Integrating Technology to Improve Medication-Use Patient Safety

Presented as a Midday Symposium at the 44th ASHP Midyear Clinical Meeting and Exhibition

Monday, December 7, 2009
Las Vegas, Nevada
Please be advised that this activity is being audio recorded for archival purposes and, in some cases, for repurposing of the content for enduring materials.
Integrating Technology to Improve Medication-Use Patient Safety

A G E N D A

11:30 a.m. – 11:35 a.m.  Welcome / Introductory Remarks
William W. Churchill, M.S., B.S.Pharm.
Program Chair

11:35 a.m. – 12:10 p.m.  The Need for Systems Integration in Health Systems: Point-of-Care Decision Support Technology for Improved Patient Care
Christopher Fortier, Pharm.D.

12:10 p.m. – 12:45 p.m.  Current Examples of Systems Integration in Health Systems – Effectively Minimizing Medication Errors

12:45 p.m. – 1:20 p.m.  Making it Happen in Your Institution: Improving Your Medication-Use Process with Closed-Loop Technologies
William W. Churchill, M.S., B.S.Pharm.

1:20 p.m. – 1:30 p.m.  Faculty Discussion and Audience Questions
All Faculty

F A C U L T Y

William W. Churchill, M.S., B.S.Pharm., Program Chair
Executive Director of Pharmacy
Brigham and Women’s Hospital
Boston, Massachusetts

Vice President of Operations – Radiology, Laboratory and Pharmacy
Lancaster General Hospital
Lancaster, Pennsylvania

Christopher Fortier, Pharm.D.
Manager, Pharmacy Support Services
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Medical University of South Carolina
Charleston, South Carolina
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Mr. Churchill declares that he has no relationships pertinent to this activity.

**Richard D. Paoletti, M.B.A., B.S.Pharm.**

Mr. Paoletti declares that he has no relationships pertinent to this activity.

**Christopher Fortier, Pharm.D.**

Dr. Fortier declares that he has no relationships pertinent to this activity.

**Ron DeChant, M.S., B.S.Pharm.**

Mr. DeChant declares that he has no relationships pertinent to this activity.
ACTIVITY OVERVIEW

This symposium will provide a discussion of integrating technology in the medication-use process, including bedside barcode and infusion device technologies with point-of-care decision support for health care systems. With the swift evolution of sophisticated information systems that allow for wireless interface with electronic medical records (eMAR) and point of care technologies, more health care systems across the country are evaluating and implementing these systems to improve patient safety and decrease medication errors. Pharmacists practicing in health systems should be key players and decision makers involved in the evaluation and selection of the numerous technologies available. It is imperative, therefore, that health-system pharmacists remain abreast of new and evolving tools and technologies that can improve clinical outcomes in their patients.

The focus of this activity is to provide an overview of best practices in using technologies with point-of-care decision support (i.e. intelligent infusion pumps and bedside point-of-care bar code verification) and the impact that integration and implementation of such technology can have on medication-use and ultimately patient safety. An automated audience response system will be used to facilitate active learning and application of knowledge to practice.

ACTIVITY OBJECTIVES

At the conclusion of this knowledge-based educational activity, participants should be able to

- Discuss the need for systems integration in the medication-use process in health systems.
- List and discuss at least two benefits of implementing intravenous infusion pump technologies with point-of-care decision support.
- Describe several examples of improvements to patient care resulting from integration of bar code technology.
- Discuss pharmacy practices and technologies that support bedside point-of-care bar code scanning.
- Identify at least three benefits that can be achieved by implementing full bi-directional system integration with existing and future medication safety technologies.
CONTINUING EDUCATION ACCREDITATION

The American Society of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. This activity provides 2.0 hours (0.2 CEUs) of continuing pharmacy education credit (ACPE activity #204-000-09-435-L01P).

Attendees must complete a Continuing Pharmacy Education Request online and may immediately print their official statements of continuing pharmacy education credit at the ASHP Learning Center at http://ce.ashp.org following the activity.

Complete instructions for receiving your statement of continuing pharmacy education online are on the next page. Be sure to record the five-digit session code announced during the activity.

Available soon at http://ashpmedia.org/symposia/technology

So that this educational activity can be shared with a wider audience, a Web-based version of it is being developed. Encourage your pharmacist colleagues who were unable to attend the Midyear to look for this free online continuing pharmacy education activity beginning in March 2010.

Please note that individuals who claim CPE credit for the live symposium are ineligible to claim credit for the Web-based activity.
Instructions for Processing CPE online at http://ce.ashp.org

The ASHP Learning Center allows participants to obtain statements of continuing pharmacy education (CPE) conveniently and immediately using any computer with an internet connection. To obtain your CPE statements for ASHP Advantage activities, please visit http://ce.ashp.org

1. Log in to the ASHP Learning Center using your e-mail address and password.
   If you have not logged in to the new ASHP Learning Center (launched August 2008) and are not a member of ASHP, you will need to set up an account by clicking on “Become a user” and following the instructions.

2. Once logged in to the site, click on “Process Meeting CE.”

3. If you are a registered attendee at the ASHP Midyear Clinical Meeting, click on the start button to the right of ASHP Midyear Clinical Meeting 2009.
   If you are not registered to attend the ASHP Midyear Clinical Meeting, click on the start link to the right of the activity title. If this activity title does not appear in your meeting list, enter the 5-digit activity code in the box above the list and click submit. The activity code for this activity is 09435. Click register again when prompted. When you receive the “thank you for registering” message, click continue. This step will bring you back to your meeting list. Click on the start link to the right of the activity title.

4. Click on the click here link to view sessions associated with the day of the activity. This activity was held on Monday, December 7, 2009.

5. Enter the session code, which was announced during the activity, and select the number of hours equal to your participation in the activity. Pharmacists should only claim credit for the amount of time they participate in an activity.

6. Click submit to receive the attestation page.

7. Confirm your participation and click submit. Your transcript page will appear.

8. Click on view/print statement of credit next to the meeting name to print your CPE statement.

<table>
<thead>
<tr>
<th>Date of Activity</th>
<th>Activity Code</th>
<th>Session Code (announced during the live activity)</th>
<th>CPE credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday, December 7</td>
<td>09435</td>
<td></td>
<td>2</td>
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</table>

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Integrating Technology to Improve Medication-Use
Patient Safety
Incorporating Technology to Improve Medication-Use and Patient Safety

Christopher Fortier, Pharm.D.
Manager, Pharmacy Support Services
Clinical Assistant Professor
Medical University of South Carolina
Charleston, South Carolina

Christopher Fortier, Pharm.D. is Manager of Pharmacy Support Services at the Medical University of South Carolina (MUSC) and Clinical Assistant Professor, South Carolina College of Pharmacy – MUSC Campus in Charleston, South Carolina. As Manager of Pharmacy Support Services, he oversees procurement/contracting, controlled substances, repackaging, compounding, given-in-clinic, and investigational drug services. Dr. Fortier has lead the implementation of bar code medication administration, smart infusions pumps, and medication reconciliation across the organization.

Dr. Fortier served on the ASHP New Practitioners Forum Executive Committee for two years and as the vice-chair in 2006-2007. Additionally, with the New Practitioners Forum he chaired the Communications and Public Affairs Advisory Group (2005-2007) and was a member of the Leadership and Career Development Advisory Group (2003-2005, 2007-2008). As a member of the ASHP Practice Manager Section he served as the vice-chair and chair on the section’s Leadership Development Advisory Group (2005-2009). He is a representative on the ASHP Foundation’s Center for Health-System Pharmacy Leadership Student and New Practitioner Leadership Task Force (2007-present). Dr. Fortier is involved with the University Health System Consortium (UHC) Pharmacy Council’s Executive Committee, and he currently chairs the Medication-Use Informatics and Technology Committee. He is a member of the South Carolina Society of Health-System Pharmacists.

Dr. Fortier received his Doctor of Pharmacy degree from the University of Connecticut and completed a PGY-1 Practice Residency and a PGY-2 Health-System Pharmacy Administration Residency at the Medical University of South Carolina Medical Center.
Integrating Technology to Improve Medication-Use Patient Safety

Christopher Fortier, Pharm.D.

PRESENTATION

The Need for Systems Integration in Health Systems: Point-of-Care Decision Support Technology for Improved Patient Care

OVERVIEW

There are numerous examples in the published literature showing the positive impact of medication-use technologies on patient and medication safety. However, there are still large gaps within the medication-use system that can lead to error. A key reason for this is the low percentage of implemented technologies that have been shown to decrease medication error rates. Contributing to these gaps is the lack of complete closed-loop integrated systems with technologies such as computerized physician order entry (CPOE), bar code medication administration (BCMA), and smart or intelligent intravenous infusion pumps. Health care organizations must understand the importance of the integration of systems and strategies that are required from the start to achieve full optimization. Pharmacy leaders should assure that they are at the table when system-wide decisions are considered pertaining to informatics and drug delivery technologies. Pharmacy departments should lead the charge for the changing roles of the pharmacist and technician with the implementation of these new technologies.

LEARNING OBJECTIVES

At the conclusion of this knowledge-based educational activity, participants should be able to

- Discuss the need for systems integration in the medication-use process in health systems.
- Identify medication safety issues that can arise by not having a fully integrated medication-use technology system.
- List general strategies needed to become a fully integrated site.
- Describe the importance of involving pharmacists in the area of informatics within health-systems.
The Need for Systems Integration in Health Systems: Point-of-Care Decision Support Technology for Improved Patient Care

Christopher Fortier, Pharm.D.
Manager, Pharmacy Support Services
Clinical Assistant Professor
Medical University of South Carolina
Charleston, South Carolina

Objectives

• Discuss the need for systems integration in the medication-use process in health systems
• Identify the medication safety issues around not having a fully integrated medication-use technology system
• List general strategies on becoming a fully integrated site
• Describe the importance of the changing role of the pharmacist within informatics
Technology Impact

• BCMA (Bar code medication administration)
  – Reduced between 50% and 90% of medication administration errors
  – Prevent 13,000 dispensing errors and 6,000 potential ADEs per year
  – Return on investment was $3.5 million

• CPOE (Computerized prescriber order entry)
  – Can reduce medication errors by 50%
  – Implementation could prevent between 570,000 and 907,000 serious medication errors each year
  – Return on investment between $5 and $10 million annually

Do you feel that you are safer now with the implementation and utilization of medication-use technologies?

What is the percent of bar code medication administration (BCMA) implemented at your institution?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%
What is the percent of computerized physician order entry (CPOE) implemented at your institution?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%

What is the percent of smart infusion pumps implemented at your institution?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%

Do your smart pumps currently interface with your BCMA system?

A. Yes
B. No
C. Do not have smart pumps
What is the percent of an electronic medical record (EMR) implemented at your institution?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%

What technologies does your pharmacy information system currently interface with?

A. CPOE, EMR, and BCMA
B. BCMA and EMR
C. CPOE only
D. EMR only
E. BCMA only
F. None of the above

What is the percentage of a fully integrated closed loop-technology system within your organization?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%
Current Technology Adoption

Healthcare Informatics Technology Implemented Across US

Technology Combinations

- BCMA without CPOE
- CPOE without BCMA
- EMR and BCMA without CPOE
- EMR and clinical documentation only
- Smart pumps without CPOE, BCMA, EMR
Table 14: Technology Used by Nurses When Administering Medications

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total N</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1039</td>
<td>468</td>
<td>45.0</td>
<td>605</td>
<td>58.1</td>
<td>606</td>
<td>57.7</td>
<td>606</td>
<td>57.7</td>
</tr>
<tr>
<td>General and children's medical-surgical hospitals by staffed beds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&lt;50</td>
<td>115</td>
<td>90</td>
<td>78.3</td>
<td>75</td>
<td>65.6</td>
<td>68</td>
<td>58.8</td>
<td>70</td>
<td>60.0</td>
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<tr>
<td>50-99</td>
<td>115</td>
<td>86</td>
<td>75.0</td>
<td>80</td>
<td>69.5</td>
<td>82</td>
<td>71.1</td>
<td>81</td>
<td>70.7</td>
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<tr>
<td>100-199</td>
<td>292</td>
<td>201</td>
<td>69.0</td>
<td>238</td>
<td>81.7</td>
<td>238</td>
<td>81.7</td>
<td>238</td>
<td>81.7</td>
</tr>
<tr>
<td>200-299</td>
<td>292</td>
<td>201</td>
<td>69.0</td>
<td>238</td>
<td>81.7</td>
<td>238</td>
<td>81.7</td>
<td>238</td>
<td>81.7</td>
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<tr>
<td>300-399</td>
<td>107</td>
<td>74</td>
<td>69.0</td>
<td>80</td>
<td>74.8</td>
<td>81</td>
<td>75.3</td>
<td>81</td>
<td>75.3</td>
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<tr>
<td>400-799</td>
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<td>86</td>
<td>72.9</td>
<td>107</td>
<td>92.0</td>
<td>107</td>
<td>92.0</td>
<td>107</td>
<td>92.0</td>
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<td>800-1399</td>
<td>138</td>
<td>97</td>
<td>70.4</td>
<td>117</td>
<td>85.2</td>
<td>117</td>
<td>85.2</td>
<td>117</td>
<td>85.2</td>
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<tr>
<td>1400+</td>
<td>138</td>
<td>97</td>
<td>70.4</td>
<td>117</td>
<td>85.2</td>
<td>117</td>
<td>85.2</td>
<td>117</td>
<td>85.2</td>
</tr>
</tbody>
</table>


Table 15: Use of Intelligent Infusion Devices (Smart Pumps)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Smart Pumps</th>
<th>Pharmacy Maintains Smart Pump Library</th>
<th>Quality Improvement Ligated From Smart Pump</th>
<th>Smart Pumps With Wires &amp; Cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1039</td>
<td>468</td>
<td>45.0</td>
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<tr>
<td>General and children's medical-surgical hospitals by staffed beds</td>
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<tr>
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</tr>
<tr>
<td>1400+</td>
<td>138</td>
<td>97</td>
<td>70.4</td>
<td>117</td>
</tr>
</tbody>
</table>

Why Lack Of Integration?

- Yet to purchase/implement key technology
- Interfaces not available
- Inflexible technologies
- Financial considerations
- Staffing resources
  - IT resources to develop interfaces
- Lack of a strategic vision and plan

Why Lack Of Integration?

- No best practices to successfully implement a comprehensive system
- Different technologies from various vendors
- Focused mainly on individual technology implementation
- Lack of research and supporting literature
- Small percentage of fully-integrated sites
Why The Need For Integration?

Where Do Med Errors Occur?

<table>
<thead>
<tr>
<th>Prescribing 39% of Errors</th>
<th>Transcribing 12% of Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>38% Wrong Dose</td>
<td>78% Illegible Signature</td>
</tr>
<tr>
<td>19% Wrong Choice</td>
<td>58% Time Missing</td>
</tr>
<tr>
<td>12% Known Allergy</td>
<td>24% Order Incomplete</td>
</tr>
<tr>
<td>6% Wrong Frequency</td>
<td>20% Order Illegible</td>
</tr>
<tr>
<td>4% Drug-Drug Interaction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dispensing 11% of Errors</th>
<th>Administering 38% of Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>37% Decimal point error</td>
<td>6,561 combinations of drug compatibilities</td>
</tr>
<tr>
<td>23% Calculation error</td>
<td></td>
</tr>
<tr>
<td>19% Dosage misdivided</td>
<td></td>
</tr>
<tr>
<td>12% Dosage not divided</td>
<td></td>
</tr>
</tbody>
</table>


System Failures

Table 7.—System Failures

<table>
<thead>
<tr>
<th>System</th>
<th>Attributed Errors</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drug knowledge dissemination</td>
<td>46 (22)</td>
<td></td>
</tr>
<tr>
<td>2. Dose and identity checking</td>
<td>40 (21)</td>
<td></td>
</tr>
<tr>
<td>3. Patient information availability</td>
<td>27 (15)</td>
<td></td>
</tr>
<tr>
<td>4. Order transcription</td>
<td>29 (16)</td>
<td></td>
</tr>
<tr>
<td>5. Allergy checks</td>
<td>24 (14)</td>
<td></td>
</tr>
<tr>
<td>6. Medication order tracking</td>
<td>18 (10)</td>
<td></td>
</tr>
<tr>
<td>7. Intravenous communication</td>
<td>17 (9)</td>
<td></td>
</tr>
<tr>
<td>8. Incomplete documentation</td>
<td>14 (8)</td>
<td></td>
</tr>
<tr>
<td>9. Standardization of doses and frequencies*</td>
<td>12 (6)</td>
<td></td>
</tr>
<tr>
<td>10. Standardization of drug distribution within units*</td>
<td>11 (6)</td>
<td></td>
</tr>
<tr>
<td>11. Standardization of procedures*</td>
<td>10 (6)</td>
<td></td>
</tr>
<tr>
<td>12. Preparation of intravenous medications</td>
<td>8 (5)</td>
<td></td>
</tr>
<tr>
<td>13. Transfers/transition procedures</td>
<td>4 (1)</td>
<td></td>
</tr>
<tr>
<td>14. Conflict resolution</td>
<td>4 (1)</td>
<td></td>
</tr>
<tr>
<td>15. Staffing and work assignments*</td>
<td>3 (2)</td>
<td></td>
</tr>
<tr>
<td>16. Feedback about adverse drug events*</td>
<td>3 (2)</td>
<td></td>
</tr>
</tbody>
</table>


Enlarged version on page 31
Supporting Outcomes

- Integrated systems
  - 73 administration errors per 100,000 doses charted
  - Prescribing errors decreased
    - Drug allergy detection
    - Excessive dosing
    - Incomplete or unclear orders
    - Renal insufficiency dose changes
    - Drugs within therapeutic range


Supporting Outcomes

- Implementing a multifunctional system can yield benefits of:
  - Increased delivery of care based on guidelines
  - Enhance monitoring and surveillance
  - Reduction in medication errors
  - Decreased rate of utilization for potentially redundant or inappropriate care


Current Gaps

- Multiple systems
- BCMA with smart pumps
- Smart pumps with EMR
- BCMA with CPOE, EMR, PIS
- CDSS not optimized
- Pharmacy preparation/dispensing safety systems
- Real-time medication surveillance systems
Human Factors

- Organizational support
  - Financial, equipment, software, staffing
- Project/change management
- Training
- Workarounds and accountability
- Impact on workflow
- Physician engagement

Strategies for Closed-Loop

Enlarged version on page 32
Plan for Full Integration

- Funding, staffing resources, equipment
- Software, network infrastructure, interfaces
- Medication-use process
  - Order entry
  - Documentation
  - Dispensing
  - Administration
- Current technology assessment
- Pharmacy has seat at table
- Strategic vision and planning

Prioritization of Systems

- Pharmacy Information System
- Automated dispensing cabinet (ADC)
- Conflicting reports
  - Some say CPOE first
  - Others BCMA
  - What about eMAR
  - Big bang vs. non- big bang
- Need to fully implement/optimize current live technologies

At the Table
Reporting Structures

- Pharmacy informatics reporting structures:
  - Pharmacy informatics division
  - To Chief Information Officer
  - To Chief Medical Information Officer
  - Information technology department with no pharmacist(s)
  - Pharmacists in IT department in addition to pharmacy informatics division

Pharmacy Informatics

- Must lead multidisciplinary medication-use integrated electronic environment initiatives
- Medication-use process connects pharmacy to rest of healthcare system
- Pharmacists responsible for patient safety throughout medication-use process:
  - Ensure that new technologies lead to safe and more effective medication use
  - Assess vulnerabilities and implement med error prevention strategies

Pharmacy Practice Model

- Changing roles of pharmacist / technician
- Acquire new skills
- Work to integrate technology into daily activities
- Pharmacist training:
  - Query tools
  - Automated monitoring software
  - Data mining tools


Conclusions

- Technology implementation will grow rapidly
- Government to play role with EHR integration
- One technology system will not solve all medication safety issues
- Ensure technologies lead to more safe and effective medication use

Conclusions

- Pharmacists must be involved and always at the table
- Clinical staff will have increased future role with drug safety technology
- Hospitals need to work with vendors to improve systems
- Research and contribution to the literature is essential
Healthcare Informatics Technology Implemented Across US

# Full Integration

## EMR Adoption Model℠

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>Q1 2009</th>
<th>Q2 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 7</td>
<td>Medical record fully electronic; HCO able to contribute CCD as byproduct of EMR; Data warehousing in use</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
<td>0.8%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Closed loop medication administration</td>
<td>3.6%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>CPOE, CDSS (clinical protocols)</td>
<td>2.8%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>37.0%</td>
<td>38.4%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Clinical Data Repository, Controlled Medical Vocabulary, Clinical Dec, may have Document Imaging</td>
<td>32.1%</td>
<td>31.6%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Ancillaries – Lab, Rad, Pharmacy – All Installed</td>
<td>9.0%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Ancillaries Not Installed</td>
<td>14.5%</td>
<td>13.4%</td>
</tr>
<tr>
<td>Total Hospitals</td>
<td>n = 5170</td>
<td>n = 5167</td>
<td></td>
</tr>
</tbody>
</table>

Data from HIMSS Analytics℠ Database  N = 5170/5167 ©2009 HIMSS Analytics
HHIMSS Analytics Database 2009.
## Table 4.
Use of Computerized Prescriber Order Entry (CPOE)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>CPOE with Clinical Decision-Support Systems</th>
<th>Must Manually Reenter Orders into Pharmacy Computer System*</th>
<th>CPOE Covers All Beds*</th>
<th>Orders Prescribers Enter into CPOE System†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1036</td>
<td>17.8%</td>
<td>1038</td>
<td>12.0%</td>
</tr>
<tr>
<td>General and children’s medical-surgical hospitals (by staffed beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>179</td>
<td>8.9</td>
<td>179</td>
<td>6.2</td>
</tr>
<tr>
<td>50–99</td>
<td>119</td>
<td>11.8</td>
<td>119</td>
<td>6.7</td>
</tr>
<tr>
<td>100–199</td>
<td>203</td>
<td>12.8</td>
<td>203</td>
<td>8.9</td>
</tr>
<tr>
<td>200–299</td>
<td>157</td>
<td>15.3</td>
<td>157</td>
<td>11.5</td>
</tr>
<tr>
<td>300–399</td>
<td>93</td>
<td>30.1</td>
<td>93</td>
<td>18.3</td>
</tr>
<tr>
<td>400–799</td>
<td>118</td>
<td>33.9</td>
<td>118</td>
<td>22.0</td>
</tr>
<tr>
<td>≥800</td>
<td>17</td>
<td>41.2</td>
<td>17</td>
<td>29.4</td>
</tr>
<tr>
<td>Veterans Affairs hospitals</td>
<td>36</td>
<td>100.0</td>
<td>36</td>
<td>86.1</td>
</tr>
<tr>
<td>Specialty hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>30</td>
<td>26.7</td>
<td>30</td>
<td>20.0</td>
</tr>
<tr>
<td>Nongovernment</td>
<td>86</td>
<td>17.4</td>
<td>86</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Table 14.
Technology Used by Nurses When Administering Medications*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BCMA</th>
<th></th>
<th></th>
<th>Type of Medication Administration Technology Used</th>
<th></th>
<th></th>
<th></th>
<th>All Manual Paper-Based Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>eMAR Only</td>
<td>eMAR with BCMA</td>
<td>eMAR, BCMA, and Electronic Nursing Documentation</td>
<td>eMAR and Electronic Nursing Documentation (without BCMA)</td>
<td></td>
</tr>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1021</td>
<td>24.1%</td>
<td>1020</td>
<td>8.5</td>
<td>4.5</td>
<td>19.6</td>
<td>13.7</td>
<td>53.8</td>
</tr>
<tr>
<td>General and children’s medical–surgical hospitals (by staffed beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>177</td>
<td>14.7%</td>
<td>177</td>
<td>8.5</td>
<td>2.3</td>
<td>12.4</td>
<td>9.0</td>
<td>67.8</td>
</tr>
<tr>
<td>50–99</td>
<td>115</td>
<td>24.3%</td>
<td>115</td>
<td>7.8</td>
<td>1.7</td>
<td>22.6</td>
<td>12.2</td>
<td>55.7</td>
</tr>
<tr>
<td>100–199</td>
<td>202</td>
<td>30.2%</td>
<td>202</td>
<td>8.4</td>
<td>5.0</td>
<td>25.2</td>
<td>14.9</td>
<td>46.5</td>
</tr>
<tr>
<td>200–299</td>
<td>156</td>
<td>36.5%</td>
<td>156</td>
<td>7.7</td>
<td>7.7</td>
<td>28.8</td>
<td>17.3</td>
<td>38.5</td>
</tr>
<tr>
<td>300–399</td>
<td>92</td>
<td>40.2%</td>
<td>92</td>
<td>8.7</td>
<td>7.6</td>
<td>32.6</td>
<td>23.9</td>
<td>27.2</td>
</tr>
<tr>
<td>400–799</td>
<td>117</td>
<td>25.6%</td>
<td>117</td>
<td>19.7</td>
<td>4.3</td>
<td>21.4</td>
<td>21.4</td>
<td>33.3</td>
</tr>
<tr>
<td>≥800</td>
<td>16</td>
<td>6.3%</td>
<td>15</td>
<td>26.7</td>
<td>0</td>
<td>6.7</td>
<td>28.7</td>
<td>40.0</td>
</tr>
<tr>
<td>Veterans Affairs hospitals</td>
<td>32</td>
<td>100.0%</td>
<td>32</td>
<td>0</td>
<td>18.8</td>
<td>8.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Specialty hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>30</td>
<td>10.0%</td>
<td>30</td>
<td>10.0</td>
<td>0</td>
<td>10.0</td>
<td>6.7</td>
<td>73.3</td>
</tr>
<tr>
<td>Nongovernment</td>
<td>84</td>
<td>15.5%</td>
<td>84</td>
<td>6.0</td>
<td>6.0</td>
<td>9.5</td>
<td>15.5</td>
<td>63.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Partial EMR</th>
<th>EMR Access for All Providers*</th>
<th>Complete EMR</th>
<th>All Clinical Documentation Captured*</th>
<th>Pharmacists View Complete EMR*</th>
<th>Pharmacists Document in EMR*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1066</td>
<td>42.9</td>
<td>514</td>
<td>53.3</td>
<td>1062</td>
<td>5.9</td>
</tr>
<tr>
<td>General and children’s medical-surgical hospitals (by staffed beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>182</td>
<td>30.8</td>
<td>55</td>
<td>46.4</td>
<td>182</td>
<td>3.3</td>
</tr>
<tr>
<td>50-99</td>
<td>120</td>
<td>45.8</td>
<td>55</td>
<td>49.1</td>
<td>119</td>
<td>2.5</td>
</tr>
<tr>
<td>100-199</td>
<td>207</td>
<td>50.2</td>
<td>104</td>
<td>45.2</td>
<td>207</td>
<td>4.8</td>
</tr>
<tr>
<td>200-299</td>
<td>164</td>
<td>53.7</td>
<td>88</td>
<td>53.4</td>
<td>163</td>
<td>3.7</td>
</tr>
<tr>
<td>300-399</td>
<td>94</td>
<td>58.5</td>
<td>55</td>
<td>50.9</td>
<td>93</td>
<td>4.3</td>
</tr>
<tr>
<td>400-999</td>
<td>126</td>
<td>57.9</td>
<td>73</td>
<td>49.3</td>
<td>125</td>
<td>4.8</td>
</tr>
<tr>
<td>≥800</td>
<td>17</td>
<td>47.1</td>
<td>8</td>
<td>62.5</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Veterans Affairs hospitals</td>
<td>38</td>
<td>100.0</td>
<td>38</td>
<td>92.1</td>
<td>36</td>
<td>89.5</td>
</tr>
<tr>
<td>Specialty hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>30</td>
<td>26.7</td>
<td>8</td>
<td>75.0</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Nongovernment</td>
<td>88</td>
<td>33.0</td>
<td>29</td>
<td>58.6</td>
<td>88</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Table 15.
Use of Intelligent Infusion Devices (Smart Pumps)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Smart Pumps</th>
<th>Pharmacy Maintains Smart Pump Library</th>
<th>Quality-Improvement Logs Used From Smart Pumps</th>
<th>Smart Pumps With Wireless Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>All U.S. hospitals (weighted estimate)</td>
<td>1020</td>
<td>44.0b</td>
<td>498</td>
<td>69.6</td>
</tr>
<tr>
<td>General and children’s medical-surgical hospitals (by staffed beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>177</td>
<td>33.9</td>
<td>60</td>
<td>68.3</td>
</tr>
<tr>
<td>50–99</td>
<td>115</td>
<td>49.6</td>
<td>57</td>
<td>64.9</td>
</tr>
<tr>
<td>100–199</td>
<td>202</td>
<td>48.5</td>
<td>95</td>
<td>66.3</td>
</tr>
<tr>
<td>200–299</td>
<td>156</td>
<td>62.8</td>
<td>98</td>
<td>77.6</td>
</tr>
<tr>
<td>300–399</td>
<td>92</td>
<td>50.0</td>
<td>46</td>
<td>82.6</td>
</tr>
<tr>
<td>400–799</td>
<td>117</td>
<td>61.5</td>
<td>72</td>
<td>83.3</td>
</tr>
<tr>
<td>≥800</td>
<td>15</td>
<td>80.0</td>
<td>12</td>
<td>100.0</td>
</tr>
<tr>
<td>Veterans Affairs hospitals</td>
<td>32</td>
<td>71.9</td>
<td>23</td>
<td>65.2</td>
</tr>
<tr>
<td>Specialty hospitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>30</td>
<td>10.0</td>
<td>2</td>
<td>50.0</td>
</tr>
<tr>
<td>Nongovernment</td>
<td>84</td>
<td>39.3</td>
<td>33</td>
<td>60.6</td>
</tr>
</tbody>
</table>

# System Failures

## Table 7.—System Failures

<table>
<thead>
<tr>
<th>System</th>
<th>Attributed Errors, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drug knowledge dissemination</td>
<td>98 (29)</td>
</tr>
<tr>
<td>2. Dose and identity checking</td>
<td>40 (12)</td>
</tr>
<tr>
<td>3. Patient information availability</td>
<td>37 (11)</td>
</tr>
<tr>
<td>4. Order transcription</td>
<td>29 (9)</td>
</tr>
<tr>
<td>5. Allergy defense</td>
<td>24 (7)</td>
</tr>
<tr>
<td>6. Medication order tracking</td>
<td>18 (5)</td>
</tr>
<tr>
<td>7. Interservice communication</td>
<td>17 (5)</td>
</tr>
<tr>
<td>8. Device use</td>
<td>12 (4)</td>
</tr>
<tr>
<td>9. Standardization of doses and frequencies*</td>
<td>12 (4)</td>
</tr>
<tr>
<td>10. Standardization of drug distribution within unit*</td>
<td>11 (3)</td>
</tr>
<tr>
<td>11. Standardization of procedures*</td>
<td>10 (3)</td>
</tr>
<tr>
<td>12. Preparation of intravenous medications by nurses</td>
<td>6 (2)</td>
</tr>
<tr>
<td>13. Transfers/transition procedures</td>
<td>4 (1)</td>
</tr>
<tr>
<td>14. Conflict resolution</td>
<td>4 (1)</td>
</tr>
<tr>
<td>15. Staffing and work assignments*</td>
<td>...</td>
</tr>
<tr>
<td>16. Feedback about adverse drug events*</td>
<td>...</td>
</tr>
</tbody>
</table>

With permission from W Churchill, Brigham and Women's Hospital, Boston, MA
Integrating Technology to Improve Medication-Use and Patient Safety

SELECTED REFERENCES AND RESOURCES


Integrating Technology to Improve Medication-Use Patient Safety

SELF-ASSESSMENT QUESTIONS

1. Adoption of key medication-use technologies in health systems across the country is below 50%?
   a. True.
   b. False.

2. Which of the following are the reasons for the lack of full technology integration?
   a. Have not purchased all technologies.
   b. Interfaces not available.
   c. Staffing resources.
   d. All of the above.

3. Which phase of the medication-use process has the second highest percentage of medication errors?
   a. Prescribing.
   b. Transcribing.
   c. Dispensing.
   d. Administration.

Answers
1. a
2. d
3. d
Integrating Technology to Improve Medication-Use and Patient Safety

Vice President of Operations – Radiology, Laboratory and Pharmacy
Lancaster General Hospital
Lancaster, Pennsylvania

Richard D. Paoletti, M.B.A., B.S.Pharm. is Vice President of Operations, Lancaster General Health in Lancaster, Pennsylvania. He is responsible for inpatient and outpatient operations of the Pharmacy, Laboratory and Radiology departments for a health care system that includes a 638-bed hospital with a level II trauma center and emergency department that experiences over 100,000 visits per year. Prior to this appointment, he served as Director of Pharmacy Services at Lancaster General where he was responsible for continuous quality improvement of pharmacy distribution, clinical activity and cost efficiency, including design and implementation of new inpatient and outpatient pharmacies utilizing barcode and robotic dispensing technologies.

Before joining Lancaster General Health in 2004, he served in various hospital pharmacy roles for over twelve years at Crozer-Keystone Health System, a five-hospital system south of Philadelphia. He is a managing partner of Shrinksafe Systems, LLC, a company that he founded to create innovative pharmaceutical packaging to improve medication safety. Mr. Paoletti and his team were recognized with two ASHP Best Practices in Health-System Pharmacy Awards in 2005 and 2009. He was recently honored as a recipient of University of the Sciences in Philadelphia Young Alumnus Award.

Mr. Paoletti received his Bachelor of Science degree in pharmacy from the Philadelphia College of Pharmacy, and Master of Business Administration degree from the University of Delaware.
Integrating Technology to Improve Medication-Use Patient Safety


PRESENTATION

Current Examples of Systems Integration in Health Systems – Effectively Minimizing Medication Errors

OVERVIEW

Careful integration of medical devices with clinical information systems holds promise on the future reduction of medical errors. Intravenous (IV) interoperability, known as auto-programming, integrates the intelligent infusion devices (IID), bar-code medication administration (BCMA) and electronic medication administration record (eMAR) systems into a bar-code driven workflow that automatically populates pharmacist-validated, provider-ordered infusion parameters on the IID. This presentation provides a case example of the interconnectivity, improved workflow and related benefits in the reduction of medication errors.

LEARNING OBJECTIVES

At the conclusion of this knowledge-based educational activity, participants should be able to

- Discuss two benefits of implementing IID technologies with POC decision support.
- Describe examples of improvements to patient care resulting from integration of barcode technology.
- Identify three benefits achieved by implementing full bi-directional integration with existing/future med safety technology.
Current Examples of Systems Integration in Health Systems: Effectively Minimizing Medication Errors

Vice President, Operations
Lancaster General Health
Lancaster, Pennsylvania

Objectives
• Discuss two benefits of implementing intelligent infusion device (IID) technologies with point-of-care (POC) decision support
• Describe examples of improvements to patient care resulting from integration of barcode technology
• Identify three benefits achieved by implementing full bi-directional integration with existing/future med safety technology

Which technologies have been implemented at your institution?
A. Bar code medication administration (BCMA)
B. Intelligent infusion devices (IIDs)
C. Both
D. Neither
Have you engaged your IT vendors in conversations regarding future connectivity of medical devices?

A. Yes
B. No

BCMA / IID interconnectivity will be implemented at my site...

A. Within the next year
B. In 1-5 years
C. Hopefully before I retire!
D. What is BCMA / IID interconnectivity?

My site has a solid wireless infrastructure that can support interconnectivity...

A. True
B. False
C. Not sure if you want pharmacy or IT opinion
IID Users: What's your library compliance?

A. Less than 25%
B. 25-75%
C. Greater than 75%
D. N/A

SMART Pumps

- LGH* – 2006
- Standardized Infusion Library
- Dosing Limits
- Automatic Dose Calculation
- Data Capture

*LGH = Lancaster General Hospital

Enlarged version on page 48
Observations

- Difficulty finding meds in library
  - Trade vs. Generic
  - Look-alikes – CefTAZidime vs CefoTETAN
  - Wrong drug selected – dose, concentration
- VTBI* / infuse over times different than order
- Wrong patient weights entered
- Ordered 55 mcg/kg/min – entered at 55mL/hr
- Library not utilized for various medications

*VTBI = volume to be infused

49%
388

Time and Motion Study

- 12 different scenarios
- Exercise all BCMA* / IID functionality

- Unexpected Manual Findings
  - Wrong Drug
  - Wrong Rate
  - Wrong Volume
  - Wrong Weight

*BCMA = bar code medication administration
Manually Programming the IID

Short video shown

Goals and Objectives

• Eliminate IV Med Errors
• Integration of Order & Pump Settings
• 100% Utilization of Library
• Reduce Manual Pump Edits
• Improve Nurse Workflow
• Accurate eMAR Documentation
• Meaningful Data for PI
• Establish Best Practice

IV Interoperability

• Ensures dose limit checking
• Minimizes number of manual programming steps
• Real time documentation
• Standardize workflow: limits one IV task
Many thanks...

Data Flow

Unique Channel Challenge

- Barcode placed on each channel
  - What is process to guarantee accuracy?
  - Who owns the process?
  - Placement MUST be consistent
  - Label solution MUST be durable

Enlarged version on page 49
Auto-Programming the IID

Programming – 17 Steps to 7

<table>
<thead>
<tr>
<th>Manual Programming</th>
<th>IV Interoperability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan patient</td>
<td>Select CCA</td>
</tr>
<tr>
<td>Scan medication and complete required fields</td>
<td>Scan patient and complete required</td>
</tr>
<tr>
<td>Manually document in eMAR/BCMA</td>
<td>Scan pump channel</td>
</tr>
<tr>
<td>Program pump:</td>
<td>Press start</td>
</tr>
<tr>
<td>Select CCA</td>
<td>Select &quot;Yes&quot; to confirm</td>
</tr>
<tr>
<td>Select line</td>
<td>Press &quot;OK&quot; to document in eMAR/BCMA</td>
</tr>
<tr>
<td>Press drug list</td>
<td>eMAR = electronic medication administration record</td>
</tr>
<tr>
<td>Scroll to find medication</td>
<td></td>
</tr>
<tr>
<td>Press standard program</td>
<td></td>
</tr>
<tr>
<td>Select dosing units</td>
<td></td>
</tr>
<tr>
<td>Enter concentration (3 steps)</td>
<td></td>
</tr>
<tr>
<td>Enter weight</td>
<td></td>
</tr>
<tr>
<td>Enter dose</td>
<td></td>
</tr>
<tr>
<td>Enter volume to be infused</td>
<td></td>
</tr>
<tr>
<td>Press start</td>
<td></td>
</tr>
<tr>
<td>Select &quot;Yes&quot; to confirm</td>
<td></td>
</tr>
</tbody>
</table>

Time and Motion Results

24.8% average reduction

Short video shown

Enlarged version on page 50
Drug Library Compliance

![Drug Library Compliance Chart]

Enlarged version on page 51

Telemetry Rate Edits

- 67 of 6,508 (1%) BEFORE
- 4 of 7,036 (0.06%) AFTER

94% Reduction

\[ p-value < 0.0001 \]

Med/Surg Rate Edits

- 85 of 14,773 (0.58%) BEFORE
- 2 of 8,635 (0.02%) AFTER

97% Reduction

\[ p-value < 0.0001 \]
HEPARIN
case example

Heparin Infusion Statistics
~ 768 Patients per Quarter
7.5 Dose (Rate) Adjustments per Patient

5750
Rate Adjustments per Quarter

Heparin Event Report Trend

Number of Reported Heparin Events

45
Heparin Event Statistics

84%
Telemetry & Med/Surg
~ 50%
Pump Settings ≠ Ordered Dose

60% Reduction in Heparin Event Reports

Barriers

- Cultural drifts in practice
- Nomenclature confusion
- Total volume / rate translations
- Staff buy-in
- Workload Volume
  - Rate changes to pharmacy
  - What is acceptable turn-around time?
- Wireless IT infrastructure
Remember...
• It takes a village…
• Don’t under-estimate cultural impact
• There is huge opportunity
• Standardization is key
• Pharmacy turn-around must be solid
• Have a downtime plan
• Info Services are your friends…

Advantages
• Ensures correct medication
• Ensures IID dose limit checking
• Auto-programs even if drug NOT in library
• Documentation – Real-time, actual event
• Pharmacist oversight on rate adjustments
• Data – supports performance improvement
• Standardizes IV Workflow Process

Suggested Readings
Order written - scanned to Pharmacy

Drug Wholesaler

Pharmacy Info System

autoPharm

“Off Carousel!” Refrigerated, compounded, large bulk, etc

“Off Carousel!” Refrigerated, compounded, large bulk, etc

LGH Technology & Automation

BPOC / EMAR

Pharmacy Info System

Drug Wholesaler

Order written - scanned to Pharmacy

“Off Carousel!” Refrigerated, compounded, large bulk, etc

LGH Technology & Automation

BPOC / EMAR
Data Flow
## Programming – 17 Steps to 7

<table>
<thead>
<tr>
<th>Manual Programming</th>
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<td>Select CCA</td>
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<td>Scan medication and complete required fields</td>
<td>Scan patient</td>
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<td>eMAR= electronic medication administration record</td>
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<td>Enter weight</td>
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<td>Enter dose</td>
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</tr>
<tr>
<td>Enter volume to be infused</td>
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<tr>
<td>Press start</td>
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<tr>
<td>Select ‘Yes’ to confirm</td>
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</tbody>
</table>
Drug Library Compliance

[Graph showing compliance to drug library over time with key points indicating progress and milestones.]

- Telemetry: non-IV Interoperability
- Medical/Surgical: non-IV Interoperability
- 100% IV Interoperability Implemented on Telemetry
- 100% IV Interoperability Implemented on Medical/Surgical
SELECTED REFERENCES


SELF-ASSESSMENT QUESTIONS

1. Integration of bar code medication administration (BCMA) and intelligent infusion devices (IIDs) facilitates direct pharmacist oversight and validation of iv medication dose adjustments as an integral part of medication management workflow.
   a. True.
   b. False.

2. Which of the following is a benefit derived from implementation of BCMA/IID integration?
   a. Improved nursing mathematics skills.
   b. Reduction of manual programming steps during iv administration.
   c. Improved wireless infrastructure.
   d. Increased pump edits during iv administration.

3. It is critical to involve which of the following departments in an implementation of BCMA/IID integration?
   a. Biomedical Engineering.
   b. Nursing.
   c. Information Services.
   d. All of the above.

Answers
1. a
2. b
3. d
Integrating Technology to Improve Medication-Use
Patient Safety
William W. Churchill, M.S., B.S.Pharm., Program Chair
Executive Director of Pharmacy
Brigham and Women’s Hospital
Boston, Massachusetts

William W. Churchill, M.S., B.S.Pharm. is the Executive Director of Pharmacy Services at the Brigham and Women’s Hospital in Boston, Massachusetts, where he is responsible for leadership of the pharmacy department and Anticoagulation Management Services. Mr. Churchill serves Brigham and Women’s as the Chairperson of the Drug Safety Committee, Vice Chairperson of the Pharmacy and Therapeutics Committee, and Co-Chairperson of the eMAR/Bar Code Scanning Project Team. He also serves the Partners Healthcare Network as the Co-Chairperson of the High Performance Medicine Improvement Team which focuses on the implementation of medication safety technology.

Mr. Churchill’s main areas of practice interest include improving the safety and efficiency of medication administration systems, design and implementation of medication safety related technology, robotics, and automation, and expanding and expanding the role of the clinical pharmacy specialist through the use of medication safety technology.

For his efforts in improving medication safety worldwide, Mr. Churchill was awarded the 2007 American Society of Health-System Pharmacists’ (ASHP) Distinguished Leadership Award. He was also selected as the 2008 Massachusetts Health-System Pharmacist of the Year by the Massachusetts Society of Health-System Pharmacists.

Mr. Churchill received his bachelor and master degrees from Northeastern University. He is adjunct Clinical Professor of Pharmacy Practice at Northeastern University, Bouve College of Health Sciences. Mr. Churchill is the Chairperson of the University Hospital Consortium’s Pharmacy Financial Performance Committee and is also a member of the University Health System Consortium (UHC) Pharmacy Executive Committee.
Integrating Technology to Improve Medication-Use Patient Safety

William W. Churchill, M.S., B.S.Pharm., *Program Chair*

**PRESENTATION**

Making it Happen in Your Institution: Improving Your Medication-Use Process with Closed-Loop Technologies

**OVERVIEW**

There are numerous examples in the published literature showing the positive impact of medication-use technologies on patient and medication safety. However, there are still large gaps within the medication-use system that can lead to error. A key reason for this is the low percentage of implemented technologies that have been shown to decrease medication error rates. Contributing to these gaps is the lack of complete closed-loop integrated systems with technologies such as computerized physician order entry (CPOE), bar code medication administration (BCMA), and smart or intelligent intravenous infusion pumps. Health care organizations must understand the importance of the integration of systems and strategies that are required from the start to achieve full optimization. Pharmacy leaders should assure that they are at the table when system-wide decisions are considered pertaining to informatics and drug delivery technologies. Pharmacy departments should lead the charge for the changing roles of the pharmacist and technician with the implementation of these new technologies.

**LEARNING OBJECTIVES**

At the conclusion of this knowledge-based educational activity, participants should be able to

- Discuss the need for systems integration in the medication-use process in health systems.
- Identify medication safety issues that can arise by not having a fully integrated medication-use technology system.
- List general strategies needed to become a fully integrated site.
- Describe the importance of involving pharmacists in the area of informatics within health-systems.
Making it Happen in Your Institution: Improving Your Medication-Use Process with Closed-Loop Technologies

William W. Churchill M.S., B.S.Pharm.
Executive Director of Pharmacy Services
Brigham and Women’s Hospital
Boston, MA

Objectives

• Describe the role of pharmacy leaders in driving the implementation of a closed-loop, medication-use system throughout the institution
• Explain the interdependency of leadership and innovation
• Describe the steps involved in designing a plan for a closed-loop, medication-use system including development of an executive steering committee, project team, charter, vision, and strategic plan
• Identify key committees and resources that should be included in the development and support of the closed-loop medication administration process
• List possible approaches to resolving common integration challenges

When making the decision to implement a closed-loop, medication-use system, what issue will influence your organization the most?

A. Overall cost and scope of project
B. Vendor capabilities
C. Human resource availability
D. IT network infrastructure issues
ASHP Vision Statement for Pharmacy Practice in Hospitals and Health Systems

Will be recognized as patient care providers and sought out by patients to help them achieve the most benefit from their therapy;

Will take a leadership role to continuously improve and redesign the medication-use process with the goal of achieving significant advances in (a) patient safety, (b) health-related outcomes, (c) prudent use of human resources, and (d) efficiency;

Will lead evidence-based medication-use programs to implement best practices, and we have an image among patients, health professionals, administrators, and public policy makers as caring and compassionate medication use experts.

What role is pharmacy playing in development and implementation of a closed-loop medication-use system at your hospital?

A. Pharmacy is taking the lead role
B. Pharmacy is co-leading
C. Pharmacy is a participant
D. Pharmacy is not involved
E. We do not have a project team in place yet

What Pharmacy Leaders Need to Do?

• Articulate strategic vision and goals for your plans to implement closed-loop technology
• Use your strategic plan to define the priorities for implementing closed-loop systems
• Communicate up and down within your organization to engage senior executives, pharmacists, physicians and nurses
• Make the case that closed-loop medication safety systems are essential to the mission of the hospital
What Pharmacy Leaders Need to Do?

- Consider all stakeholders and options including the politics of critical decisions.
- Think big and creatively in order to tackle the problems that may seem to be insurmountable.
- Do the right things “right”!
- Adapt, overcome and persevere!

What is Innovation?

- The term innovation refers to a new way of doing something. It may refer to incremental, radical, and revolutionary changes in thinking, products, processes, or organizations.
  - Wikipedia 2009

What are we talking about changing?

- It’s not about pharmacists, nurses, or physicians
- It is about a complex set of processes that are used by all three disciplines to provide medication therapy for our patients.
  - Often these processes are not connected or only connected in one direction
- We used to call it the Unit Dose System!
  - We now call it the Medication-Use System (MUS)
Quote

....If we were to sit down and carefully design the most inefficient, labor intensive, and difficult to control system that one could imagine...it would be our present 'Medication-Use System.'

> Wm. Churchill

Leadership and Innovation - What is the Connection?

• Leaders have a focus on the future and what our medication-use systems will look like “down the road.”
• Leaders facilitate change, and promote new directions.
• Leaders encourage new directions to develop new ideas and champion the new ideas of their team.
• Leaders generate more change by stimulating the creativity of their team rather than relying only on their own ideas.

Leadership and Innovation - What is the Connection?

• Encouraging your staff to innovate is fostering leadership in them.
• Leaders create the culture of innovation by:
  – assuring that risk taking and failure are not punished
  – rewarding innovation and celebrating success
• Leaders remove barriers to being more innovative.
• Leaders develop the innovative skills of their individual team members.
How ready is your organization to take on a closed-loop medication-use project?

A. We are ready now and just waiting for our vendors to catch up.
B. We are in the early planning and discussion stages.
C. We have not started to discuss this.

Where Do We Begin?

Formation of Medication Safety Technology Leadership Team

- Secure senior executive, medical, and nursing leadership support and resources to oversee the Medication-Use System. Should include: CNO, CPO, CIO, CFO, CMO.
- Team should be led by Chief Pharmacy Officer and the Chief Nursing Officer.
  - Team meets at regular intervals.
  - Team controls budget and resources allocation.
- Develop Team charter and Mission Statement.
Governance for Clinical Systems

The Electronic Medication Management (EMM) Steering Committee will oversee the ongoing development and maintenance of the advanced clinical applications that are used by hospital clinicians to manage the closed-loop, medication-use process.

EMM Guiding Principles

- The development of medication safety systems should focus on improving quality of care, as defined by safety, timeliness, effectiveness, efficiency, equity, and patient-centeredness.

- Medication Safety Systems must
  - Support good clinical workflow
  - Support the patient’s care journey through multiple departments
  - Facilitate multi-disciplinary communication
  - Be reliable and adequately supported
EMM Guiding Principles (cont.)

• Clinical data interoperability is highly valued. Avoid implementation and development of clinical systems that would lead to data disintegration.
• Both short-term and long-term costs of the project should be fully accounted for in making decisions about clinical systems. These include long-term costs to achieve clinical data interoperability.
• Clinical systems need to comply with hospital policies, external regulatory and legal requirements.

Create the Vision of the Ultimate System

High Performance Medicine Team Components of the Ideal Medication Administration System

Basic Requirements for a Safe Medication-Use Process

• Software
  – CPOE (computerized prescriber order entry)
  – eMAR (electronic medication administration record)
  – Pharmacy systems
  – Medication Decision Support systems
  – Incident Reporting software
  – ADE (adverse drug event) Surveillance software
  – Medication reconciliation
Basic Requirements for a Safe Medication-Use Process

• Hardware
  – Wireless infrastructure
  – Bar coding (patient ID, nurse ID, medication ID)
  – Medication repackaging
  – Intelligent infusion pumps
  – Automated medication dispensing machines
  – Drug storage carousels
  – Robotics

• “Peopleware” (because electronics won’t do it alone…)
  – Teamwork training
  – Walk rounds
  – User feedback
  – Robust medication safety improvement teams
  – Infrastructure support teams
  – Dedicated Medication Safety Officer

• System integration and connectivity

Strategic Roadmap

• Your project’s Strategic Roadmap is another key tool that will play a large part in your success by providing:
  – Strategies that zero in on keys to success for your closed-loop system
  – Provides everyone in your organization with specific goals and action plans to guide their daily, weekly and monthly actions
The BWH* Strategic Plan
Focus on Safe Medication Administration

- **What?**
  - Reduce medication errors, increase the safety of our patients by enabling care providers to make more informed decisions during the medication-use process

- **How?**
  - Reengineer the medication administration process
  - Implement safe and effective medication administration technologies, including:
    - Practitioner Order Entry
    - Intelligent Infusion Pumps
    - Clinical pharmacist on units
    - eMAR
    - Bar coding verification of medications, patients, and staff
    - Closed-loop integration

* BWH = Brigham and Women’s Hospital

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**Medication Management Systems Strategic Roadmap**

<table>
<thead>
<tr>
<th>Tower - Medical</th>
<th>Paraling - Psychiatric</th>
<th>Info Tech/Admin</th>
<th>Nursing Administration</th>
<th>Months of Entry</th>
<th>Planned Year</th>
<th>Actual Year</th>
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**Enlarged version on page 75**

**Medication Management Systems Strategic Roadmap**

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**Enlarged version on page 76**
Create Alternate Strategies to Meet Business Owner Needs

Set aside plans to build Order Entry (OE)-neutral pharmacy system
- ‘Teach’ eMAR to talk to NICU Rx system
- Maintain existing adult Rx system

Benefits
- Smaller project scope for NICU eMAR
- No need to retrofit new pharmacy system into BICS Brigham Integrated Computing System OE and eMAR infrastructure
- Possible parallel development for pharmacy piece

Price
- Decide whether to move toward OE-neutral pharmacy system when we tackle ED eMAR

Has your organization developed a strategic vision and roadmap for deployment of closed-loop, medication-use systems?

A. Strategic vision only
B. Roadmap only
C. Both strategic vision and roadmap
D. We have nothing developed

Merging Technology with Medication-Use System Future Needs

<table>
<thead>
<tr>
<th>Medication-Use System Future Needs</th>
<th>Technology Enablers Future Needs</th>
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</thead>
<tbody>
<tr>
<td>Outcomes</td>
<td>Close Loop Technology</td>
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<td>Productivity</td>
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<tr>
<td>Cost Control</td>
<td>Clinical Decision Support</td>
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<tr>
<td>Information Management</td>
<td>Robust EMR Software</td>
</tr>
</tbody>
</table>

Assure that your MUS is ready for the future!
Automating IV Drug Delivery Platform

“Seamless digital pathway from Computerized Provider Order Entry to the patient vein”

Pervasive Wireless Environment

Integration, common data sets and models, intuitive outputs, mobility, and Enterprise wide clinical decision support are all key components to a successful medication administration process.

Auto-Charting to Flow Sheet

- Nurse is prompted with readings and okays the charting
- Provides combination of safety and time savings
Closed-Loop Technology Can Provide New Tools for Clinical Pharmacy Specialists

- Nurse is prompted with readings and okays the charting
- Provides combination of safety and time savings

Real time vital sign data from electronic flow sheets

Real Time data from IV pumps including current flow rate and pump alerts

Real time data from eMAR on med administration

Bar Code Verification and Real-Time Documentation is Needed Everywhere!

Robotic Technology

- Improves accuracy and safety of dispensing and preparation via bar code verification
- Improves speed and efficiency of delivery and preparation
- Improves utilization tracking and inventory management
- Frees up valuable pharmacist time for clinical care duties
IV Robotic Devices for On-site On-Demand IV Admixture Preparation?

- Integration with Pharmacy and eMAR system
  - Real time bi-directional interfaces
- Remote verification capability for checking pharmacist
- Documentation available for central data warehouse

Peopleware to keep it all going

Infrastructure support

Need to develop committee leadership infrastructure support system to maintain and improve the safety gains achieved through medication safety technology
### Resolving Integration Challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Approach</th>
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<tbody>
<tr>
<td>Wireless IV pump programming</td>
<td>Customize the BCMA workflow to meet both needs</td>
</tr>
</tbody>
</table>
| Identify software and data reporting needs in eMAR, pharmacy, and electronic flow sheets | • Flow charting  
• FMEA (failure mode effect analysis)  
• SWOT Analysis (strengths, weaknesses, opportunities, threats) |
| Vendor integration issues                        | In-house IT integration team                          |
| Data capture, storage and reports               | Planner, dashboard, reminder, report writer tools     |
| Network Security issues                         | • In-house IT network team  
• Vendor Integration team                          |
| Wireless network coverage and/or latency         | In-house IT network team                              |

### IT Network Support team

- Wireless transmission security issues  
  - WPA vs. WPA II
- Degree of coverage for WiFi connectivity
- Selection of mobile form factors for daily use and real time data mining  
  - Power levels and interference with hospital network

### Drug Safety Committee

- Sub-committee of the Pharmacy & Therapeutics Committee  
  - Co-chairs from nursing and pharmacy  
  - Staffed by the Medication Safety Officer
- Primary responsibilities  
  - Adverse drug event and medication error surveillance  
  - Development and implementation of system enhancements for the prevention of future events  
  - Identify areas of improvement to prevent future events  
  - Data trending  
  - Review of high risk medications  
  - Utilization of alerts from ISMP (Institute for Safe Medication Practices)
Order Set Committee

- Order set committee is sub-committee of drug safety committee
- Co-chairs from nursing and pharmacy
- Staff pharmacists and nurse educators staff the committee.
- Order sets include:
  - Cardiac surgery
  - Orthopedic
  - Thoracic
  - Endocrine
  - Radiology - Oral Contrast

Smart Pump Library Management

- Multidisciplinary sub-committee of Drug Safety Committee
  - Nursing
  - Pharmacy
  - BioMed
- Charged with development, management, and implementation of smart pump drug libraries
- Responsible for testing, verification and rollout of drug libraries

eMAR – Bar Code Verification Committee

- Sub-committee of the EMM Committee
  - Co-chairs from nursing and pharmacy
  - Staffed by the Info Systems Project Manager
- Primary responsibilities:
  - Development and implementation of system enhancements for the bar code verification systems
  - Identify areas of improvement to prevent future adverse events or user interface problems
  - Data trending
  - Review end-user feedback suggestions
  - Prioritization of enhancements and patient care critical software upgrades
Some Final Thoughts...

- No single intervention (bar coding, eMAR, CPOE, automation etc.) will solve all of our problems in the Medication Administration System. We need them all, and we need them in a closed-loop environment.
- Closing the loop with sharing of common information and data will improve safety, efficiency and ease of use of our Medication-Use Systems.
- Beware of new sources of error and user initiated work arounds!
Governance for Clinical Systems
Create the Vision of the Ultimate System

High Performance Medicine Team 2:
Components of the Ideal Medication Administration System

Guiding Principles:
- Auto Identification Of Patient
- Auto Identification Of Staff
- Unit Of Use Bar Code Labeling
- Use Of Secure WiFi Transmission
- Use Of Automation
- Multi-disciplinary Patient Care Teams
- Use Of Smart Infusion Pumps
- Integration Of Information, Work Flow & Patient Care
- Use Of Biometrics
- Use Of RFID
- System-wide Enterprise Process Tracking
## Medication Management Systems
### Strategic Roadmap

<table>
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<tr>
<th></th>
<th>Order Entry</th>
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<tr>
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<td>FY12</td>
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**Key:**
- Done prior to FY08
- FY09
- FY10
- FY11
- FY12
- FY13
- n/a
- TBD

75
## Medication Management Systems
### Strategic Roadmap

<table>
<thead>
<tr>
<th></th>
<th>Electronic Flowsheets</th>
<th>Physician Documentation (Basic)</th>
<th>Nursing Documentation (Basic)</th>
<th>Nursing Assessment</th>
<th>Multidisciplinary Plan of Care</th>
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</table>

**Key:**
- FY: Fiscal Year
- n/a: Not Applicable
- Done prior to FY08: Indicates completion prior to the fiscal year 2008.
Pervasive Wireless Environment

Integration, common data sets and models, intuitive outputs, mobility, and Enterprise wide clinical decision support are all key components to a successful medication administration process.
Auto-Charting to Flow Sheet

- Nurse is prompted with readings and okays the charting
- Provides combination of safety and time savings
Closed-Loop Technology Can Provide New Tools for Clinical Pharmacy Specialists

- Nurse is prompted with readings and okays the charting
- Provides combination of safety and time savings
- Real time vital sign data from electronic flow sheets
- Real time data from IV pumps including current flow rate and pump alerts
- Real time data from eMAR on med administration
## Resolving Integration Challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Approach</th>
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</thead>
<tbody>
<tr>
<td>Wireless IV pump programming</td>
<td>Customize the BCMA workflow to meet both needs</td>
</tr>
</tbody>
</table>
| Identify software and data reporting needs in eMAR, pharmacy, and electronic flow sheets | • Flow charting  
• FMEA (failure mode effect analysis)  
• SWOT Analysis (strengths, weaknesses, opportunities, threats) |
| Vendor integration issues                          | In-house IT integration team                                              |
| Data capture, storage and reports                 | Planner, dashboard, reminder, report writer tools                         |
| Network Security issues                            | • In-house IT network team  
• Vendor integration team                                                   |
| Wireless network coverage and/or latency           | In-house IT network team                                                  |
Integrating Technology to Improve Medication-Use and Patient Safety

SELECTED REFERENCES AND RESOURCES


Integrating Technology to Improve Medication-Use Patient Safety


Integrating Technology to Improve Medication-Use Patient Safety

SELF-ASSESSMENT QUESTIONS

1. Adoption of key medication-use technologies in health systems across the country is below 50%?
   a. True.
   b. False.

2. Which of the following are the reasons for the lack of full technology integration?
   a. Have not purchased all technologies.
   b. Interfaces not available.
   c. Staffing resources.
   d. All of the above.

3. Which phase of the medication-use process has the second highest percentage of medication errors?
   a. Prescribing.
   b. Transcribing.
   c. Dispensing.
   d. Administration.

Answers
1. a
2. d
3. d