Northwell Health Laboratories: Standardizing Early Detection of Acute Kidney Injury in an Integrated Delivery Health System

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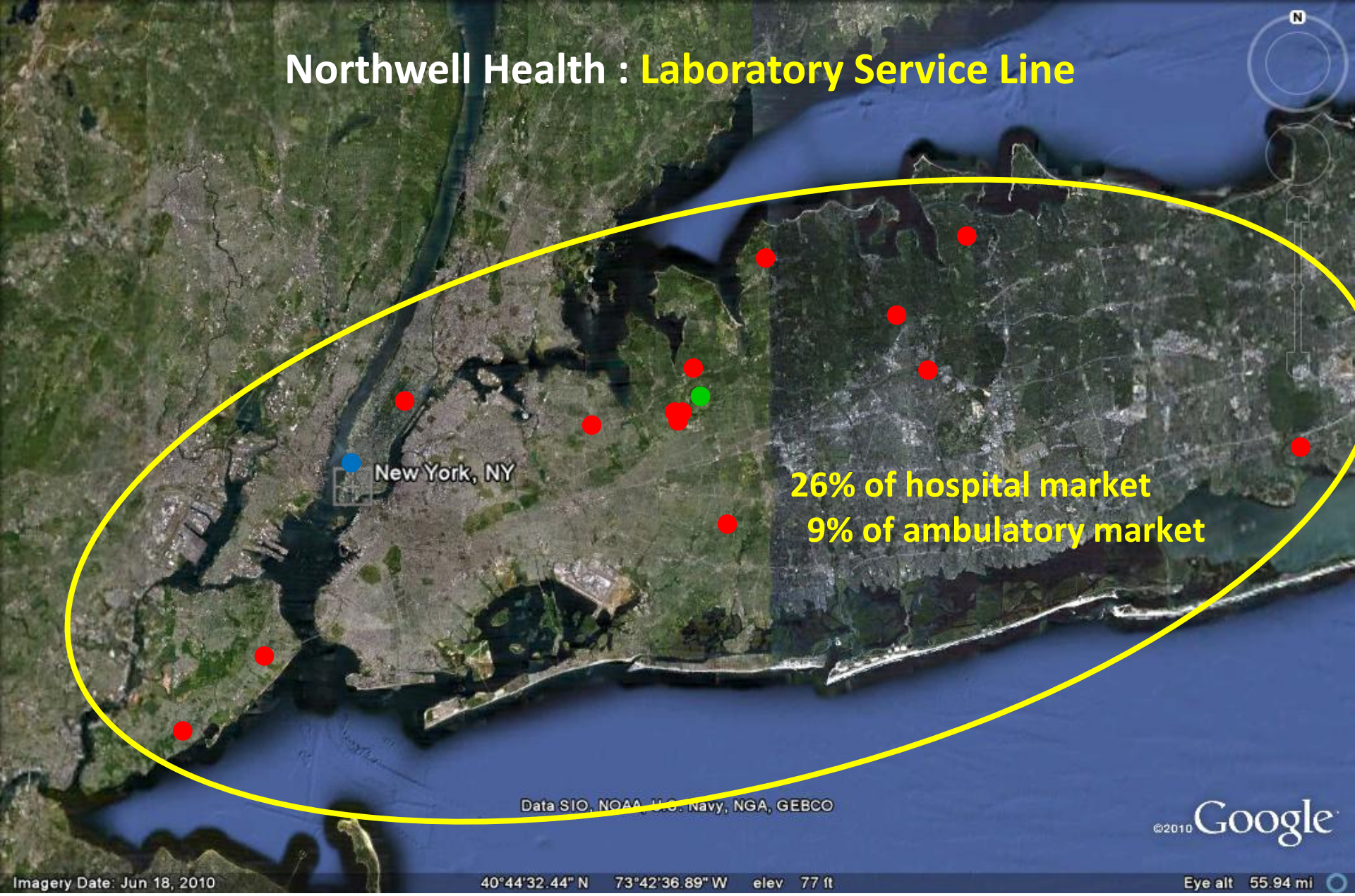
Disclosures

- None

Northwell Health : Laboratory Service Line



- Reference laboratory
- Hospitals (26% of market)
- Free-standing Emergency Room

Network of SNFs, AmbSurg, UrgiCenters
400+ practice locations
~2M unique patients per year

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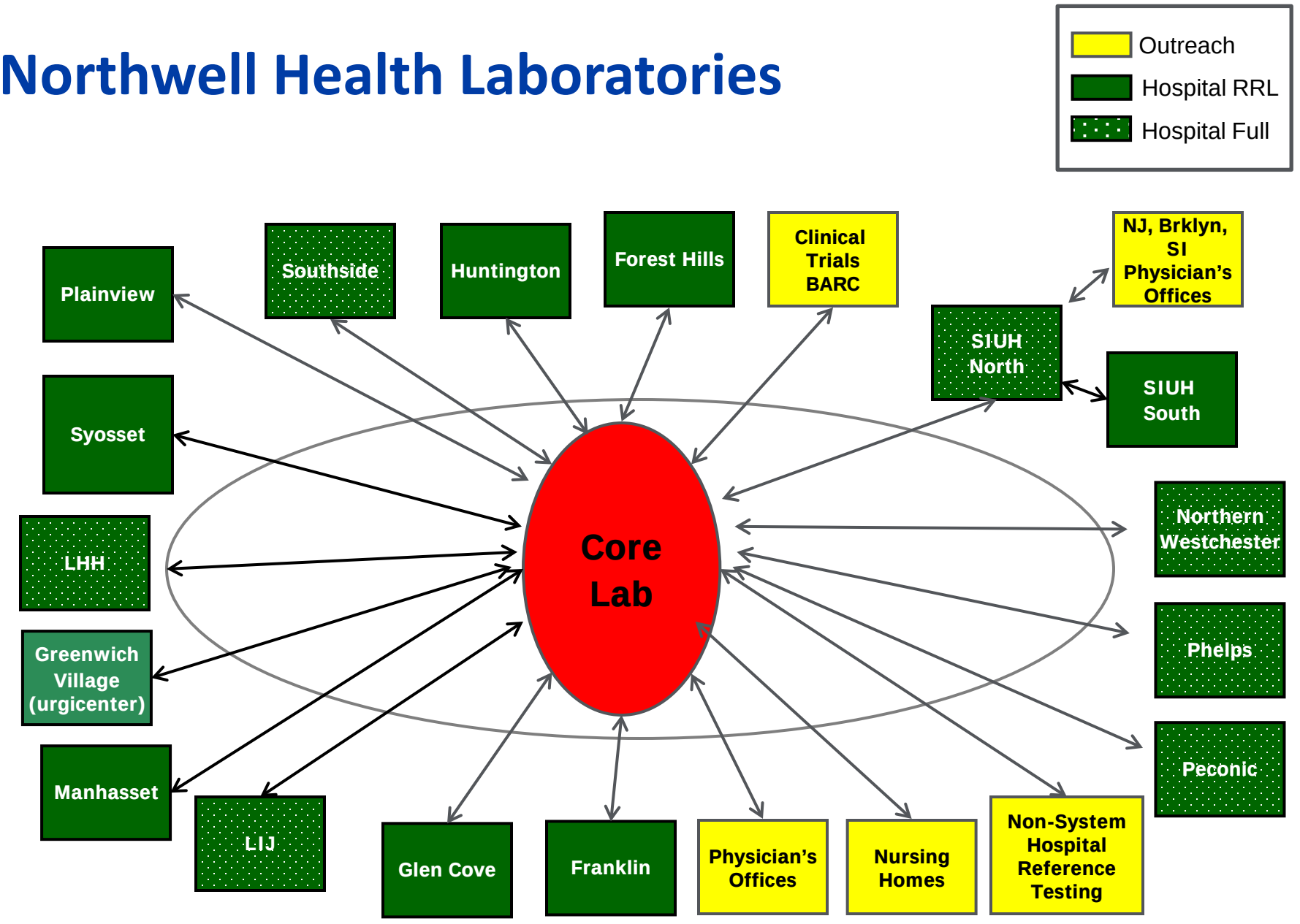

Plus: 32 Patient Service Centers, in-office phlebotomy, home draw, network support of POLs

Introduction

- Acute Kidney Injury (AKI) – also known as Acute Renal Failure
- Inpatient diagnosis
- High variability in standards of care -> poor outcomes, high costs
- Laboratories can play a leading role in driving quality improvement strategies outside of the lab
- Standardize early identification of AKI and reduce variability in care

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Objectives

- Economic importance of AKI and why laboratory involvement is crucial in improving clinical and financial outcomes
- Evidence based criteria for the diagnosis and staging of AKI
- How AKI detection algorithms can be embedded in clinical laboratories to standardize early detection
- Reduce variability in the diagnosis, staging and management in real world settings
- Show value of laboratory to important stakeholders – patients, clinical providers, health systems and payers

Problem Statement (Opportunity)

- CMO of Forest Hills Hospital (FHH) approached the laboratory leadership in July 2013
- Radio contrast-induced AKI was a common problem at FHH
- At least 3 cases of AKI /day - contributed to approximately 2 excess days in length-of-stay (LOS)
- Can the laboratory do anything to prevent or mitigate this ?

Back of the Envelope Math – Projected Cost Savings

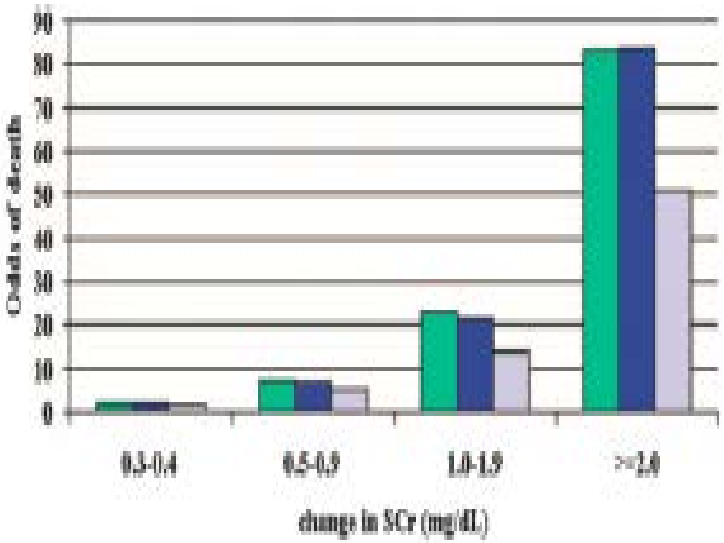
- 3 cases of AKI / day - contribute to 2 days excess LOS

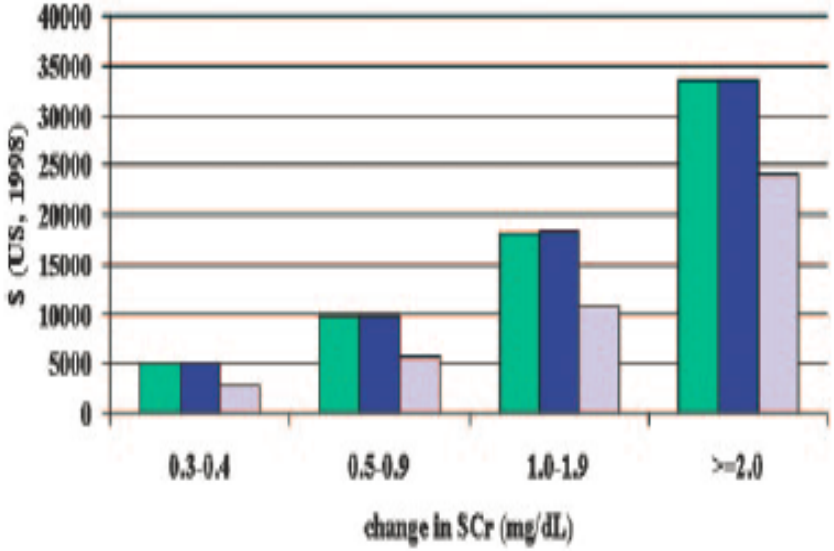
- Variable cost = $500 / day (conservative estimate)
  - 3 cases / day X 365 = 1095 cases / year
  - 2 excess days/case x 1095 = 2190 excess days in LOS
  - 2190 excess days x $500 per day = $ 1,095,000

- A million dollars in projected cost savings at Forest Hills Hospital alone

- Huge potential for system wide savings

Significance of small incremental increases in Serum Creatinine





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

Acute Kidney Injury, Mortality, Length of Stay, and Costs in Hospitalized Patients

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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 Clinical Significance

- More likely AKI affects 5-10 % of all hospitalized patients and majority are cared for 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
- This is a broad problem in all hospital settings across all specialties

AKI Evidence Based Diagnostic Criteria

- Diagnosis relies on incremental rise in inpatient creatinine 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

AKI Diagnostic and Staging Criteria

- KDIGO group published consensus guidelines by incorporating aspects of RIFLE and Acute Kidney Injury Network (AKIN) definitions

- **KDIGO Diagnostic Criteria** requires detection of small incremental rise in Serum Creatinine (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

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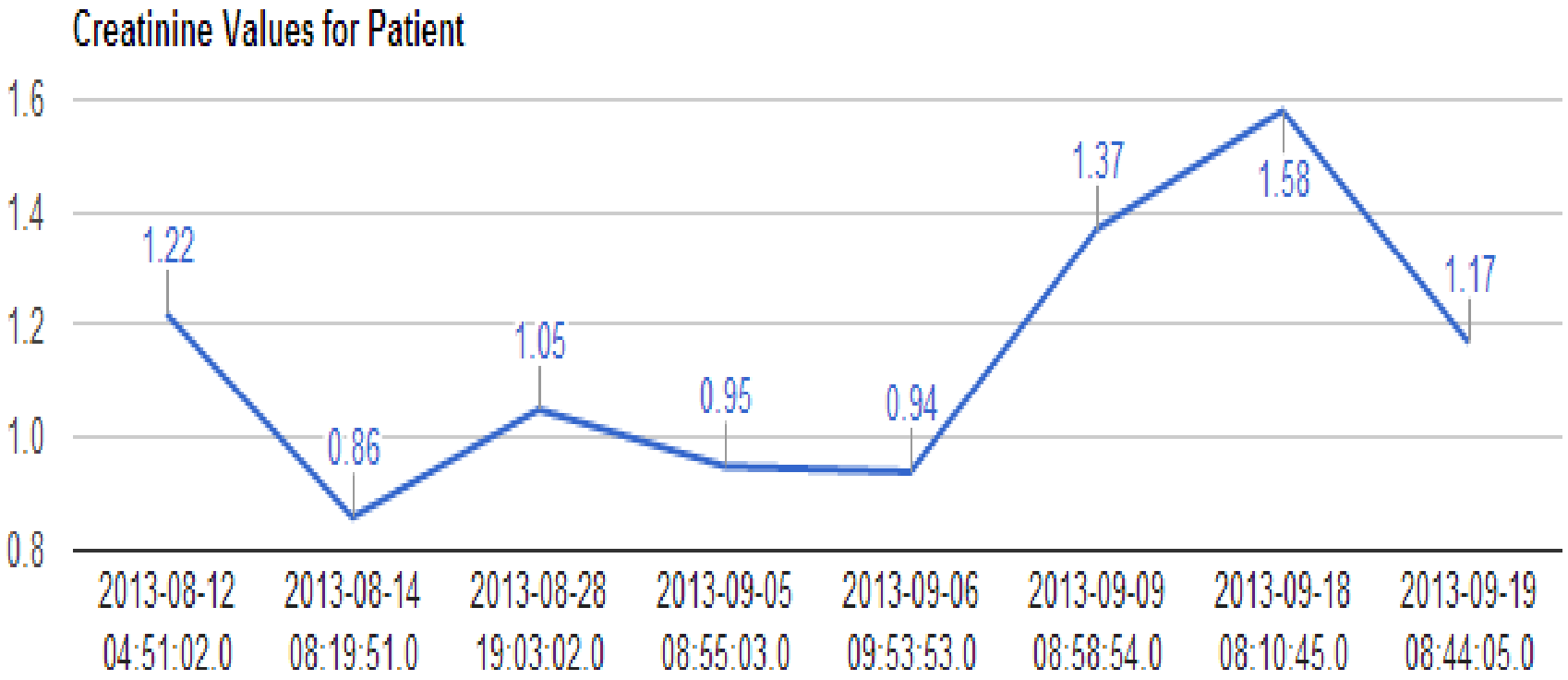
Inpatient Creatinine Monitoring for AKI



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

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Baseline Creatinine - KDIGO guidelines

- KDIGO allows for "**clinical judgment**" in establishing AKI diagnosis and identifying baseline

- 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 creatinine should be

- Different surrogates for baseline 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 - KDIGO Guidelines

Examples

Table 7 | AKI diagnosis

	Serum Creatinine mg/dl (µmol/l)					Diagnosis AKI?	
CASE	Baseline	Day 1	Day 2	Day 3	Day 7	Criterion 1 50% from baseline	Criterion 2 ≥0.3mg/dl(≥26.5µmol/l) rise in≤48 hours
A	1.0 (88)	1.3 (115)	1.5 (133)	2.0 (177)	1.0 (88)	Yes	Yes
B	1.0 (88)	1.1 (97)	1.2 (106)	1.4 (124)	1.0 (88)	No	Yes
C	0.4 (35)	0.5 (44)	0.6 (53)	0.7 (62)	0.4 (35)	Yes	No
D	1.0 (88)	1.1 (97)	1.2 (106)	1.3 (115)	1.5 (133)	Yes	No
E	1.0 (88)	1.3 (115)	1.5 (133)	1.8 (159)	2.2 (195)	Yes	Yes
F	?	3.0 (265)	2.6 (230)	2.2 (195)	1.0 (88)	Yes	No
G	?	1.8 (159)	2.0 (177)	2.2 (195)	1.6 (141)	?	Yes
H	?	3.0 (265)	3.1 (274)	3.0 (265)	2.9 (256)	?	No

Solution – Implementation of Laboratory AKI Alert

- Automated hospital wide real-time laboratory electronic alerting system using a modified delta checking algorithm in LIS
- Minimum inpatient creatinine as the baseline value (KDIGO recommendation)
- Alert clinicians before creatinine value goes outside reference range - clinicians can act on a rising trend
- Proactively detect AKI at the earliest possible stage (increased sensitivity)
- Standardize early recognition & minimize variability in application of KDIGO criteria

Laboratory AKI Alert

- Use “rolling” baseline minimum SCr for delta checking
- The alert compares each new SCr result with a previous rolling minimum baseline SCr for the same patient within the same inpatient encounter.
- If there is a clinically significant 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 was flagged.
- Our modified delta checking algorithm was highly sensitive and captured >99.8 % of patients at-risk for AKI
- Results which did not meet the delta criteria were not flagged

Surprising Findings

- We expected to see between 5-10 AKI alerts at Forest Hills Hospital (250 beds)
- ~ 40 alerts / day which corresponded to 20 patients/day at-risk for AKI
- 8% incidence rate in a busy community hospital
- Based on these findings we decided to use this alert for hospital-wide AKI detection

Implementation of Laboratory AKI Alert

- Extensive validation of alert between Sept 2013 to October 2013
- Physician education and awareness campaign was conducted by CMO (November 2013 to December 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

- Active alerts - alert fatigue and inability to assess patients in a systematic manner

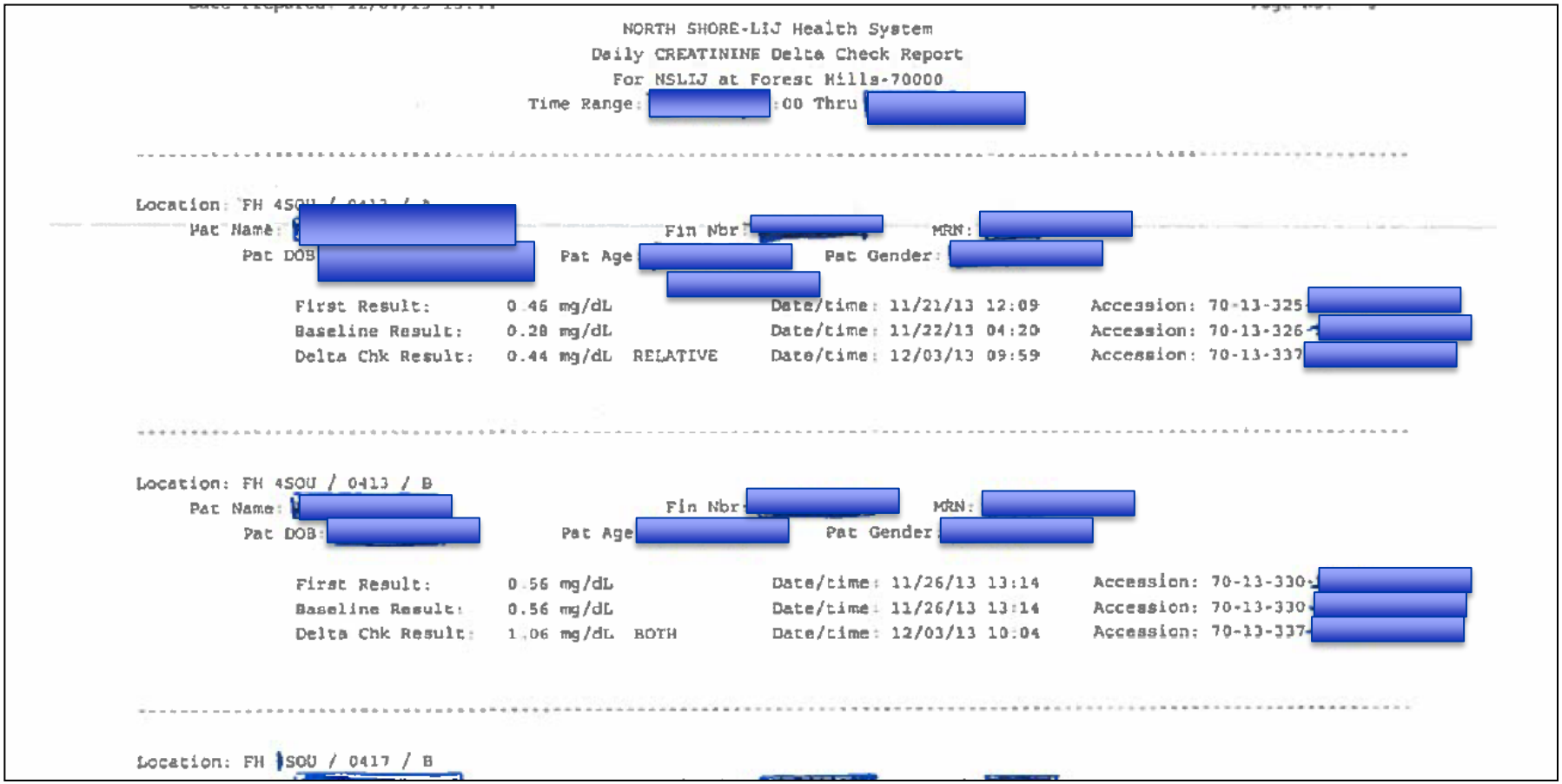
- LIS programmed to generate an electronic report of AKI episodes within the previous 24 hours with patients room and bed location

- 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 - all members of the clinical team aware of which patients were at-risk for AKI.

- If these patients were clinically confirmed to have AKI -> immediate management and intervention was initiated (fluids, adjusting dose of nephrotoxic medications and more)

Daily AKI Report



NORTH SHORE-LIJ Health System
Daily CREATININE Delta Check Report
For NSLIJ at Forest Hills-70000
Time Range: [redacted]:00 Thru [redacted]

Location: FH 4SOU / [redacted]
Pat Name: [redacted] Fin Nbr: [redacted] MRN: [redacted]
Pat DOB: [redacted] Pat Age: [redacted] Pat Gender: [redacted]

First Result:	0.46 mg/dL		Date/time: 11/21/13 12:09	Accession: 70-13-325[redacted]
Baseline Result:	0.28 mg/dL		Date/time: 11/22/13 04:20	Accession: 70-13-326[redacted]
Delta Chk Result:	0.44 mg/dL	RELATIVE	Date/time: 12/03/13 09:59	Accession: 70-13-337[redacted]

Location: FH 4SOU / 0413 / B
Pat Name: [redacted] Fin Nbr: [redacted] MRN: [redacted]
Pat DOB: [redacted] Pat Age: [redacted] Pat Gender: [redacted]

First Result:	0.56 mg/dL		Date/time: 11/26/13 13:14	Accession: 70-13-330[redacted]
Baseline Result:	0.56 mg/dL		Date/time: 11/26/13 13:14	Accession: 70-13-330[redacted]
Delta Chk Result:	1.06 mg/dL	BOTH	Date/time: 12/03/13 10:04	Accession: 70-13-337[redacted]

Location: FH [redacted]SOU / 0417 / B

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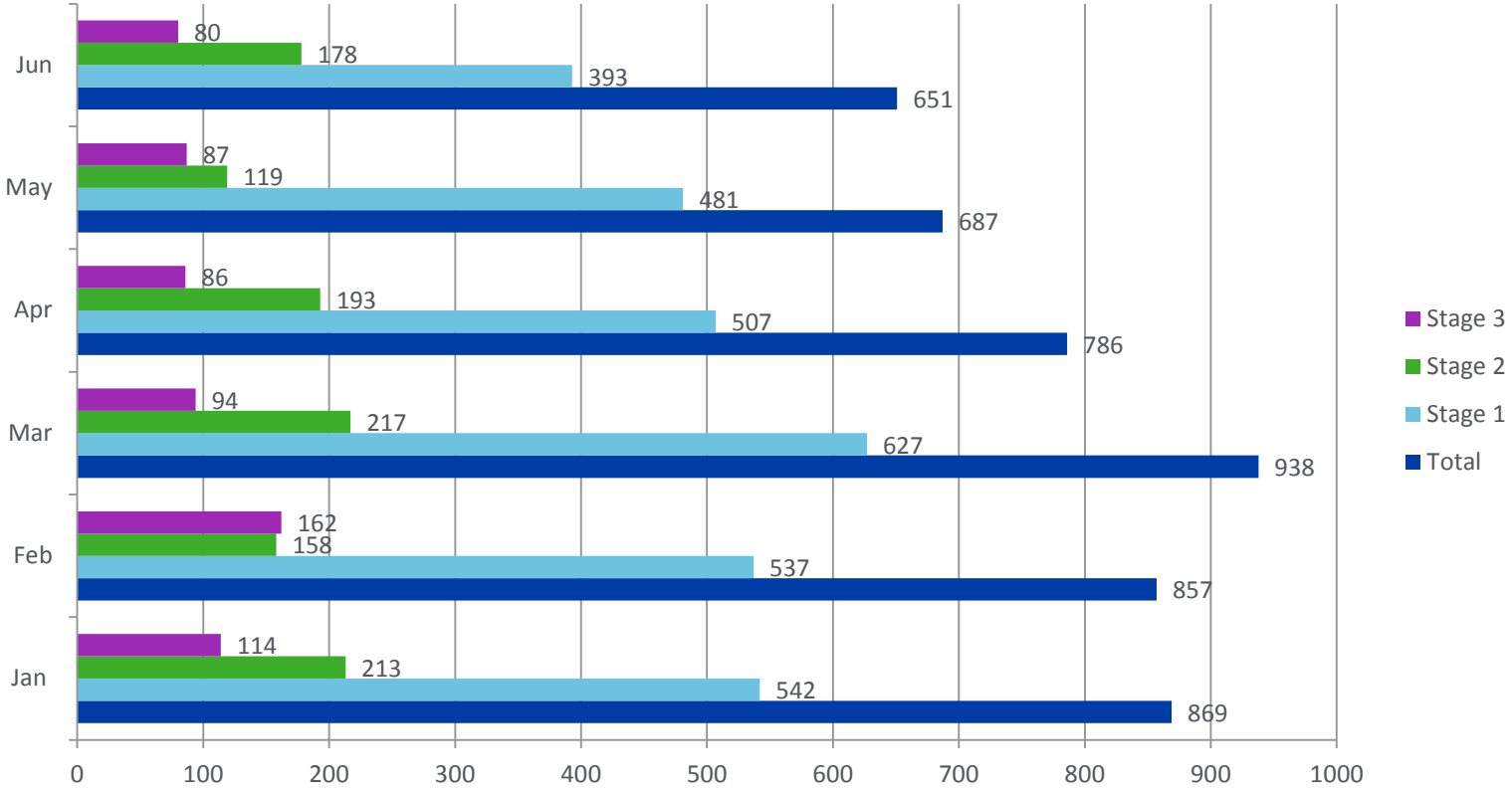
Daily AKI Report

- All AKI alerts grouped by patient location (unit, bed)

- For each patient with AKI alert following were reported
  - lab value and time of first inpatient SCr value
  - lab value and time of baseline SCr value
  - lab value and time of SCr which met the AKI criteria

- Which delta criteria was met
  - an absolute rise of 0.3 mg/dl
  - a relative rise of 50% from baseline

Results from FHH Pilot (Jan 1, 2014 to Jun 30, 2014)



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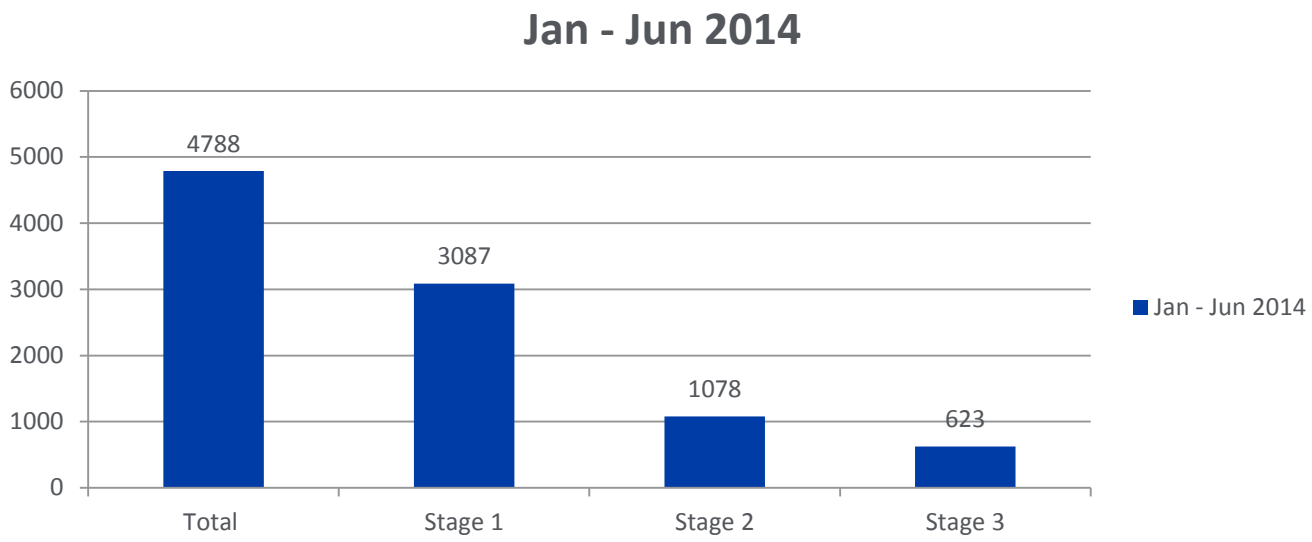
Results from FHH Pilot (Jan 1, 2014 to Jun 30, 2014)

- 8 % incidence rate

- > 10 % prevalence rate over 6 months



Comparison of Lab Data with Administrative Data (Jan 1, 2014 to Jun 30,2014)

- AKI prevalence rate based on hospital DRG and ICD-10 codes was only in the 3-5 % range

- Administrative data had good specificity but poor sensitivity – typically only capture d severe AKI (stage 2 and 3)

- Unlike laboratory data, administrative codes could not classify disease severity or estimate the true disease burden

- Laboratory prevalence estimates of AKI were much higher (10 to 20%)

- Significant gap between coded DRG diagnoses of AKI compared with laboratory AKI detection

Diffusion of Laboratory AKI Reporting to 9 Northwell Hospitals

- Daily AKI reporting was implemented at 9 other Northwell Hospitals starting in Aug ,2014.
- Application of standardized reporting using the Cerner Millennium laboratory Information System for all hospitals. Single laboratory database mitigates interoperability gaps in EMR systems
- A system-wide partnership between the CDI team and Laboratory Service line Medicine created
- Accurately staging AKI (1 to 3) and track prevalence rates based on laboratory data

Laboratory Partnership with Clinical Documentation Improvement (CDI) Specialists

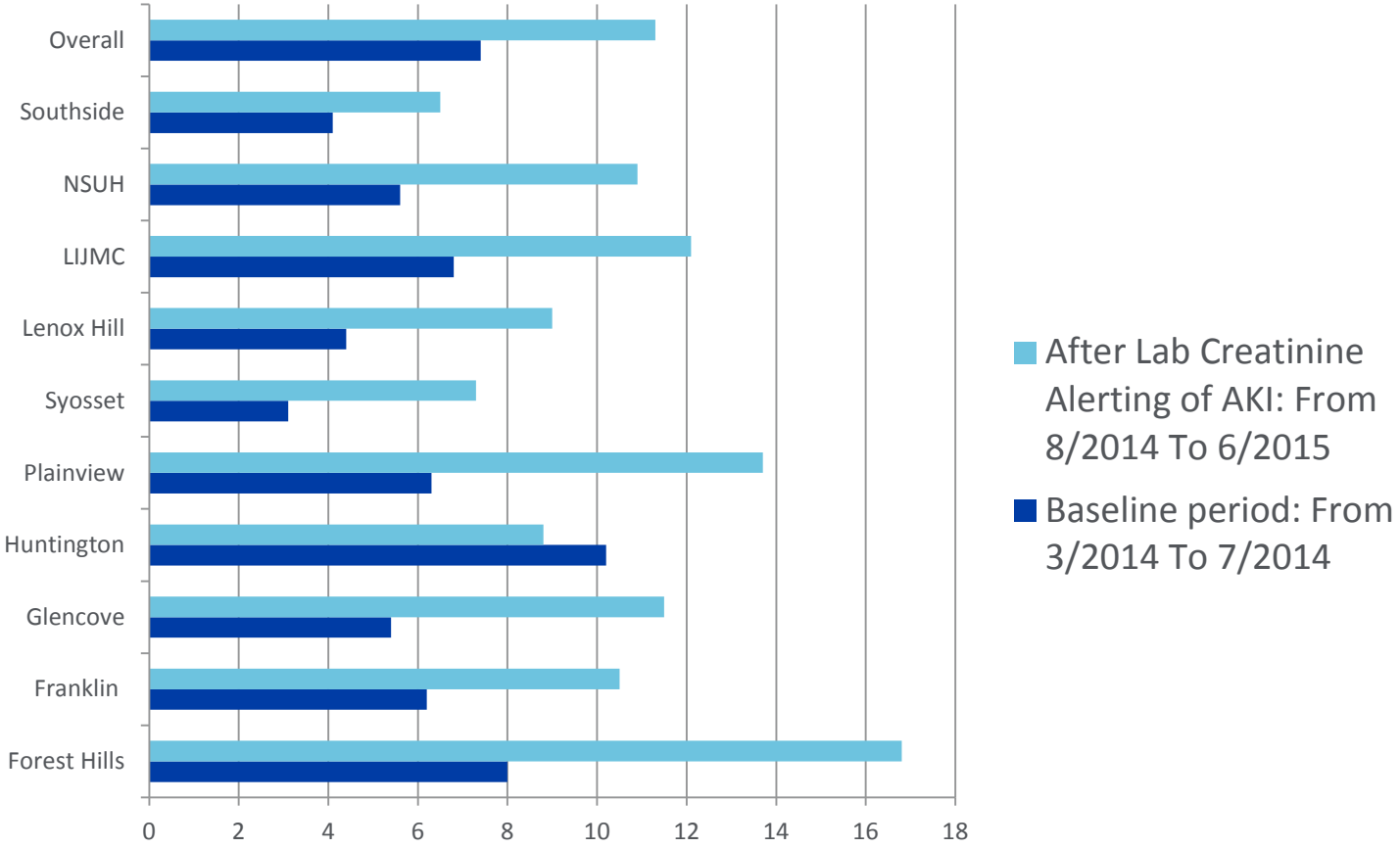
•Poor provider recognition, lack of awareness, inability to apply KDIGO criteria, lack of clinical decision support

• Poor clinical documentation of AKI

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

•Medical coders educated about diagnostic criteria for AKI

Northwell System Administrative Data (DRG)



Percentage of all cases with a secondary DRG diagnosis of AKI (Medicare FFS and HMO only)

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Enhanced Inpatient Reimbursement*

- The system-wide AKI capture rate has increased from 7.4 % (in July 2014) to 12.9 % (in July 2015) since the daily lab AKI reporting and education program for physicians began
- Average revenue increase per DRG with secondary diagnosis of AKI is $700
- Secondary diagnosis of AKI /month in 2014 (avg.) = 615
- Secondary diagnosis of AKI / month in 2015 (avg.) = 930
- Increase in secondary diagnosis of AKI from 2014 to 2015 = 315 cases
- Increased in reimbursement / month because of secondary diagnosis of AKI= 315 x 700 = $ 220,500
- Increase system reimbursement for 2015 = $ 220, 500 X 12 = ~ $ 2.65 million

*Capturing correct disease severity through correct coding
(note: system lead = Gerard Brogan, MD)

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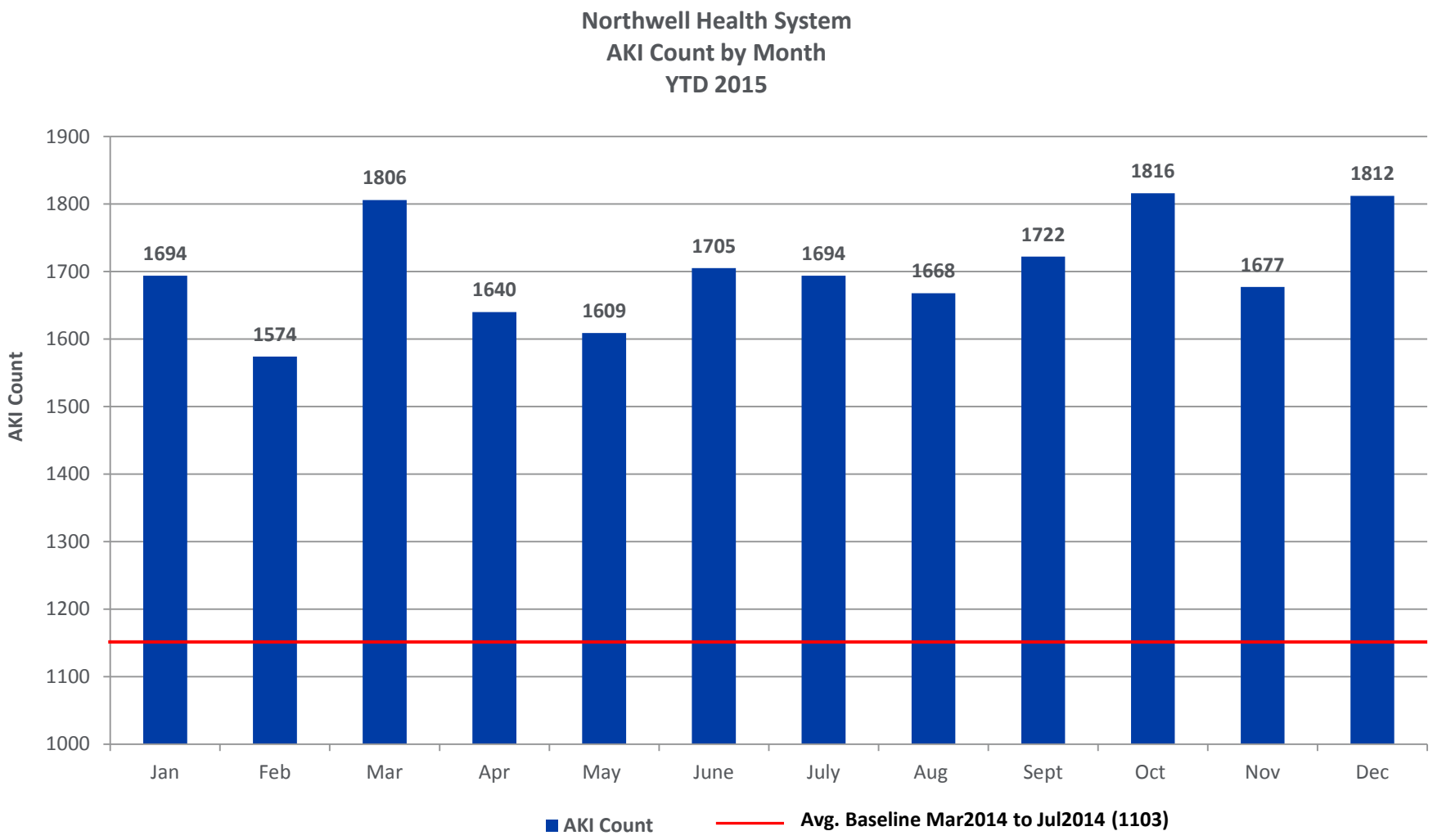
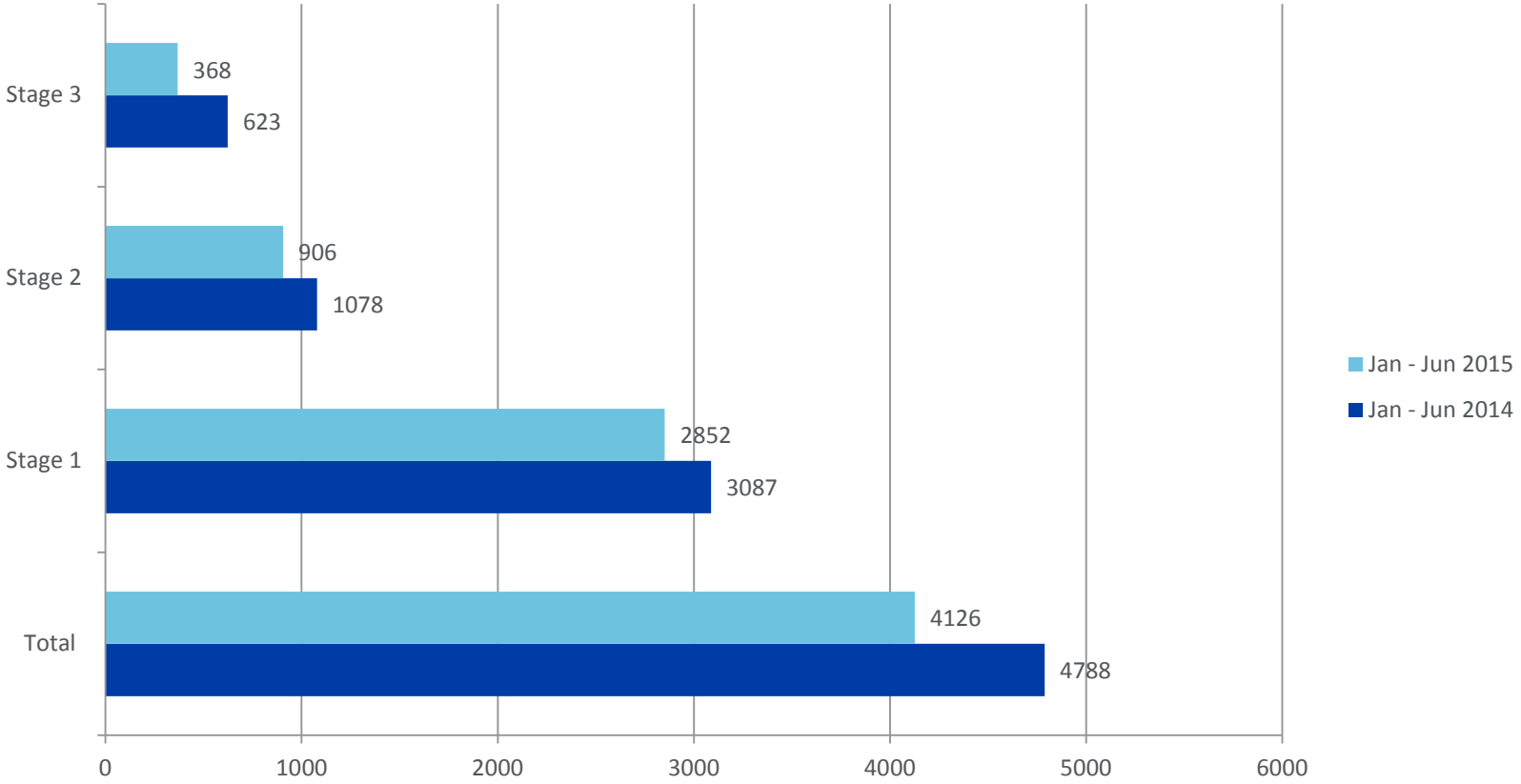
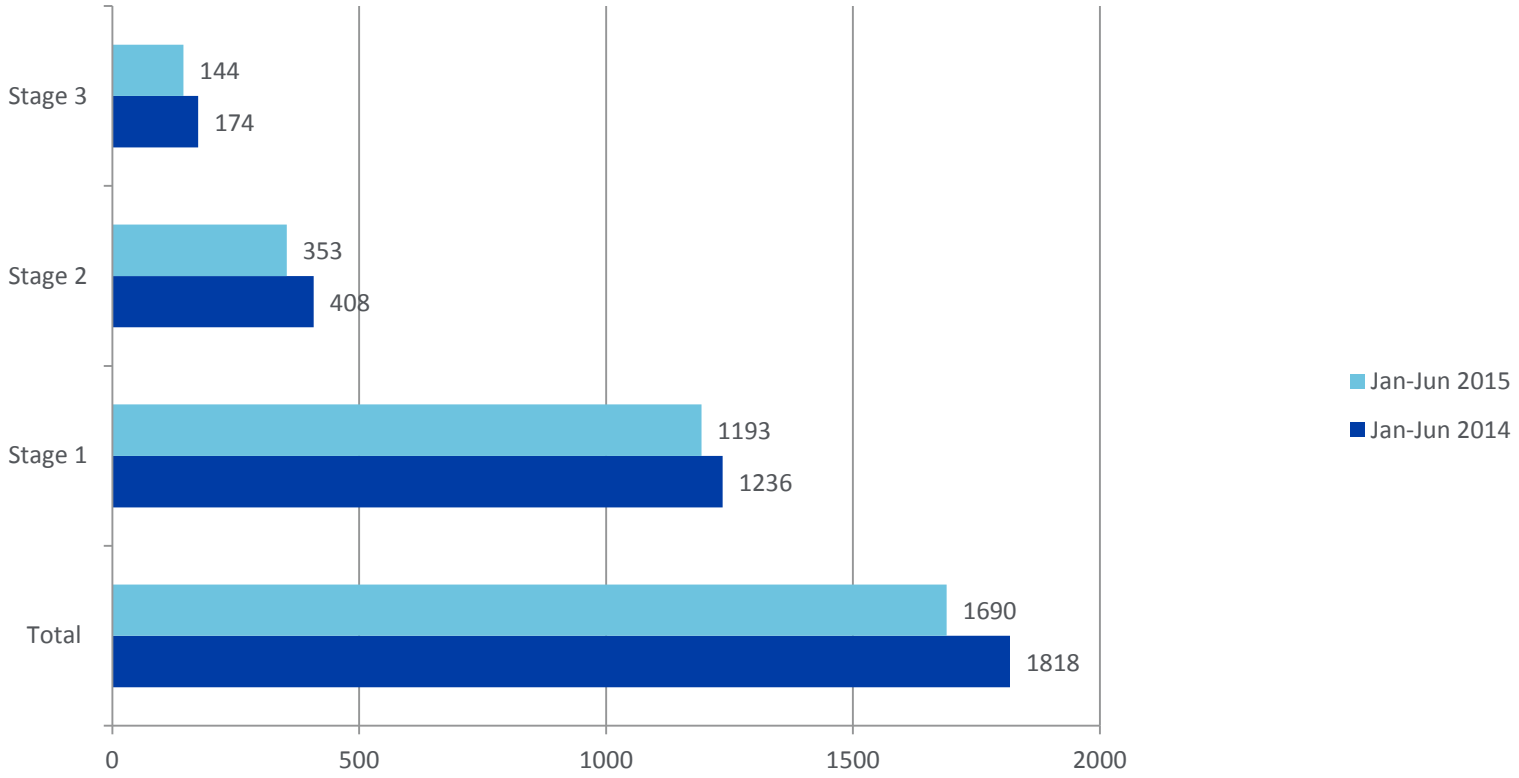
Acute Kidney Injury



Forest Hills Laboratory Data (# alerts 2014 vs. 2015)



Forest Hills Laboratory Data (# patients 2014 vs. 2015)



Laboratory Data vs. Administrative Data

- Significant reduction in frequency of stage 2 and 3 AKI alerts but no significant change in frequency of stage 1 alerts

- Increase in captured DRG diagnosis (CC/MCC) of AKI because of better provider recognition and documentation

- Laboratory data played a significant role but not the only factor in improved clinical and financial results

- Physician education and buy-in critical for success.

- Multi-factorial informatics intervention improved the sensitivity and specificity of early detection of AKI (stage 1) while at the same time reduced episodes of late stage AKI (stage 2 and 3)

Hurdles and Challenges

- Lack of access to administrative data which can be readily linked to laboratory data

- Remains very difficult to calculate total cost-of-care and therefore effect of laboratory intervention

- Laboratory data is not linked to other data sets such as pharmacy and claims data

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

- Real effect on outcomes (e.g. reduction in mortality) remains elusive because of multiple confounding variables

Pearls for Implementation (5 steps)

1) Create algorithms for diagnostic work-up

- Delta creatinine is highly sensitive and captures > 99.8 % of patients at-risk for AKI

- standardize early and systematic recognition of AKI and minimize variability in application of KDIGO diagnostic criteria

- prompt interventions focused on basic elements of care (fluid administration and medication management)

2. Simplify result complexity to give a holistic picture of the patient/disease condition and manage diagnostic test information flow

- 7 am daily AKI alert notification of CMO → distributed to units

- Used as rounding tool and integrate within clinical workflow

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Pearls for Implementation of AKI Alert (5 steps)

3. Change physician behavior by education in advance of implementation of alert and optimize personalized clinical decision for the patient

4. Focus on clinical documentation and partner with Health Information Management Professionals

   Improve compliance of accurate clinical documentation for proper coding by capturing correct disease severity

5. Always think about prospective data collection for outcomes evaluation
   - Prevalence data (laboratory data vs. administrative data)
   - Stage of AKI
   - LOS, costs-of-care and mortality

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AKI remains Under Diagnosed and Under Recognized

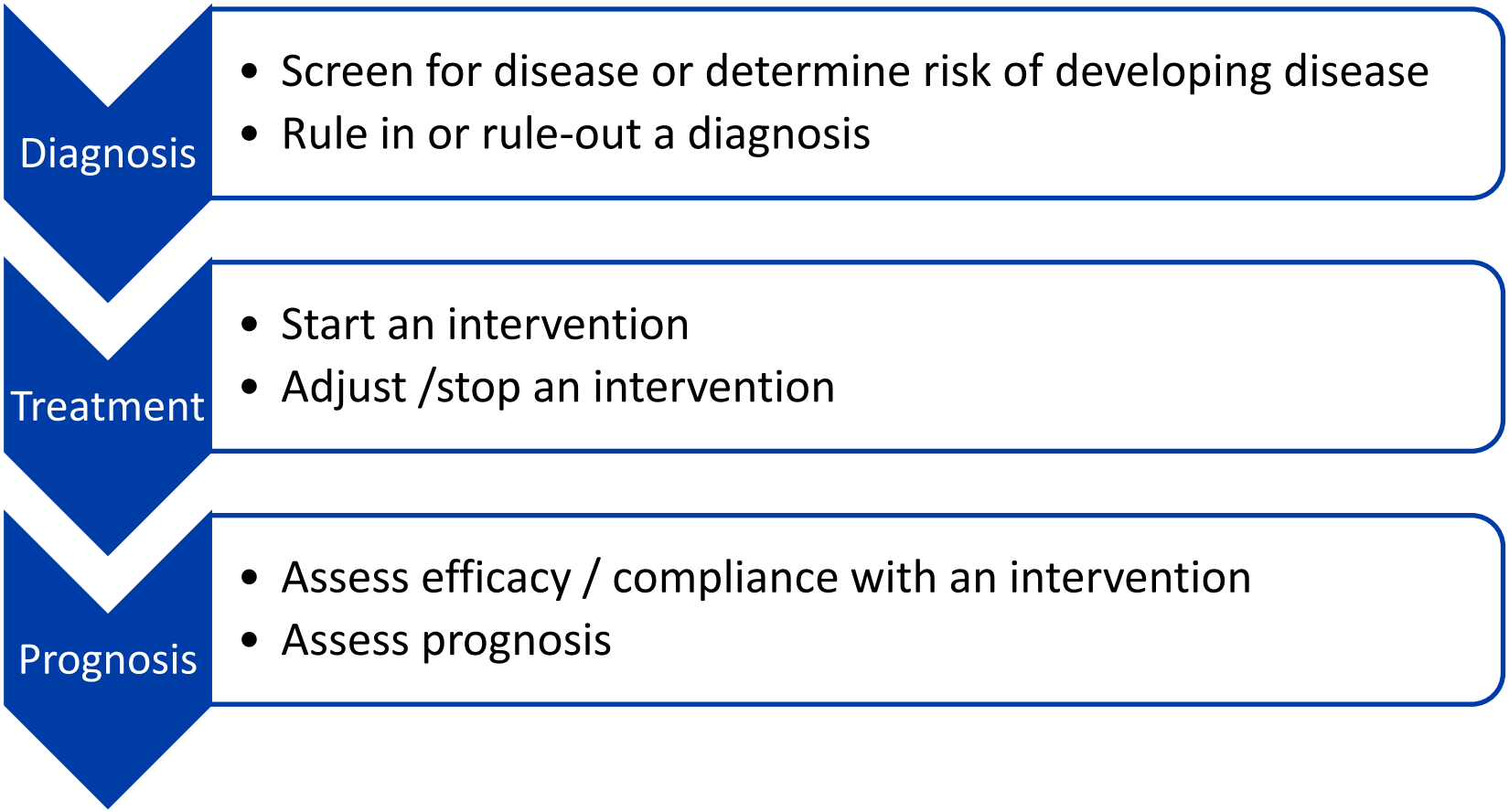
Seemingly simple evidence-based guidelines – but applying them prospectively and consistently in routine clinical practice has many practical challenges

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

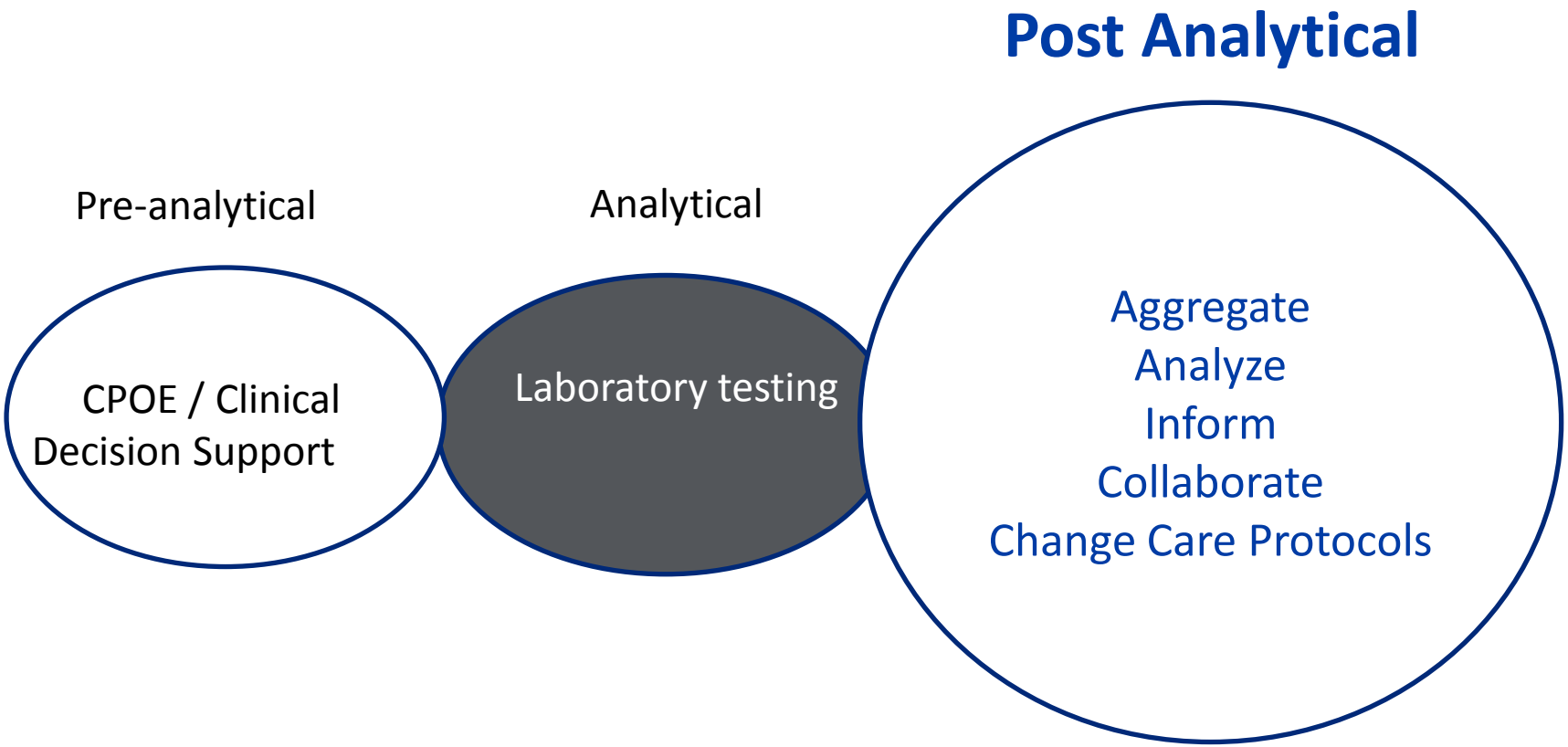
Lack of effective electronic decision support tools in the EMR that help diagnosis within the normal clinical workflow

Variable standards of care in diagnosis which leads to sub-optimal clinical outcomes

Value of Laboratory Tests in Clinical Decision Making



My message as a Clinical Pathologist



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Show Value of Laboratory

- Value to Providers
  - Minimizing variability in diagnosis and application of evidence based diagnostic criteria
  - Clinical Decision Support and improve Patient Safety
- Value to Health System
  - Benefit of early detection and reduction in AKI stages 2 and 3
  - Accurate documentation of disease severity (DRG and Case-Mix Index)
- Value to Payers
  - Understanding true disease burden and hence clinical risk
  - Reducing incidence of CKD (post AKI episode) and long term costs
  - Reduction in inpatient dialysis costs because of early AKI detection

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