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine (0.1 mg/kg) [may double &amp; repeat]</td>
<td>3mg/mL</td>
<td>0.033 x 12</td>
<td>0.4 mL ADENOSINE</td>
</tr>
<tr>
<td>Amiodarone (5 mg/kg)</td>
<td>50 mg/mL</td>
<td>0.1 x 12</td>
<td>1.2 mL AMIO</td>
</tr>
<tr>
<td>Atropine [Bristojet] (0.02 mg/kg) *</td>
<td>0.1 mg/mL</td>
<td>0.2 x 12</td>
<td>2.4 mL ATRO</td>
</tr>
<tr>
<td>Calcium Chloride 10% (20 mg/kg) [PALS Dose]</td>
<td>100 mg/mL</td>
<td>0.2 x 12</td>
<td>2.4 mL Ca Cl</td>
</tr>
<tr>
<td>Epinephrine 1:10,000 [IV / IO]</td>
<td>0.1 mg/mL</td>
<td>0.1 x 12</td>
<td>1.2 mL EPI</td>
</tr>
<tr>
<td>Epinephrine 1:1,000 [ALL ETT and High Dose]</td>
<td>1 mg/mL</td>
<td>0.1 x 12</td>
<td>1.2 mL EPI</td>
</tr>
<tr>
<td>Lidocaine (1 mg/kg) *</td>
<td>20 mg/mL</td>
<td>0.05 x 12</td>
<td>0.6 mL LIDO</td>
</tr>
<tr>
<td>Magnesium Sulfate (25 mg/kg)</td>
<td>500 mg/mL</td>
<td>0.05 x 12</td>
<td>0.6 mL MAG SULF</td>
</tr>
<tr>
<td>Naloxone TEST DOSE (0.01 mg/kg) *</td>
<td>0.4 mg/mL</td>
<td>0.025 x 12</td>
<td>0.3 mL NARC TEST</td>
</tr>
<tr>
<td>Naloxone (0.1 mg/kg) *</td>
<td>0.4 mg/mL</td>
<td>0.25 x 12</td>
<td>3 mL NARC</td>
</tr>
<tr>
<td>Sodium Bicarb (1 mEq/kg)</td>
<td>1 mEq/mL</td>
<td>1 x 12</td>
<td>12 mL NaHCO3</td>
</tr>
</tbody>
</table>

* = ETT Dose 2-3 times IV Dose

**DEFIBRILLATION = 25 JOULES**

**CARIOVERSION = 6 JOULES**

**MAY DOUBLE AND REPEAT**

<table>
<thead>
<tr>
<th>PARALYTIC DRUGS</th>
<th>CONCENTRATION</th>
<th>DOSE mL/KG</th>
<th>FINAL DOSE (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine (0.01 mg/kg) [for less than 8 years old only]</td>
<td>1 mg/mL</td>
<td>give minimum dose</td>
<td>0.15 mL ATRO</td>
</tr>
<tr>
<td>Rocuronium (1.2 mg/kg)</td>
<td>10 mg/mL</td>
<td>0.12 x 12</td>
<td>1.4 mL ROC</td>
</tr>
<tr>
<td>Succinylcholine (2 mg/kg)</td>
<td>20 mg/mL</td>
<td>0.1 x 12</td>
<td>1.2 mL SUCC</td>
</tr>
<tr>
<td>Vecuronium (0.2 mg/kg)</td>
<td>1 mg/mL</td>
<td>0.2 x 12</td>
<td>2.4 mL VEC</td>
</tr>
</tbody>
</table>

*After any med is administered in a peripheral line flush with 5 mL NS

MAY DOUBLE AND REPEAT
Hype and Reality

- Institute of Medicine reports
  - POE one of 14 med-safety recommendations, not centerpiece
    - *To Err Is Human*, p. 183, 191-92
  - Greater emphasis on simple, proven fixes
    - Unit dosing, pharmaceutical software, standard solutions
- Leapfrog: altruism and self-interest
  - Not just Fortune 500 employers
  - Every major insurer (formulary control, physician-specific drug usage)
  - Every major clinical IT vendor
POE meets clinical reality

• Pre-POE written orders expressed *intent*, which a domain expert (pharmacist, RN, rad tech, etc.) translated into action

• POE removes the translator
  • Precision vs. accuracy
  • End-user data entry requires either simple interface or expert user; POE has complex interface, part-time users
  • Order nuances (schedule, stop date, linking) often opaque even to expert users
  • POE requires unfamiliar granularity in each order (schedule, carrier, formulation, etc.)
  • POE picklists make visible entire formulary, including unfamiliar options (20 forms of insulin, 10 of morphine, etc.) that users sometimes order by mistake
  • Ancillaries, previously expert fixers/mediators, now simply reject orders and tell docs to re-enter → delay in care delivery
Standard alert signal & noise

- Drug-drug interaction
  - 15% of drug orders triggered alerts
  - House staff overrode 97.4% of alerts
  - 2.6% that resulted in order changes,
    - two-thirds of substitutions inappropriate or dangerous
      - Heparin + coumadin, clopidogrel + aspirin, spironolactone + potassium
  - Ambiguous messages such as “GENERALLY AVOID” or “CONTRAINDICATED”
  - Alert invisible to pharmacists
  - Did not distinguish med route (ophthalmic beta blockers)
The Paper Albatross

• Creates more paper
• Paper is recycled faster
• Orders have to be printed to provide a hard copy back up
• 24 hour summary printout
• One screen order set may translate into 13 pages of printed orders
Interface Problems

• Juxtaposition Error
  – “Something is too close to something else”
  – “Clicked the wrong thing”

• Wrong Patient
  – Not all interfaces make the patient context clear

• Wrong Time
Cost

- High Profile failure (Cedars Sinai)
- Purchase prize low compared to implementation costs (1:10)

- Brigham and Women's Hospital
  - cumulative net savings of $16.7 million
  - net operating budget savings of $9.5 million
  - break-even after 5-8 years)

THANK YOU

clehmann@jhmi.edu
Year 1: Using Risk Models to Identify and Prioritize Outpatient High-Alert Medications

Years 2-4: Risk-Informed Interventions in Community Pharmacy: Implementation and Evaluation

Donna Horn, RPh, DPh
Judy Smetzer, RN, BSN, FISMP

These studies are supported by grant numbers 1P20HS017107 and R18HSO17910 from the Agency For Healthcare Research and Quality

I do not have any relevant financial relationships with any commercial interests to disclose.
Year 1: Using Risk Models to Identify and Prioritize Outpatient High-Alert Medications

Aims

• Develop risk models for four high-alert medications
• Identify error pathways
• Identify approaches for reducing the risk of harm

Methods

• Mapped out the dispensing processes
• Focus group provided input into the construction of the risk models for each high-alert medication
• Quantified the risk of failures within risk models
• Determined the impact of error-reduction strategies
Details: Point-of-Sale Errors

- Initiating errors
  - Bagging error: 0.4/1,000
  - Retrieval error: 3/1,000
- PADE: 1.22/1,000 (64% capture)
- Opening bag at point of sale
  - 56% reduction in PADE (0.534/1,000)
- Increase compliance with identification from 50% to 80%
  - 34% reduction in PADE (0.804/1,000)
- Increase patient counseling from 30% to 80%
  - 27% reduction in PADE
- Interventions together: 86% reduction
Details: Selecting the Wrong Dose

- Wrong dose of warfarin
  - Initiating error 1/10 prescriptions
  - PADE: 9.25/10 million prescriptions (99.9% capture)
  - Eliminate barcode scanning
    - 95,340% increase in risk (9/10,000)
  - Use cheat sheet 30% of time
    - 265,011% increase in risk (2/10,000)
  - Increase patient counseling from 30% to 80%
    - 67% reduction in risk (3/10 million)
  - Increase automated dispensing from 20% to 50%
    - 35% reduction in risk (5/10 million)
- Two interventions together: 78% reduction in risk
Details: Prescribing Errors

- Wrong dose of fentanyl or inappropriate use of drug
  - Initiating error 1/1,000 prescriptions
  - PADE: 7.30/10,000 prescriptions (27.0% capture)
  - Opioid history at drop off (50% patients, 40% capture rate)
    - 40% decrease in risk (0.439/1,000)
  - Increase patient counseling from 10% to 80%
    - 64% decrease in risk (0.263/1,000)
  - Two interventions together
    - 78% decrease in risk
Discussion and Conclusions

• Prescribing errors
  – Designed to capture straightforward mistakes
  – Poorly designed to capture errors associated with inappropriate drugs or doses due to patient factors
  – More frequent and effective counseling
    • Reduce PADEs by 64%

• Dispensing errors
  – Vulnerable to data entry errors, wrong patient errors
    • Second verification process reduced risk by 87%
    • Opening bag during customer sale reduced risk by 56%
  – Reliable for detecting drug/dose selection errors due to bar-coding, automated dispensing, pill images
Years 2-4: Risk-Informed Interventions in Community Pharmacy: Implementation

- Intervention 1
  - Scripted mandatory patient counseling
    - Warfarin and low-molecular weight heparin
    - Fentanyl patches
    - Methotrexate
    - Insulin analogs
    - Hydrocodone and oxycodone (with acetaminophen)

- Intervention 2
  - Readiness assessment for bar-coding technology

- Intervention 3
  - Risk assessment/intervention scorecard using risk models from first study: HAMERS tool
Intervention 1: Patient Counseling

• Pre-intervention observation in pharmacies
  – 50 observations completed
  – 4 states
    • 2 with mandatory counseling
    • 2 with mandatory offer to counsel
  – Preliminary findings
    • No counseling in states with offer to counsel
      – Counseling for OTCs more common than for prescription drugs
    • More frequent counseling in states with mandatory counseling
      – Differences between state enforcement of counseling
      – Not covering information linked to PADEs
Intervention 1: Patient Counseling

• Implementation Tool Kit
  – Scripted counseling materials, checklists, health questions
  – Consumer handouts about targeted drugs
    • Specifically targets known causes of PADEs
**Warfarin**

**Too little, too much!**

Too much warfarin can lead to a blood clot. Too much warfarin can lead to bleeding.

**Signs of bleeding**
- Unusual pain, swelling, discomfort
- Unusual or easy bruising
- Pink or brown urine
- Prolonged bleeding from cuts or gums
- Persistent/heavy, unusual bleeding that does not stop within 7 minutes
- Unusual heavy menstrual flow
- Coughing up blood

**Signs of a clot**
- Leg/chest pain
- Fast heart rate
- Coughing, shortness of breath
- Fever
- Arm or leg swelling, redness, warmth, tenderness
- Brain/head pain, vision changes, ache, dizziness, weakness or dizziness on one side of body

**Foods high in vitamin K**
- Dark leafy vegetables
- Broccoli and Brussels sprouts
- Chickpeas
- Green leafy vegetables
- Asparagus, kale, green beans
- Broccoli
- Milk

**Watch for Signs of Bleeding or Clot!**

Serious bleeding can occur even if you take warfarin exactly as prescribed. Also, you can still get a blood clot while taking warfarin. Report any signs of bleeding and see a doctor on the back to your doctor immediately.

For more information to help keep you safe, visit: www.consumermedsafety.org

---

**Top 10 List of Safety Tips for Warfarin**

1. **Stop smoking.** Smoking decreases the effectiveness of warfarin and increases the risk of bleeding.
2. **Avoid or limit alcohol.** Alcohol can interact with warfarin and affect the body's ability to clot. Aim for no more than one drink per day. Men should aim for no more than two drinks per day.
3. **Avoid or limit certain medications.** Some medications can interact with warfarin and change the way it works. Talk to your doctor or pharmacist before taking any new medications.
4. **Avoid or limit foods high in vitamin K.** Vitamin K can affect how warfarin works. Foods high in vitamin K include leafy greens, broccoli, Brussels sprouts, and kale. Talk to your doctor or pharmacist about any questions you have.
5. **Follow your doctor's instructions.** Your doctor will monitor your blood clotting with a test called the INR. Follow your doctor's instructions for taking your warfarin and for having your INR checked.
6. **Follow your doctor's instructions.** Your doctor will monitor your blood clotting with a test called the INR. Follow your doctor's instructions for taking your warfarin and for having your INR checked.
7. **Follow your doctor's instructions.** In the rare case of emergency, stop taking your warfarin and call 911 or your doctor immediately. If you think you may be having a stroke or other emergency, call 911 or your doctor immediately.

**Watch for Signs of Bleeding or Clot!**

Serious bleeding can occur even if you take warfarin exactly as prescribed. Also, you can still get a blood clot while taking warfarin. Report any signs of bleeding and see a doctor on the back to your doctor immediately.

For more information to help keep you safe, visit: www.consumermedsafety.org
Intervention 1: Patient Counseling

Measures

• Post-implementation observation
  – Prescribing/dispensing/self-administration errors
  – Barriers/facilitators to counseling
  – Quality of counseling sessions

• Self-administered surveys to patients
  – Perception of counseling encounter/value of handouts
    • Increase understanding? New information? Change behavior?
  – Require treatment for a PADE?

• Self-administered surveys to pharmacists
  – Perceived value and impact of counseling
Intervention 2: Bar-coding Readiness Assessment

- 46-50% of community pharmacies in the US do not use barcode technology for product verification
- 100 pharmacies participating in the study
- Survey to determine why non-users are still non-users
- Phase 1
  - 5 pharmacies pilot testing the tool
  - 100 pharmacies will complete the assessment and submit findings
  - Pharmacies will complete survey to measure perceived value
- Phase 2
  - Pharmacies from Phase 1 that have since implemented bar-coding will complete survey to measure actual value
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Directions for Entering Data and Generating Reports

Legal Protection of Readiness Assessment Data Submitted to ISMP

Readiness Assessment for Pharmacy Leadership/Owner

Demographics

Readiness Assessment Tool

Readiness Assessment for Pharmacy Staff

Demographics

Readiness Assessment Tool

Appendix A—Putting Bar-Coding Technology into Context

Uses and Benefits of Bar-coding Technology in Community Pharmacies

Impact of Barcode Product Verification Systems on Dispensing Errors

Incidence of Bar-Coding Technology in Community Pharmacies

Factors that Impact the Decision to

Implement a Barcode Product Verification System

Challenges Implementing Barcode Product Verification Systems

Selecting the Right Barcode Product Verification System

Costs Associated with Barcode Product Verification Systems

Conclusions

Appendix B—Vendor Selection

Elements to Consider During Vendor Selection

Appendix C—Costs

Direct Costs Associated with Barcode Verification Systems

References

*Photo on front cover courtesy of Relay Laundry, LLC.
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Intervention 3: HAMERS
(High-Alert Medication Error Risk Scorecard)

• Risk models translated into practical assessment tool and scorecard

• Tool Kit will include:
  – HAMERS tool (webpage download)
    • Scorecard with qualitative (distribution of risk) and quantitative (PADE rates) information
    • Tool calculations driven by reports from original risk models
**Intervention 3: HAMERS**

- 3 principal elements
  - AND gates
  - OR gates
  - basic events

- Includes the effects of:
  - Capture opportunities
  - Human errors
  - At-risk behaviors and procedural deviations
  - Mechanical/technology failures

- Modeling team estimates rates of failure based on human factors
Human Error Probabilities

Probability estimates to quantify risk

Unfamiliar task performed at speed/no idea of consequences 5:10
Task involving high stress levels 3:10
Complex task requiring high comprehension and skill 15:100
Select ambiguously labeled control/package 5:100
Failure to perform a check correctly 5:100
Error in routine operation when care required 1:100
Well designed, familiar task under ideal conditions 4:10,000
Human performance limit 1:10,000
Intervention 3: HAMERS

Inputs

• Set-up questions
  – System attributes: Require data entry verification for pharmacists?
  – Availability: Use bar-coding technology? Specific computer alerts?
  – Prescription volumes?

• Exposure rates
  – Frequency of counseling patients?

• Capture opportunities
  – What percent of errors will not be caught during this step?

• At-risk behaviors
  – Frequency of choosing not to ask a customer for a second identifier?

• Human errors
  – Frequency of forgetting to read back an oral prescription? (preset)
Output

- Scorecard that quantifies the risk of specific PADEs
- Bar graph that shows distribution of risk
  - Which tasks/elements contribute most to the PADE?
- Menu of interventions to reduce risk
  - Pharmacy makes changes to inputs based on the planned interventions
  - Pharmacy receives a revised scorecard that quantifies improvements based on planned interventions
    - If (intervention) is implemented, then risk that the PADE will reach the patient is ___%.
    - If risk factor is (increased/decreased) by ___%, then risk that the PADE will reach the customer is __%. 
Instructions
You have selected the tool associated with wrong dose prescribing errors. Now you must specify which high-alert medication(s) you want to evaluate, and how often you fill prescriptions for these medications. While this tool can be used to evaluate wrong dose prescribing errors with any drug, focusing on high-alert medications helps to reduce the risk of errors that can cause the greatest harm to patients.

Question 1a
Please list the name(s) of the medication(s) or class of medications involved in the wrong dose prescribing errors you want to evaluate.

Answer - Medications List:

Question 1b
Please provide the number of prescriptions (new prescriptions and refills combined) filled annually for the medications involved in these errors. Include generic brands and all strengths if applicable. Add all generics, brands, and strengths together.

Answer - Number of prescriptions filled annually:
The next set of questions are associated with the process of entering the prescription into the pharmacy computer. The questions will explore how often pharmacists and pharmacy associates enter prescriptions for these medications, and how many prescriptions are for refills or for new patients (patients new to the pharmacy or new to the drug therapy). You will also be asked to estimate how often the wrong dose prescribing errors are missed during data entry given specified conditions. This set of questions apply only to the data entry process. The data entry verification process and drug utilization review process are addressed in a later section.

Question 7

What percent of prescriptions for these medications are entered into the pharmacy computer by a pharmacy associate (e.g., technician, pharmacy student, pharmacy resident)? (E57 and E59)

Please be sure to consider daytime, nighttime, and weekend/holiday staffing when averaging the percents.

Answer: 0%, <1%, 1%, 5%, then 5% increments

EXPOSURE RATE
Question 9
A pharmacist is entering a prescription into the profile of an existing patient who has previously taken the same drug or another drug within the same class. On average, what percent of the wrong dose prescribing errors will be missed by a pharmacist during data entry (when there are no computer dose alerts)? (E68)

Note: This does not include response to computer alerts; alerts are factored in during the pharmacists' drug utilization review (DUR). Just estimate how often the pharmacist would miss the prescribing error during the data entry process without the help of a computer alert.

Answer: <1%, 1%, 5%, then 5% increments

Question 25
What percent of the time does a pharmacist ignore the duplicate therapy alert for the medications in question or fail to give the alert his/her full attention? (E63)

Answer: 10%, 15%, then in 5% increments

At-risk Behavior

Missed Capture Opportunity
High-Alert Medication Error Reduction Scorecard (HAMERS)

Scorecard Risk Report

### Rank ordering of Risk Contributors

<table>
<thead>
<tr>
<th>Risk Contributor</th>
<th>Probability</th>
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<tbody>
<tr>
<td>Final product verification does not occur by pharmacist (human error)</td>
<td>70.0%</td>
</tr>
<tr>
<td>Pharmacist does not catch an error occurring during product verification with out-of-range dose (human error)</td>
<td>60.0%</td>
</tr>
<tr>
<td>Data entry verification does not occur (ABP)</td>
<td>50.0%</td>
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<tr>
<td>Prescription error not detected when system flags prescription and DOR is conducted</td>
<td>40.0%</td>
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<tr>
<td>Prescription error not detected during data entry, verification with independent check</td>
<td>30.0%</td>
</tr>
<tr>
<td>Prescribing error not detected during data entry, verification with independent check</td>
<td>20.0%</td>
</tr>
<tr>
<td>Prescribing error not detected during data entry, verification with independent check</td>
<td>10.0%</td>
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<tr>
<td>Prescribing error not detected during data entry, verification with independent check</td>
<td>0.0%</td>
</tr>
<tr>
<td>Pharmacy staff does not catch an error occurring during data entry, existing patient profile</td>
<td>70.0%</td>
</tr>
<tr>
<td>Prescribing error not detected during data entry, verification with independent check</td>
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*Funded through a grant from the Agency for Healthcare Research and Quality (AHRQ). Copyright: 2010 ISMP and OE*
Thank You!

Donna Horn: dhorn@ismp.org
Judy Smetzer: ismetzer@ismp.org
Questions & Answers

Our Panel:

Donna Horn, R.Ph., D.Ph., director of patient safety at the Institute for Safe Medical Practices (ISMP)

Andrea M. Wessell, PharmD., B.C.P.S., C.D.E., associate professor at the Medical University of South Carolina and PPRNet (Practice Partner Research Network) investigator

Christoph “Chris” U. Lehmann, M.D., F.A.A.P., associate professor of pediatrics and a board-certified neonatologist in the Eudowood Neonatal Pulmonary Division at the Johns Hopkins University School of Medicine

Judy Smetzer, R.N., B.S.N., vice president at the Institute for Safe Medication Practices (ISMP)
Coming Soon!

Our next event

A webinar examining health information technology and patient centered care

Stay tuned for exact date, time and registration information
Thank You for Attending

This event was brought to you by the AHRQ National Resource Center for Health IT

The AHRQ National Resource Center for Health IT promotes best practices in the adoption and implementation of health IT through a robust online knowledge library, Web conferences, toolkits, as well as AHRQ-funded research outcomes.

A recording of this Web conference will be available on the AHRQ National Resource Center Web site within two weeks.

http://healthit.ahrq.gov
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<td>Avoiding Potential Drug-Drug Interactions</td>
<td>98.8%</td>
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<td>98.5%</td>
<td>98.4%</td>
<td>98.7%</td>
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<td>89.7%</td>
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<td>Avoiding Potentially Inappropriate Therapy</td>
<td>69.9%</td>
<td>70.8%</td>
<td>68.7%</td>
<td>76.3%</td>
<td>79.6%</td>
<td>79.3%</td>
<td>80.6%</td>
<td>81.1%</td>
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<td>Monitoring/Preventing Potential Adverse Drug Events</td>
<td>74.2%</td>
<td>75.5%</td>
<td>77.9%</td>
<td>78.6%</td>
<td>79.2%</td>
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