Next Generation Clinical Information Systems: Is It Time to Jump?

Elaine Remmlinger, Principal and National Service Director

Stacy Melvin, Consultant

Kurt Salmon Associates
www.kurtsalmon.com
Topics to Be Addressed

- Clinical Information Systems Vision
- Marketplace Status
- Implementation Realities
- The Future
Imagine...

Patient Presents in ER with Chest Pain and Shortness of Breath

Access Full Patient History
Patient Is on CHF Protocol
Tests Ordered/Results Added
New Drug Treatment Recommended
Instant Access to Research/Knowledge Sources
Drug Treatment Ordered
Alert Indicates Less Expensive Drug Alternative
Drug Order Revised and Administered
Patient Outcome Recorded
Primary Care MD Notified
Information Used for Clinical and Financial Analysis

Ubiquitous access enables decision making & analysis

Clinical Data Repository
Data Warehouse
Imagine...

- Integrated information sources
- Automated information capture and delivery
- Ordering based on evidence-based protocols
- Proactive, “educated” alerts
- Advanced analytical capabilities
- Personalization based on user needs/practice
The desired direction for health care IT seems clear, but there are many challenges ahead...
Reaching this goal requires that we understand where we’re going, as well as where we’ve been...
Clinical Information System (CIS):
- Set of core applications supporting day-to-day inpatient and ambulatory services
  - CPOE/Order Entry
  - Results Retrieval
  - Multidisciplinary Documentation
  - Rules-based Clinical Decision Support
  - Clinician Access and Reporting Tools
  - Clinical Data Repository
  - Pharmacy
Definitions -- Distinctions Blurring...

- **Clinical Data Repository (CDR):**
  - Longitudinal patient-centric information
  - Component of the CIS, but not the CIS
  - Incorporates multi-media
  - Provides long-term retention

- **Computer-based Patient Record (CPR):**
  - Includes CIS, CDR, knowledge sources, enterprise network, feeder systems, etc.
  - Compendium of information regardless of origin
  - Enterprise and community
Beginning in the 1980s, CIS products focused primarily on charge capture and were oriented to unit secretaries.
The Past

These systems do not meet current needs…

- No longitudinal patient history
- Unfriendly user interface -- character-based screens
- Point to point interfaces
- Limited depth of clinical information
- Not clinician oriented
- No clinical decision support

...and yet, they are still being used by many health care organizations today...
Impetus for Change

- Technology and medical science innovation
- The Internet
- Consumerism and increased expectations
- Evidence-based medicine
- Focus on patient safety and medical error reduction
Impetus for Change -- Patient Safety

- High visibility of patient safety due to the Institute of Medicine reports, the Leapfrog Group, and other such initiatives

- Industry Response
  - Federal and state regulation
  - Local and national coalitions
  - Patient safety programs and reporting systems
  - Advanced Clinical Systems
  - Medication Management systems
Impetus for Change -- Patient Safety

- Provider Response
  - Implement medical error reporting systems
  - Develop IT strategies
  - Focus on CPOE, clinical decision support, and Medication Management systems
  - Investigate fragmented solutions
  - Leverage existing systems -- supplement, surround
  - Acquire new systems
  - Improve clinical processes
Current Direction

- Replace the paper-based chart
- Contain patient-centric information over time
- Integrate multi-media
- Facilitate communication throughout the continuum
- Provide access to external knowledge sources
- Meet clinical, legal, and administrative requirements
Current Direction

- Incorporate decision support tools to support evidence-based medicine
- Enhance quality, productivity, and efficiency
- Reduce medical errors through CPOE
- Ensure confidentiality and integrity (HIPAA)
- Appear seamless and user-friendly to end-users
Is This the Right Time to Invest?

- Are marketplace offerings real or vaporware?
- Where does the marketplace truly stand?
- Are newer products better than legacy offerings?
- Will there be a loss of function when converting?
- What is the value?
- Are there benefits?
Marketplace Status

- Product focus in transition
  - From financial/administrative to clinical
  - Combining inpatient and ambulatory

- Mature, outdated legacy products have continued support

- Migration from legacy systems is difficult and expensive

- Health care IT investments limited due to budget constraints

- Immature new products slowly being implemented
Marketplace Status

- Vendor products still not integrated
- Medical and information technology integration underway
- Web tools and technology being incorporated
- Niche products serving some needs
- Ancillary function or other key components may be lacking
- System performance not optimal
Medication Administration Process

1. Physician Orders
2. Unit Clerk Transcription
3. Nurse Reviews
4. Chart Copy to Pharmacy
5. Order Entry in Pharmacy
6. Pharmacist Verifies
7. Pharmacy Dispenses
8. Pharmacy Inventories
9. Medication Sent to Unit
10. Nurse Retrieves
11. Nurse Confirms
12. Nurse Administers

Functional Focus -- Patient Safety
## Functional Focus -- Patient Safety

### Advanced CIS Automates Many Current Manual Functions

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>MANUAL PROCESS</th>
<th>AUTOMATED SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prescription/Transcription</strong></td>
<td>• MD Writes Order&lt;br&gt;• Clerk Enters&lt;br&gt;• Nurse Reviews&lt;br&gt;• Order to Pharmacy&lt;br&gt;• Pharmacist Enters</td>
<td>• CPOE&lt;br&gt;• Alerts/Interaction&lt;br&gt;• Knowledge Sources</td>
</tr>
<tr>
<td><strong>Pharmacy Management</strong></td>
<td>• Pharmacist Verifies&lt;br&gt;• Formulary Referenced&lt;br&gt;• Update Patient Profile&lt;br&gt;• Maintain Inventory</td>
<td>• Patient Profile&lt;br&gt;• Drug Utilization Management&lt;br&gt;• Inventory Management&lt;br&gt;• Medication Formulary</td>
</tr>
<tr>
<td><strong>Dispensing</strong></td>
<td>• Pharmacist Verifies and Dispenses&lt;br&gt;• Nurse Retrieves</td>
<td>• Robotics&lt;br&gt;• Bar Coding&lt;br&gt;• Secured Dispensing Cabinets</td>
</tr>
<tr>
<td><strong>Medication Administration</strong></td>
<td>• Nurse Confirms&lt;br&gt;• Nurse Records in Chart</td>
<td>• Bar Coding&lt;br&gt;• Online MAR</td>
</tr>
</tbody>
</table>
Functional Focus -- CPOE

- Is not a standalone application, but a module of a CIS
- Automates the prescription/transcription process:
  - Replaces handwritten orders
  - Eliminates transcription, reducing delays and errors
  - Provides order sets and care paths
  - Ensures completeness
- Applies real-time, interactive alerts and warnings through clinical decision support tools
Functional Focus -- CPOE

- Is oriented to physician practice
- Enables standardization of many practices
- Predominantly occurring in teaching facilities or in organizations with “owned” physicians
- Few live sites
- May require a mandate for many organizations
Functional Focus -- CPOE

While early accomplishments are well documented...

- Brigham and Women’s Hospital
  - CPOE reduced error rates by 55% -- from 10.7 to 4.9 per 1,000 patient days
  - Serious medication errors fell by 88%

- LDS Hospital
  - 70% reduction in ADEs

- Wishard Memorial
  - 12.7% decrease in total charges
  - 0.9 days reduction in LOS
Functional Focus -- CPOE

- Time required for direct physician interaction
- Response time expectations
- Ease of use
- Specialty-specific/physician-specific needs
- Flexibility of information display
- Security
- Point of care devices
- Concern about “cookbook” medicine
- Lack of mandate

...obstacles to full use persist
Functional Focus -- Physician Oriented

- **Select patient from list**
  - Patient location
  - Patient status
  - Clinical summary
  - New results
  - Review outstanding tests/labs

- **Perform Assessment**
  - History & Physical
  - Review/graph results
  - Provide documentation
  - Provide values/notes
Functional Focus -- Physician Oriented

- **Place Orders**
  - Structured orders
  - Standard order sets
  - Personal order sets
  - Alerts/expert rules
  - Dosing recommendations and calculations
  - Exception documentation and audit trail
  - Electronic signature

- **Additional Features**
  - Access knowledge sources
  - Link to care plans
  - Provide patient education
  - Direct data acquisition
  - Wireless messaging/alerts
Functional Focus -- Nurse Oriented

- **Select from Patient List**
  - Patient location
  - New orders
  - New results
  - Previous assessments/progress notes
  - Automated task lists

- **Charting**
  - Personalized worklists
  - Assessments and updates
  - Critical paths/care plans
  - Flowsheet formatting
  - Graphical results trending

- **Additional Features**
  - Ambulatory support
  - Access knowledge sources
  - Provide patient education
  - Direct data acquisition
  - Wireless messaging/alerts
Functional Focus -- Alerts/Expert Rules

- Duplicate orders
- Drug-drug interactions
- Allergy checking
- Dose-range checking
- Drug-laboratory value interactions
- Drug-food interactions
- Disease contraindications
- Clinical protocols/guidelines
- Diagnostic indications

Check
Order Error for Amphotericin 100ng IV q24h
AMPH05C: **1.7 MG/KG/DAY** exceeds 1.5 MG/KG/DAY high dose., Pharmacy Dose Warnings

- Checking against hospital formulary
- IV incompatibilities
- Clinical algorithms
- Alternative suggestions/treatments
- Expiring orders
- Alert escalation
- Automatic paging
- Reminders for treatment
Barriers to Implementation

Financial

- High one-time and ongoing direct costs
- Significant investment in planning, designing, process redesign, and training
- Few organizations successfully achieve desired ROI (many have not even attempted measurement)
- Tangible benefits difficult to quantify
- Qualitative improvements potentially significant
### Potential Benefits

<table>
<thead>
<tr>
<th>Quality Improvements</th>
<th>Process Improvements</th>
<th>Error Reductions</th>
<th>Cost Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate lost orders</td>
<td>Order sets</td>
<td>Appropriate dosing recommendations</td>
<td>Duplicate order elimination</td>
</tr>
<tr>
<td>Eliminate illegible handwriting</td>
<td>Protocols</td>
<td>Eliminate dosing errors</td>
<td>Improve charge capture</td>
</tr>
<tr>
<td>Improve documentation</td>
<td>Expedite ordering</td>
<td>Interaction checking</td>
<td>LOS reduction</td>
</tr>
<tr>
<td>Enhance communication</td>
<td>Cycle time reduction</td>
<td>Interactive alerts</td>
<td>Reduce malpractice</td>
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<tr>
<td>Continuity of care</td>
<td>Alerts</td>
<td>Online knowledge sources</td>
<td>Reduce data entry</td>
</tr>
<tr>
<td>Reduce variances</td>
<td>Automate documentation</td>
<td>Medication administration verification</td>
<td>Alternative guidelines/formularies</td>
</tr>
<tr>
<td>Patient context</td>
<td>Access anytime, anywhere</td>
<td>Improve legibility</td>
<td>Lower cost interventions</td>
</tr>
<tr>
<td>Coded data for outcomes analysis</td>
<td>Reduce turnaround</td>
<td>Diagnostic indications</td>
<td></td>
</tr>
</tbody>
</table>
Barriers to Implementation

*Cultural*

- Resistance to change
- Overall comfort level with technology
- Willingness to use computers during patient interaction
- Requires active leadership from clinicians

*Many benefits are dependant on direct use by physicians*
Barriers to Implementation

**ORIENTATION**
- Ease of use
- Sub-second response time
- Intuitive design
- Personalization
- Minimal inservice time
- Flexible
- Follows caregiver workflow

**FUNCTION**
- Clinically focused
- Comprehensive/integrated
- Efficient
- Integrated knowledge sources
- Integrated tools
- Interactive decision support
- Reduced paperwork

**TECHNOLOGY**
- Web-browser
- Windows-based
- Clinical desktop
- Voice recognition
- Multi-media
- Rules engine

**ACCESS**
- Virtual availability 24/7
- Help desk available
- Multiple devices
- System reliability
Barriers to Implementation

Product Status

- There is no silver bullet
- Increasing market activity
- No single site doing it all
- Development is promising
- Independent vendor performance reports
Navigating the Marketplace

The solution for a particular health care organization depends on multiple factors

- Current system(s) in place
- Desired functionality
- Academic or community hospital focus
- Integration requirements
- Infrastructure prerequisites
- Existing budgetary constraints
- Availability of financial and human resources
- Risk threshold
Navigating the Marketplace -- Requirements

Core Requirements

- Order Entry/Physician Order Entry
- Integrated Rules Engine/Clinical Decision Support
- Results Retrieval/Clinical Data Repository
- Multidisciplinary Clinical Documentation
- Pharmacy

Integration Requirements

- Interface Engine
- Clinical Desktop
- Web-based Remote Access
- Master Patient Index
Navigating the Marketplace -- Requirements

Other “Integrated” Applications

- Patient Scheduling
- Admission, Discharge, and Transfer (ADT)
- Emergency Department
- Oncology
- Cardiac Services
- Perioperative Services
- Laboratory
- Radiology
- Patient Billing
- Medical Records
- Others?
# Navigating the Marketplace -- Select Vendors

<table>
<thead>
<tr>
<th>Vendors</th>
<th>EMPI</th>
<th>CPOE</th>
<th>Alerts</th>
<th>CDR</th>
<th>Pharmacy</th>
<th>Clinical Doc</th>
<th>ED</th>
<th>Product Suite</th>
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<td>EpicCare, EpicCenter</td>
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<td>HCIS- Magic, Client Server</td>
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<td>A</td>
<td>Invision</td>
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<td>-</td>
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<td>-</td>
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<td>VisualMED</td>
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<td>A/P</td>
<td>A/P</td>
<td>A/P</td>
<td>-</td>
<td>F</td>
<td>A/P</td>
<td>VisualMED System</td>
</tr>
</tbody>
</table>

**Status:** 10/01

**Key:**  
- **A** = Available  
- **P** = Partially Available  
- **D** = In Development  
- **F** = Future  
- **T** = Third Party
Navigating the Marketplace

Alternative Strategies

Single Vendor

- Applications
  - CPOE
  - Results Reporting
  - Rules Engine
  - Pharmacy
  - Clinical Documentation
  - Instrument Interfaces
  - Clinical Data Repository
- Interface Engine
- Clinical Desktop

Core Vendor and Best of Breed Add-ons

- Applications
  - CPOE
  - Results Reporting
  - Rules Engine
  - Clinical Data Repository
  - Clinical Desktop

OR

Hybrid Solution

- CORE & Pharmacy
- Other Add-ons
Navigating the Marketplace -- Niche Systems

Emergency Department Information System (EDIS) Requirements

- Triage
- Patient Tracking
- Order Entry
- Results Retrieval
- Documentation
- E&M Coding

Alternative Strategies

Standalone EDIS
Core CIS
Selected Standalone EDIS Modules & Core CIS
Integrated CIS/EDIS

Integration Is Extremely Difficult
Will Not Fully Satisfy ED Requirements
Compromise Solution
Ideal Solution

Issues to Consider

- Marketplace Availability of New Solution
- Functional Depth/Acceptability to Users
- Cost of Options

Key:
- Unique ED Function
- Overlapping ED/CIS Function
- Integrated ED/CIS
Navigating the Marketplace

Organizational Impact

- What changes in workflow will be required?
- What policy and procedure changes will result?
- What is the Total Cost of Ownership of alternative strategies?
- What are the potential benefits?
- How do alternative strategies impact affiliates?
- What are the resource requirements for the implementation?
- How much and what type(s) of training will be required?
# Navigating the Marketplace

## Conduct Adequate Due Diligence

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
<th>Support</th>
<th>Technology</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are they a good business – will they survive a merger?</td>
<td>Does it do what you need/want?</td>
<td>Will there be adequate resources to implement and maintain it?</td>
<td>Does it fit in with your standards?</td>
<td>What are the capital and operating costs?</td>
</tr>
<tr>
<td>Are they subject to unusual Wall Street pressure?</td>
<td>Does it integrate with the other things you have in your plan?</td>
<td>Is this a living offering or a dead end?</td>
<td>Is the hardware, software, or database proprietary?</td>
<td>What are the lifecycle costs?</td>
</tr>
<tr>
<td>Do you fit in with the client base in size, location, and needs?</td>
<td>How much will you need to customize to implement it?</td>
<td>Will you be able to really learn to use it?</td>
<td>What are the infrastructure needs?</td>
<td>What are the performance and timing risks?</td>
</tr>
</tbody>
</table>
# Navigating the Marketplace -- Cost

## COST FACTORS
- Modules Purchased
- Inhouse or Remote/ASP
- Number of Entities, Users, etc.
- Scope - Inpatient, Ambulatory, etc.

## COST COMPONENTS
- Hardware
- Software
- Interfaces
- Implementation/Conversion
- Training
- Support/Maintenance/Upgrades
Navigating the Marketplace

**Key Success Factors**

- Understanding of project goals and objectives
- Buy-in from all levels of the organization
- Appropriate expectation setting and communication
- Effective project management
- Active physician and leadership involvement
- Sufficient training prior to go-live
- Adequate support post implementation
### Vision for the Future

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>2000 REALITY</th>
<th>2005 PREDICTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPOE</td>
<td>• Limited to teaching hospitals; growing interest in community hospitals</td>
<td>• Maturity in academic settings; 50% utilization by progressive community providers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Widespread development of rules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Aggressive sites piloting voice-activated POE</td>
</tr>
<tr>
<td>Results</td>
<td>• More robust CDR</td>
<td>• Aggressive providers filmless and paperless; cultural transition to eliminate paper</td>
</tr>
<tr>
<td>Reporting</td>
<td>• Beginning move to multi-media with rapid growth in digital imaging</td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>• Momentum towards CPR; majority use paper-based chart</td>
<td>• Providers reliant on computer access; most information available electronically</td>
</tr>
<tr>
<td>Access</td>
<td>• Electronic retrieval of results significant</td>
<td>• Web-based remote access a necessity</td>
</tr>
<tr>
<td></td>
<td>• Increased remote access demand</td>
<td>• Widespread PDA use for results; use for POE immature</td>
</tr>
<tr>
<td></td>
<td>• PDA use for static information</td>
<td></td>
</tr>
</tbody>
</table>
### Vision for the Future

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>2000 STATUS</th>
<th>2005 PREDICTION</th>
</tr>
</thead>
</table>
| **Progress Notes** | *Physician resistance*  
*Predominantly used in ED and ambulatory sites*  
*Increased use seen with physician-oriented systems*  
*Lack of standards* | *Growing use in inpatient environment*  
*Template-based documentation more widespread*  
*Aggressive sites piloting voice activated documentation*  
*Continued pursuit of standards* |
| **Knowledge Sources** | *Access for reference*  
*Information remains fragmented* | *Integrated access with patient context* |
| **Patient Access** | *Early adopters to web-based information; political momentum for widespread access* | *Technology widely available, but not widely used* |
Vision for the Future -- Long-term

Clinical Analysts
- Disease Management Models
- Approved Formulary Development
- Research Protocols
- Evidence Based Critical Pathways

Physicians
- Alert to Protocol
- Approved Formulary Order Entry
- Dynamic Literature Search
- Protocol Team Alert

Managers
- Compliance Monitoring
- Outcomes Management
- Quality Management
- Medical Research
Vision for the Future -- Long-term

- Integrated view
- Single click access
- Patient context
- Outcomes focused
- Evidence based
- Standards
Vision for the Future -- Long-term

Closed-Loop Decision Making

Operational Decisions
- Clinical alerts
- Critical pathway enabled
- Order Entry/Results
- Approved formularies at prescription
- Dynamic literature searches

Strategic Decisions
- Identify high cost populations
- Compare against regional best practice benchmarks
- Choose a high volume/high variance population

Tactical Decisions
- Critical pathway development
- Best practice resource utilization profile
- Variance reporting
- Physician profiling

Analytical Information Use

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Vision for the Future -- Long-term

Advanced Analysis

Data Mining

Disease Management Pop Models

Phase of Care Analysis

Time Series Analysis

Clinical Model Engine

Clinical Report Cards

Compliance Control Charts

Digital Dashboards

Clinical Alerts

Intelligent Order Entry

Disease Population Flagging

Application Integration & Embedded Intelligence

Query & Reporting

Clinical Operational Financial

Information Delivery & Proactive Alerting

Clinical Alerts

Rules Engine

EAI

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Vision for the Future

Technology advances will enable product evolution

- Integration of biomedical and information technology
- Becoming increasingly paperless and filmless
- Maturation of voice recognition
- Medical vocabulary/common terminology
- Incorporation of benchmark data
- "Virtual" integration through e-tools
- Wireless limitations addressed
- System performance and reliability improved
Is It Time To Make The Investment?

QUESTIONS???

Elaine Remmlinger, Principal and National Service Director  
212.508.8374  
eremmlinger@kurtsalmon.com

Stacy Melvin, Consultant  
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smmelv@kurtsalmon.com