Next Generation Clinical and Anatomic Pathology

Delivering More with Collaboration, Analytics, Automation and Precision Medicine

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New Financial Realities in Healthcare

- US government funds > 50% of our nation’s $3.8 trillion healthcare expenditures
- Lab testing: >$60 billion
  - 3% of health care cost (1.5% of Medicare)
  - dictates 70% of downstream spend
- Lab must reduce cost, increase quality and speed, improve overall outcome and cost

\[
\text{Value} = \frac{\text{Quality}}{\text{Cost}}
\]
Lab’s role in Care Transformation

- Reduce waste, unneeded testing
- Use of appropriate testing
- Faster, more valuable results
- Coordinate lab tests across spectrum of care
  - Inpatient, outpatient, outreach
- Be more integrated, more available to care team
- Create IT solutions in physician workflow

Labs are well-positioned to influence cost/quality

In-house lab team is a great asset in cost control
Increasing Lab Value

• Appropriate Laboratory Utilization
• Pathology Consultation
• Automation/lab efficiency
• New approaches to diagnosis
Lab utilization improvement

- Right test at the right time
  - Clinician understanding of 50-100 tests
  - Strongest predictor of lab order patterns is residency
  - Technology evolving quickly
- Tests over-ordered? under-ordered? Who orders?
- Nomenclature
- Interpretive guidance (today’s docs are less prepared to use the lab properly)
CBC with differential
Hours between reported result and next order
Surveyed Physicians’ reasons for ordering multiple CBC with diff tests within 24 hours on inpatients

- Ordering error: 60%
- Ordered by other service: 10%
- Clinical situation changed: 10%
- Personal preference: 20%

NorthShore University HealthSystem
Potential financial impact, CBC/diff

Over 500 tests/month ordered more frequently than q 24 hours on inpatients…

Potential cost impact:

- 500 x $4 = $2000 (Automated diff)
- 100 x $10 = $1000 (Manual diff)

$3000 monthly for one test

“Once a day” and “once a stay” duplicate order alerts!

Clean up order sets!
Once in a Lifetime test intervention

- For germline genetic tests
- Need unique test code
- Ability to scan over all encounters
- Designed alert to include previous test result
  - value-add to clinicians!
- Prevention of duplicate germline testing:
  - Cost savings significant!
  - 25% still ordered? Who orders tests?
Blood utilization management

• Major source of variability and expense
• Significant implications for clinical outcome
Randomly assigned ICU pts.
- Restrictive (hgb <7.0, target 7-9)
- Liberal (hgb <10.0, target 10-11)
- 1° outcome; 30 day mortality

Younger & healthier patients did BETTER with less blood

Pulmonary and cardiac outcomes drove improvement

<table>
<thead>
<tr>
<th>2° Outcome</th>
<th>Restrictive</th>
<th>Liberal</th>
<th>Signif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hosp. mortality</td>
<td>22.2%</td>
<td>28.1%</td>
<td>p=0.05</td>
</tr>
<tr>
<td>MI</td>
<td>0.7%</td>
<td>2.9%</td>
<td>p=0.02</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>5.3%</td>
<td>10.7%</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>ARDS</td>
<td>7.7%</td>
<td>11.4%</td>
<td>p=0.06</td>
</tr>
<tr>
<td>Multiorgan fail (adj)</td>
<td>20.6%</td>
<td>26.0%</td>
<td>p=0.07</td>
</tr>
</tbody>
</table>
Blood Utilization data

RBCs/100 DC compares favorably with other academic medical centers

Hospital D is an outlier

16 RBCs/100 DC at S would = 338 RBCs saved, $67,648

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>% patients with RBC trx</td>
<td>4.8%</td>
<td>7.6%</td>
<td>6.0%</td>
<td>8.7%</td>
<td>7.2%</td>
</tr>
<tr>
<td># RBC Units</td>
<td>2557</td>
<td>2021</td>
<td>1635</td>
<td>1796</td>
<td>8009</td>
</tr>
<tr>
<td>RBC's / 100 Discharges</td>
<td>11.4</td>
<td>16.0</td>
<td>13.5</td>
<td>19.7</td>
<td>16.1</td>
</tr>
<tr>
<td>% of 2 units tx back-to-Back</td>
<td>57.7%</td>
<td>55.7%</td>
<td>58.5%</td>
<td>67.7%</td>
<td>59.9%</td>
</tr>
<tr>
<td>% with Hgb&gt;11 after 1-2 B-to-B</td>
<td>4.2%</td>
<td>6.2%</td>
<td>7.2%</td>
<td>9.0%</td>
<td>6.8%</td>
</tr>
</tbody>
</table>
Transfusion Notice

RBC Transfusion Issue
In the absence of active acute ischemic syndrome or bleeding, transfusion can typically be avoided for patients with HGB ≥ 8.

RBC Transfusion Guidelines

Options for closing the BestPractice Advisory

1. Continue with the order by selecting an 'Acknowledgement Reason' by clicking one of the buttons below.
2. To cancel the transfuse order and to order a CBC, select 'Accept' below.

Acknowledgement reason: Active Bleeding Other (Comment)

Remove unsigned order: TRANSFUSE RED BLOOD CELLS Back to back RBC transfusions should be avoided. Consider repeat CBC before transfusion of 2nd unit Check for a pre-medicat [...] (Last done by Alexander McLain Grubbs on 11/13/2014 at 9:39 AM)

Add to unsigned orders: CBC W/O DIFFERENTIAL (Last done by Alexander McLain Grubbs on 11/12/2014 at 4:10 PM)
Alerts launched

RBC Utilization

- Blue line: RBC's per 100 discharges
- Red line: % Pts w/ RBC txn trigger hgb > 8.0 tx'd
- Green line: % Back-to-back RBC txn's

FY13-Q3, FY14-Q1, FY14-Q3, FY15-Q1, FY15-Q3, FY16-Q1, FY16-Q3, FY17-Q1, FY17-Q3
Clinical/Financial impact of transfusion interventions

38% reduction in RBCs transfused per 100 discharges

83% reduction in RBCs transfused at hemoglobin >8

94% reduction in back-to-back RBCs transfused

The reduction in COGs was $2.1M overall

57% reduction, adjusted for inflation, in COGs per inpatient encounter between FY’12 and FY’17.
Increasing consultation and communication

- Clinicians live in electronic medical record
- Electronic communications prevail
- Information at fingertips

- Clinicians
  - Don’t know lab
  - Don’t know Pathologists
  - Don’t take time/don’t have time
  - Life measured in clicks
MyPathologist

• Purpose

"MyPathologist" provides a direct connection between clinicians, and Pathologists and Lab Scientists to answer questions such as:

- Should a test be ordered?
- Which test should be ordered?
- How should this test result be interpreted?
- Is follow-up testing needed?
- I need clarification of a cytology/histology report

• Location
Generates In Basket Message

Message is prepopulated to lead user through the process of receiving help.
The on-call resident will receive a page notification that a My Pathologist Message has been sent to their In Basket.

Follow up with service in under 2 hours

Great feedback!

Educational value!

Theparee, et al, Academic Pathology, 2018
*Put data in the hands of clinicians....*

Lab website

What’s Going around App

**NorthShore Respiratory Illness - 2015-16**

Colors represent the proportion of all patients seen in the Medical Group who had the syndrome of interest. Areas with insufficient data for accurate estimates are not colored.
Lab is primary source of medical information

- All patients get lab tests
- 70% of data in EMR is lab-derived
- What to do with that data?
Lab-driven predictive analytics
Electronic Cardiac Arrest Risk Triage (eCART)

Existing Medical risk indicators
- Age, years
- Number of ICU stays
- Respiratory rate, bpm
- Heart rate, bpm
- Systolic bp, mm Hg
- Diastolic bp, mm Hg
- Temperature, degrees C
- Pulse pressure index
- Oxygen saturation, %
- Mental status (AVPU)
- Sodium, mEq/L
- Potassium, mEq/L
- Alkaline phosphatase, U/L

Bicarbonate, mEq/L
- Anion gap, mEq/L
- BUN, mg/dL
- Creatinine, mg/dL
- BUN-creatinine ratio
- Glucose, mg/dL
- Calcium, mg/L
- WBC, K/μL
- Hemoglobin, g/dL
- Platelets, K/μL
- Total protein, g/dL
- Albumin, g/dL
- Total bilirubin, mg/dL
- AST, U/L

Multicenter Development and Validation of a Risk Stratification Tool for Ward Patients
Figure 2. Shown is the percentage of patients who reached each electronic Cardiac Arrest Risk Triage (eCART) score during their ward admission in the validation cohort, with each outcome and the entire study population shown as a separate line. ICU = intensive care unit.
Patient List with eCART scores

eCART scores are made available in the EMR to all health care providers (HCPs): attending physicians, residents, non-physician providers, floor and ICU nurses and unit nurse managers. Scores are presented on every HCPs patient list.
Value of new technologies/automation

• Workload efficiency, reproducibility
• Addresses workforce issues
• Lower cost
• Faster results
Significant impact on TAT, LOS

Time to ID cut by ~8 hours
>$250K impact on cost outside lab (LOS)

Tests performed/FTE increased 14%

6 FTEs $500K annual savings
Core lab redesign: chemistry, hematology, and central receiving
Core Lab today
Core Lab Roche Automation

Pre-analytics: Lab assistants (better use of med techs)
  • 8100: (Less human touch/error -- FTE Savings)
    » Single entrypoint for most specimens (chem, heme)
    » Preps (spin, aliquot, label) samples for other tests

Analytics:
  • Optimize technologist duties (Improved Staff Utilization)
  • Analytic modules optimized
  • Faster assay incubation times (as little as 9 min)
    – STAT prioritization (Improved patient care)
    – Expanded Test Menu: bring testing in-house, fewer other platforms (better care, cost savings)

Post Analytic: Storage and retrieval automated
## ROI: Financial Results

<table>
<thead>
<tr>
<th></th>
<th>FY18 Volume</th>
<th>FY18 Savings Combined Chem and Heme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost Per Test Change (FY15-FY18)</strong></td>
<td>2,363,536</td>
<td>$2,032,641</td>
</tr>
<tr>
<td><strong>FY18 Volume</strong></td>
<td>(20% increase from 2015)</td>
<td></td>
</tr>
<tr>
<td><strong>FY18 Savings</strong></td>
<td></td>
<td>$2,032,641</td>
</tr>
</tbody>
</table>

Without automation, 10 more FTEs needed!

Cumulative Savings: $3.24M
Genomic Pathology

Sample → Genomic analysis →
  Diagnosis → Treatment design → Monitoring

Heritable disease
Cancer
Infection

Infection
Cancer

Cancer therapy
Antimicrobial resistance
Pharmacogenomics

NorthShore University HealthSystem
Anatomic Pathology in the post genome era
Evolution of Non–Small-Cell Lung Cancer (NSCLC) Classification

©2013 by American Society of Clinical Oncology
Detection of molecular alterations
Ion Torrent Semiconductor Sequencing Chip

First chemistry cycle:
- Determine first base
  - To initiate the first sequencing cycle, add all four labeled reversible terminators, primers, and DNA polymerase enzyme to the flow cell.

Image of first chemistry cycle:
- After laser excitation, capture the image of emitted fluorescence from each cluster on the flow cell. Record the identity of the first base for each cluster.

Before initiating the next chemistry cycle:
- The blocked 3’ terminus and the fluorophore from each incorporated base are removed.
Clinical application of NGS in Anatomic Pathology

• Diagnosis
  – Growing number of tumors require molecular eval

• Prediction of treatment response
  – Gene mutations needed
  – NCCN guidelines for Lung, Colon, CNS, others
  – Tumor Mutational Burden for immunotherapy

• Monitoring, resistance
  – Mutations causing chemotherapy resistance
  – Cell free tumor DNA in plasma

• Need for better reimbursement, regulatory clarity, quality/reference materials, training
THANK YOU!