A View from the Other Side: Changes in Pharmacy Practice After a Decade of an Integrated Computerized Provider Order Entry (CPOE) System

Stephen K. Huffines, Pharm. D.
Associate Director Pharmacy
steve.huffines@vanderbilt.edu
Presentation Goals

• Discuss brief history of CPOE at VUMC
• Understand the strategic importance of CPOE to institution
• Understand changes in pharmacy practice at a mature CPOE site
• Understand the change in resource needs and functions with a mature CPOE site
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Definition of “mature”
- System is deployed properly including:
  - Complete implementation
    - No dual systems
  - Use of system by physicians
    - CDS presented to physician
  - Integrated with pharmacy system
    - For safety and efficiency
  - Provides relevant decision support
Vanderbilt University Medical Center

Vanderbilt University Hospital
Vanderbilt Children’s Hospital
Vanderbilt Psychiatric Hospital

832 Beds
700 Average Daily Census
2,800 Daily Clinic Visits
200 Daily ED Visits
700 House Staff

Pharmacy Department
Patient care
Education
Research
History of CPOE System
1994 - 2006
History of CPOE at VUMC

- May 1994 – After failure of early vendor system, clinicians developed intuitive CPOE system
- December 1994 - Stable design after 6 months of development
- Implementation by unit followed,
  - CCU 4/95
  - MICU, BMT 9-10/1995
  - Adult Medicine & Surgery 1996
  - Pediatrics & OB/Gyn 1997
  - PICU 12/2001  NICU 4/2003
  - Ped ED 2003, Adult ED March 2004
  - Psychiatric Hospital 2005
- CPOE product sold to vendor 2001
- Back install of commercial CPOE product in Spring 2006
- CPOE - Pharmacy system interfaced in from start
CPOE System - Environment & Perspective

✓ Concept of prescribing and dispensing system
  ...providing appropriate functionality for each
✓ CPOE – Pharmacy system integrated from start
  ...provides safety & efficiency
✓ System has been continuously developed and improved
  ...to provide functionality for specific patient populations
✓ Order entry by physicians (residents) not mandated
  ...now part of culture and strategic recruiting tool
  ...complete turn over of 4 groups of residents since beginning
CPOE – by the numbers

All inpatient units are implemented

6+ Million

Electronic med orders processed since 1994

4,300

Electronic med orders processed per day

Medication Orders

- 78%
- 14%
- 6%
- 2%

Physician
Nurse
Nurse Prac
Pharmacist
Adoption of CPOE
1994 - 2006
Adoption of CPOE

- Slow to be adopted
  - Leapfrog – One of three original safety actions
  - ISMP – Recommended to enhance medication safety
  - California HealthCare Foundation – Recommended for all facilities
- Adoption rates run from 6-10%
- Fewer have fully integrated CPOE-Pharmacy Systems
- Pharmacists have great opportunity to advocate and influence one of the more complex components of the CPOE system
  - Process training
  - Clinical training
  - Experience with clinical systems
Reasons for slow adoption of CPOE

- Concerns about the upfront capital and future maintenance
- Technical & personnel infrastructure to support a complex system
- Time required to full implementation - other competing initiatives
- Physician resistance
- Change management required throughout the institution
- Unconvinced of the benefits of CPOE
- Functionality of systems & well publicized failures

**Pharmacy issues**
- Institutional initiative – not pharmacy generated
- Not included early enough in the process – a long journey ahead
- Concerns about resource needs
- Adequately trained pharmacists
- Poor understanding of benefits
  - Must fully understand capabilities of the system
  - Must know how to position pharmacy to maximize benefits
- May feel threatened that CPOE can reduce the need for pharmacy/pharmacist
The Backdrop: Institutional Growth & Change in Systems
1994 - 2006
## Growth of VUMC

<table>
<thead>
<tr>
<th>Statistics</th>
<th>FY1994</th>
<th>FY2006</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharges</td>
<td>29,001</td>
<td>48,922</td>
<td>69%</td>
</tr>
<tr>
<td>Patient Days</td>
<td>172,757</td>
<td>254,396</td>
<td>47%</td>
</tr>
<tr>
<td>Clinic Visits</td>
<td>380,000</td>
<td>1,019,715</td>
<td>268%</td>
</tr>
<tr>
<td>ED Visits</td>
<td>46,497</td>
<td>90,870</td>
<td>95%</td>
</tr>
<tr>
<td>Surgical Cases</td>
<td>7,895</td>
<td>38,647</td>
<td>489%</td>
</tr>
<tr>
<td>LOS</td>
<td>6.0</td>
<td>5.2</td>
<td>13%</td>
</tr>
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# Growth of the Pharmacy

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<tr>
<td>Doses Dispensed</td>
<td>2.71MM</td>
<td>4.94MM</td>
<td>82%</td>
</tr>
<tr>
<td>Rxs Dispensed</td>
<td>78,528</td>
<td>225,841</td>
<td>290%</td>
</tr>
<tr>
<td>Drug Cost</td>
<td>17.4 MM</td>
<td>72MM</td>
<td>414%</td>
</tr>
<tr>
<td>FTEs</td>
<td>145</td>
<td>252</td>
<td>74%</td>
</tr>
<tr>
<td>Salary Cost</td>
<td>6.2MM</td>
<td>18.5MM</td>
<td>298%</td>
</tr>
<tr>
<td>Doses PPD</td>
<td>15.7</td>
<td>19.4</td>
<td>24%</td>
</tr>
</tbody>
</table>
# Pharmacy Systems

<table>
<thead>
<tr>
<th></th>
<th>1994</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Order receipt &amp; Med order processing</strong></td>
<td>Copy of physicians order by fax, tube or courier, process location specific</td>
<td>98% Electronic, process from any location with shared work assignments</td>
</tr>
<tr>
<td><strong>Dispensing Systems</strong></td>
<td>Traditional Unit Dose/IV program with ADMs for narc, prns, emergency meds</td>
<td>Cartless ADM System in 115 locations, profile except for operative/procedure areas</td>
</tr>
<tr>
<td><strong>Infusion Technology</strong></td>
<td>Standard Infusion Pumps</td>
<td>Smart Infusion Pumps</td>
</tr>
<tr>
<td><strong>Satellites</strong></td>
<td>All Services 6 Locations</td>
<td>Order review, first dose 3 Locations</td>
</tr>
</tbody>
</table>
Increased Expectations: Service Level And Response Time
Pace of business/care

- Information is flowing much more rapidly
- Information is equally available to all professionals
- Patients are moving through the system much more rapidly
  - LOS decrease from 6.0 to 5.2
    - LOS critical to financial viability
    - Effectively managed LOS critical to quality of care
- Very high expectations on response time
  - Lowest of our service scores – although we rate higher than all other departments
- Decentralized dispensing model makes many meds available immediately
- Pharmacy must create systems to support this pace of care
  - Timely, Safe, Efficient & Flexible
VUMC Medication Order Processing Time

- <1 min, 20%
- 2-5 min, 45%
- 6-10 min, 14%
- 11-15 min, 5%
- 16-30 min, 9%
- 31-60 min, 1%
- >60 min, 6%

From time of order generation through pharmacy processing of order:

- 65% Processed within 5 minutes
- 84% Processed within 15 minutes
- 93% Processed within 30 minutes
- 7% are held pending patient room assignment
Volume of Business/Care: Creating additional capacity with CPOE
Volume of business/care

• Persistent, almost insidious, growth of institution & pharmacy
• Care provided during stay much more intense
  – Increased number of transactions/procedures from all departments
• Pharmacy services provided much more intense
  – Doses PPD move from 15 to 19
  – Complexity of therapy
• Pharmacy must create systems to provide additional capacity to support the increased workload
Pharmacy Staffing – Order Processing

• Factors
  – 98% electronic – not supporting dual systems
  – CPOE – Pharmacy systems fully integrated
  – Constant refinement to improve safety/efficiency of order processing
  – Consolidation of pharmacy locations – geographically neutral
  – Off site order review now common
    • 12% of facilities use offsite review

<table>
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<tr>
<th>Order Processing</th>
<th>1998</th>
<th>2006*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacists involved in order processing</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Orders processed / day</td>
<td>2200</td>
<td>4300</td>
</tr>
<tr>
<td>Orders processed PPD</td>
<td>4.7</td>
<td>5.75</td>
</tr>
</tbody>
</table>

76% increase in efficiency of order processing

1Am J Health-Syst Pharm Vol 63 Feb 2006       *Based on July – Oct 2006

Vanderbilt Medical Center
Integration of Systems – (CPOE – Pharmacy)

- No integration – receive printouts
- Dispensing order communicated to pharmacy electronically
- Prescribing order communicated to pharmacy electronically with manual conversion
- Prescribing order translated to dispensing order via intelligent interface
- Prescribing order translated to dispensing order via intelligent interface with order confirmation sent back to CPOE system
Pharmacy Manipulation of Inbound Orders

![Bar chart showing percentage of Direct Hit and User Override for years 1994, 1998, and 2006.]

- **1994**: Direct Hit 40%, User Override 60%
- **1998**: Direct Hit 60%, User Override 40%
- **2006**: Direct Hit 95%, User Override 5%

Legend:
- **Direct Hit**
- **User Override**
Excellent method to disseminate information house wide or to a targeted group

- Drug Shortage or market withdrawal
- Black Box Warning
- Formulary Restriction
- Therapeutic Exchange

Attention: Piperacillin-Tazobactam (Zosyn) in Short Supply

Due to the manufacturing issues, Piperacillin-Tazobactam (Zosyn) is in short supply in VUH.

In an effort to conserve Zosyn for patients in whom alternate therapy is not an option, the Pharmacy & Therapeutics Antibiotic Sub-Committee asks clinicians to consider ordering alternatives to Zosyn whenever possible.

Options:

- Colistimethate Injection
- Piperacillin Injection

OR

- Gentamicin Injection
- Tobramycin Injection
- Amikacin Injection
- Levofloxacin Oral
- Levofloxacin IV

If Piperacillin-Tazobactam (Zosyn) was selected to provide broad spectrum coverage, including anaerobes, but Pseudomonas coverage is not needed, then consider:

- Levofloxacin Oral
- Levofloxacin IV

OR

- Metronidazole Injection
- Metronidazole Oral

- Ampicillin-sulbactam (Unasyn) Injection
- Ertapenem (invanz) Injection
Clinical Activities after CPOE
Pharmacy Staff – Clinical Activities

• Mature CPOE system will change the clinical activities and should enhance efficiency
• Facilitate more comprehensive management of patients and/or increase the breadth of coverage
• Time is spent on monitoring/solving rather than gathering data – all professionals share the same data
• Pharmacist interventions are still essential but will be different
Pharmacy Staff – Clinical Activities

• Pharmacist interventions should be used to modify systems
  – Add CDS when possible to deal with reason for intervention and assess impact

• Use evidence based medicine to develop / review order sets & clinical decision support

• New skills that are important:
  – Understand how to leverage system to improve patient care
  – Understand data available & how to obtain
  – Develop skill/art of strategic use of massive amounts of data to improve patient outcomes
Resource Needs: Operational
System/Informatics Pharmacist Role in CPOE

- Gains in efficiency must be devoted to system management and development
- Partner in Medical Center informatics team
  - Active role in all medication-related issues within the institution
  - Pharmacist involvement not restricted to the core informatics team members.
  - Expertise of varied pharmacy staff members is critical
    - Operational, Pediatrics, Oncology, Trauma, Transplant
- Primary responsibility for maintaining medication orderables and their clinical attributes
- Customization of commercial knowledge content
  - Dose Range and Drug Interactions
  - Review of clinical override report
System/Informatics Pharmacist
Role in CPOE

• Project coordination both internal to pharmacy and working with other departments/groups
• Systems Testing/Training
  – Complex systems require extensive testing & training
• Systems Integration
  – The art of the deal and critical to ROI
• Institutional Initiatives & P& T Committee
  – Regulatory Mandates
  – Patient Safety Initiatives
  – Cost Savings
  – Patient satisfaction
  – Staff satisfaction
<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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<tr>
<td>Active Inpatient Drug Studies</td>
<td>45</td>
</tr>
<tr>
<td>P &amp; T – Drug not available</td>
<td>25</td>
</tr>
<tr>
<td>P &amp; T – Directive based on safety &amp;/or cost</td>
<td>36</td>
</tr>
<tr>
<td>Dosing Advisors</td>
<td>112</td>
</tr>
<tr>
<td>Dosing Advisors based on multiple factors</td>
<td>140</td>
</tr>
<tr>
<td>Drug selection / informational</td>
<td>57</td>
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<tr>
<td>Closed/Updated Interventions</td>
<td>286</td>
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**Intervention File Directory**
Managing Change & Complexity
Managing Change

- System implementation and subsequent development (CPOE) represents a profound change for users
- The complexity and integration of systems demand that the pharmacy properly manage change
- Users’ concerns must be continuously respected, listened to, and addressed – continuous development
- Change management is 75-90% of the effort to implement technology solutions: technical implementation is 20-25% of the effort¹
- Investments must be made in change management and leaders must enhance these skills
- When the CPOE system is the solution there will be insatiable demand for medication applications

Managing Change

• The CPOE system as a solution to all problems
  – “it seems like every new organizational mandate filters down to the fingertips of our primary care physicians in the form of something else that needs to be entered through the computer…”¹
  – Remain objective – make certain computer is right solution
  – There is no disgrace with a simple solution
  – Periodic assessment of results

• Proper change management will create a culture of involvement and innovation

¹JAMIA Vol 13, #5 Sep/Oct 2006
Types of Unintended Consequences Related to CPOE

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1JAMIA Vol 13, #5 Sep/Oct 2006
Why do systems fail?

| Communications          | Ineffective outgoing communication  
|                         | Ineffective listening  
|                         | Failure to effectively prepare the staff for the new system |
| Culture                 | Hostile culture within the information systems organization  
|                         | Hostile culture toward the information systems area  
|                         | No strategies to nurture or grow a new culture |
| Underestimation of complexity | Missed deadlines and cost overruns  
|                         | Lost credibility |
| Scope Creep             | Failure to define and maintain original success criteria  
|                         | Failure to renegotiate deadlines and resources if criteria do change |
| Organizational          | No clear vision for the change - Unintended consequences  
|                         | Ineffective reporting structure - Staff turnover and/or competency  
|                         | **Provision of a technical “fix” to a management problem**  
|                         | Lack of full support  
|                         | **Roles & responsibilities not clearly defined - Several people vying to be “in charge”**  
|                         | **Adequate resources not available from the beginning**  
|                         | **Failure to benchmark existing practices - Inability to measure success** |
| Technology              | System not dependable - System too technology oriented  
|                         | Lure of the leading (bleeding) edge - Inadequate testing |
| Training                | Inadequate or poor quality training  
|                         | Poor timing of training – too early or too late |
| Leadership issues       | Leader too emotionally committed - Leader’s time over committed  
|                         | Too much delegation without control - Failure to get ownership in the effort  
|                         | Leader’s political skills weak - “Lying” to get initial approval |
ADEs and CPOE
ADEs & CPOE Impact

• Must aggressively manage the transition and new opportunities for error
  • Learning curve
  • Constant change & development
  • Dual systems
  • Conversion tables
  • Unreasonable expectations

• When properly managed, reduction of error potential is significant

• Many studies have evaluated short range changes
  • Including studies from VUMC PICU
  • Ideally, these studies would assess from beginning to mature product
Elevate Pillar Goals

- **PEOPLE**
  - Reduce turnover rate
  - Elevate retention
  - Elevate employee satisfaction
  - Elevate physician satisfaction

- **SERVICE**
  - Elevate patient satisfaction
  - Service satisfaction
  - Would recommend

- **QUALITY**
  - Achieve lowest mortality rate
  - Perform in top 10% of clinical quality measures
  - Eliminate medication errors

- **GROWTH**
  - Exceed patient volumes
    - In-patient admissions
    - Out-patient visits
    - Surgical operations
    - Emergency visits
  - Increase sponsored research
  - Expand referring physician base

- **FINANCE**
  - Increase annual revenue:
    - Hospitals and clinics
    - Vanderbilt Medical Group
  - Increase annual net income
  - Save 5% of VMC cash flow
ADEs & CPOE Impact

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  • Ideally, these studies would assess from beginning to mature product
ADEs & CPOE Impact

• A powerful tool with wide range applications
• From legibility to complex patient specific decision support
  – Communications
  – Abbreviations
  – Black box warnings
  – Sound alike, look alike
  – Range orders
  – Allergy checking
  – Dose range
  – Interactions
  – Patient specific decision support
  – Surveillance
  – Research
Drug information tailored to patient age and weight

Demographic information for patient

Only those weight-based doses appropriate for patient appear on screen
## Preventing Medication Errors - IOM

### Prevention Strategies

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<th>Strength of Evidence</th>
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Pharmacy Informatics Training

• Most pharmacy students do not know informatics as a specialty area exist
• Since there is no exposure the interest level is unknown
• Colleges of Pharmacy training in Informatics*
  – 73 Colleges of Pharmacy curricula studied
    • 33% have some form of pharmacy informatics course
    • 16% require some form of pharmacy informatics course
• Current demand and complexity demand formal training programs
• Expose informatics to students, residents, pharmacists

*Allen Flynn, Pharm. D., St. Joseph Mercy Health System
Currently 4 Informatics Residencies are filled

12 Informatics Residencies will be available next year

Spread the word – all need to be filled!

Compiled by Alan Chung, Informatics Resident
Conclusion

• Not if, but when you make it to the other side, you will find a tool that you and your patients require & demand

• Pharmacist involvement in the Informatics Team is critical to make it to the other side – development to continuous improvement

• Medication process is complex and offers a high return on investment in patient safety and operational efficiency

• Understanding what awaits you on the other side is essential to properly position the pharmacy
Questions…

steve.huffines@vanderbilt.edu
fred.hargrove@vanderbilt.edu
www.vanderbiltpharmacy.com