Standardizing Detection of Acute Kidney Injury in an Integrated Delivery Health System

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Disclosures

• None
Northwell Health Laboratories

- Plainview
- Southside
- Huntington
- Forest Hills
- Clinical Trials BARC
- SIUH North
- SIUH South
- NJ, Brklyn, SI Physician’s Offices
- Northern Westchester
- Phelps
- Peconic
- LHH
- Greenwich Village (urgicenter)
- Manhasset
- LI
- Glen Cove
- Franklin
- Physician’s Offices
- Nursing Homes
- Non-System Hospital Reference Testing

Plus: 32 Patient Service Centers, in-office phlebotomy, home draw, network support of POLs
Objectives

• Evidence-based criteria for diagnosis and staging of AKI

• Laboratories are positioned to take a leading role in driving quality improvement strategies outside the lab

• Standardize early detection and reduce variability in diagnosis, and management by embedding clinical decision support in workflows

• Laboratories can improve clinical and financial outcomes and demonstrate value to all stakeholders – patients, providers, health systems and payers
Problem Statement (Opportunity)

• CMO of Forest Hills Hospital (FHH) approached the laboratory leadership in July 2013

• Radiocontrast-induced AKI contributed to at least 3 cases of AKI per day

• Variable cost = $500 / day (conservative estimate)
  - 3 cases / day × 365 = 1095 cases / year
  - 2 excess days/case × 1095 = 2190 excess days in LOS
  - 2190 excess days × $500 per day = $1,095,000

• A million dollars in projected cost savings at FHH alone. Huge potential for system wide savings.
Significance of small incremental increases in Serum Creatinine (SCr)

AKI associated with increased odds of in-hospital mortality (6 to 30 fold), length of stay (3 to 7 days) and total costs of care ($4000 to $10,000) per patient encounter.
AKI Clinical Significance

• AKI affects 15-20 % of all hospitalized patients and majority are cared by non-nephrologists (aka general internists, surgeons, ER physicians)

• Incidence may be as high as 20 to 30 % in critical care settings

• AKI encompasses a variety of disease states and is a frequent co-morbidity

• Broad problem in all hospital settings across all specialties
AKI Economic Significance

• AKI represents roughly 5% of total hospital costs

• “With conservative incidence rate of 5% - the annual health care expenditures that are attributable to hospital-acquired AKI exceeded $ 10 billion in the United States”

• All three outcomes- mortality, LOS, costs - worsen as AKI progresses from Stage 1 to 3

• Increased likelihood of CKD and hence renal replacement therapy costs
AKI Evidence Based Diagnostic Criteria

• Diagnosis relies on incremental rise in inpatient SCr value over a minimum **baseline** value within a **fixed** time **period**

• Multiple definitions of AKI have been used
  - Acute Kidney Injury Network criteria (AKIN)
  - Risk, Injury, Failure criteria (RIFLE)

• Subtle but important differences in how diagnostic criteria are applied

• KDIGO group published consensus guidelines by incorporating aspects of RIFLE and AKIN definitions
AKI Diagnostic and Staging Criteria

• SCr measurement is necessary for both diagnosis and staging of AKI

• **KDIGO Diagnostic Criteria** requires detection of small incremental rise in SCr above patient’s baseline SCr value based on either one or both of the following criteria
  a) 0.3 mg/dl rise above baseline within 48 hours (absolute)
  b) 1.5 to 1.9 times baseline within 7 days (relative)

• **AKI Stages**
  - **Stage 1**: SCr increase by >= 0.3 mg/dl from baseline or SCr increase by 1.5 to 1.9 times baseline
  - **Stage 2**: SCr increase by 2.0 to 2.9 times baseline
  - **Stage 3**: SCr increase by >= 3.0 times baseline or SCr greater than 4 mg/dl
Baseline Creatinine - KDIGO guidelines

• KDIGO allows for “clinical judgment” in determining baseline SCr and establishing diagnosis of AKI

• KDIGO states: “it is reasonable for a patient without CKD (previous normal renal function) to assume that SCr will be stable over several months/years. SCr levels obtained during this timeframe would reasonably reflect pre-morbid baseline.”

• No consensus on what the baseline SCr should be and different surrogates have been used
Time Frame for AKI – KDIGO guidelines

• Increase in SCr $> 0.3$ mg/dl AKI criteria can only be applied prospectively when the baseline has been measured within the preceding 48 hours.

• The increase in SCr $>1.5$ times baseline AKI criteria can be used retrospectively and prospectively with broad interpretation.

• No clear recommendation as to when the 1-week or 48-hour time period can occur.
AKI remains Under Diagnosed and Under Recognized

• Seemingly simple evidence-based guidelines – but applying them prospectively and consistently in routine clinical practice has many practical challenges

• Lack of awareness among providers, especially among non-nephrologists who most commonly encounter AKI

• Lack of effective electronic decision support tools in the EMR that help in diagnosis within the normal clinical workflow

• Variable standards of care which contribute to sub-optimal clinical outcomes and high costs
Solution – Implementation of Laboratory AKI Alert

• Apply KDIGO criteria prospectively and consistently in routine hospital practice → minimize variability

• Automated hospital wide real-time laboratory electronic alerting system using a modified delta checking algorithm within LIS

• Minimum inpatient creatinine as the baseline value. Use “rolling” baseline minimum SCr for delta checking

• Alert clinicians before creatinine value goes outside reference range so that clinicians can detect a rising trend
Laboratory AKI Alert

• Our algorithm compares each new SCr result with a previous rolling minimum SCr within the same inpatient encounter.

• If there is a SCr rise of
  - 0.3 mg/dl within 48 hours (absolute criteria)
  OR
  - 50% rise (1.5 x) compared to the baseline within 7 days (relative criteria), then the result is flagged.

• Results which do not meet the delta criteria are not flagged

• Our modified delta checking algorithm is highly sensitive and captures > 99.8% of patients at-risk for AKI
Inpatient Creatinine Monitoring for AKI

Diagnosis relies on incremental rise in inpatient creatinine value over a minimum baseline value within a fixed time period.
Implementation of Laboratory AKI Alert

• At Forest Hills Hospital (FHH) → ~ 40 alerts / day which corresponded to 20 patients/day at-risk for AKI

• 10-12% incidence rate in a busy community hospital

• Extensive validation of the algorithm between Sept 2013 to Oct 2013

• Physician education and awareness campaign conducted by the CMO between Nov 2013 to Dec 2013

• Active engagement with physician champions and nursing staff

• Care navigators were tasked with following up on all patients identified at-risk for AKI
Active vs. Passive alert – Embedding CDS in the workflow

• Active alerts reduce clinical impact because of alert fatigue and inability to assess patients in a systematic manner

• Instead of generating one alert at a time, the LIS programmed to generate a report of all AKI episodes within the previous 24 hours with patient’s room and bed location

• Rounding tool: The report emailed to clinical and nursing leads of all units at 7 am in the morning

• Report discussed at 8 am ward rounds ⇒ ensure all members of the clinical team are aware of patients at-risk for AKI

• If these patients were clinically confirmed to have AKI ⇒ immediate management and intervention initiated (fluids, adjusting dose of nephrotoxic medications and more)
Daily AKI Report
Results from FHH Pilot - Jan 2014 to Jun 30 2014

**Absolute # Alerts**

- Total: 6000
- Stage 1: 4000
- Stage 2: 2000
- Stage 3: 1000

**Lab AKI Episodes/Discharges**

- Stage 1: 18
- Stage 2: 14
- Stage 3: 10

**DRG AKI Episodes/Discharges (%)**

- AKI: 4.5
- ATN: 1.0
Results from FHH Pilot – Jan 2014 to Jun 2014

![Bar chart showing AKI Episodes / Discharges (%) for LAB Data and DRG Data]
Comparison of Lab Data with Administrative Data (Jan 1, 2014 to Jun 30, 2014)

• At FHH: AKI incidence rate based on hospital DRG data was only in the 5-6% range

• Administrative data had good specificity but poor sensitivity – typically only captured severe AKI (stage 2 and 3)

• Unlike laboratory data, administrative codes did not classify disease severity or estimate the true disease burden of AKI

• At FHH: Laboratory estimates of AKI were much higher (>20%)

• Significant gap between coded DRG diagnoses compared with laboratory detection
Laboratory Partnership with Clinical Documentation Improvement (CDI) Team

• Poor provider recognition of AKI, lack of awareness and inability to apply KDIGO criteria, lack of clinical decision support

• All factors translated into poor clinical documentation of AKI

• Providers educated by CDI specialists regarding accurate clinical documentation of AKI to capture disease severity

• Medical coders educated about diagnostic criteria for AKI and how administrative codes (MS-DRG) were insufficient to capture true incidence and severity of AKI
2014 Forest Hills

- Percent AKI
- AKI Only
- ATN Only
- Total AKI
- Linear (Lab AKI)

PILOT PERIOD
LAB and CDI CAMPAIGN
GO LIVE FOR OTHER HOSPITALS

Jan 2015
Diffusion of Laboratory AKI Reporting to other Northwell Hospitals

- Based on the initial results of the pilot, daily AKI reporting was implemented at 7 additional Northwell Hospitals starting in Jan 2015

- Standardized reporting using the Cerner Millennium LIS

- Single laboratory database mitigates interoperability gaps in EMR systems

- System-wide partnership between the CDI team and Department of Pathology and Laboratory Medicine created

- Accurately staging AKI (stage 1 to 3) based on laboratory data and track incidence based on both laboratory and DRG data
ALL STAGES

Lab AKI Episodes / Discharges

Forest Hills  Franklin  Glencove  Huntington  Manhasset  Plainview  Southside  Syosset

ALL STAGES

Absolute # Lab AKI Episodes

Forest Hills  Franklin  Glencove  Huntington  Manhasset  Plainview  Southside  Syosset
### LAB DATA - ALL HOSPITALS

<table>
<thead>
<tr>
<th>Year</th>
<th>Stage 1 %</th>
<th>Stage 2 %</th>
<th>Stage 3 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>76.48%</td>
<td>18.07%</td>
<td>5.45%</td>
</tr>
<tr>
<td>2015</td>
<td>76.93%</td>
<td>17.26%</td>
<td>5.81%</td>
</tr>
<tr>
<td>2016</td>
<td>79.37%</td>
<td>15.35%</td>
<td>5.28%</td>
</tr>
</tbody>
</table>
Conclusions – Laboratory Defined AKI Episodes

• Statistically significant increase in % of episodes classified as Stage 1 AKI (76.48 % in 2014 → 79.37% in 2016)

• Statistically significant decrease in % of episodes classified as Stage 2 AKI (18.07 % in 2014 →15.35 in 2016)

• No statistical change in % of episodes classified as Stage 3 AKI (5.45 % in 2014 → 5.28 % in 2016)

• Over a 3-year period there was no overall statistically significant change in the % of episodes classified as AKI based on laboratory alerting (21-22%)

• Increase in less severe episodes of AKI (stage 1) and decrease in more severe episodes of AKI (stage 2)

• Changes more pronounced at 4/8 hospitals (Forest Hills, Huntington, Syosset, Glencove)
DRG ATN Episodes/Discharges

- Forest Hills
- Franklin
- Glencove
- Huntington
- Manhasset
- Plainview
- Southside
- Syosset

Year:
- 2014
- 2015
- 2016
LAB AKI Episodes vs. DRG AKI Episodes (% of Discharges)

LAB Total AKI Total Rate
DRG Total AKI Total Rate
Enhanced Inpatient Reimbursement*

*Capturing correct disease severity through correct coding
(note: system lead = Gerard Brogan, MD)
Conclusions – AKI DRG Data

• Significant gap in between “lab detected AKI episodes” and “coded DRG AKI episodes” in 2014

• This gap narrowed in 2015 and continued to improve in 2016 → better capture of disease severity → significant increase in revenue

• Laboratory played a leading role but not the only factor in improved clinical and financial results

• Physician education and buy-in critical for success → Increase in capture of DRG diagnosis because of better provider recognition and documentation

• Multi-factorial informatics intervention improved the sensitivity and specificity of early detection of AKI (stage 1) and reduced episodes of late stage AKI (stage 2 and 3)
Pearls for Implementation

• Embed diagnostic algorithm and evidence-based criteria within LIS
  - Delta creatinine is highly sensitive and captures > 99.8% of patients at-risk for AKI
  - Standardize early recognition of AKI and minimizes variability in application of KDIGO criteria

• Simplify result complexity → manage diagnostic test information flow
  - Rounding tool and decision support within clinical workflow

• Physician buy-in advance of implementation of alert (behavior change)

• Increase compliance of clinical documentation → partner with Health Information Management (Good documentation reflects good clinical care!!!)

• Prospective data collection to show impact
  - Laboratory data vs. administrative data
  - Project Management
Challenges and Future Work

• Lack of access and understanding of administrative data (DRG) and claims data which can be readily linked to laboratory data

• Difficult to accurately calculate total cost-of-care and therefore assess real clinical impact of laboratory interventions

• Laboratory data needs to be linked to other data such as pharmacy data in real-time to improve surveillance of AKI

• Lack of eMPI prevents linking of inpatient laboratory data to outpatient data and prevents longitudinal follow-up of patients

• Real effect on outcomes (mortality, morbidity) remains elusive because of multiple confounding variables
My message as a Clinical Pathologist

Pre-Analytical

- Apply EBM principles
- Embed Clinical Decision Support
- Understand Clinical Workflow
- Physician education
- Behavior change

Post-Analytical

- Aggregate & Analyze
- Inform & Collaborate
- Change Care Protocols
- Link to Other Datasets

Analytical

Laboratory testing
Demonstrate Value of the Laboratory

• **Value to Providers**
  - Provide clinical decision support based on evidence-based criteria → reduce variability in diagnosis
  - Reduce diagnostic latency → reduce severe AKI episodes

• **Value to Health System**
  - Improve clinical documentation of disease severity
  - Increase in revenue

• **Value to Payers**
  - Understand true disease burden of AKI
  - Reduction in inpatient dialysis costs for severe AKI
  - Reducing incidence of CKD (post AKI episode) and long term costs
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