Clinical Laboratory Informatics: Building an Infrastructure for Improving Quality and Enhancing Value

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October 5, 2011
Outline

Role of informatics in the redesign of key laboratory/healthcare processes:

1. Provider order entry and utilization management
2. Test result management
CPOE is a key step for Pathology since orders set up the entire lab testing cascade.
Respect Human Limits in Process Design

• Avoid reliance on memory
• Avoid reliance on vigilance
• Use constraints and forcing functions
• Simplify key processes
• Standardize work processes
Order Entry vs. Order Communication

“Why are you doing this….We already have a lab order entry system. It works fine.”
Computerized Provider Order Entry (CPOE)

Providers

Test orders entered

CPOE

Processing, analysis

Laboratory Information System (LIS)

Clinical Area

Laboratory
Computerized Provider Order Entry (CPOE)

- No communication to laboratory system
- Huge amounts of wasted effort filling out requisitions, triplicate order entry
- Thousands of wrong tube errors per year
- 30% of orders were free text ("take as typed"); poor search function
- Pathology had minimal influence in CPOE group
Computerized Provider Order Entry (CPOE) AND Order Communication

WISH LIST:

- Pathology has control of menu, templates, order entry rules
- Must be able to make changes to system in real time without IS involvement
- Real time data must be available for QI, auditing and follow-up
Building Software That Gets Smarter

“I’ve been at MGH for 30 years and I have yet to see a project get to phase two.”
-- Dick Emrich, MGH LIS Director

1) **A strong vocabulary and data model** can make getting to phase two unnecessary

2) **Monitoring actual use** is critical to understanding how to improve the underlying data model
   - If you have a system that can learn you need a teacher
   - Don’t wait for complaints/user feedback
   - Create monitoring reports for use on Day 1
   - Expect and embrace failure!
Inpatient/ED Provider Order Communication

- Needed way for Pathologists to be able to control and maintain the order entry system
  - This requires that the POE team cede control to Pathology
  - LIS systems are not capable of performing the needed knowledge management tasks

Lab Orders

Inpatient/ED Provider Order Entry

Lab Info System

Providers

Laboratory Staff
How to “fix” the LIS: Middleware

- Middleware products specialize in one function or another (pre-analytic automation, autoverification, analysis rules, template reporting, digital image management, interpretive reporting, result reporting)
- Increasingly taking over functions of the core LIS products
What do we need?

• Need a different type of middleware
  – Not in the middle between the LIS and analyzers
  – Sits in between the LIS and rest of the enterprise information systems

• Need to incorporate the Lean concepts of eliminating waste and maximizing information flow to the various data consumers:
  • Enterprise decision support
  • Inpatient order entry
  • ED order entry
  • Outpatient order entry
  • Online laboratory handbook
MISSION: Catalog, enhance, and share laboratory knowledge

Inpatient/ED Provider Order Entry

Lab Orders

MGH PathConnect Middleware

Lab Info System

Providers

Online Laboratory Handbook

Outpatient Order Entry

Laboratory Staff

AJCP 2010;133:860-869
## MGH PathConnect Middleware

- Synchronizes with Laboratory Information System (LIS)
- Receives data from LIS regarding each test
- LIS test data can be augmented with ordering messages, alerts, search terms, related tests
- Allows cataloging of Pathology data such that it can be shared with other parts of the organization

### Laboratory Data Table

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AJCP 2010;133:860-869
MGH PathConnect Middleware

Permits Pathology to have total control over Provider Order Entry screens

Inpatient/ED Provider Order Entry

MGH PathConnect Middleware

Lab Info System

Lab Orders

Providers

Online Laboratory Handbook

Outpatient Order Entry

Laboratory Staff

AJCP 2010;133:860-869
POE Lab Ordering Screen

The order entry group leaves us “white space” that the lab fills in.

User Interface Built Entirely from MGH PathConnect Data

• Provider order entry calls middleware web service to build test dictionaries in a “just in time” manner

• Data behind the interface can be updated in real time by Pathology via the web service
Lab Ordering Screen

Complex Decision Trees Built Entirely from Database

- Complex decision trees can be represented in the middleware and be readily updated by Pathology
- Permits rapid responses to utilization issues
Improving Vitamin D Utilization with CPOE

Middleware enables rapid (minutes, to author and update test) responses to utilization issues.

- Adding non-interruptive ordering message dropped 1,25 OH vitamin D orders by 70% (p < 0.001)
- Cost savings = $20K/yr
Creatine Kinase MB

• CK-MB: cardiac specific isoform used in the diagnosis of ACS and related conditions
• Largely obsolete test yet still ordered over 36,000 times per year on MGH inpatients
  – Cost $38,000 per year
• Obtained cardiology, medicine, and ED approval to restrict use solely to the post-PCI setting
• Removed CK-MB from POE templates and created ordering message and pop-up screen to capture indication
MGH Order Entry Screen

Passive, non-interruptive ordering message
CK-MB Additional Info Screen
(Interruptive Alert)

- Middleware updates took 5 minutes to author, test, and implement
- No IS involvement required
Inpatient CK-MB Results Per Day

- Sustained 80% reduction in CK-MB orders within 3 weeks
- Cost savings of $30 K/year

Added interruptive alert to POE
Building Software That Gets Smarter

“I’ve been at MGH for 30 years and I have yet to see a project get to phase two.”
– Dick Emrich, MGH LIS Director

1) A strong vocabulary and data model can make getting to version two unnecessary

2) Monitoring actual use is critical to understanding how to improve the underlying data model
– Create monitoring reports for use on Day 1
– Expect and embrace failure!
– If you have a system that can learn you need content
Daily reports of all searches and orders

Expect Failure: Monitoring Reports for Orders and Search

1. Provider Order Entry
   - Cache

2. Lab Orders
   - a) Non-productive searches
   - b) Free text orders

Provider Order Entry

MGH PathConnect Middleware
- Web services
- XML

Lab Info System
- ODBC

Providers

Laboratory Staff
Analysis of User Search Productivity

Daily reports of all user searches, results, and orders available to lab
Reasons for Nonproductive Searches

(e.g. “syfillis”, “ferritan”)

FIX: Update middleware with misspellings

(e.g. “celiac”)

FIX: Update middleware with synonyms

(e.g. “insulin”)

FIX: Add test via middleware

Reason for Nonproductive Search

AJCP 2010;133:860-869
Expect Failure: Monitoring Reports for Orders and Search

1. Daily reports of all searches and orders

2. a) Non-productive searches
   b) Free text orders

Provider Order Entry

MGH PathConnect Middleware

Lab Info System

Provider

Cache

Web services

XML

MS SQL

ODBC

Laboratory Staff
Free Text Orders (e.g. “workarounds”)

- Free text (directly typed) orders monitored on a daily basis
- Free text is essential to eliminate before orders are communicated to the LIS
- Report permits near real time intervention with non-compliant physicians and/or system changes (adding tests, improving search)

Order communication start

- Current free text percentage 0.32% (4 sigma)
Provider Order Entry

- Provider Order Entry is a **key leverage point** for Pathology to improve ordering practices, prevent ordering errors, and avoid pre-analytic error.
- Pathology should have control over all laboratory order entry modules (IP/ED/OP) to permit rapid responses to ordering issues.
- Centralization of laboratory knowledge and understanding ordering behavior is essential to improve **utilization**.
Misaligned Incentives
(“Quality improvement can be a path to financial ruin”)

- Currently most incentives in healthcare are poorly aligned with quality outcomes
- Incentives encourage overutilization and do not reward “process quality”
- Healthcare finance reform is already starting to change this
- Leadership is required to effect change
Projected MGH Reference Lab Expenses FY10

15% annual growth rate for overall reference lab testing expenses

How can we head off this impending crisis?
Building a Data Infrastructure

• Needed real time data on reference laboratory test usage to facilitate monitoring
  – Test data, provider data, patient data, location data
• Enhanced middleware to add key fields for each of 2,100 reference laboratory tests:
  – Cost, performing laboratory, type of test, provider type
• Automatically digest daily feed from the Lab Information System (LIS), POE, admitting (daily census data) to provide integrated, clean data source for reporting and analysis
  ➔ MGH Pathology DataMart
MHG Pathology DataMart

- Daily reports on ordering practices, search
- Expanded test profiles
- Daily result reporting detail

- Hospital Census Data (Admitting Dept)
- Orders
- Test Profiles
- Results

- Provider Order Entry
- MGH PathConnect Middleware
- Lab Info System

- Web services
- ODBC
- XML

- Cache
- MS SQL

- Lab dashboard
- Practice “report cards”
- Statistical process control charts
- Detailed utilization tracking/analysis

AJCP 2011;135:108
Genetic testing expense has been rising an average of 26% per year since FY2002

Non-genetic testing expense has been rising an average of 6.5% per year since FY2002
Genetic tests ordered by top 25 providers account for 27% of entire reference lab expense
Healthcare Variability

• **Variability in a process is almost always a sure sign of waste**

• **Geography** is the number one cause of variability in health care processes
  – “Who you see is what you get”

• Process improvement in industry is all about reducing variability (hitting the target specification)

• How to reduce utilization variability…
Reference Lab Testing: Pediatric Genetics

Genetic tests ordered by 6 providers account for 15-20% of all reference lab expenses

High level of variability among providers
Approach for Pediatric Genetics

There is a high level of variability which likely represents inefficient utilization

1. Creation of a reference laboratory formulary will improve utilization
   - Green: **Anyone** can order (aldosterone)
   - Yellow: **Staff specialists in that field** ONLY can order (Trofile assay for ID; Complete Hereditary Ataxia panel for neurology). Requires order or approval by Specialist in that field.
   - Red: **Not Recommended** for clinical use. Requires approval by Pathology based gatekeeper (Leptin).

2. Regular reporting of reference lab utilization to providers will improve utilization.

3. Development of practice standards will improve utilization.
Pediatric Genetics Providers
(4/5 Top Ordering Physicians, 15-20% of all sendout expenses)
(e.g. “who you see is what you get”)
SPC: Weekly Pediatric Genetics Reference Laboratory Expense

1: Meeting with Chief of Service, sent data to providers
2: Meeting with entire team, “report cards” reviewed
3: Review developed practice guidelines, monitoring data

AJCP 2011;135:108
• First year in a decade that below budget (by $1.6 M)
• First year on record that genetic testing costs declined
• Over $500,000 in costs directly avoided via practice guidelines
• Project would not have been successful without highly detailed, real time data
Lessons Learned

- Focus on front line processes and information flow will be essential in the next chapter of healthcare.

- Pathologist/Infomaticians are well positioned to occupy key roles in the organization to create system level solutions and increase the value of the diagnostic process.

- Assess the entire testing process
  - Use forcing functions in order entry systems to improve utilization and reduce redundant testing.

- Pathology should maintain control of laboratory ordering modules of order entry system.

- Create tracking systems that capture the relevant data for analysis/metrics and system improvements.
Thank You

**MGH Pathology**
- Ricky Grisson
- Ji Yeon Kim
- Jason Baron
- Kent Lewandrowski
- Victor Brodsky
- Chris Nero

**Partners**
- Irina Kamis
- Erin Graydon Baker
- Balaji Singh
- Shalini Batra
- Sidi Belkziz
- Hal Myers
- Alex Demyanov

**MGH Medicine**
- Andy Karson