The Lab Hitchhiker’s Guide to the Pitfalls and Opportunities in the Handling of Lab Test Data in the EHR

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2:00 PM
The speaker for this session has *no* relevant financial relationships with commercial interests to disclose.
Session Objectives

- Identify potential failure modes in the build of the EHR/laboratory orders interface
- Identify potential failure modes in the build of the laboratory/EHR results
- Discuss strategies for laboratories to reduce patient safety risk in the development of electronic laboratory orders and results reporting interfaces
UW Health is an academic health system which includes:
- University of Wisconsin School of Medicine and Public Health (UW SMPH)
- University of Wisconsin Hospital and Clinics (UWHC)
- University of Wisconsin Medical Foundation (UWMF)

The UW Health mission is to meet the health needs of Wisconsin and beyond through comprehensive excellence in education, research, patient care and community service.

**University of Wisconsin School of Medicine and Public Health**
- More than 1,100 faculty in 11 basic science departments and 15 clinical departments that include primary care, specialty areas and subspecialties.
- Faculty engaged in teaching, research and clinical activities.
- Physician faculty practice at more than 50 locations and care for patients at UWHC, Meriter, St. Marys, William S. Middleton Veterans and other Wisconsin hospitals.
- Basic and clinical research is funded by grants from NIH, other federal agencies and industry sponsors.
- Comprehensive educational offerings for training medical students, residents, fellows and continuing medical education.

**University of Wisconsin Hospital and Clinics**
- 471-bed tertiary care facility.
- Level One Trauma Center.
- Med Flight helicopter.
- One of the nation’s largest organ transplant programs.
- More than 6,000 full- and part-time employees at 12 clinical and non-clinical locations.
- Self-supporting; operated since 1996 as a public authority.
- One of four hospitals nationwide recognized by AHA Quest for Quality program.

**University Health Care**
- Nonprofit medical foundation organized for the benefit of UW School of Medicine and Public Health and to act as the practice plan for more than 900 faculty physicians with 1,900 non-physician staff.
- Largest medical group in Wisconsin and among 10 largest in the nation.
- Operates 30 clinics.
- Physicians provide care at UWHC, Meriter, St. Marys, William S. Middleton Veterans and other Wisconsin hospitals.
- Marketed as UW Health Physicians.

**Unity Health Plans Insurance Corporation**
- 75,000 member health plan serving 20 counties in south central Wisconsin.
- Offers a range of insured products for groups and individuals, including HMO and POS.

**Paul P. Carbone Comprehensive Cancer Center**
- One of 39 National Cancer Institute-designated comprehensive centers nationwide.
- Affiliated regional cancer centers in Appleton, Beloit, Johnson Creek, Manitowoc, Oshkosh, Wausau and Wisconsin Rapids, WI and Freeport, IL.
- Faculty of more than 250 physicians, physician-scientists and basic researchers across the UW-Madison campus.
- Operates CancerConnect.
- Offers 200-250 clinical trials ongoing at any given time.

**Department of Family Medicine Clinics**
- 4 clinics in Dane County; other clinics in Appleton, Augusta, Eau Claire and Wausau; residents also serve as staff at several Milwaukee clinics.
- Rural training tracks in Antigo, Baraboo and Menomonie.
Region of Patient Origin

- 44% primary
- 28% secondary
- 13% tertiary
- 16% other
Major Clinical Programs

- Critical Care
  - Level One Adult and Pediatric Trauma Center, with ASC-verified Burn Center, EICU
- Organ Failure and Transplant Center
- Carbone Comprehensive Cancer Center
- American Family Children’s Hospital
- Heart, Vascular and Thoracic Care
- Neurology and Neurosurgery
- Orthopedics and Rehab
UW Health Laboratory Services

- Three separately managed diagnostic laboratory systems with combined annual testing volumes over 5,000,000
- 50 CLIA licensed testing facilities and over 500 testing personnel
Our Journey Began
Current EHR Applications

- Registration and Scheduling
- Ambulatory
- Inpatient
- Clinical Documentation
- Pharmacy
- Radiology
- Emergency
- Transplant
- OR
- Anesthesia
- Oncology
- Home Health

*Laboratory and Cardiac Cath
Laboratory Information Systems

EHR orders and results interfaces:
- McKesson
- Powerpath
- Hemocare Lifeline
- HLA

Other orders and results interfaces
- Outreach clients: Beaker and Soft
- Reference Labs: ARUP, Mayo, WSLH (under development)
Health-care organizations are rushing to implement Electronic Health Records (EHR), a drive now fueled by the billion of dollars in government funding related to adoption of the EHR.

Implementation of an EHR involves both new challenges and opportunities for the laboratory community, whether laboratory information systems are interfaced to or integrated with the EHR.
Growth of the EHR
Core Functionalities

- **Health information and data** – An EHR system must include certain patient data, such as patient demographics, allergies, list of medications taken, medical and nursing diagnoses, clinical narratives, and *lab test results*.

- **Results management** – Managing test results of all types electronically can improve quality of care. For example, computerized results can be accessed more easily by providers; help to *reduce redundant and additional testing*; and can *allow for better interpretation of results and easier detection of medical abnormalities*.

- **Order Entry/Order Management** – Computerized provider order entry can help to *eliminate lost orders* and *reduce uncertainty caused by indecipherable handwriting*. In addition, it can help to *generate related orders automatically, monitor for duplicate orders*, and reduce the time to fill orders.

To read the IOM letter report, “**Key Capabilities of an Electronic Health Record System**” online, visit [http://www.nap.edu/catalog/10781.html](http://www.nap.edu/catalog/10781.html)
Growth of the EHR
Core Functionalities

- **Order Entry/Order Management** Computerized medication ordering has been shown to reduce the number of non-intercepted medication errors by up to 83% by utilizing functions for medication dose and frequency, *displaying relevant labs*, and checking for drug allergies and drug interactions.

- **Decision Support** – *Computerized decision support systems* (e.g., reminder systems) have demonstrated their effectiveness in enhancing clinical performance for many aspects of health care including prevention, prescribing of drugs, diagnosis and management, and detection of adverse events and disease outbreaks.

- **Electronic Communication and Connectivity** – Electronic *communication tools such as email*, have been shown to be effective in facilitating communication among providers and between providers and patients.

To read the IOM letter report, “**Key Capabilities of an Electronic Health Record System**” online, visit [http://www.nap.edu/catalog/10781.html](http://www.nap.edu/catalog/10781.html)
Growth of the EHR
Core Functionalities

- **Patient Support** – Computer-based patient education has been found to be successful in primary care.

- **Administrative Processes** – Electronic scheduling systems help to increase the efficiency of health care organizations and provide more timely service to patients. In addition, computerized decision support tools have been found to help in identifying eligible patients for clinical trials and supporting drug recalls.

- **Reporting and Population Health Management** – Public and private health care organizations have reporting requirements for patients safety, quality of care and public health. Having the data for these reports available electronically will save time and resources.

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American Recovery and Reinvestment Act (ARRA) of 2009

- Nearly $20 billion dollars allocated to increase physician adoption of EHR technology
- To qualify physicians must adopt certified technology and achieve *meaningful use* objectives
ARRA Meaningful Use

- Security and privacy
- **CPOE**
- Drug decision support
- Problem list
- Electronic prescribing
- Medication list
- Medication allergy list
- Demographics
- Advance directives
- Vital signs
- Smoking status
- **Lab test results**
- Patient lists
- CMS quality reporting

- Patient reminders
- Clinical decision rules
- Progress note
- Insurance eligibility
- Electronic claims submission
- Patient electronic copy
- **Patient electronic access**
- Patient specific educational resources
- Patient clinical summary
- **Exchange clinical information**
- Medication reconciliation
- **Reportable lab submission**
- Electronic syndromic surveillance
The Laboratory Perspective: Electronic Health Record

- Total Testing Process: from clinician order to communication of results

  - **Pre-analytical**: right patient, right specimen, right test at the right time (*orders management*)

  - **Analytical**: accurate and reproducible results

  - **Post-Analytical**: information presented is accurate, timely, accessible, interpretable, and presented to right person (*results management*)

- **Post-post analytical**
“Begin with the end in mind”
Covey 1989

“If you don't know where you are going, then you probably won't end up there.” ~Forrest Gump
New Safety Challenges
Orders Management

Safety is collecting the right specimen from the right patient at the right time for the right test and building systems so that critical calls are made and final results route to the responsible caregiver

- Patient identification - (right patient)
- Who is the provider and what is the location attached to the order?
- Building orders (right test)
- Collection Issues (right test, right time)
Building Orders
Impact on Results Routing

- Who is the provider who needs to receive the result?
  - Ordering
  - Encounter
  - Authorizing
  - Admitting
  - Attending
  - Discharging
  - Primary Care
  - Referring
  - Consult
  - Copy to....

- How or when is that provider attached to the order or the result?
Building Orders
Impact on Results

- Results routing schemes
- Does the ordering location drive results routing?
- Where is the critical result to be called?
- Where is the patient located (transfers)
New Safety Challenges
Results Management

Safety is getting the right result to the right person at the right time in a usable/interpretable format

- Regulatory requirements and the legal medical record
- Displays and explosion of environments
- Flags
- Corrections and updates
- Communication of results: routing, messaging and handoffs
- Integrating lab data across performing labs
- Integration of outside lab data
## The Post-Analytical Process

Walz and Darcy, Clinics in Laboratory Medicine, March 2013

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accurate and timely results communicated by the laboratory (Lab process)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>2</td>
<td>Results received by a responsible caregiver (Lab and clinical process)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>3</td>
<td>Results reviewed (Clinical process)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>4</td>
<td>Results interpreted correctly (Lab and clinical process)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>5</td>
<td>Appropriate follow-up (Clinical process)</td>
</tr>
</tbody>
</table>
Identification of Post Analytical Patient Safety Risks

**Results not communicated from lab**
- Tests performed but not resulted
- Critical notifications failed or were not timely
- Results not communicated: Interface errors, print failures, mail/fax failures

**Results not received by correct provider**
- Organization has not defined correct provider
- Results routing logic errors: wrong provider, wrong pool, sorting results by abnormal
- Provider record issues
- Departed providers with active inboxes
- Changed results

**Results not interpreted correctly:**
- Display of results incomplete, ambiguous or confusing
- Flagging or alert failures

**Results not reviewed**

**High Risk Gaps in Appropriate Follow-up**
- Change in patient location or provider of care
- Inpatient results returned post-discharge
- Recommended post-discharge tests not performed
Accurate and Timely Communication of Results

<table>
<thead>
<tr>
<th>Failure</th>
<th>Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests performed but not reported</td>
<td>Review lists</td>
</tr>
<tr>
<td>Patient identification error in results reporting</td>
<td>Corrected reports/variance</td>
</tr>
<tr>
<td>Delay in reporting</td>
<td>Turnaround time monitor</td>
</tr>
<tr>
<td>Incorrect calculation</td>
<td>Verification of calculations</td>
</tr>
<tr>
<td>Critical result notification failed or delayed</td>
<td>Critical call timeliness</td>
</tr>
<tr>
<td>Results not sent due to communication failures</td>
<td>Interface error monitor</td>
</tr>
</tbody>
</table>
Identification of Post Analytical Patient Safety Risk

**Results not communicated from lab**
Tests performed but not resulted
Critical notifications failed or were not timely
Results not communicated: Interface errors, print failures, mail/fax failures

**Results not received by correct provider**
Organization has not defined correct provider
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Provider record issues
Departed providers with active inboxes
Changed results

**Results not interpreted correctly:**
Display of results incomplete, ambiguous or confusing
Flagging or alert failures

**Results not reviewed**

**High Risk Gaps in Appropriate Follow-up**
Change in patient location or provider of care
Inpatient results returned post-discharge
Recommended post-discharge tests not performed
The Display

It used to be so simple
Display of Results
What is included with the result?

- Result/Value
- Units of measure
- Reference range
- Collect date/time
- Flags: abnormality, changed, critical
- Lab comments
- Performing laboratory
- Trailing zeros
Display of Results

Explosion of Environments

- Chart equivalent: report of an individual test or panel
- Cumulative/chronological view: called EHR Patient Summary Record
- Reports
- Discharge summaries
- Emergency Department Tracking Board
- Flow-sheets
- Patient letters
- Patient portal and smart phone portal
- Data pulled through community exchanges
- Smart phone and tablet applications
Results Management

Display of Results

- Which displays will lab control, which will allow lab to have input?
- Which display is the legal medical record of the result?
- Can others add information to what was sent from the lab?
Display of Results

Legible and interpretable?

- Columns
- Proportional spacing
- Commas and decimals
- Scale
- AM/PM vs. 24 hour clock
- “Hidden” lab results, aka comments
<table>
<thead>
<tr>
<th>Antibody Screen (U...)</th>
<th>Negative</th>
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</thead>
<tbody>
<tr>
<td><strong>Basic Chem 1</strong></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>135</td>
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<tr>
<td>Potassium</td>
<td>3.8</td>
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<tr>
<td>Chloride</td>
<td>109</td>
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<td>CO2</td>
<td>22</td>
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<tr>
<td>Anion Gap</td>
<td>10</td>
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<tr>
<td>BUN</td>
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<td>Creatinine</td>
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<td>Glucose</td>
<td>94</td>
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<tr>
<td><strong>Basic Chem 2</strong></td>
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<tr>
<td>Calcium (UWHC)</td>
<td>8.7</td>
</tr>
<tr>
<td>Magnesium</td>
<td>2.1</td>
</tr>
<tr>
<td>Phosphate</td>
<td>2.3</td>
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<td><strong>CBC</strong></td>
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<tr>
<td>White Cell Count</td>
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<tr>
<td>Red Cell Count</td>
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<tr>
<td>Hemoglobin</td>
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<td>Hematocrit</td>
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<td>MCV</td>
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<tr>
<td>MCHC</td>
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<td>RDW</td>
<td>13.3</td>
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<td>RDW SD</td>
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<td>Platelet Count</td>
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<td>Bacterial</td>
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<td></td>
<td>2</td>
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<td>Value</td>
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<table>
<thead>
<tr>
<th>Test Description</th>
<th>2</th>
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<tbody>
<tr>
<td>PREGNANCY TESTS</td>
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<tr>
<td>BETA-HCG (UWMF)</td>
<td></td>
<td>9656.4</td>
<td>H</td>
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<tr>
<td>PREGNANCY KIT TEST...</td>
<td></td>
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<td>Positive</td>
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<tr>
<td>TOTAL BETA HCG (UWHC)</td>
<td>22909.8</td>
<td>13181.2</td>
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The Fishbone – Really??
<table>
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<tr>
<th>Royal Navy</th>
<th>Royal Navy (revised)</th>
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<tr>
<td>A</td>
<td>A</td>
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<tr>
<td>B</td>
<td>B</td>
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<tr>
<td>C</td>
<td>C</td>
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<td>D</td>
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<td>F</td>
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<td>G</td>
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<td>I</td>
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<td>K</td>
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<td>L</td>
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<td>M</td>
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<td>N</td>
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<td>V</td>
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<td>W</td>
<td>W</td>
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<tr>
<td>X</td>
<td>X</td>
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<tr>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Z</td>
<td>Z</td>
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</table>

**Flags**

<table>
<thead>
<tr>
<th>Flag</th>
<th>Flag</th>
</tr>
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<tbody>
<tr>
<td>BE</td>
<td>AH</td>
</tr>
<tr>
<td>CO</td>
<td>AS</td>
</tr>
<tr>
<td>DE</td>
<td>PO</td>
</tr>
<tr>
<td>DI</td>
<td>SB</td>
</tr>
<tr>
<td>FO</td>
<td>OP</td>
</tr>
<tr>
<td>ST</td>
<td></td>
</tr>
</tbody>
</table>
Subject line: “FW: Wrong again or right, not sure”
Flagging Results
Subject line: “FW: Wrong again or right, not sure”
Results Management
Flagging Results

- Multiple labs with inconsistent flagging
- Changing flags from the legacy system: impact on clinicians
- Can non-lab comments add flags to results?
- One flag fits all
- Flagging fatigue; when every result is flagged, flags are no longer important
### Flagging Results

#### Inconsistency between Views

*where oh where are the uom?*

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTT</td>
<td>27.5</td>
</tr>
<tr>
<td>ACTIVATED PTT</td>
<td>...</td>
</tr>
</tbody>
</table>

**DIABETES**

**POC GLUCOSE (UWHC)**

**CBC**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED CELL COUNT</td>
<td>1.9</td>
</tr>
<tr>
<td>HEMOGLOBIN</td>
<td>7.3</td>
</tr>
<tr>
<td>HEMATOCRIT</td>
<td>22</td>
</tr>
</tbody>
</table>

**ANEMIA/IRON**

**RETIC (UWHC)**

### Component Results

<table>
<thead>
<tr>
<th>Component</th>
<th>Result</th>
<th>Flag</th>
<th>Reference Range</th>
<th>Units</th>
<th>Status</th>
<th>Lab</th>
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<tbody>
<tr>
<td>White Cell Count</td>
<td>7.8</td>
<td></td>
<td>3.8 - 10.5</td>
<td>K/UL</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>Red Cell Count</td>
<td>1.9</td>
<td>L</td>
<td>3.8 - 5.2</td>
<td>M/uL</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>6.1</td>
<td>LL</td>
<td>11.6 - 15.6</td>
<td>g/dL</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>18</td>
<td>LL</td>
<td>34 - 46</td>
<td>%</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>MCV</td>
<td>91</td>
<td></td>
<td>80 - 97</td>
<td>fL</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>MCHC</td>
<td>35</td>
<td></td>
<td>32 - 36</td>
<td>g/dL</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>RDW CV</td>
<td>13.2</td>
<td></td>
<td>11.7 - 14.7</td>
<td>%</td>
<td>Final</td>
<td>MAIN</td>
</tr>
<tr>
<td>RDW SD</td>
<td>44.1</td>
<td></td>
<td>36.0 - 46.0</td>
<td>fL</td>
<td>Final</td>
<td>MAIN</td>
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<tr>
<td>Platelet</td>
<td>278</td>
<td></td>
<td>160 - 370</td>
<td>K/UL</td>
<td>Final</td>
<td>MAIN</td>
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</table>
# Flagging Results

## Non-Lab Flags/Flag Fatigue

<table>
<thead>
<tr>
<th>CBC</th>
<th>WHITE CELL COUNT</th>
<th>7.2 *</th>
<th>01/31/07 1242</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED CELL COUNT</td>
<td></td>
<td>4.65 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>HEMOGLOBIN</td>
<td></td>
<td>14.0 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>HEMATOCRIT</td>
<td></td>
<td>40.7 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>MCV</td>
<td></td>
<td>87.6 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>MCH</td>
<td></td>
<td>30.1 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>MCHC</td>
<td></td>
<td>34.4 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>RDW</td>
<td></td>
<td>11.9 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>PLATELET COUNT</td>
<td></td>
<td>299 *</td>
<td>01/31/07 1242</td>
</tr>
<tr>
<td>MPV</td>
<td></td>
<td>7.4 *</td>
<td>01/31/07 1242</td>
</tr>
</tbody>
</table>

- Clinician comment flag: in this case the asterisk indicates a review comment from the clinician attached to every result
- Note lack of justification on the decimal
The Rumsfeld Rule

"Absence of evidence is not evidence of absence!"

-- Carl Sagan, Astronomer

"Absence of evidence is not evidence of absence!"

-- Donald Rumsfeld, Military strategist
Flagging Results
“Normal vs Abnormal”

- The absence of an abnormality flag sent by the lab does not mean the result is normal.
- Huge pressure in the EHR to sort results into normal and abnormal and even going as far as to interpret the absence of a flag as a normal result.
- High risk for anatomic pathology, microbiology, blood bank, reference lab tests, scanned results.
Results Management
“Normal vs. Abnormal”

**FINAL DIAGNOSIS:**
CYTOLOGIC EXAMINATION: Positive, adenocarcinoma.

**ADDITIONAL FINDINGS:**
Please refer to surgical pathology case S-07-12539.

**COMMENTS:**
This case was reviewed by the pathologist.

**ADEQUACY ASSESSMENT:**
This aspirate was performed by the radiologist/clinician.
This aspirate was assisted by the cytotechnologist.
Pass 1: Inadequate for assessment. Pass 2: Adequate for assessment. SMS adequacy assessment was established after 2 passes. SMS

<table>
<thead>
<tr>
<th>GROUP</th>
<th>COMPONENT (W/O NORMALS)</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC CHEM 1</td>
<td>GLUCOSE</td>
<td>117 ▲ 08/08/07 09:56</td>
</tr>
<tr>
<td>BASIC CHEM 2</td>
<td>Lactate values are normal</td>
<td></td>
</tr>
<tr>
<td>INR</td>
<td>INR (U/wc)</td>
<td>3.5 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td>CBC</td>
<td>HEMOGLOBIN</td>
<td>2.4 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td></td>
<td>HEMATOCRIT</td>
<td>31 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td></td>
<td>MCV</td>
<td>72 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td></td>
<td>MCHC</td>
<td>31 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td></td>
<td>RDW</td>
<td>16.1 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td>TUMOR MARKERS</td>
<td>CA125 (U/wc)</td>
<td>7000 ▼ 08/08/07 08:57</td>
</tr>
<tr>
<td>CYTOLOGY, NON-GYN</td>
<td>Lactate values are normal</td>
<td></td>
</tr>
<tr>
<td>SURGICAL PATHOLOGY</td>
<td>Lactate values are normal</td>
<td></td>
</tr>
</tbody>
</table>


Results Management
Corrections and Updates

- Original retrievable?
- Is correction sent by interface as a new result and not linked to original
- Do updates apply retroactively? (Example of the cancer staging, age of the patient and reference ranges)
- How does one verify the information that was viewable at the time of care?
- Consider terminology and system behavior: use of preliminary and final, final preliminary, edited and corrected
Results Management

Corrections and updates

- Laboratory systems will, in general, embed the original result in the corrected result. Special considerations in dealing with corrections in the EHR include asking are the original results still retrievable in the EHR?

- When a result is corrected does the correction update any place in the EHR the result was pulled: e.g. flow sheets and summary reports
  - Scenarios for single and multiply corrected results should be tested through the lab displays to the derivative displays in the EHR
Results Management

Handoff Communication

- Messaging to clinicians a powerful tool of the EHR
- Decisions on who receives messages: ordering, attending, PCP, admitting, clinic staff
- Illusion of communication
Results Management
Communication Handoffs

- Baseline non-EHR data indicates 35.9% of recommended post-discharge procedures not completed (*Archives Internal Med* 6/25/07)

- Results of tests ordered on the inpatient encounter returning post-discharge
Results Routing
Results Routing Survey

- For electronic routing of **Ambulatory laboratory results** to physicians
  - Are results sent to the attending physician (aka authorizing, billing) Y/ N
  - Are results also sent to an ordering provider if different from attending Y/N -
  - Are results also sent to a primary care provider if different from attending? Y/ N

- Are physicians allowed to opt out of receiving all Ambulatory lab results? If yes what exceptions are allowed- check all that apply
  - Can choose to receive no lab results
  - Can choose to receive "abnormal" results only
  - Can choose to receive Anatomic results (surg path and cyto) but not clinical lab results
  - Other - please explain

- If physicians do not receive all Ambulatory results, who manages these results?
  - Nurses
  - Medical Assistants
  - Other

- Please describe routing of **Inpatient laboratory results**
  - All results are sent to attending physicians  Y N
  - If no please check all that apply
  - No results are sent to attending physicians
    - Some but not all results are sent to attending physicians, check all that are routed to physicians
      - AP results
      - Micro
      - Molecular
      - Sendout tests
      - Test results reported after discharge of patient from hospital
Results Routing

- Do you know who receives electronic results in your organization?
- Have you validated for each routing scheme?
- Are custom routing schemes allowed by department, by clinic, by provider or by result?
- Who maintains?
Results Routing
Things to consider

- Inpatient vs outpatient
- Anatomic pathology vs clinical lab
- Emergency Department
- Urgent care: pediatrics vs adults
- Results returned post-discharge
- The inpatient “discharge orders”
Results Routing
The Illusion of Communication

- Or – you send a result and no one is there to receive it
- What is the process for absent or departed providers?
In May of 2011 a kidney transplant program in the US was voluntarily shut down following a failure to follow-up on a laboratory test result.

The results of a positive hepatitis C test sat in a living kidney donor's medical record for more than two months before her kidney was transplanted into a man who did not have the virus, according to the findings of a federal investigation into the case.

But despite at least six chances to review the test result and possibly stop the transplant because of the potentially lethal hepatitis C infecting the donor, none of the doctors or nurses involved in the case did so, according to the Centers for Medicare and Medicaid Services (CMS) investigation.
Patient death or serious injury resulting from failure to follow up or communicate laboratory, pathology, or radiology test results.
New SRE

- A patient might suffer injury for delay in care if your laboratory report did not reach the responsible clinician or if the result was received but not communicated to the patient or acted upon by the provider.

- Does the laboratory clearly understand the routing of results from all information systems. Particularly if the electronic record has been implemented, has the laboratory audited to ensure that results are routed appropriately and have been received.

- The laboratory can also be a powerful voice for the Patient Safety in organizational discussions to determine who is the clinician responsible for followup of laboratory results in all scenarios. When an test is collected from an inpatient but results received after discharge who is responsible for followup and can you ensure they have received the information? Do clinics track that results of all diagnostic tests ordered have been received and that results are communicated to patients.
Integrating Data Across Performing Laboratories
Results Management

Integrating data across performing labs

- Exceptional clinical benefits related to an integrated longitudinal view of all lab data on a patient

- Different performing labs with major method differences, hospital labs and physician office labs, POC results, outside results

- Clinicians, many, “don’t care about the performing lab” and don’t recognize that this can impact ability to integrate information
### CHEMISTRY-INTEGRATED

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<thead>
<tr>
<th>Date</th>
<th>Potassium</th>
<th>Sodium</th>
<th>Calcium</th>
<th>Chloride</th>
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<tr>
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**Flowsheet Data**

![Graph showing flowsheet data](image)
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>POTASSIUM-UWMF</td>
<td>3.61-4.81 mEq/L</td>
<td>3.81</td>
<td>3.61</td>
<td>4.81</td>
<td>4.61</td>
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<tr>
<td>POTASSIUM-UWHC</td>
<td>3.63-4.83 mEq/L</td>
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<td></td>
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<tr>
<td>POTASSIUM-OTHER</td>
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<td>3.87</td>
<td>2.77 (A)</td>
<td>3.77</td>
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<tr>
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<tr>
<td>SODIUM-OTHER</td>
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<td>137</td>
<td>77 (A)</td>
<td>137</td>
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<tr>
<td>CALCIUM-UWMF</td>
<td>8.1-10.1 mg/dL</td>
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</tr>
<tr>
<td>CALCIUM-UWHC</td>
<td>8.3-10.3 mg/dL</td>
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<td></td>
</tr>
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<td>CALCIUM-OTHER</td>
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<td>7.7 (A)</td>
<td>8.7</td>
<td>7.7 (A)</td>
<td>8.7</td>
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<tr>
<td>CHLORIDE-UWMF</td>
<td>91-101 mmol/L</td>
<td>91</td>
<td>101</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHLORIDE-UWHC</td>
<td>93-103 mmol/L</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHLORIDE-OTHER</td>
<td>97</td>
<td>87 (A)</td>
<td>97</td>
<td>87 (A)</td>
<td>97</td>
</tr>
<tr>
<td>BICARBONATE-UWMF</td>
<td>21-31 mEq/L</td>
<td>21</td>
<td>31</td>
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<tr>
<td>BICARBONATE-UWHC</td>
<td>23-33 mEq/L</td>
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<td></td>
</tr>
<tr>
<td>BICARBONATE-OTHER</td>
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<td>17 (A)</td>
<td>27</td>
</tr>
<tr>
<td>CREATININE-UWMF</td>
<td>0.81-1.21</td>
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<td>1.21</td>
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<td>CREATININE-UWHC</td>
<td>0.83-1.23</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CREATININE-OTHER</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results Management

Outside Lab Data

- Exceptional clinical benefits related to an integrated longitudinal view of all lab data on a patient
- Not reference lab data or data manually entered into an LIS or POC lab data
- Scanned documents
  - Not a discrete data element
  - Can’t be graphed or pulled into flow-sheets
Results Management

Outside Lab Data

- Patient performed home results – enter or not?
- Manually entered data
  - Risk of transcription error
  - How will you distinguish these results from those performed by system labs?
  - What will you require as fields to be entered?
  - Will the original report be scanned?
## Volume Statistics

### External Result Entry

**July – December 2010**

<table>
<thead>
<tr>
<th>Section</th>
<th>Patients</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF Onc</td>
<td>348</td>
<td>6,926</td>
</tr>
<tr>
<td>HC Onc</td>
<td>1,952</td>
<td>39,890</td>
</tr>
<tr>
<td>Transplant</td>
<td>15,385</td>
<td>311,425</td>
</tr>
<tr>
<td>Other Dept</td>
<td>1,079</td>
<td>13,881</td>
</tr>
<tr>
<td>6 month actual</td>
<td>18,764</td>
<td>372,122</td>
</tr>
<tr>
<td>12 month projected</td>
<td>37,528</td>
<td>744,244</td>
</tr>
</tbody>
</table>
• LOINC®
  - Logical Observation Identifiers Names and Codes

The Holy Grail
Meaningful Use Vocabulary Standard for Laboratory Results in a Patient Summary Record

- Facilitates electronic exchange of results
- Need to “pool results” without matching idiosyncratic local codes
- Keep local codes, add LOINC code in HL7 result message so can “file” result (Say in organization’s EHR Patient Summary Record or HIE, health information exchange-unrelated organizations, reference labs should have their results LOINCed for you.)
Lab test observation is a question, the observation value (actual result) is an answer

- LOINC provides codes for the question (IE what is the test-LOINC code for culture)

- Other coding systems (such as SNOMED) provide codes for the answers (IE what is specific result-S. aureus). (the two would be very useful for pulling public health or research data from pooled results)
- **LOINC®**
  - Logical Observation Identifiers Names and Codes

- LIS systems must attach correct LOINC code to the result message sent to an EHR patient summary record.

- EHR system must be able to receive, store and properly file lab result component in the patient summary record by LOINC code and display result with human readable format (not LOINC number).

- Remember, the LOINC code is based on tests from a specific lab. The LOINC code will always be determined by the LIS data, and then matched to the EMR patient summary record (starter set codes for result components from Vendor is just a guess-after coding your lab, can use matching program then modify starter set as necessary).
New External Results Challenges

HIE

- Requests to use screen shots as source for manual transcription of external lab results via EER
- Lab data lacks critical required elements including date/time of specimen collection and identity of performing laboratory
- Printed lab results sent to HIM to scan, essentially duplicating data already in our record
### Lab Results

**C-REACTIVE PROTEIN - Final result (Tue Feb 15, 2011 10:00 AM)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRP</td>
<td>28.4 (H)</td>
<td>Low:&lt;7.4 (mg/L)</td>
</tr>
</tbody>
</table>

**Specimen**
Blood - XBlood Serum

---

**SED RATE WESTERGREN AUTO - Final result (Mon Feb 14, 2011 12:00 AM)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SED RATE</td>
<td>23</td>
<td>0-25 (mm/Hr)</td>
</tr>
</tbody>
</table>

**Specimen**
Blood
The Brave New World

- The electronic patient portal (2 versions) – web version vs the smart phone application
- Smart phone and tablet applications for results viewing
- Health Information Exchanges – push or pull data into the electronic record
# Diabetes Test Results

These are your diabetes related test result components. You may view a list of all your test results for more information.

<table>
<thead>
<tr>
<th>Name</th>
<th>Standard Range</th>
<th>9/24/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHOLESTEROL</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>CREATININE</td>
<td>0.55-1.05 mg/dL</td>
<td>0.60</td>
</tr>
<tr>
<td>E-GER</td>
<td>60-120 mL/min/1.73sqm</td>
<td>106</td>
</tr>
<tr>
<td>GLUCOSE</td>
<td>70-99 mg/dL</td>
<td>100</td>
</tr>
<tr>
<td>HDL CHOLESTEROL (UWMF)</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>LDL CHOLESTEROL (UWMF)</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>RATIO (UWMF)</td>
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<tr>
<td>TRIGLYCERIDES</td>
<td>145</td>
<td></td>
</tr>
</tbody>
</table>

[Show this as a graph]

[Back to the Home Page]
Hitchhiker’s guide
Checklist for Results Builds

- Begin with the end in mind
- Displays
- Flags
- The Rumsfeld rule: find it
- Handoff of communication
- Integrating across performing lab
- External results
- Results routing
- The holy grail (LOINC)
- Brave new world – smart phones, tablets and the patient portal (multiple versions)
Hitchhiker’s guide
Checklist for Results Validation

- All performing labs
- Prelim and final
- Most problematic displays: multiple organisms and displays
- Corrected and edited
- Tumor markers and interpretive comments
- Inbasket – prove routing
Key Points

- Get involved
- Take ownership
- Be a collaborative partner to clinicians
- Be an advocate for patients
- Find resources for LOINC
Summary

- Laboratories must continue to assess the post-analytical phase of the total testing process using monitors such as critical call notification, turnaround time, changed reports and accuracy of result transmission from the LIS across interfaces and in paper reports.
- Laboratories must become advocates for patient safety by developing new quality monitors to ensure that results posting in electronic health records are interpretable and are received and reviewed by responsible providers of care.
- The explosion of environments in which laboratory results are displayed, such as smart phones, tablets and patient portals, make the management of test results an increasingly error-prone process.
- High risk transitions of care, such as the patient being discharged from the hospital with pending laboratory tests, should be a focus for developing new quality processes and monitors.
You are Not Alone on the Journey

Your work is keeping patients safe
Now you stay safe!
Thank You!

Questions?