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

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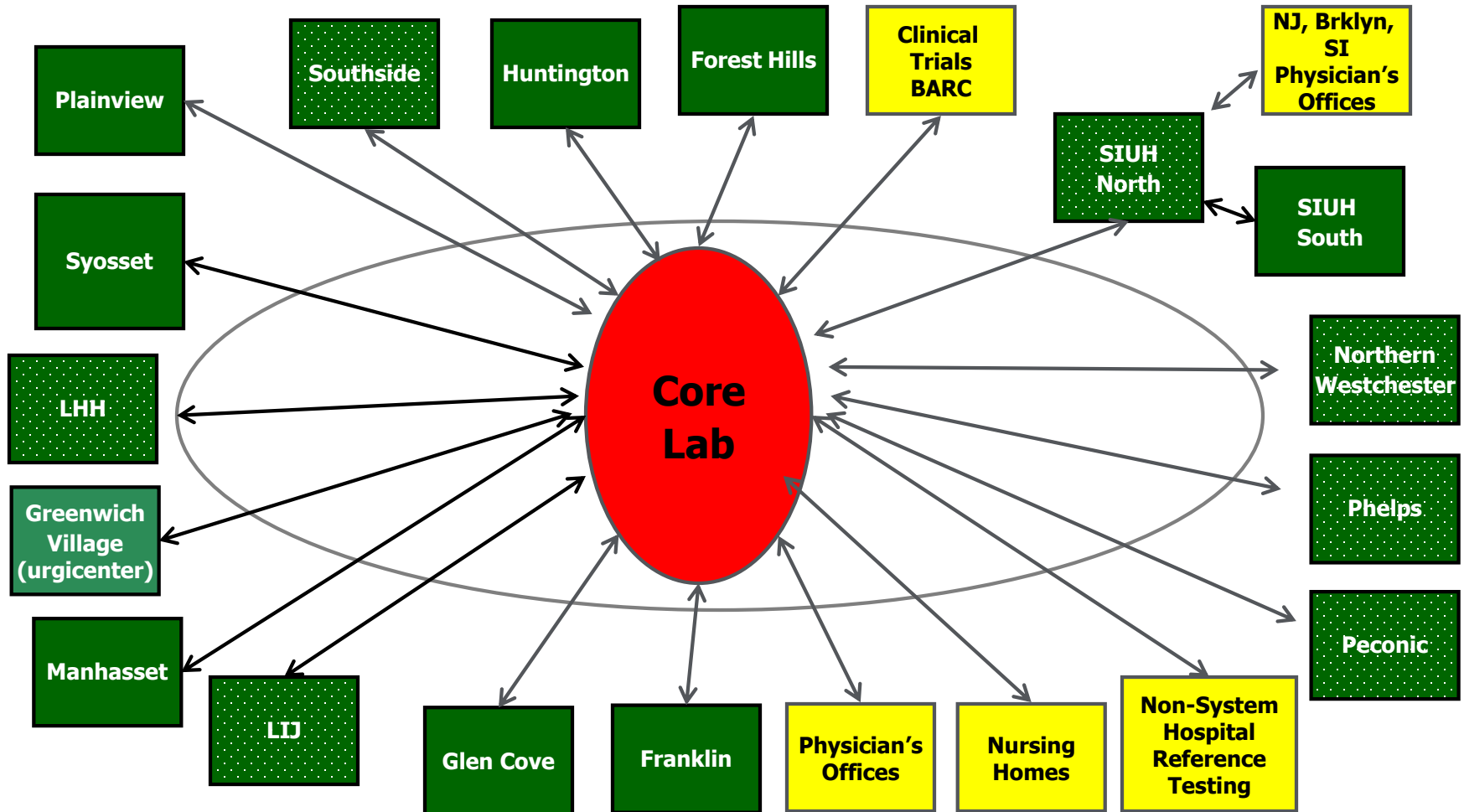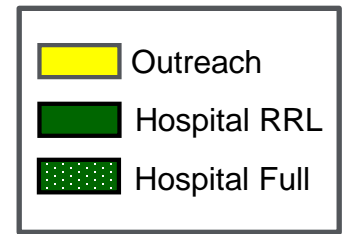*Hofstra Northwell School of Medicine, NY*

5/4/2017

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Disclosures

- None

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Legend:
- Outreach (yellow)
- Hospital RRL (dark green)
- Hospital Full (dotted green)

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

Core Lab

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

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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 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 FHH alone. Huge potential for system wide savings.

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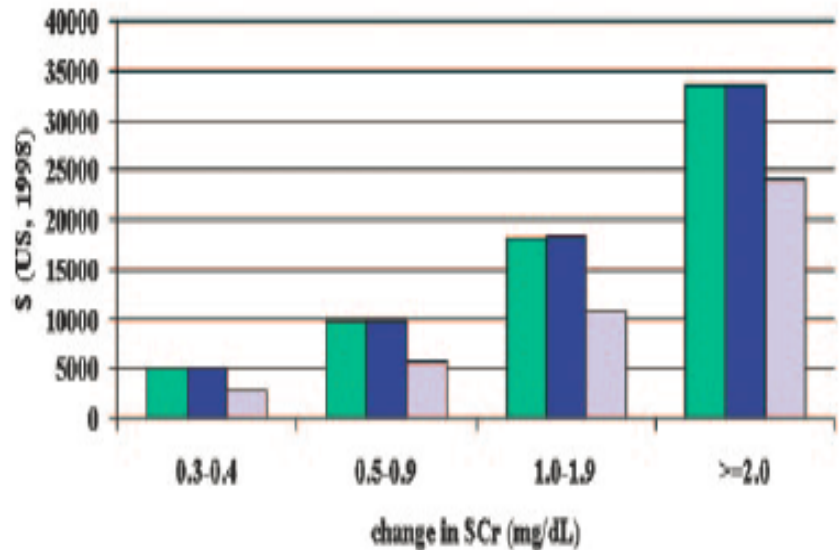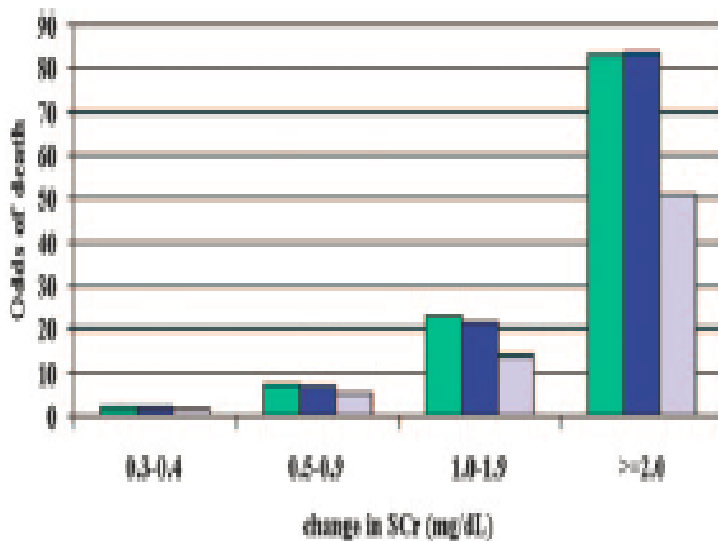
AKI associated with increased odds of in-hospital mortality (6 to 30 fold), length of stay (3 to 7 days) and total costs of care ($4000 to $10,000) per patient encounter

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

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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

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AKI Evidence Based Diagnostic Criteria

- Diagnosis relies on incremental rise in inpatient SCr value over a minimum <u>baseline</u> value within a <u>fixed</u> **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

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AKI Diagnostic and Staging Criteria

- SCr measurement is necessary for both <u>diagnosis</u> and <u>staging</u> 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**
  <u>Stage 1:</u> SCr increase by >= 0.3 mg/dl from baseline or SCr increase by 1.5 to 1.9 times baseline
  <u>Stage 2:</u> SCr increase by 2.0 to 2.9 times baseline
  <u>Stage 3:</u> SCr increase by > = 3.0 times baseline or SCr greater than 4 mg/dl

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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 $\geq$ 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 $\geq$ 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.

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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 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

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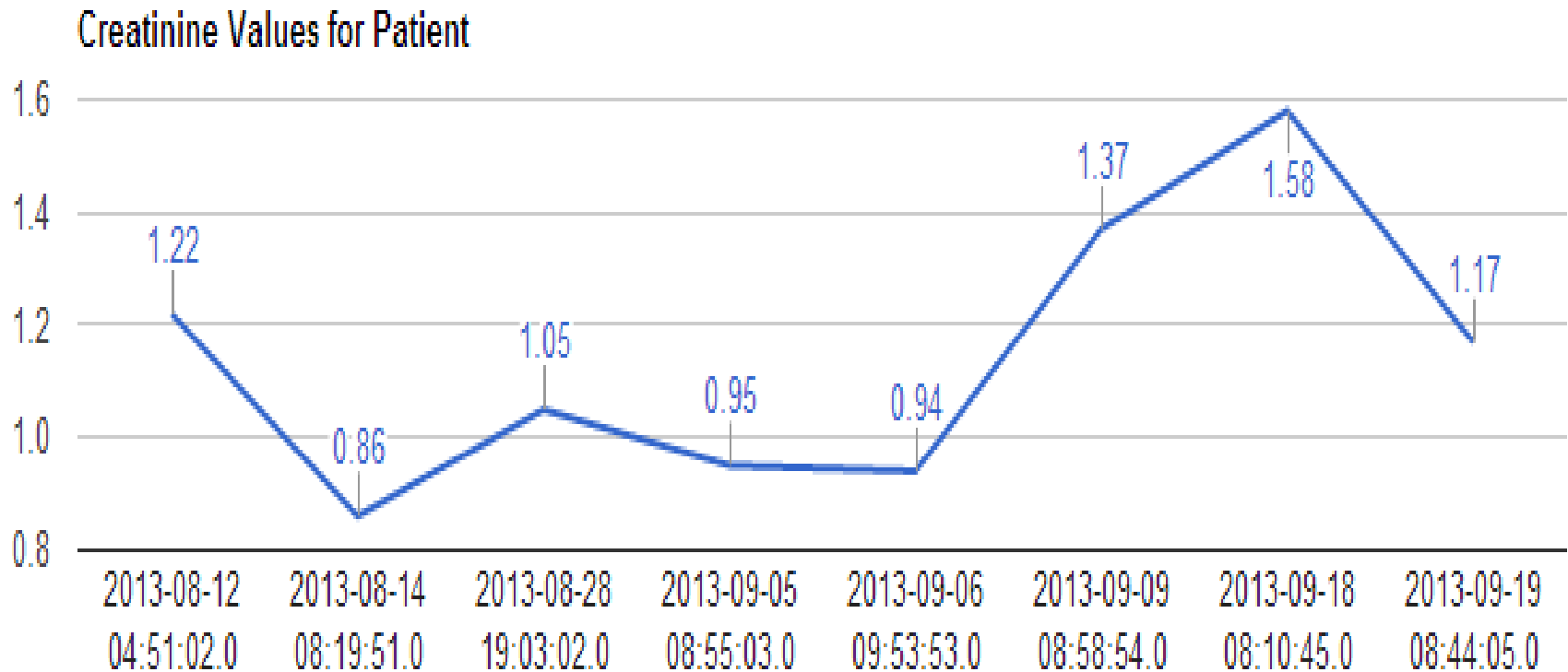
Solution – Implementation of Laboratory AKI Alert

- 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

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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

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Inpatient Creatinine Monitoring for AKI

Creatinine Values for Patient

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

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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

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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

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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 / 0413 / A
  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]
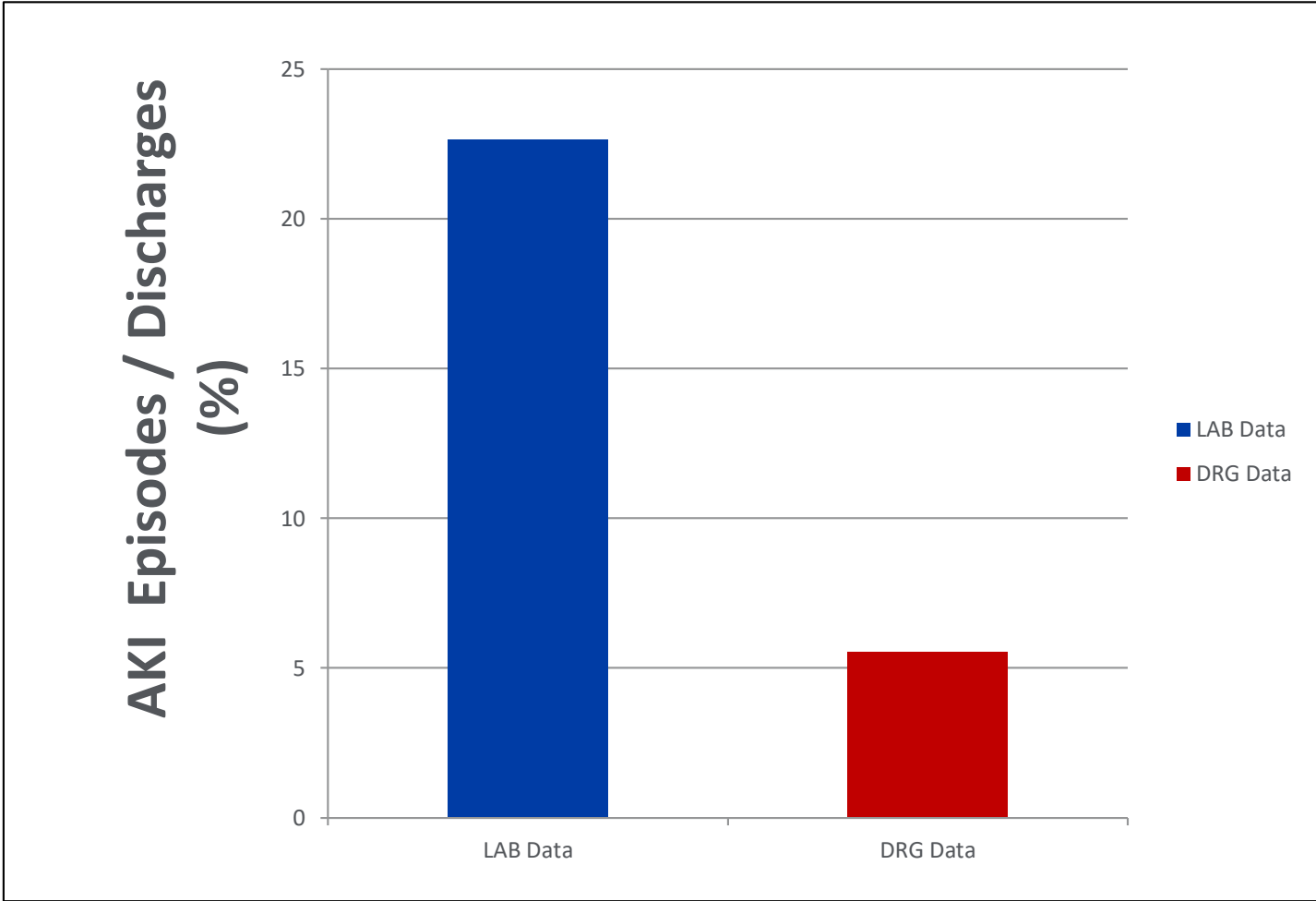
    First Result: 0.56 mg/dL   Date/time: 11/26/13 13:14   Accession: 70-13-330[REDACTED]
    Baseline Result: 0.56 mg/dL   Date/time: 11/26/13 13:14   Accession: 70-13-330[REDACTED]
    Delta Chk Result: 1.06 mg/dL BOTH   Date/time: 12/03/13 10:04   Accession: 70-13-337[REDACTED]

Location: FH 4SOU / 0417 / B

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Results from FHH Pilot - Jan 2014 to Jun 30 2014
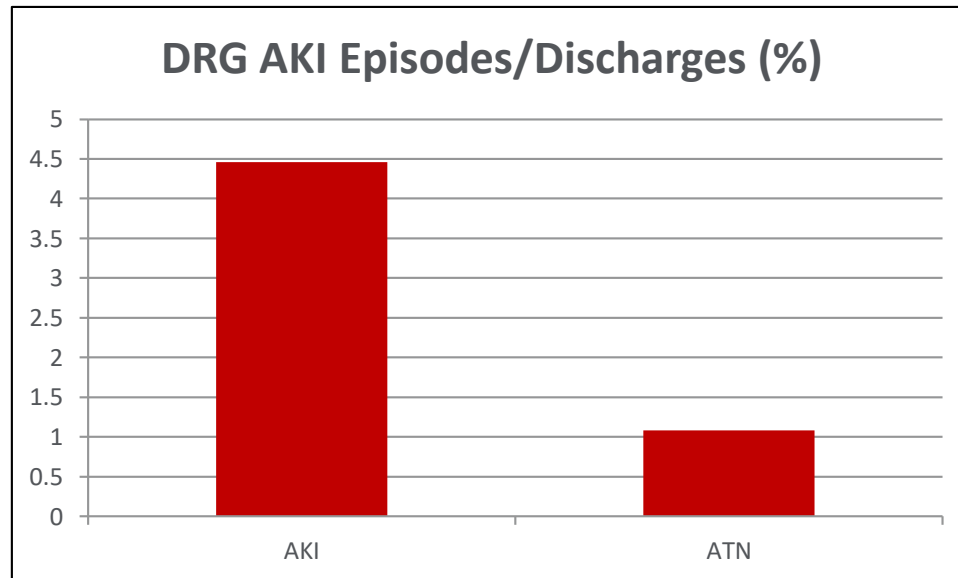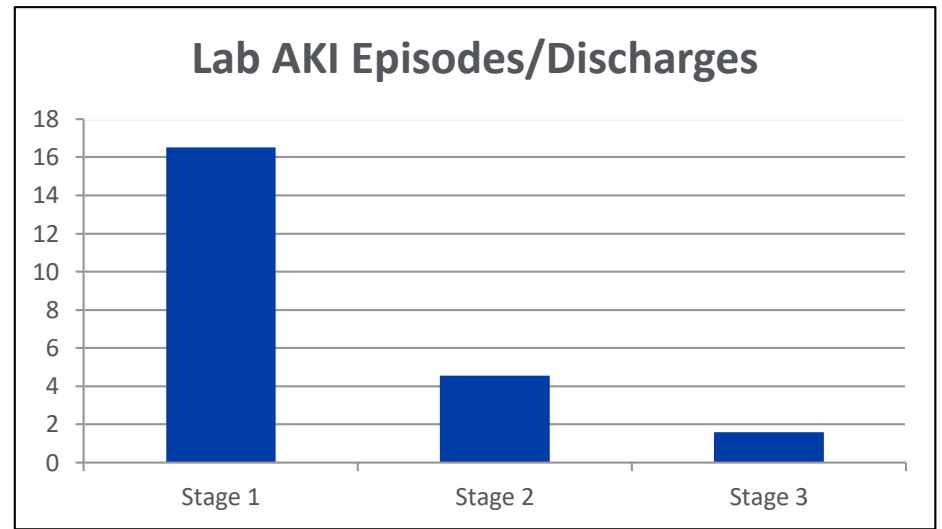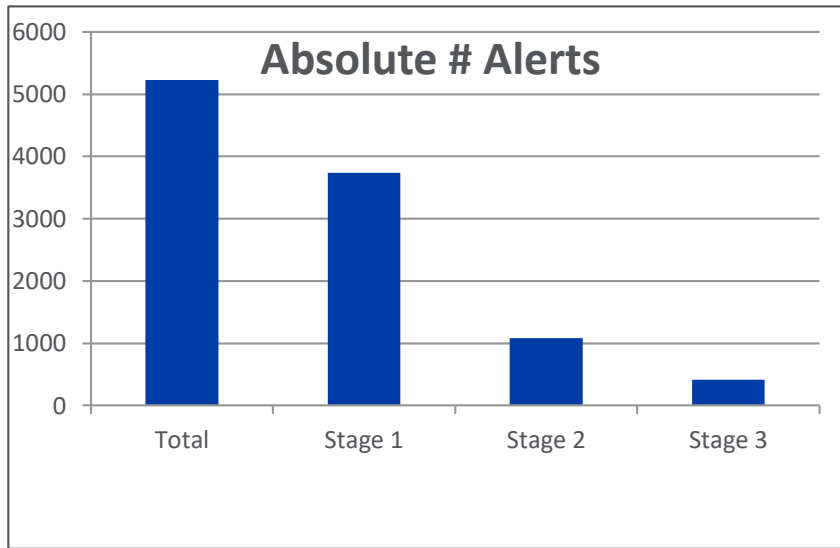
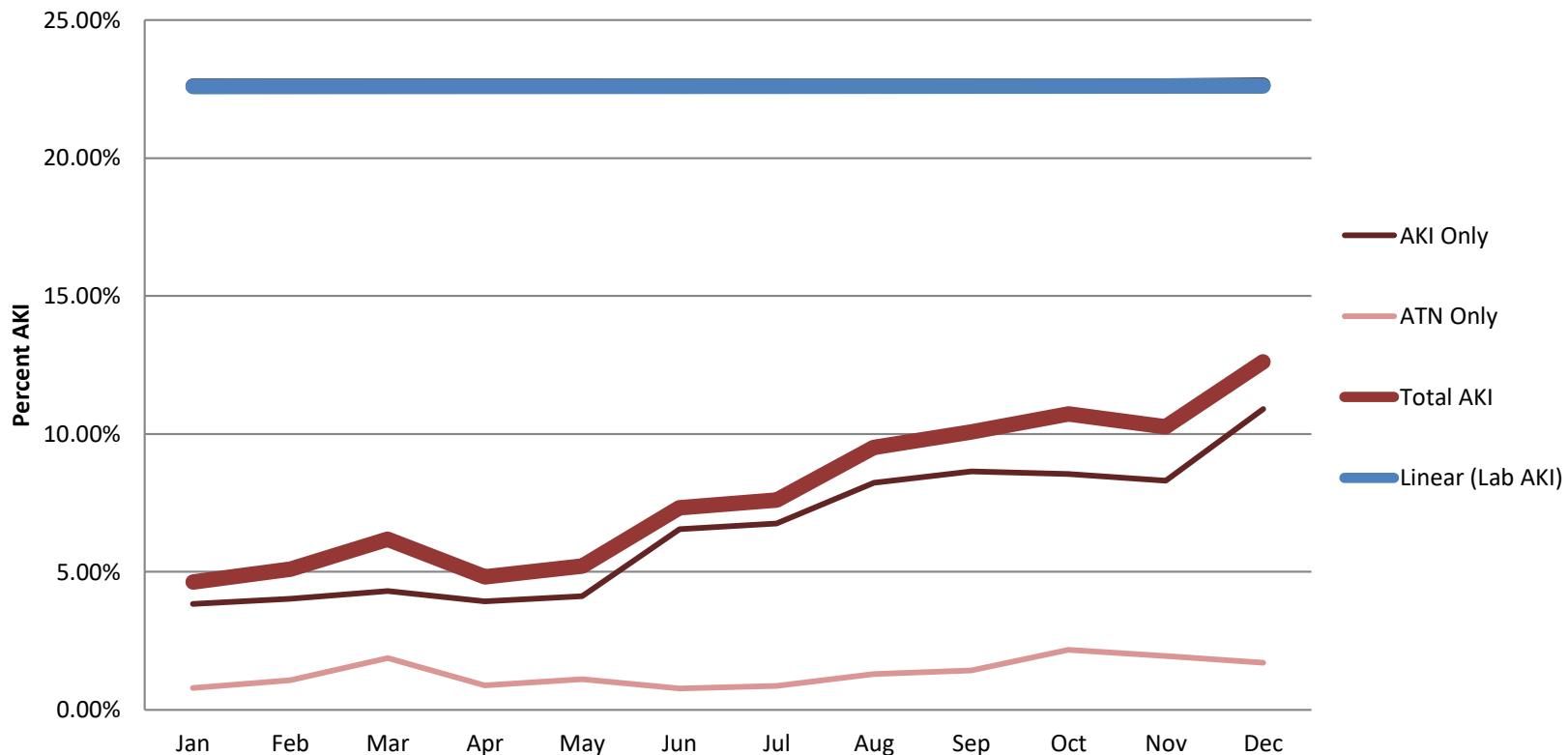# Results from FHH Pilot – Jan 2014 to Jun 2014

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
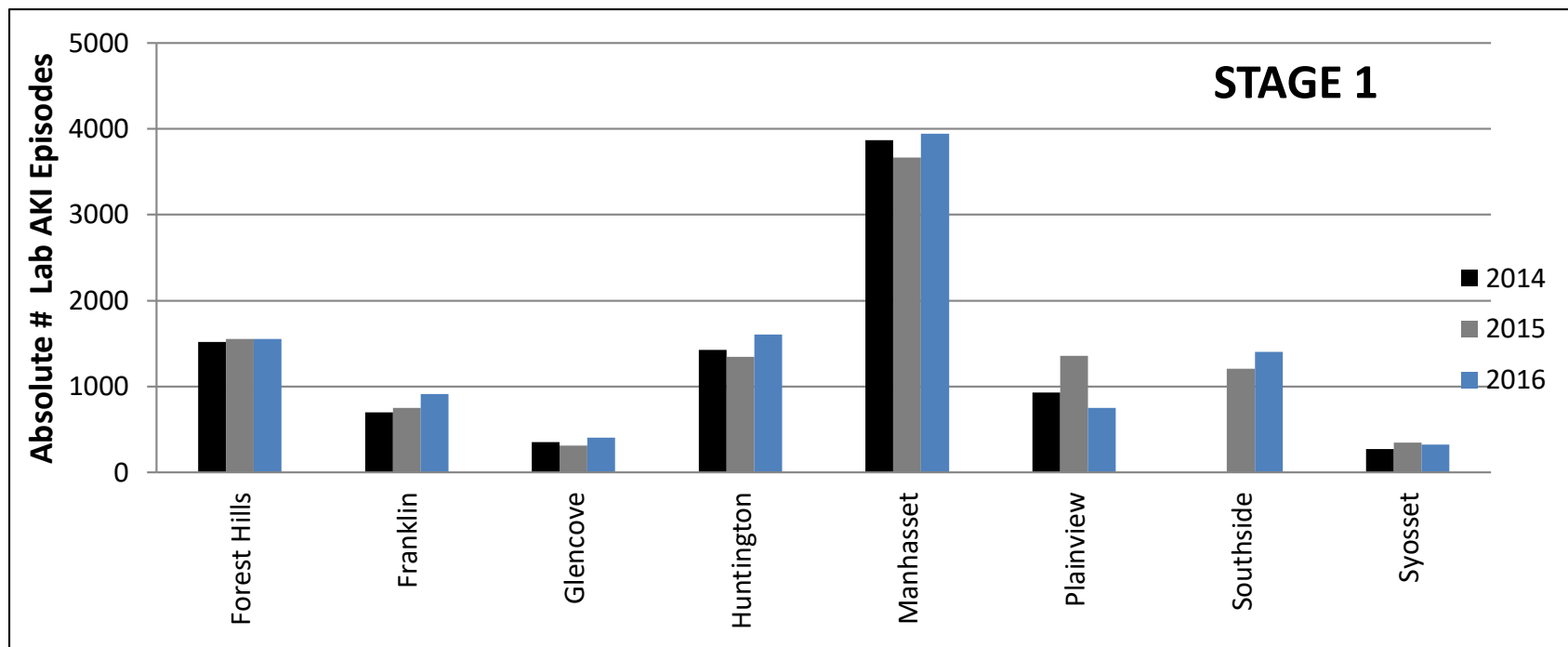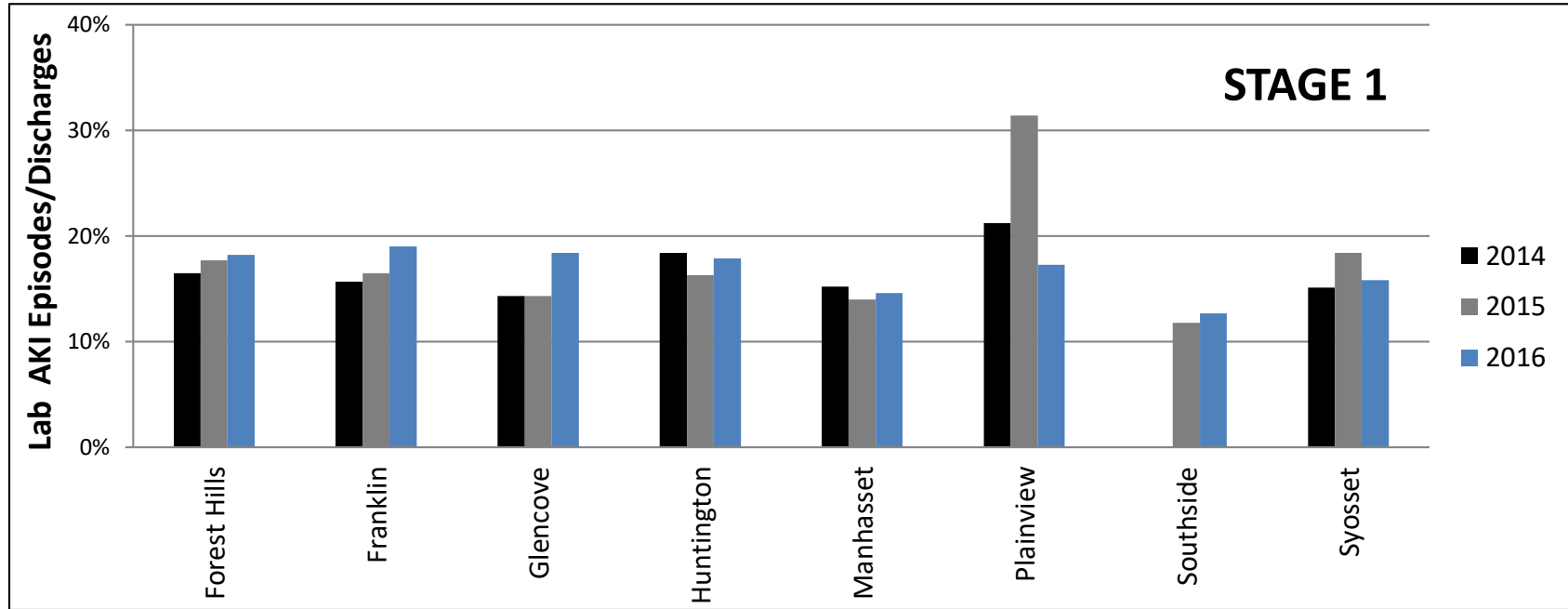
2014 Forest Hills

Legend:
- AKI Only
- ATN Only
- Total AKI
- Linear (Lab AKI)

Y-axis: Percent AKI (0.00%, 5.00%, 10.00%, 15.00%, 20.00%, 25.00%)

X-axis: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

PILOT PERIOD

LAB and CDI CAMPAIGN
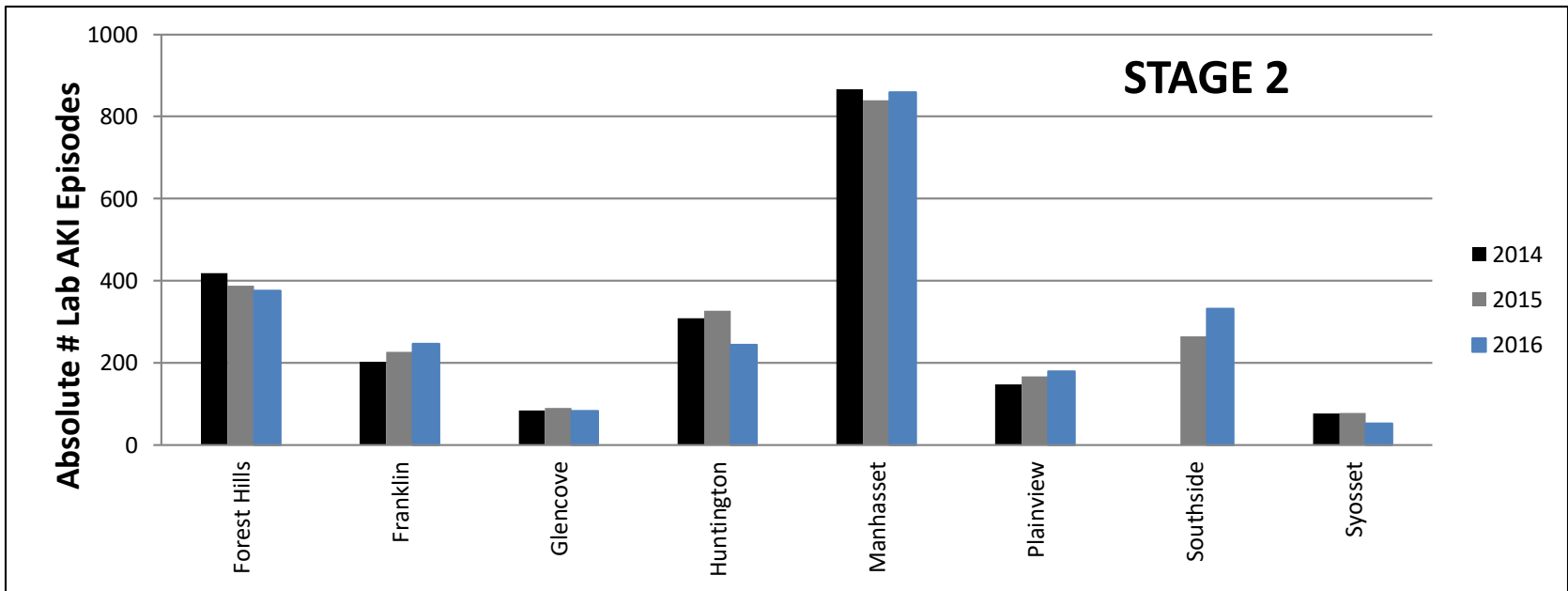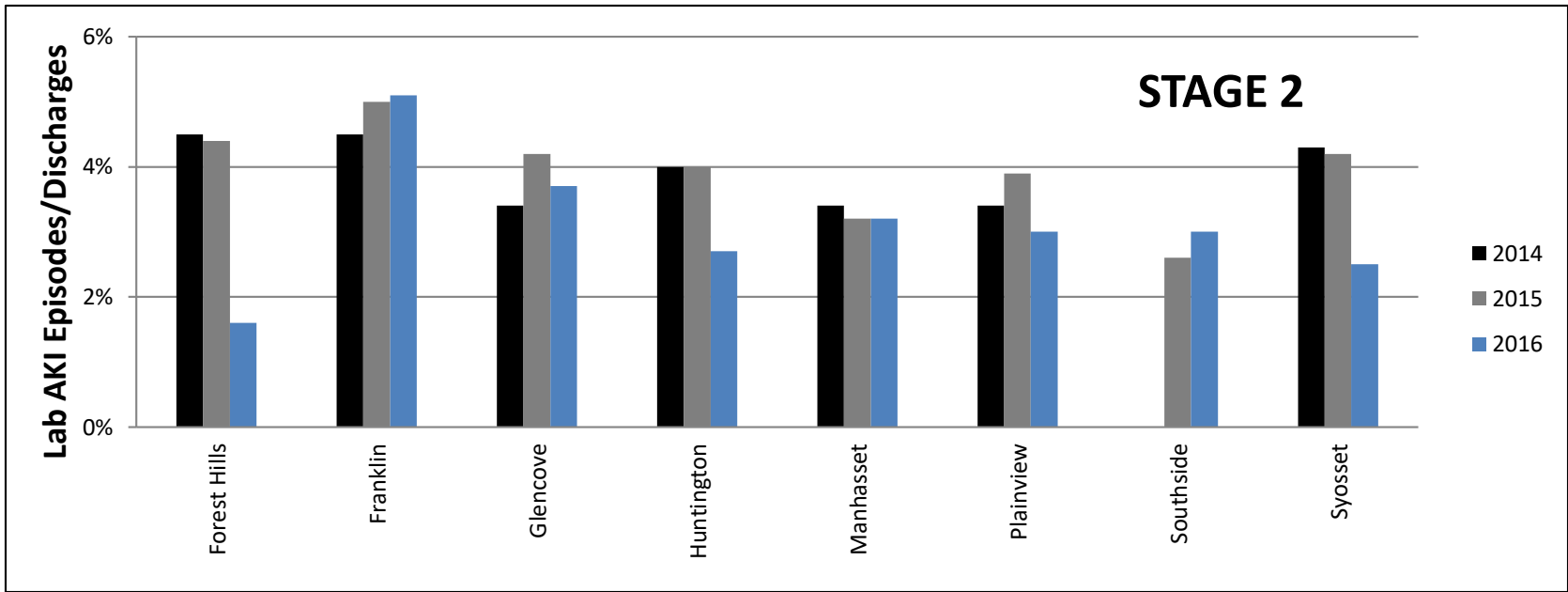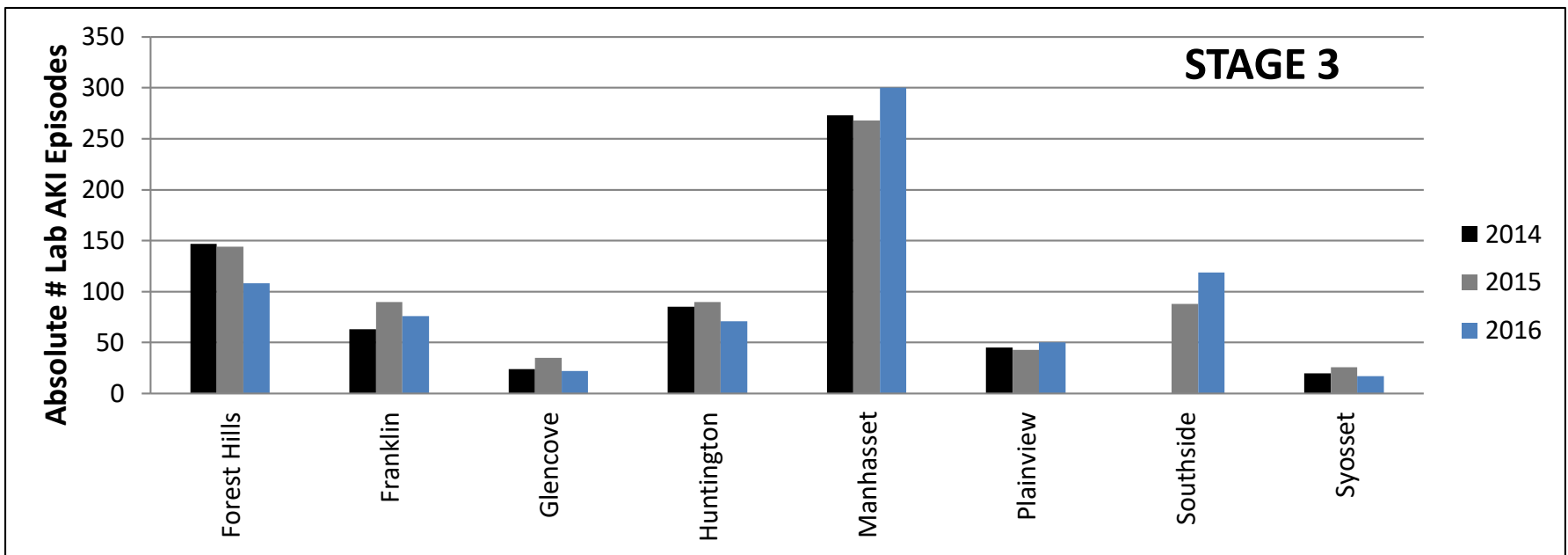
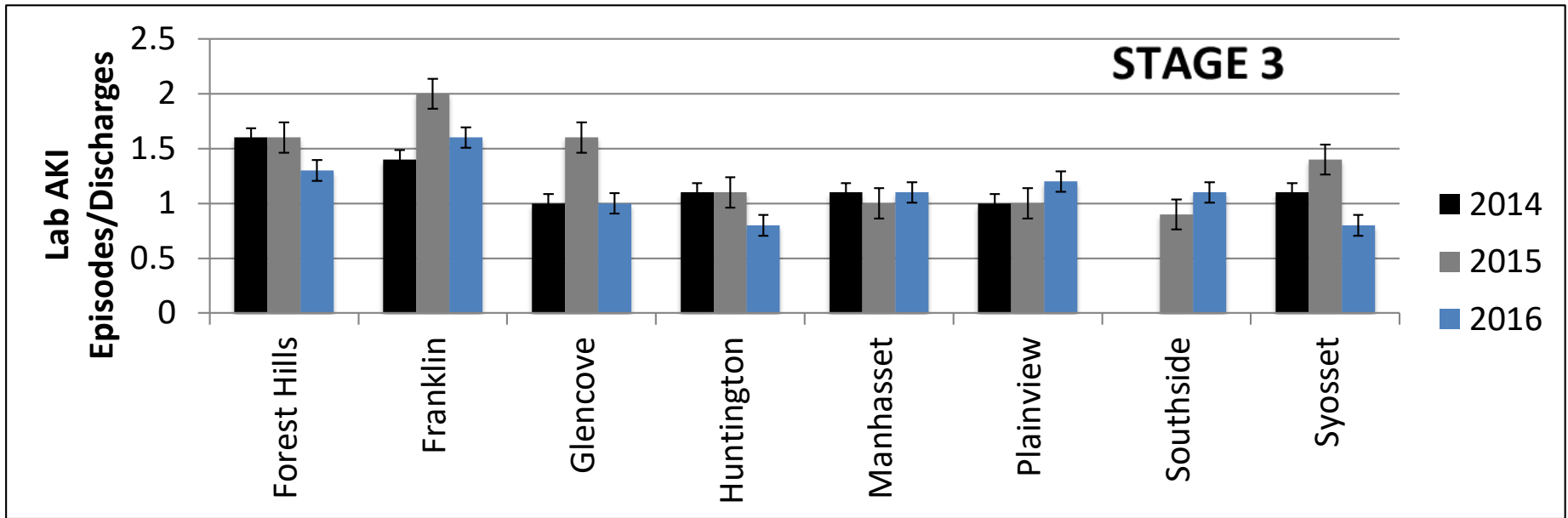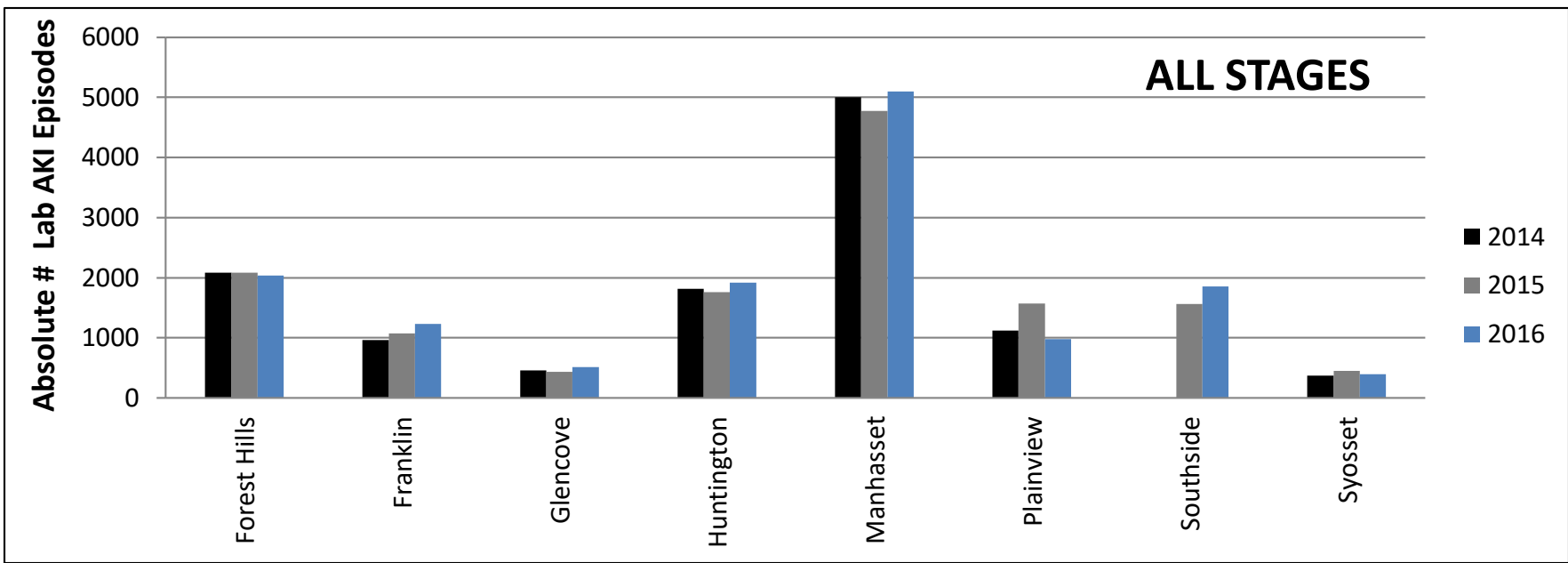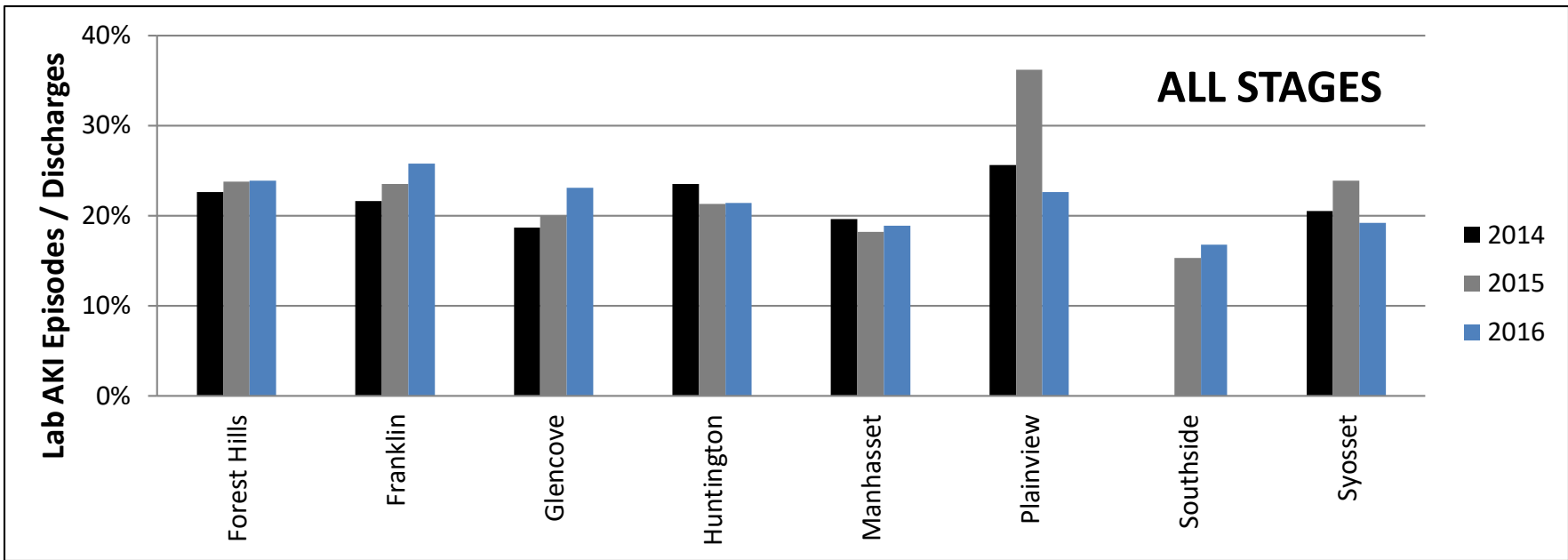GO LIVE FOR OTHER HOSPITALS

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

STAGE 1

STAGE 1

STAGE 2

Top chart: Lab AKI Episodes/Discharges by site (Forest Hills, Franklin, Glencove, Huntington, Manhasset, Plainview, Southside, Syosset) for years 2014, 2015, 2016.

Bottom chart: Absolute # Lab AKI Episodes by site (Forest Hills, Franklin, Glencove, Huntington, Manhasset, Plainview, Southside, Syosset) for years 2014, 2015, 2016.

Figure: STAGE 3 — Lab AKI Episodes/Discharges by site (2014, 2015, 2016)

Figure: STAGE 3 — Absolute # Lab AKI Episodes by site (2014, 2015, 2016)

ALL STAGES

Top chart: Lab AKI Episodes / Discharges (%) by hospital (Forest Hills, Franklin, Glencove, Huntington, Manhasset, Plainview, Southside, Syosset) for years 2014, 2015, 2016.
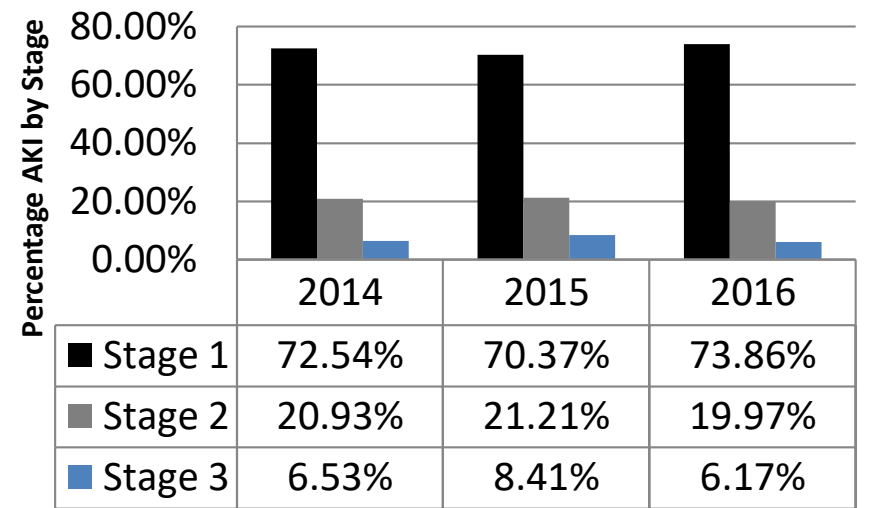
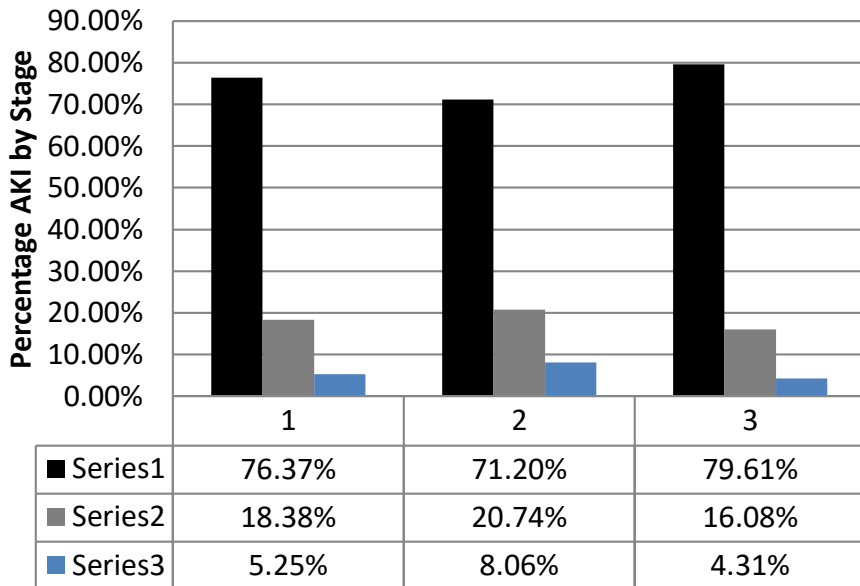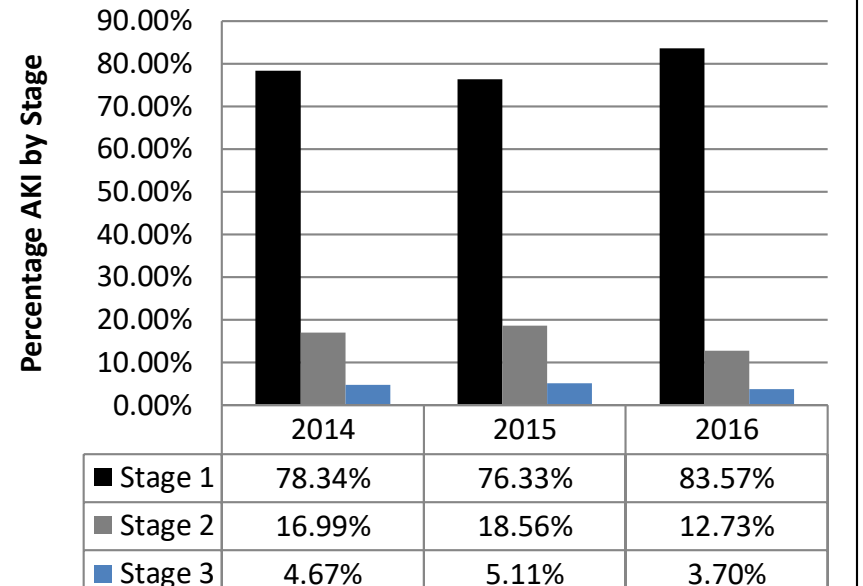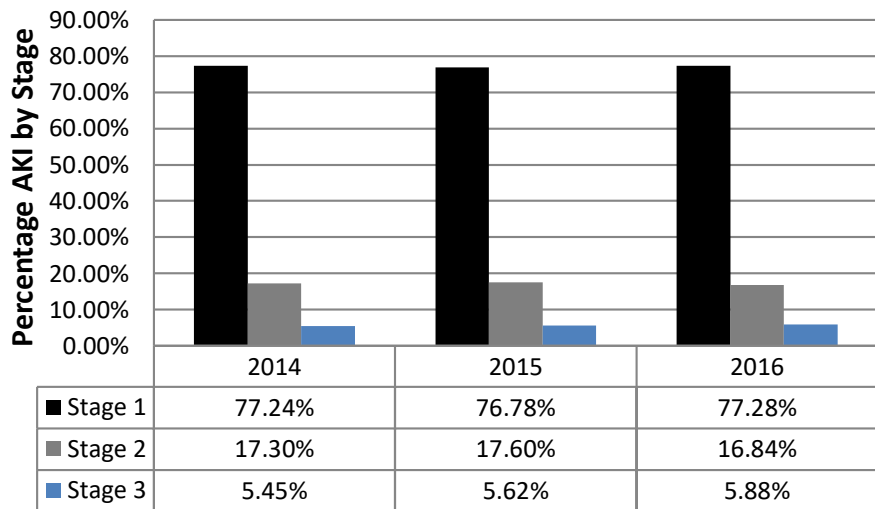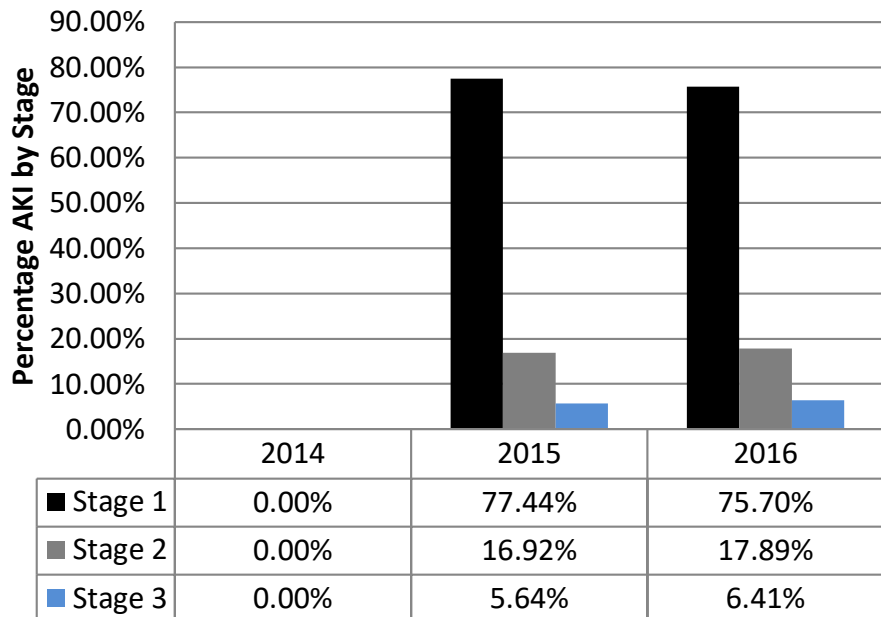Bottom chart: Absolute # Lab AKI Episodes by hospital (Forest Hills, Franklin, Glencove, Huntington, Manhasset, Plainview, Southside, Syosset) for years 2014, 2015, 2016.

Forest Hills

Percentage AKI by Stage

	2014	2015	2016
■ Stage 1	72.91%	74.45%	76.25%
■ Stage 2	20.04%	18.64%	18.44%
■ Stage 3	7.05%	6.92%	5.31%

Franklin

Percentage AKI by Stage

	2014	2015	2016
■ Stage 1	72.54%	70.37%	73.86%
■ Stage 2	20.93%	21.21%	19.97%
■ Stage 3	6.53%	8.41%	6.17%

Glencove

Percentage AKI by Stage

	1	2	3
■ Series1	76.37%	71.20%	79.61%
■ Series2	18.38%	20.74%	16.08%
■ Series3	5.25%	8.06%	4.31%

Huntington

Percentage AKI by Stage

	2014	2015	2016
■ Stage 1	78.34%	76.33%	83.57%
■ Stage 2	16.99%	18.56%	12.73%
■ Stage 3	4.67%	5.11%	3.70%

Manhasset

	2014	2015	2016
■ Stage 1	77.24%	76.78%	77.28%
■ Stage 2	17.30%	17.60%	16.84%
■ Stage 3	5.45%	5.62%	5.88%

Y-axis: Percentage AKI by Stage

Plainview

	2014	2015	2016
■ Stage 1	82.86%	86.60%	76.63%
■ Stage 2	13.13%	10.66%	18.27%
■ Stage 3	4.02%	2.74%	5.10%

Y-axis: Percentage AKI by Stage

Southside

	2014	2015	2016
■ Stage 1	0.00%	77.44%	75.70%
■ Stage 2	0.00%	16.92%	17.89%
■ Stage 3	0.00%	5.64%	6.41%

Y-axis: Percentage AKI by Stage

Syosset

	2014	2015	2016
■ Stage 1	73.71%	76.84%	82.44%
■ Stage 2	20.87%	17.37%	13.23%
■ Stage 3	5.42%	5.79%	4.33%

Y-axis: Percentage AKI by Stage

LAB DATA - ALL HOSPITALS

|	2014	2015	2016
■ Stage 1	76.48%	76.93%	79.37%
■ Stage 2	18.07%	17.26%	15.35%
■ Stage 3	5.45%	5.81%	5.28%

Percentage AKI by Stage

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)
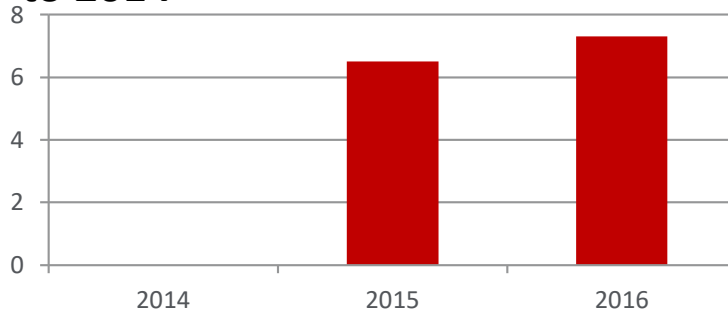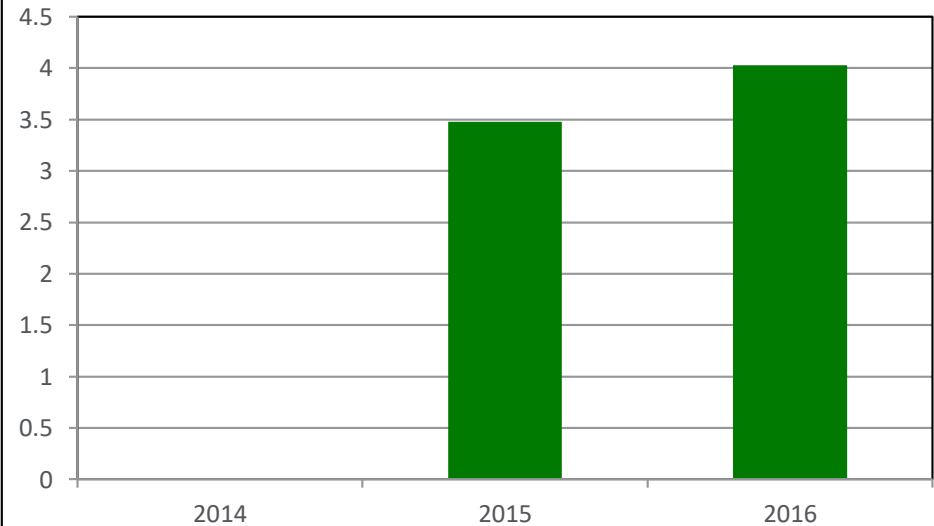
LAB AKI Episodes vs. DRG AKI Episodes (% of Discharges)
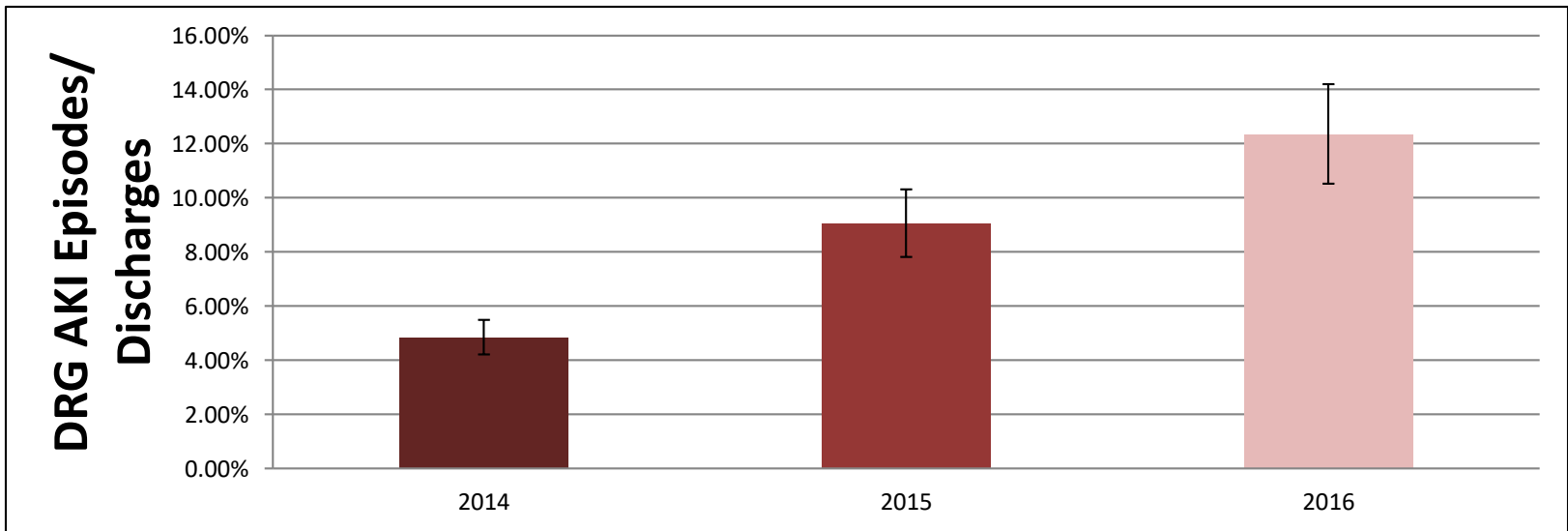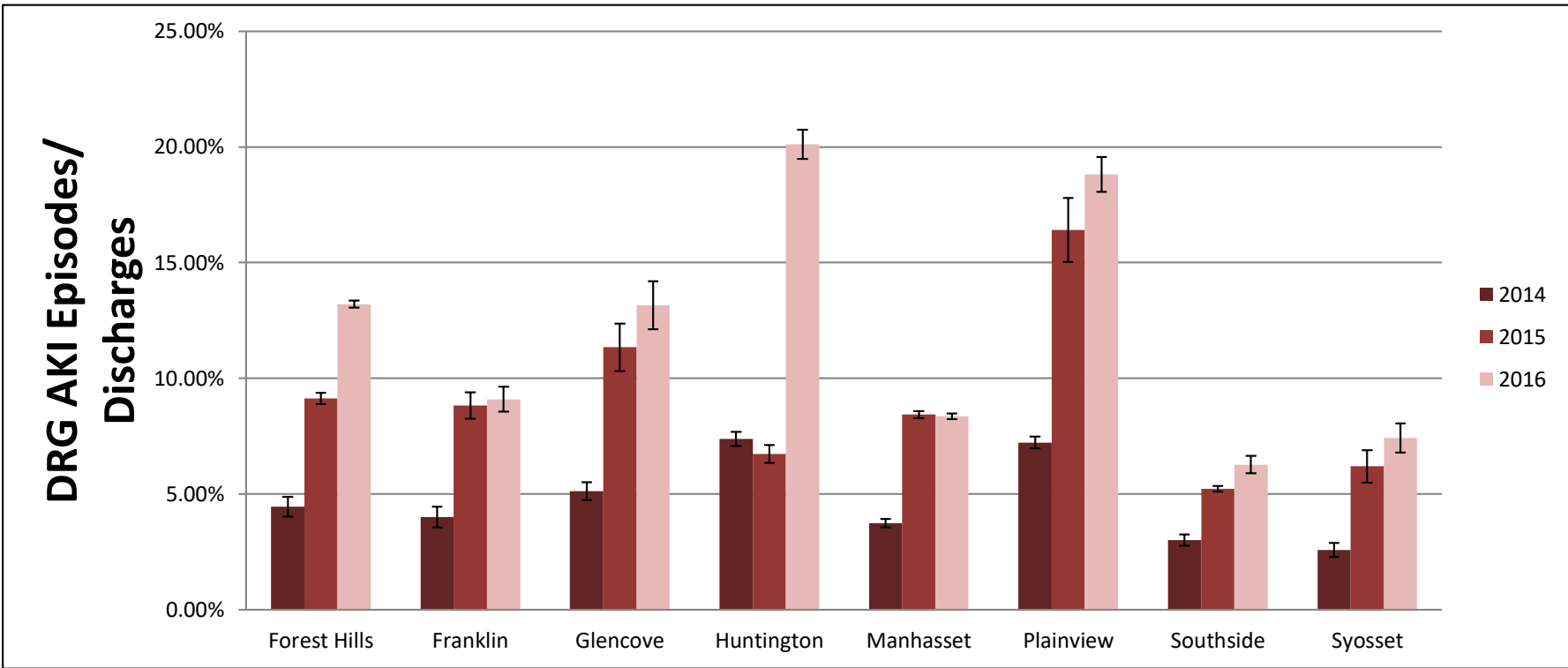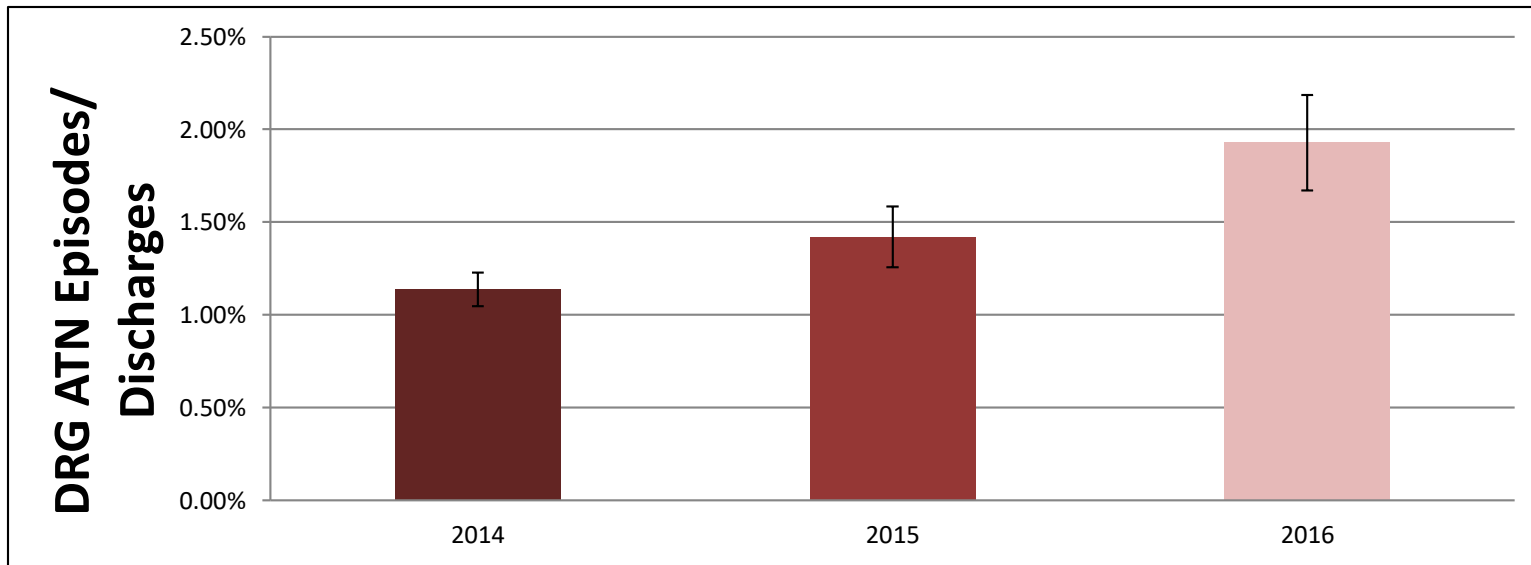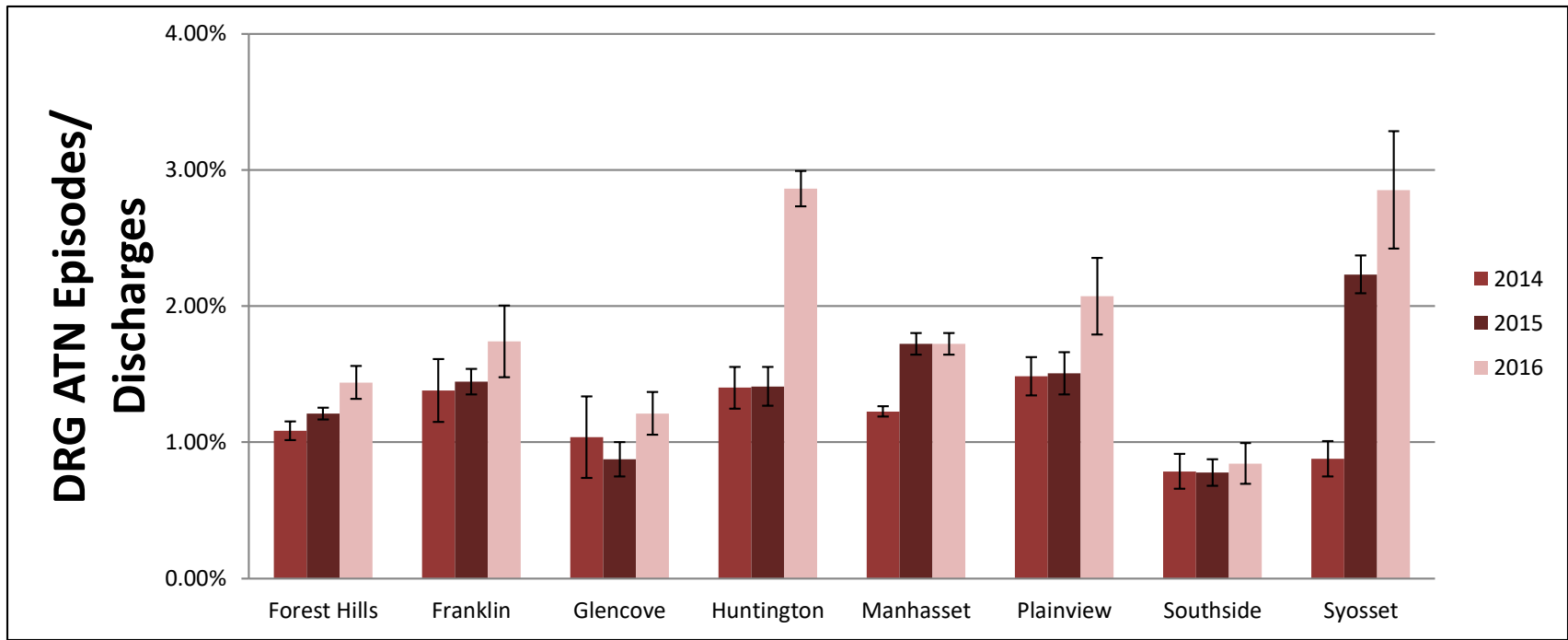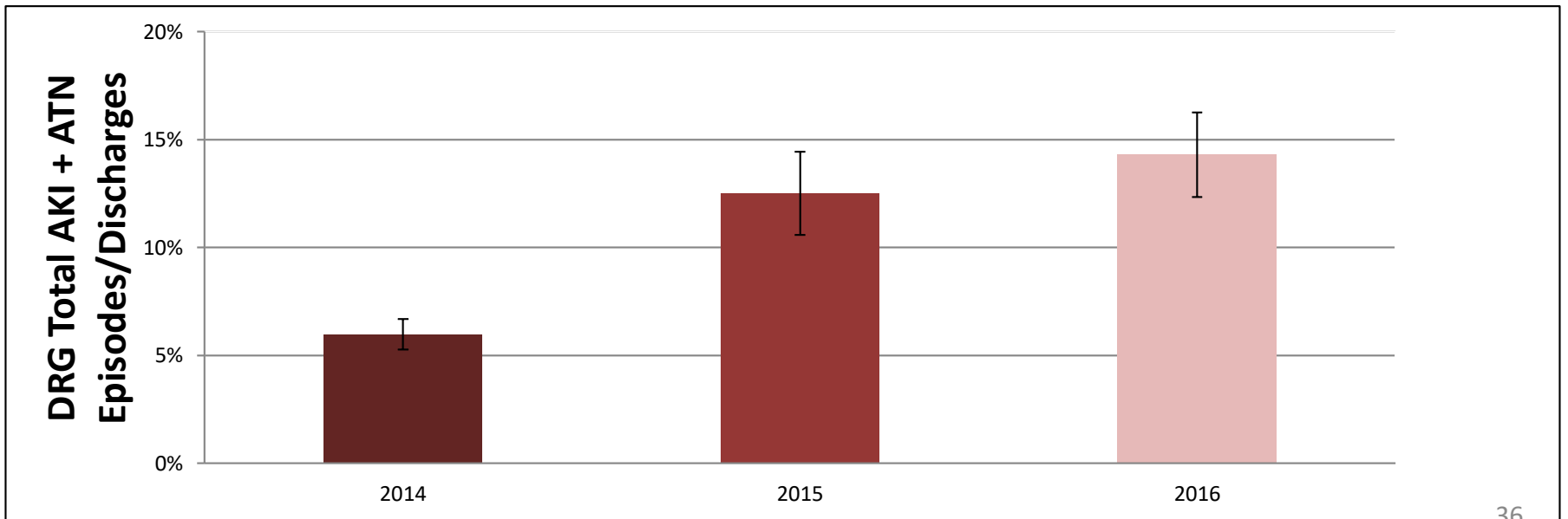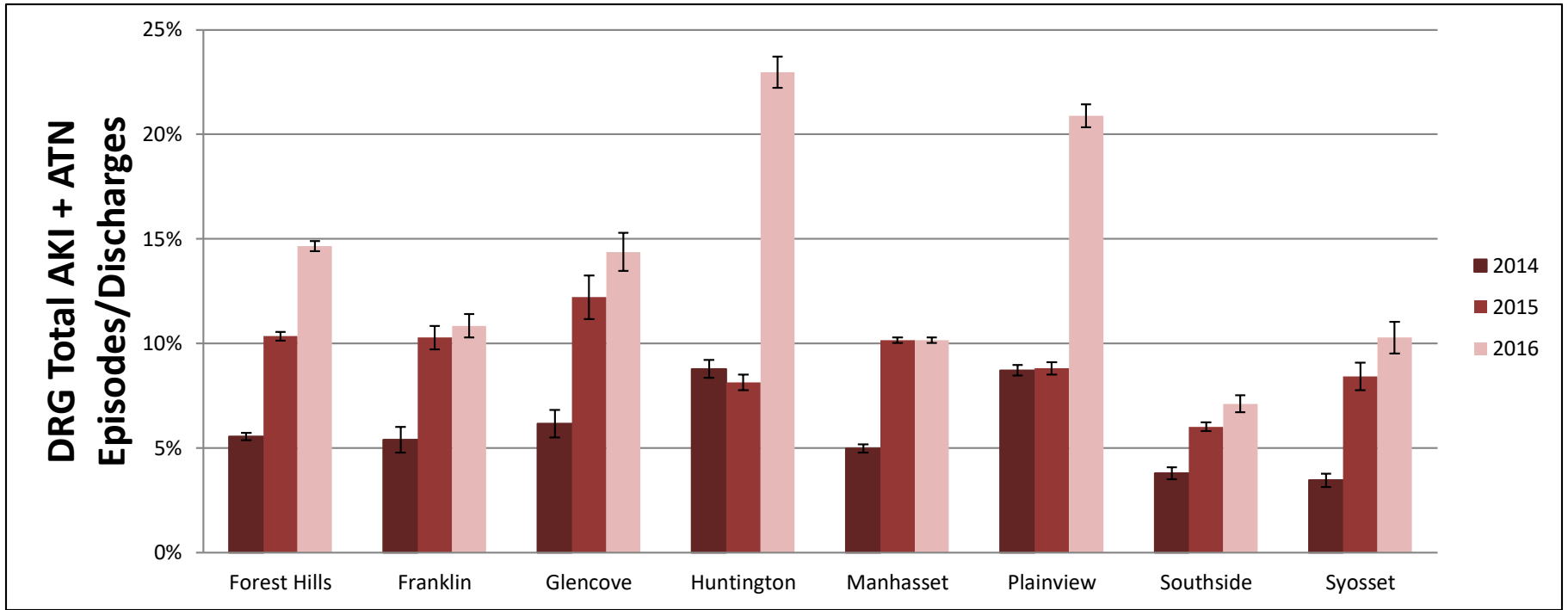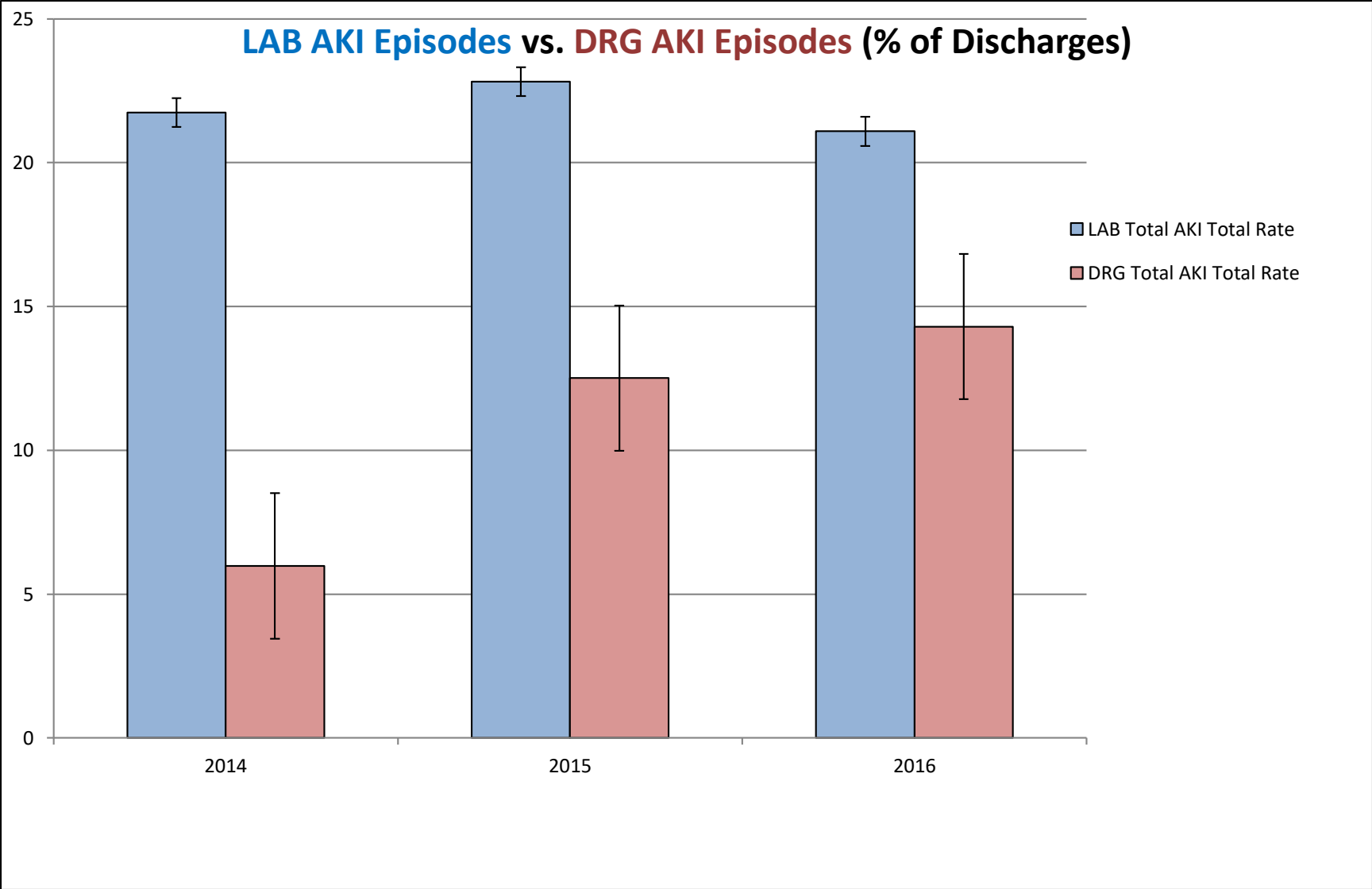
Enhanced Inpatient Reimbursement*

Increase in Coded AKI Capture Rate (%)- compared to 2014

Increase in Coded AKI Cases - compared to 2014

Increase Reimbursement ($ millions)- compared to 2014

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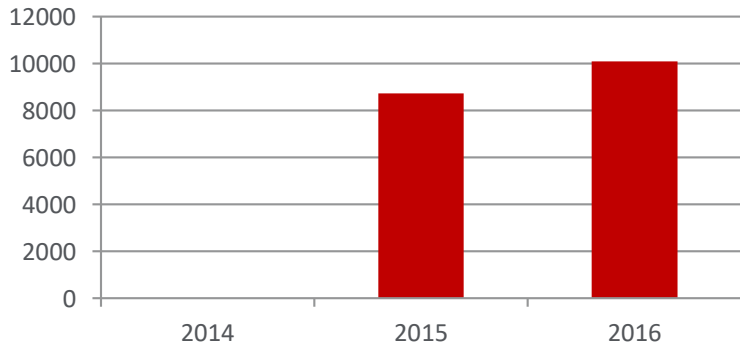
Conclusions – AKI DRG Data

- 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

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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

Post-Analytical

Analytical

Laboratory testing

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

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

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

Acknowledgements

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