Demonstrate the Value of Laboratory Test Information: Linking the Laboratory to other Healthcare Systems to Improve Patient Care

Catherine Otto, Ph.D., MBA, MLS(ASCP)CM
Rutgers University
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Objectives

- Define informatics, its use and importance as a competency for all healthcare practitioners.
- Explain how the use of informatics with laboratory test information can improve patient outcomes.
- Identify two laboratory tests to link to other healthcare systems to improve patient outcomes.

Health Care Quality & Patient Safety

- “The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.”
  IOM, Crossing the Quality Chasm, 2001

- “freedom from accidental injury: avoidance, prevention, and amelioration of adverse outcomes or injuries stemming from the process of care”
  IOM, To Err is Human, 2000

Safe Laboratory Testing (Healthcare) is

- Safe
- Effective
- Efficient
- Timely
- Patient-centered
- Equitable

What is informatics?

- Informatics:
  - “science of processing data for storage and retrieval”; “information science”
  - “the collection, classification, storage, retrieval and dissemination of recorded knowledge”

- Medical informatics/Biomedical informatics:
  - “interdisciplinary field that studies and pursues the effective uses of biomedical data, information and scientific inquiry, problem solving and decision making, motivated by efforts to improve human health”
    - American Medical Informatics Association, www.amia.org/biomedical-informatics-core-competencies

- Bioinformatics
  - “the collection, classification, storage and analysis of biochemical & biological information using computers, especially as applied in molecular genetics and genomics”

Competencies to Improve Patient Safety

Source: Health Professions Education, A Bridge to Quality, Institute of Medicine, 2003
Transformations in Healthcare using Medical Informatics

- Manage information
- Communicate
- Improve delivery of healthcare
- Reduce errors
- Make decisions

Informatics to Manage Information

- System
  - Demographics, medical history, diagnosis, co-morbidities, allergies
  - Diagnostic Data—laboratory, radiology, other
  - Pharmacy Data—medications
  - Therapy Data—physical, occupational, chemotherapy
  - Documentation of out-patient visits

Informatics to Communicate

- System
  - Electronic communication between patient & provider
  - Notification of test results
  - Reminders for appointments & other care
- Laboratory
  - Send test results to clinicians
  - Send test results to patients/clients
  - Remind patients/clients of upcoming laboratory test orders

Informatics to Improve the Delivery of Healthcare

- EHR/EMR
  - One record for inpatient and outpatient records
  - One record for test results, medications, appointments, notes
- LIS
  - Labeling
  - Identification of type of specimen
  - Worklists
  - Pending lists
  - Interface between instruments and reporting
  - Automatic verification

Informatics to Reduce Errors

- Standardize and automate processes, provide information, flagging alerts
- CPOE = computerized provider order entry
- Bar coding
- Delta checks
- Interface between instruments & LIS
Informatics to Make Decisions

• System
  – CPOE

• Laboratory
  – Reflex testing

Informatics to Make Decisions—Utilization for Hospitalized Patients

• CPOE
• Prior to implementing EHR, >95% hospitalized patients on internal medicine service had orders for daily laboratory tests
• Removed option of ordering daily recurring laboratory tests
• Outcome: ratio of laboratory tests performed/# of inpatients per day = number of tests per patient per day


Informatics to Make Decisions—Laboratory Utilization for Hospitalized Patients

• Outcomes:
  – Length of stay decreased
  – Mortality did not increase
  – Readmission rates decreased

• Surveyed clinicians:
  – Forgot to order tests evening before
  – Delay in receipt of laboratory test information
  – Required a change in their process
  – Decrease in clinician productivity


Informatics to Make Decisions

• System—CPOE
• Results of most recent testing event displayed
• Recommendations for appropriate testing
• Cost of laboratory test displayed

Informatics to Make Decisions—Utilization for Hospitalized Patients

• Reduced utilization of:
  – PT/INR
  – Hepatic panel
  – Magnesium
  – Phosphorus
• Tests returned to pre-EHR institution
  – Basic metabolic profile
  – CBC


Competency: Utilize Informatics

• What does utilize informatics competency entail?
• What do practitioners need to be able to do/understand/use with respect to utilize informatics?
  – Optimize information in the LIS
  – Incorporate decision analytic tools
  – Link laboratory test information with other systems

Competency: Utilize Informatics

• “Word processing, presentation & data analysis software”

• “Communicate using email, instant messaging, listservs, and file transfers”

• “Search, retrieve, manage and make decisions using electronic data from internal information databases and external online databases and the Internet”

Competency: Utilize Informatics

• “Understand security protections such as access control, data security, data encryption and directly address ethical and legal issues related to the use of information technology in practice”

• “Enhance education and access to reliable health information for patients”

Competency: Utilize Informatics—Specific to Medical Laboratory Science

• Incorporate a statistical approach to data evaluation
  – Quality improvement studies

• Use electronic data to support decision & measure outcomes
  – Evidence-based practice

Use Informatics to Evaluate—Utilization Management

• Mean Abnormal Result Rate ➔ indicates ordering selectivity
  • If one test ordered, MARR = 25%
  • If 9 or more ordered, MARR = 7%

Source: Naugler CT et al. Mean Abnormal Result Rate, Proof of Concept of a New Metric for Benchmarking Selectivity in Laboratory Test Ordering. Am J Clin Pathol. 2016; 145: 568-573

Mean Abnormal Result Rate per Requisition vs Number of Tests Ordered per Requisition

Source: Naugler CT et al. Mean Abnormal Result Rate, Proof of Concept of a New Metric for Benchmarking Selectivity in Laboratory Test Ordering. Am J Clin Pathol. 2016; 145: 568-573

Number of Physician vs Yearly Mean Abnormal Result Rate

Source: Naugler CT et al. Mean Abnormal Result Rate, Proof of Concept of a New Metric for Benchmarking Selectivity in Laboratory Test Ordering. Am J Clin Pathol. 2016; 145: 568-573
Yearly Mean Abnormal Result Rate vs Yearly Total Test Volume per Physician

Source: Naugler CT et al. Mean Abnormal Result Rate, Proof of Concept of a New Metric for Benchmarking Selectivity in Laboratory Test Ordering. Am J Clin Pathol. 2016; 145: 568-573

Connecting Laboratory Information with Other Systems

Connecting Laboratory Information with Other Systems

Linking Microbiology Laboratory Data to Infection Control

• Monitor laboratory test information & health system database
  – Review positive laboratory test results
  – Compare to multidrug resistant organism database
• Order contact precautions
  – Automatically order after positive laboratory test results finalized
• Discontinue precautions & inactivate pathogen flags
  – Identify past cases of multidrug resistant organisms to determine if eligible to be cleared


Linking Microbiology Laboratory Data to Infection Control

Trigger Tools to Identify Adverse Drug Events

• Institute for Healthcare Improvement Triggers:
  • Clostridium difficile positive stool culture
  • aPTT > 100 seconds
  • INR > 6
  • Glucose < 50 mg/dL
  • Rising BUN or serum Creatinine (2x) over baseline


Linking Laboratory to Pharmacy—Send Results to Pharmacy

• Send positive C.difficile stool culture
• Send Glucose < 50 mg/dL
• Send rising BUN or serum Creatinine levels

Linking Laboratory to Hospital Risk Management System

- Others used to identify Adverse Events:
  - aPTT > 100 seconds
  - INR > 6
  - Transfusion of blood or blood products
  - Positive blood culture
  - Any infection occurring after hospital admission


Does Your Laboratory Participate in Providing Evidence for Potential Adverse Events?

- If so, for which tests?
- If not, what tests would you consider setting up a flag, to warn of potential adverse event?

Linking Laboratory to Pharmacy

Source: Schiff GD. Linking Laboratory and Pharmacy, Arch Intern Med 2003; 163: 893-900

Linking Chemistry (TSH) Laboratory Data to Pharmacy System

- Uncover diagnostic errors
- Determine frequency of failed follow-up of ↑ TSH
- 2.6 % & 2.1% unaware of hypothyroidism
- Often seen in ED or walk-in clinic, or while hospitalized
- Lack of follow-up appointment

Source: Schiff GD. Missed hypothyroidism diagnosis uncovered by linking laboratory and pharmacy data. Arch Intern Med. 2005; 165: 574-577

Linking Chemistry (HbA1c) Laboratory Data to Pharmacy System

- Evaluate diabetes care: changes in therapy based upon Hemoglobin A1c values
- 9 multispecialty groups submitted data – 4,818 patients
- HbA1c > 8% for 27% of study population
- HbA1c > 8% with no further testing for at least 90 days
- 54% of patients with actionable HbA1c did not have change in therapy initiated


Linking Chemistry (HbA1c) Laboratory Data to Pharmacy System

- Implementation in 21st Century:
  - Link to pharmacy
    - Send these test results to pharmacy system
    - Pharmacy identifies a list of patients with test values & links to their prescription information
  - Alerts can be created between Pharmacy & EHR/EMR systems

Linking Microbiology Laboratory Data to Pharmacy System

- Managing positive culture results for patients discharge from Emergency Department
- Urine, wound, and blood cultures
- All positive blood cultures—contact physician
- Phone patients with positive blood culture
- Review antimicrobial prescribed with sensitivity results
- Increased the rate of antimicrobial-related interventions
- Identified inappropriate anti-microbials prescribed for resistant organisms


Linking Microbiology Laboratory Data to Pharmacy System

- Average of 6 hours 35 minutes (range 1 hour 9 minutes to 21 hours 33 minutes) to administer new antibiotic upon notification of organism identification
- Longer delay during night shift (10 hours 33 minutes vs 4 hours 7 minutes)
- Pediatric cardiovascular, medical and surgical intensive care

Source: Grant MJC et al. Clinician response time for positive blood culture results in a pediatric ICU. Heart & Lung. 2015; 44: 426-429

Informatic Tool to Improve Warfarin Dosing

- Genetics InFormatics Trial (GIFT) to prevent DVT
- Study participants: 65 years of age
- Received one month of warfarin therapy after elective hip or knee arthroplasty
- Focus for study: first 11 days of therapy
- Created an algorithm that uses previous INR value with current INR value to estimate new warfarin dose


<table>
<thead>
<tr>
<th>Post Operative Day</th>
<th>INR</th>
<th>Dose estimate (mg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.6</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>2.2</td>
<td>3.2</td>
</tr>
<tr>
<td>5</td>
<td>3.1</td>
<td>5.5</td>
</tr>
</tbody>
</table>

An alert is created if the new dose is > 10% than the weighted average of the previous two doses estimates. Use of the author’s equation would have estimated the dose for day 5 at 5.2 mg/d.

Informatics Tool to Manage Warfarin Dosing

Gaps in Laboratory Testing Process in Primary Care

- Test ordering processes
  - Paper copy of test orders
  - Electronic health record
  - Clinical flow sheets & guidelines
- Test tracking processes
  - Lack of tracking system for tests ordered and reconciliation method for orders & test results
- Communicating test results to patients
  - Multiple methods to contact patients
  - 25% of respondents—tell patients: no notification = normal test results


Errors in Testing Process in Primary Care

- Breakdowns in the following processes:
  - test ordering, reporting of results, patient notification
- Delays in diagnosis
  - Patients do not always receive test result information within 24 hours of physician receipt of test results
- Communication gaps within the Physician Office Practice
  - Lack of defined responsibilities as to who handles test reconciliation and communicating test results with patient
- Errors in judgment & cognition
  - Lead to test ordering errors & errors in test interpretation
- Lack of Patient Centeredness
  - Lack of a systematic & consistent method to inform patients of test results


Notification of Abnormal Laboratory Test Results in EMR

- Studied 4 alerts
  - HbA1c ≥ 15%
  - Positive Hepatitis C antibody
  - Prostate-specific antigen ≥ 15 ng/mL
  - TSH ≥ 15 mIU/L
- 10.2% of alerts were unacknowledged
- 6.8% lacked timely follow-up
- Alerts for new vs known diagnosis more likely to lack timely follow up (odds ratio 7.35 (4.16-12.97))


Linking Laboratory Test Information to Emergency Department

- Emory University Hospitals
- aftER Care
- Automatically populates a list of pending tests
- Reviewed at end of each shift
- Clinician documents receipt of test results
- Contact patient with test results

Source: Fantz C. et al. No news is not always good news. Clinical Laboratory News. 2013 January

Informatics and Test Reporting

- Patient receives confirmation that laboratory test is performed
  - Send ALL laboratory test results to the patient
Wrap-Up

- Utilizing informatics to continue to improve patient safety with respect to laboratory testing
  - Infections, adverse drug reactions, chronic disease management
- Identify information that requires immediate action to create a linked system
  - Infections, adverse drug reactions, chronic disease management
- Create opportunities to improve the communication of laboratory test information
  - Emergency department, care transitions, patients
- Collaborate with colleagues in healthcare system
  - Pharmacists, clinicians, nurses

Resources

- Institute for Healthcare Improvement
  www.ihi.org
- American Medical Informatics Association
  www.amia.org
- Agency for Healthcare Quality and Research
  www.ahqr.gov
- Cochrane Database of Systematic Reviews
  www.cochranelibrary.com

Contact Information

- Catherine Otto
- co247@shp.rutgers.edu
- cathyottopatientsafety@gmail.com