



## **Saving Lives in Real-time**

Cincinnati Children's approach to leveraging event-driven analytics to change the outcome

**HIMSS**

CENTRAL & SOUTHERN OHIO *Chapter*



**What would you do differently?**

# Agenda

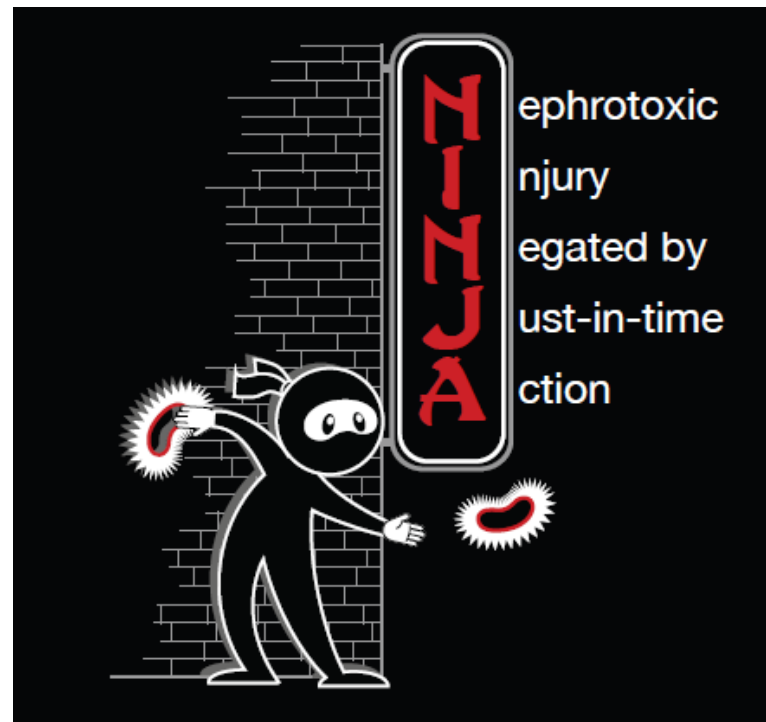
- CCHMC Introduction
- Our Journey
  - Where it began: The Ninja Project
  - Real-time risk assessment: GARDIaNS
  - Building the advantage
- Best practices
- Future trends

# About Cincinnati Children's

- Stand-alone academic, pediatric medical center
- 598 licensed beds
- ~1M patient encounters / year
- 3rd highest recipient of pediatric NIH funding
- 3rd ranked pediatric center, top 10 in all ranked subspecialties (US News)
- Awarded HIMSS Stage 7 in 2013
- Epic customer since 2007
- Tibco customer since 2007



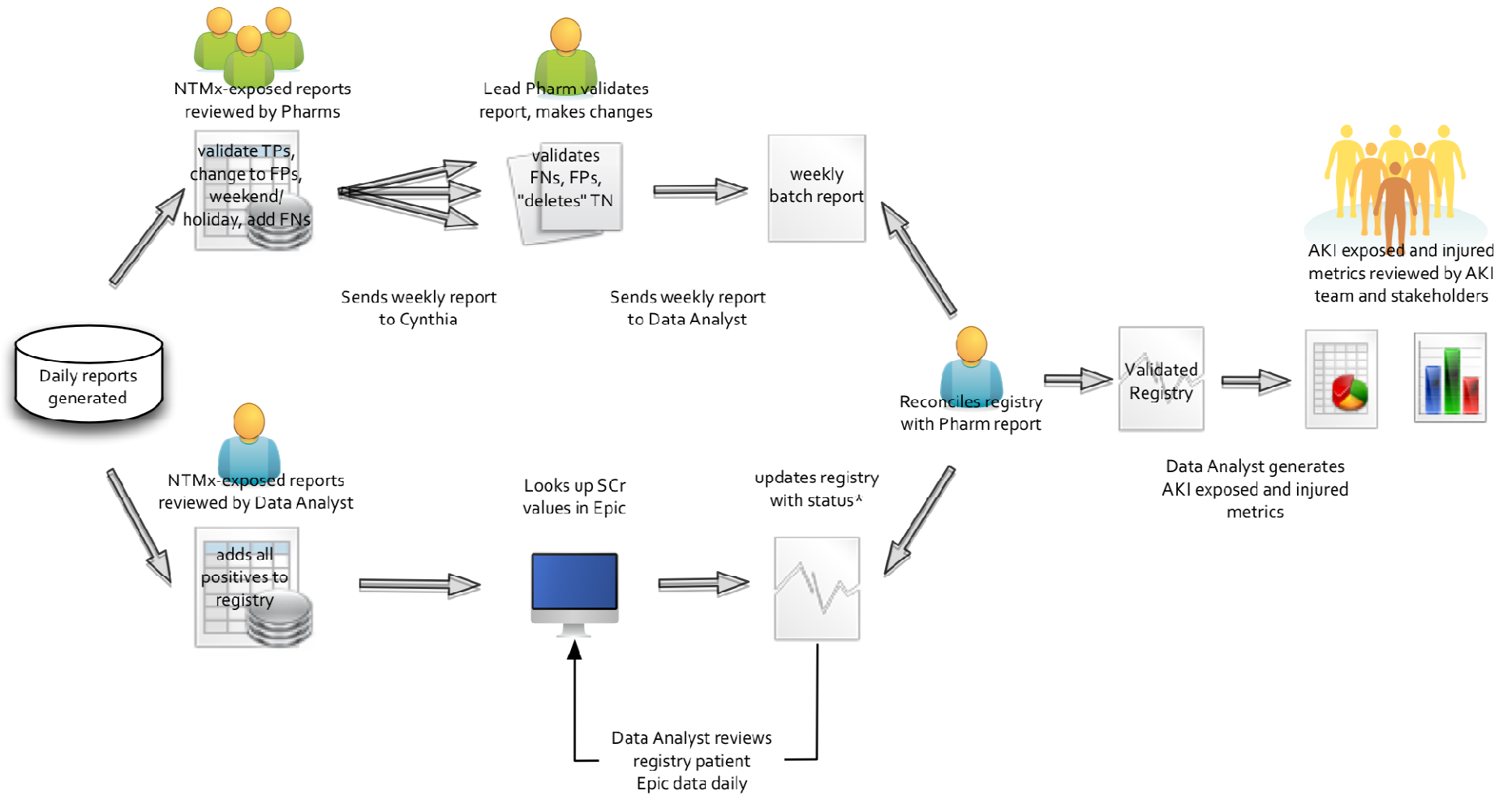
# Where it all began....



## The Problem: Nephrotoxic Medication Associated AKI

- One of the most common causes of AKI in non-critically ill hospitalized children
- A portion of NTMx-AKI goes unnoticed due to lack of systematic kidney function surveillance in exposed children
  - Multiple studies show SCr measured at least every four days only 50% of the time in children receiving multiple NTMx
- NTMx-AKI may be a potentially modifiable adverse safety event if
  - At-risk patients are identified
  - Systematic SCr monitoring is instituted reliably in at-risk patients
  - AKI is avoided and/or mitigated by reducing unnecessary NTMx exposure

# Initial Workflow

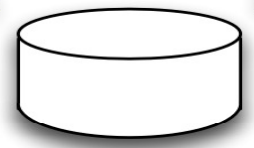


# Revised Workflow

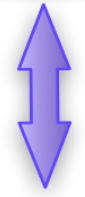
NTMx-exposed reports reviewed by Pharms



Lead Pharm validates report, makes changes



AKI exposed and injured metrics reviewed by AKI team and stakeholders

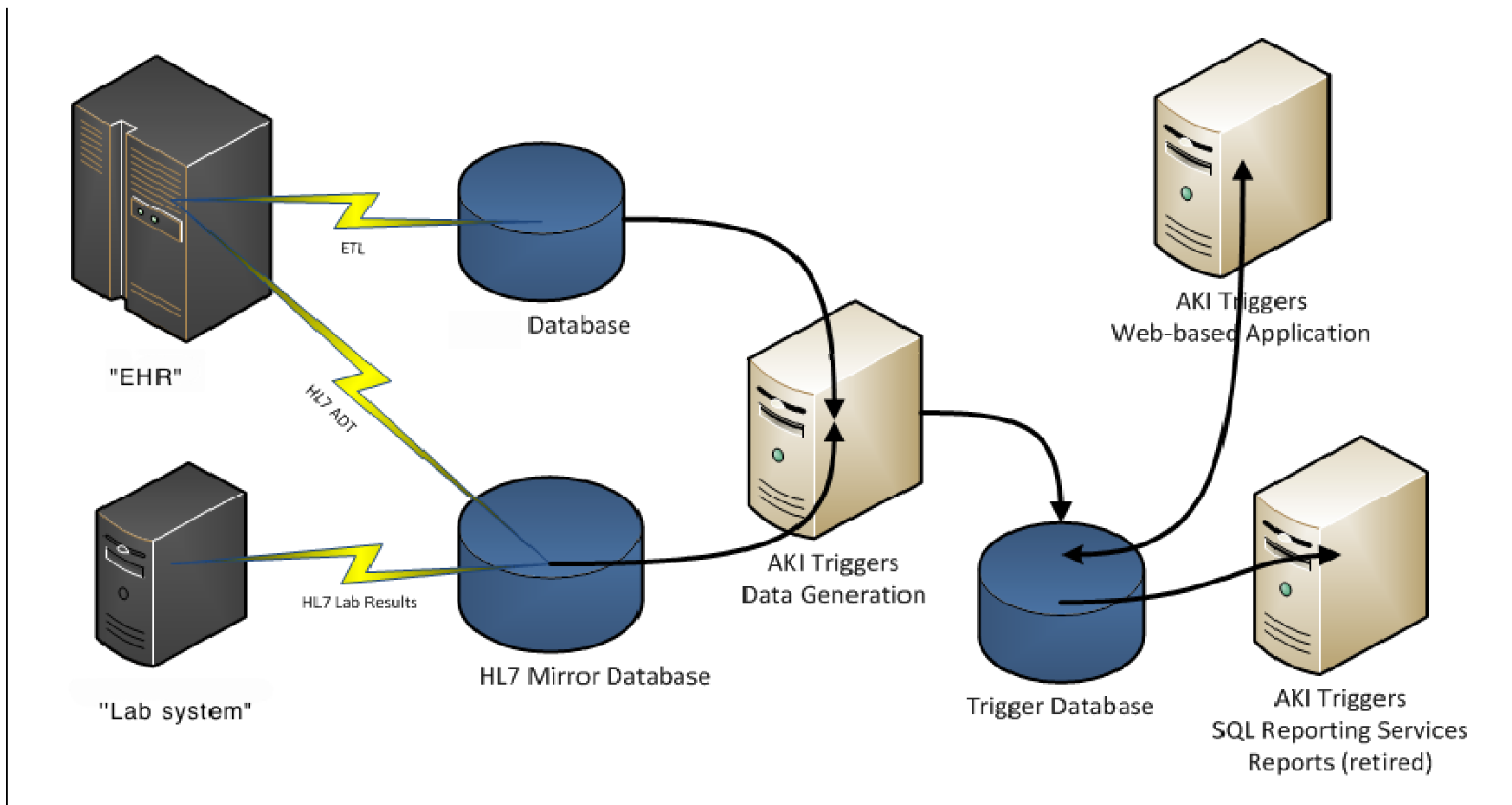


NTMx-exposed reports reviewed by Data Analyst





# The System & Data Flows



# The Trigger Logic

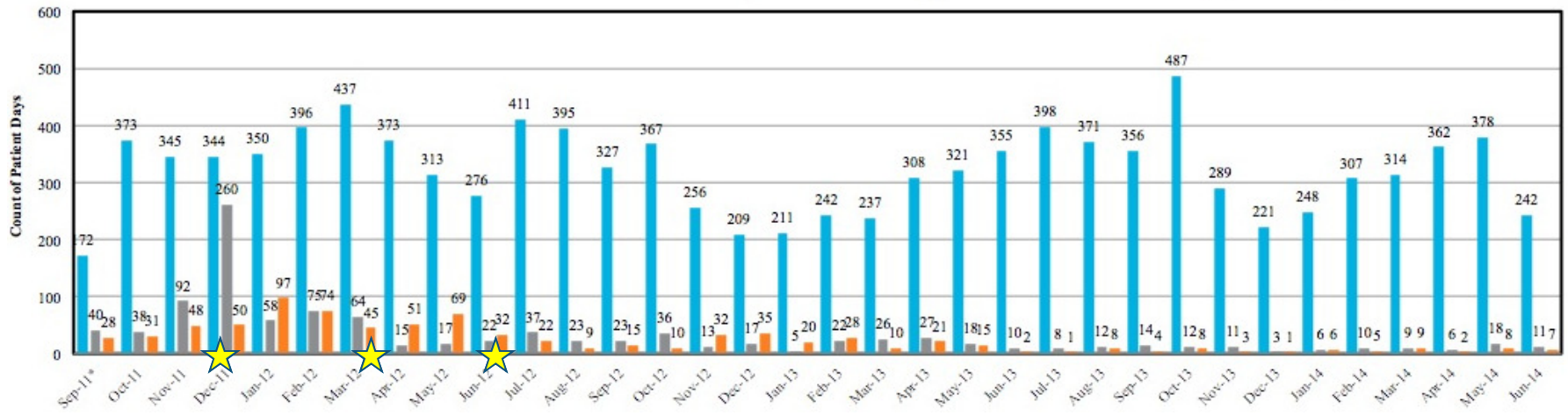
Trigger Name	Clinical Criteria	Trigger Logic
<i>Exposure Triggers</i>		
≥3 NTMx	Patients received 3 or more nephrotoxins (NTMx) on the same calendar day <sup>a</sup>	Unique Medical Record Number (MRN) AND located in an inpatient unit AND at least 3 NTMx with a status of “given” on the MAR AND same calendar day <sup>a</sup>
IV AG ≥3 days	Patient received intravenous (IV) aminoglycoside (AG) for 3 or more days in a row	Unique Medical Record Number (MRN) AND located in an inpatient unit AND IV AG on the MAR as “given” AND for 3 sequential days
<i>Injury Triggers</i>		
pRIFLE criteria	Patient’s SCr increased by ≥50% above baseline <sup>b</sup> ; Risk,R; 50-99% above baseline Risk I; 100-199% above baseline Risk F; ≥200% above baseline Risk L,E; not applicable, chronic disease-based	Unique Medical Record Number (MRN) AND has a SCr lab value on the prior day AND current SCr value >1.5 <sup>b</sup> baseline any SCr value from prior 6 months;  If current SCr = 50-99% increase, risk strata = R OR If current SCr = 100-199% increase, risk strata = I OR If current SCr = ≥200 increase, risk strata = F
≥0.3mg/dL increase SCr in 48 hrs	Patient’s SCr increased by at least 0.3mg/dL within a 48 hour window	Unique Medical Record Number (MRN) AND has a SCr lab value on the prior day AND current SCr value ≥0.3mg/dL increase SCr over any SCr value from prior 2 days

# Optimizing the Triggers

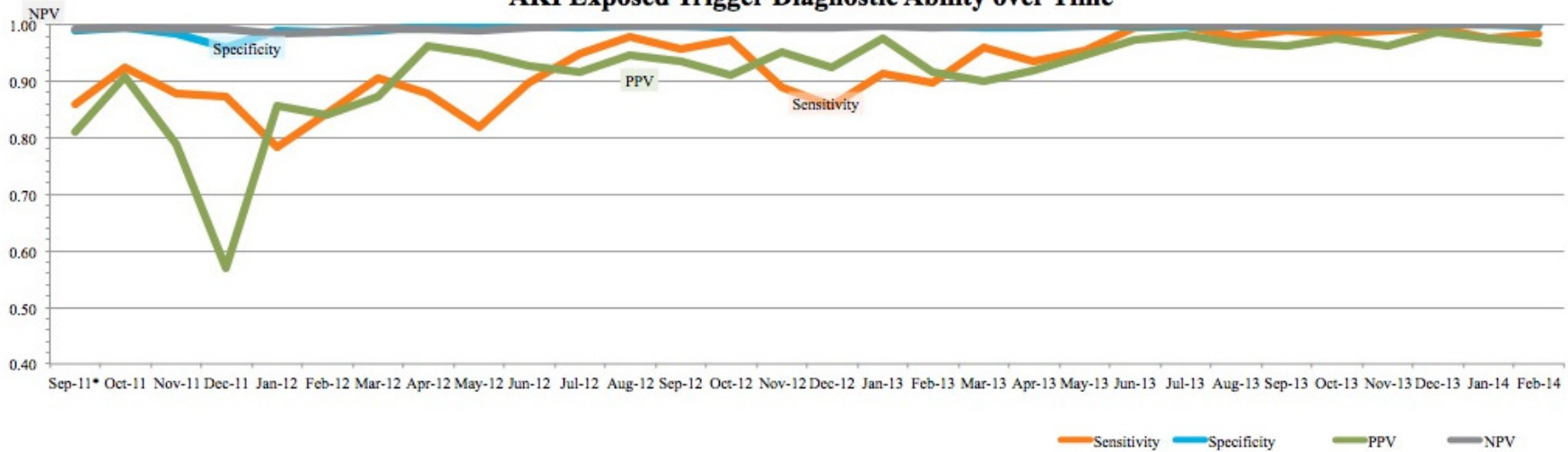
★ Trigger change

### Counts of Exposed AKI Trigger Characteristics

■ True Positives (TPs) ■ False Positives (FPs) ■ False Negatives (FNs)



### AKI Exposed Trigger Diagnostic Ability over Time



# Outcomes

- Children with high NTMx exposure (IV AG for  $\geq 3$  days OR  $\geq 3$  NTMx develop AKI 25% of the time
- In year 1 we observed a 42% reduction in days in AKI per exposure (AKI intensity)
  - Resulted from earlier AKI detection and withdrawal of NTMx
- In year 2 we observed
  - 20% reduction in NTMx prevalence rates
  - 33% reduction in AKI prevalence rates
  - 34% reduction in AKI rates in NTMx-exposed patients
  - Sustained reduction in AKI intensity
- Socializing work to other institutions

Research Article

aci Applied Clinical Informatics 1

## Development and Performance of Electronic Acute Kidney Injury Triggers to Identify Pediatric Patients at Risk for Nephrotoxic Medication-associated Harm

E.S. Kirkendall<sup>1,2,3,4</sup>; W.L. Spires<sup>2</sup>; T.A. Mottes<sup>2</sup>; J.K. Schaffzin<sup>3</sup>; C. Barclay<sup>4</sup>; S.L. Goldstein<sup>5</sup>

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# Learnings

- Custom design, implementation, QA maintenance costly
- Query logic is complex, difficult to implement electronically
- Able to reliably execute complex query logic and inclusion/exclusion criteria
- Rapid-cycle improvement often at odds with static technical requirements
- Application can be difficult to test given workflow and limited “test” data

# GARDIaNS

Real-time patient risk assessment

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G.A.R.D.I.a.N.S.



user id



password

Login ↻

Scrambler Active

## What is it?

- Real-time patient risk assessment and management solution
- Feeds from Epic from HL7 and web service interfaces
- Optimized to be used on a tablet device
- User specific views based on roles (organizational, unit, patient)

## Solution Objectives

- Increase situational awareness in patient safety, flow, and family experience
- Increase efficiency in delivering situational awareness information
- Decrease reliance on paper leading to a convergence of data sources

# GARDIaNS Indicators for Risk

## Situational Awareness

- Off Service/Off Unit
- Watcher
- High Risk Therapy
- Communication Concerns
- PEWS score
- Flight Risk
- Employee Safety Risk
- SA "F" Concerns
- Patient of Interest
- Critical Safety Risk
- PSY – Watch Hot
- PSY – Watch Cold
- PSY – Medical Concerns
- PSY – Self Threat
- PSY – Aggressor
- PSY – Family Concern
- PSY – Flight Risk

## Safety

- Critical Tube Patients
- Prevention Standards Compliance
- Potential Security Risk
- At risk for hurting themselves

## Patient/Family Experience

- Surgical Add-On Patients
- Patients with multiple consults
- Patients with multiple surgical services

## Flow

- Patients pending admission to unit
- Discharges predicted in next 4 hours



# Organizational Overview



Concise snapshot of organization with a summary of each unit.

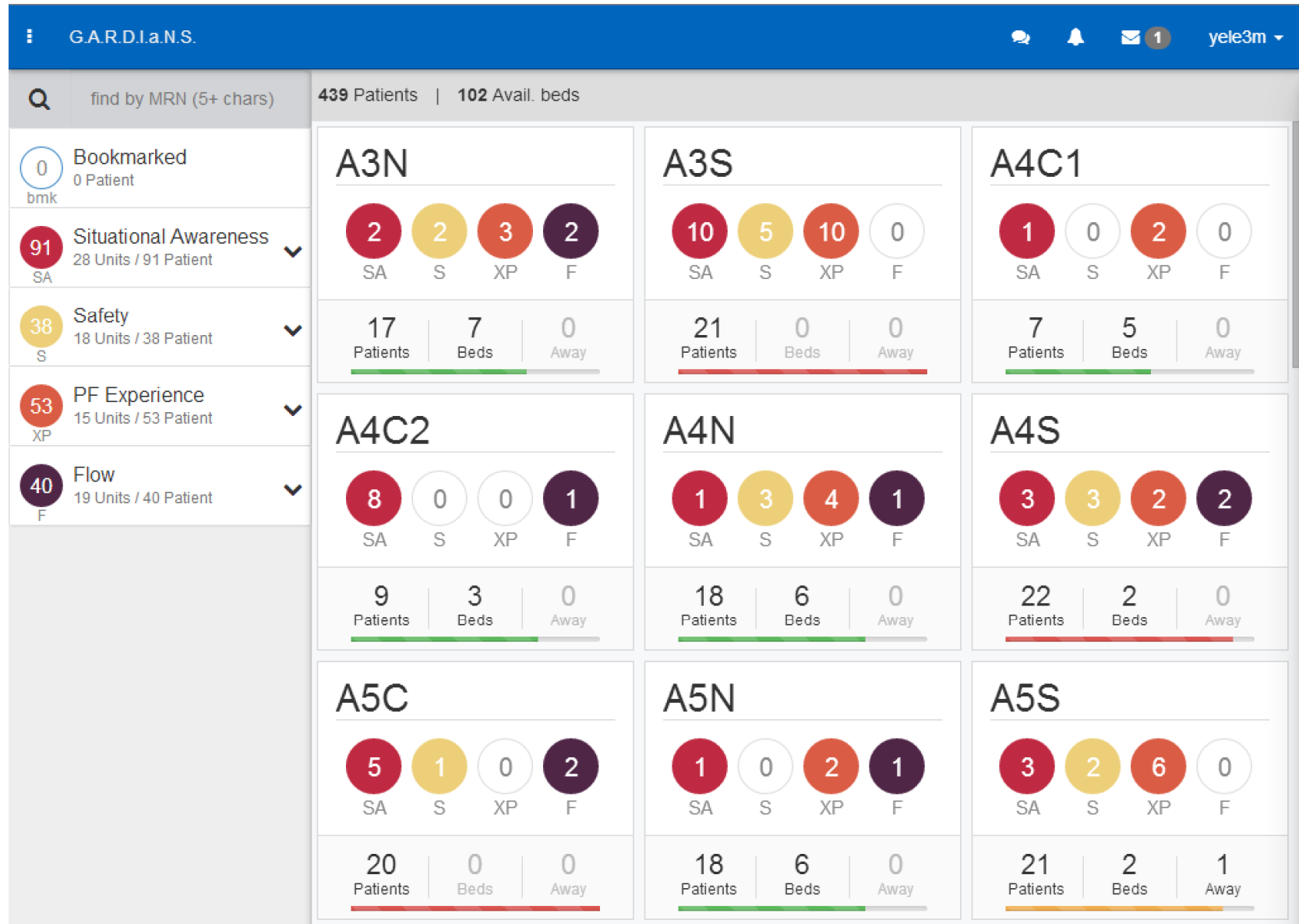
## Targeted Users

- Hospital Clinical Administrators
- Flow Coordinators
- Clinicians that manage multiple units

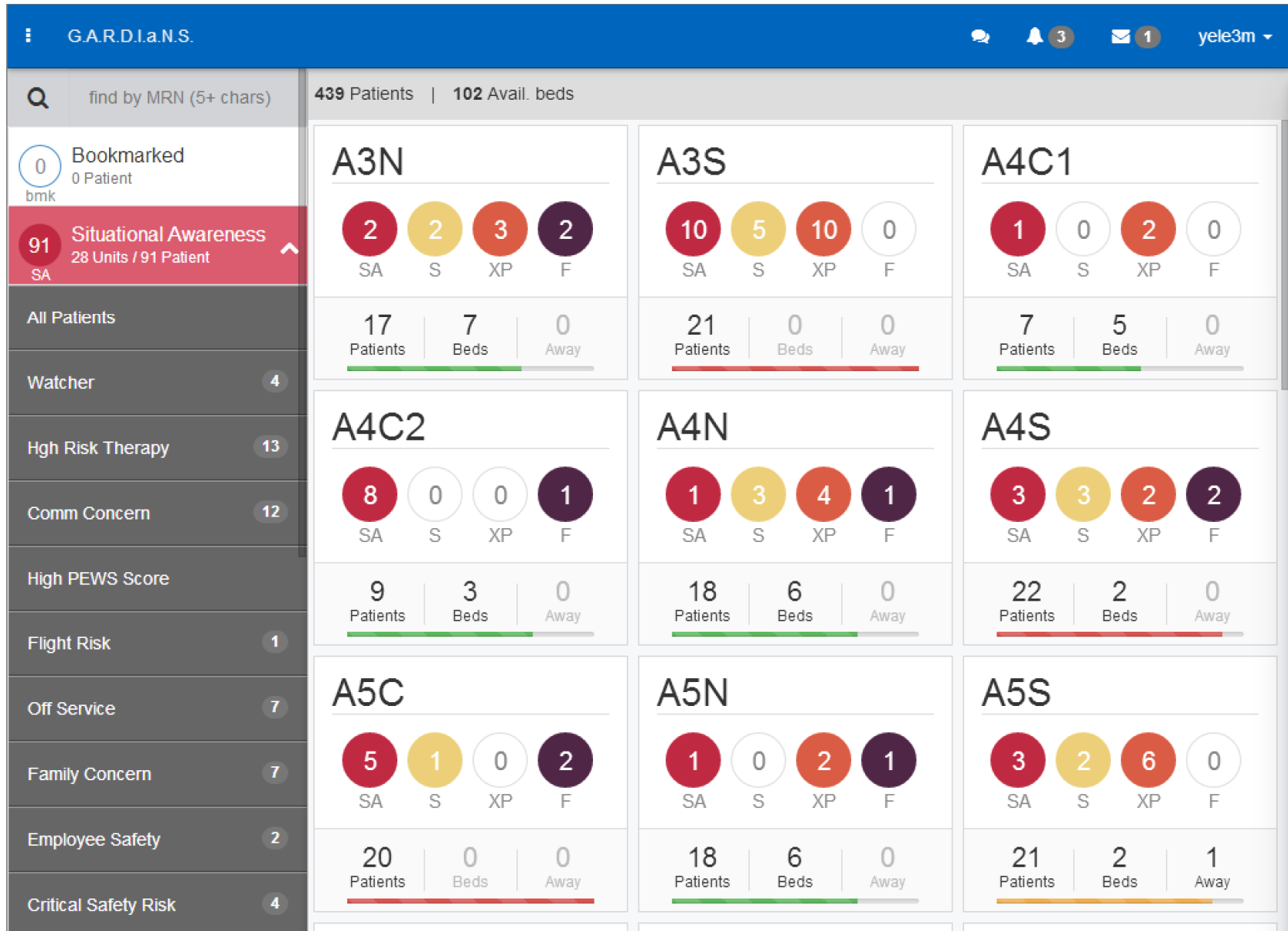
## Critical Components

- Risk classification for each inpatient unit
- Drill Down Ability
- Safety, Flow & Experience components

# Organizational Overview



# Organizational Overview



# Organizational Overview

G.A.R.D.I.a.N.S.


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0
Bookmarked  
0 Patient

91
Situational Awareness  
28 Units / 91 Patient

All Patients

Watcher 4

High Risk Therapy 13

Comm Concern 12

High PEWS Score

Flight Risk 1

Off Service 7

Family Concern 7

Employee Safety 2

Critical Safety Risk 4

A662E2
Prevention Standards

MRN: 99965765
Reminder

Luo, Hannah

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SA

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XP

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bmk

Team: Yellow Team

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Watcher

A639U5
Reminder

MRN: 99916543

Kierkegaard, Paul

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Team: Cardiology

**Suspendisse**Sed elementum imperdiet felis in com...

Watcher

A783Q3
Reminder

MRN: 99948594

Wilde, Dawn

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Team: Pulmonary

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Watcher

B484U2

MRN: 99956621

Jackson, Ishmael

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Team: Lumen Team

**Cras**Aliquam malesuada nisi non erat feugiat,

Watcher

# Unit Level View



Snapshot view of patients on the unit with associated indicators.

## Targeted Users

- Medical Directors
- Clinical Directors
- Charge Nurses

## Critical Components

- Overall unit risk classification
- Mitigation plans for Situational Awareness patients
- Safety, Flow and Experience considerations

# Unit Level View

G.A.R.D.I.a.N.S.

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←
88% Capacity
| 1 Away From Unit
| 4 Pending d/c
| Pending Admits: 1 Today / 0 Tomorrow

<div style="border-bottom: 1px solid #ccc; padding: 5px;"> <span style="border: 1px solid #ccc; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-bottom: 5px;">0</span> <p><b>Bookmarked</b> 0 Patient</p> <p style="font-size: 10px; color: #ccc;">bmk</p> </div> <div style="border-bottom: 1px solid #ccc; padding: 5px;"> <span style="border: 1px solid #ccc; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-bottom: 5px; background-color: #c00000; color: white;">2</span> <p><b>Situational Awareness</b> ▾ 2 Patient</p> <p style="font-size: 10px; color: #ccc;">SA</p> </div> <div style="border-bottom: 1px solid #ccc; padding: 5px;"> <span style="border: 1px solid #ccc; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-bottom: 5px; background-color: #ffc000;">1</span> <p><b>Safety</b> ▾ 1 Patient</p> <p style="font-size: 10px; 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# Unit Level View

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find by MRN (5+ chars) ← **88% Capacity** | 1 Away From Unit | 4 Pending d/c | Pending Admits: 1 Today / 0 Tomorrow 📊

0 Bookmarked  
0 Patient  
bmk

**2** Situational Awareness  
2 Patient  
SA

1 Watcher

High Risk Therapy

1 Comm Concern

High PEWS Score

Flight Risk

1 Off Service

Family Concern

Employee Safety

Critical Safety Risk

Patient of Interest

**A625I4**  
MRN: 99985311  
Voltaire, Xena

**2** SA | **0** S | **0** XP | **0** F | bmk

Team: General Surgery  
**Fusce quis**Nullam ac  
**Nam vel accumsan ante**,Curabitur ac  
**Communication Concern: Fish out of Water**

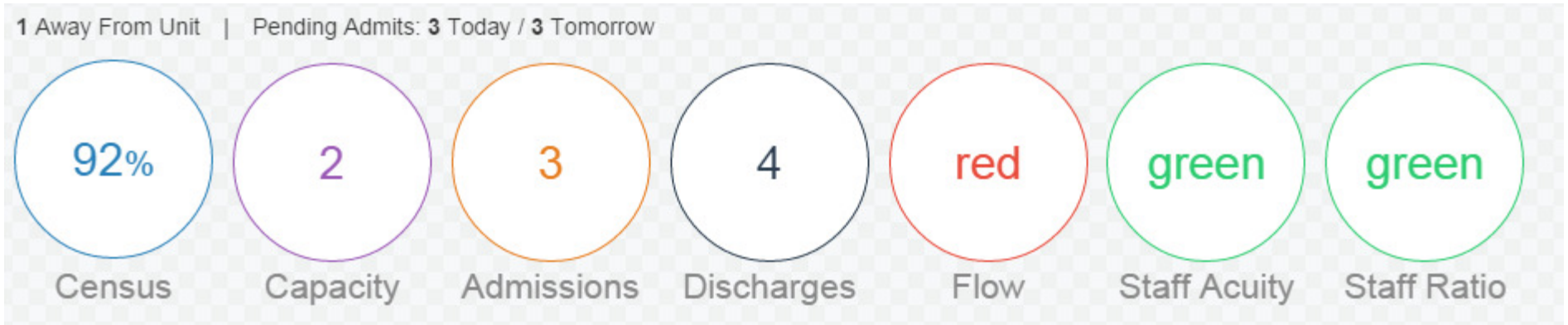
**A676N4**  
MRN: 99949922  
Baratheon, Zelda

Prevention Standards   
Reminder

**1** SA | **0** S | **0** XP | **0** F | bmk

Team: Yellow Team  
**Fusce**Curabitur vitae odio sollicitudin, tincidunt nun...  
📌 Watcher

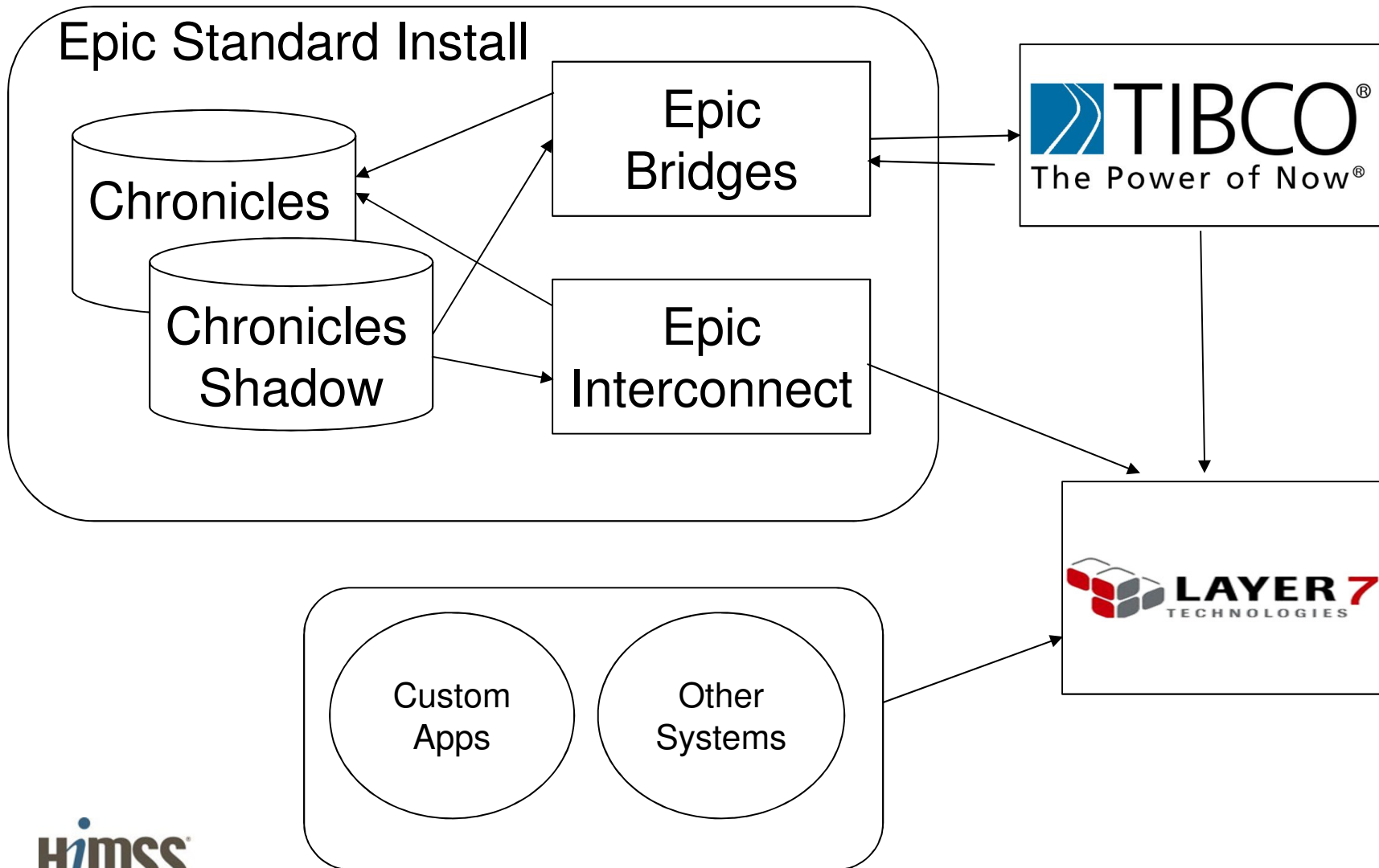
# Unit Level Health



- Capacity percentage
- Available bed capacity
- Pending Admissions for Today/Tomorrow
- Patients away from unit
- Patients Predicted for Discharge
- State of Flow for day based on Staffing
- Staffing acuity
- Staffing ratio



# IT Infrastructure



# Building the Advantage

Scaled, platform based event processing

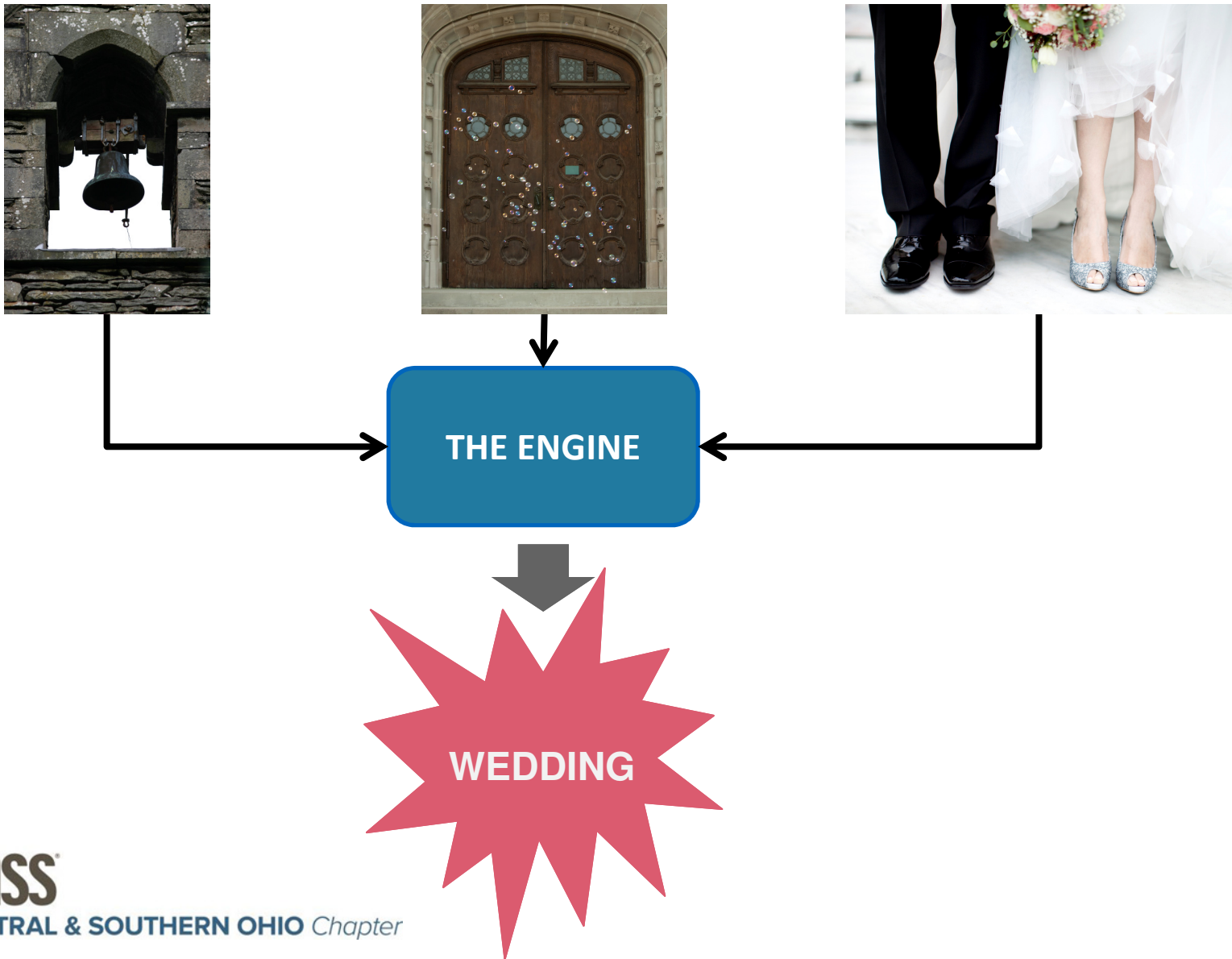


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# Why Platform Based?

- Ability to abstract and centralize the business logic layer
- Ability to analyze and correlate multiple streams of information
- Ability to integrate with the enterprise service bus
- Ability to integrate with existing web services and algorithms
- Ability to experiment with flows and business logic in parallel
- Ability to scale capacity across server resources

# Real-Time Correlation

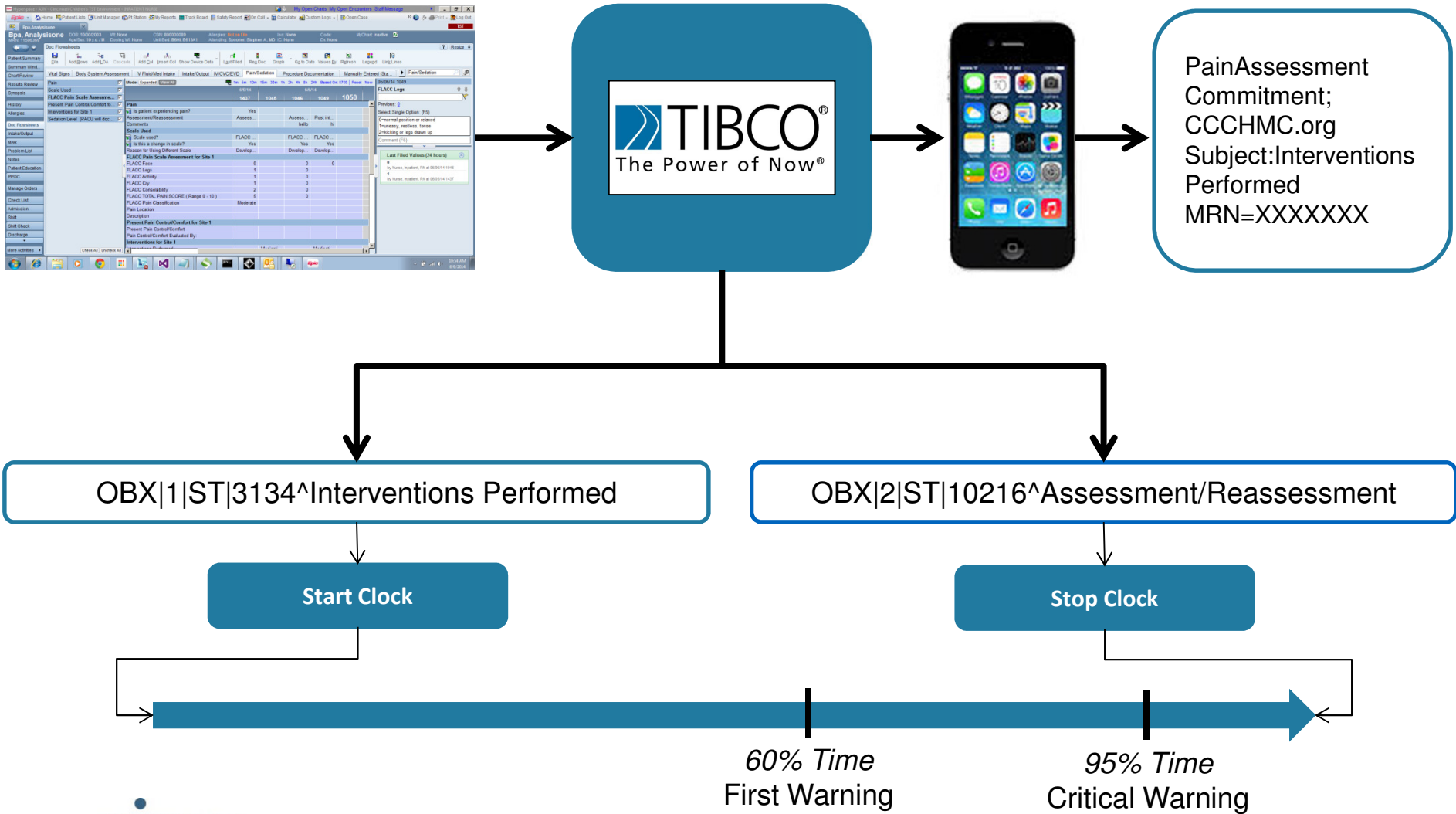


## Initial Use Case – Pain Assessments

- Pain is closely monitored and is assessed along with patient vitals
- If an assessment leads to a medication intervention then pain should be reassessed within a policy defined amount of time.
- Compliance metric is tracked for Magnet and Joint Commission evaluations

**Can we use real-time events to drive compliance to 100%?**

# How it works



# User Centric Concept

Keeping your care commitments can be a daunting task!! Multiple patients, work processes, and new initiatives can make it difficult to keep track of your documentation and assessment deadlines. Unfortunately, if you miss something you usually find out too late to make the desired impact for the patient.

Introducing **Commitment Keepers** from Cincinnati Children's Information Services!

**Commitment Keepers** provides timely reminders on key safety assessments and documentation allowing you to keep your care commitments to your patients. Reminders can be sent directly to GARDIANS or to your Voalte phone. Better yet, **Commitment Keepers** always reflects the latest thinking in quality improvement and patient safety keeping you up-to-date on the latest hospital-wide initiatives.

**Commitment Keepers** is yet another innovative solution brought to you by Cincinnati Children's Information Services Department. We have years of experience integrating patient systems and successfully transmitting patient data to increase the quality and speed of patient care.

**Commitment Keepers** helping you keep your care commitments!



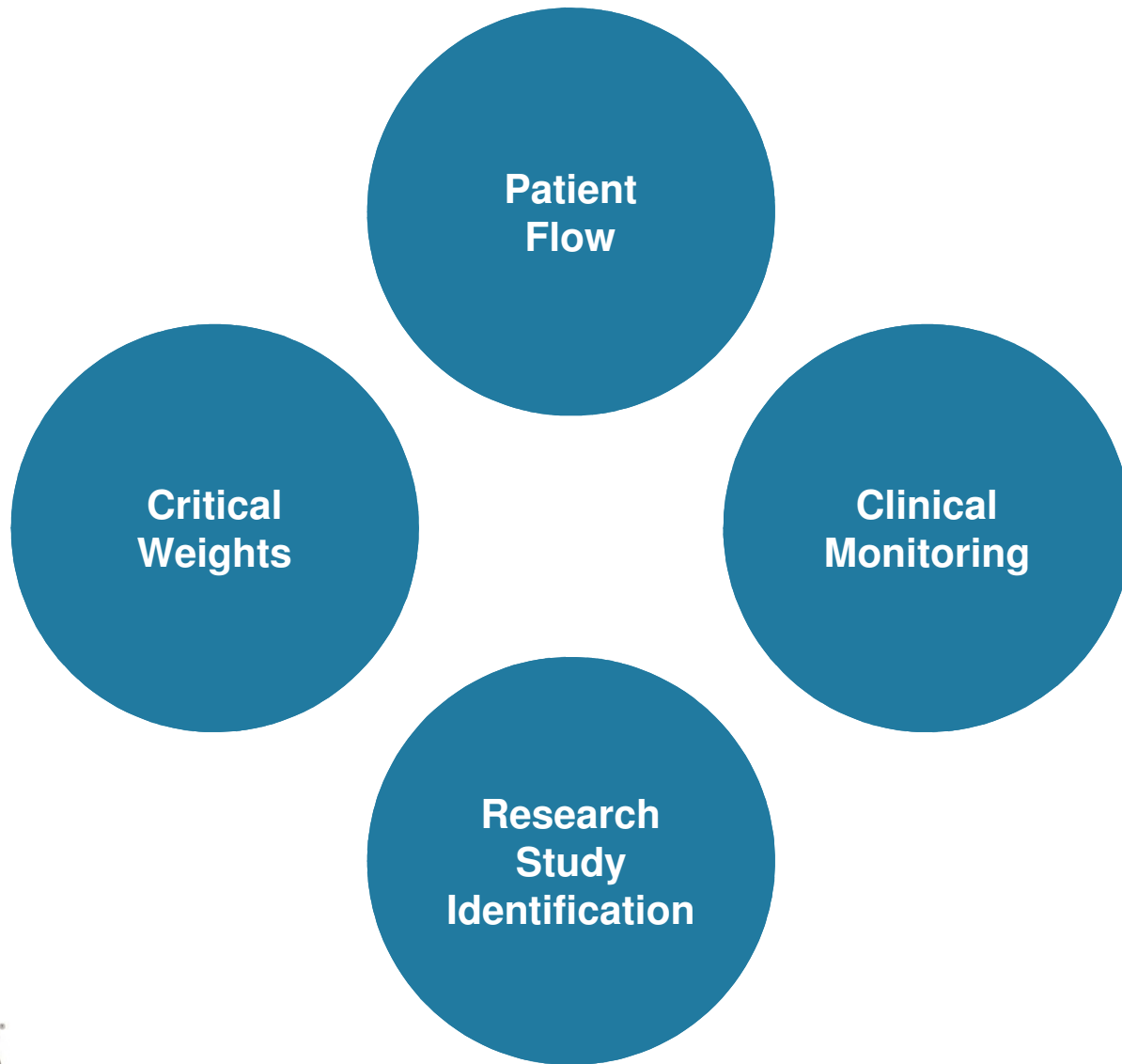
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# Learnings to Date

- Too many ideas, focus on 1 or 2 quick wins
- Go for a use case that is already being measured
- Depending on the use case a “data scientist” could be useful
- Need to fully understand the workflow
- Beware of the possible negative perception of “tracking”
- Notification is important, but do not let it derail the project



# Future Use Cases



# Best Practices and Future Trends

Lon McMillan, Chief Healthcare Strategist  
TIBCO Software Inc



# Best Practices

- Integrate everything
- Think differently about processes
- Change the context
- What's disruptive or transformative in healthcare may be commonplace in other industries



# Future Trends

- Convergence and collaboration between payers and providers
- Checklists – The “routinization of healthcare”
- Looking out of the windshield instead of in the rear-view mirror
  - Big Data → Fast Data
  - Evidence-based decision-making → Real-time decision-making
  - Sentinel events, bio-surveillance, and real-time epidemiology
- Internet of Things (IoT)
  - Virtual visits requiring integration of videoconferencing, remote vitals, and other health data
  - Patient and asset tracking, sensors, smart healthcare facilities
- Social media, advertising, and gamification in healthcare
  - Healthcare as a social network
  - Wellness or location incentives
  - Context specific (time, location, personal) ads
- Personalized healthcare through applied genomics



# Acknowledgments

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Anthony Coleman

## Epic Clindoc

Sandy Sharfe

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**Stuart L. Goldstein**, MD, Director, Center for Acute Care Nephrology

## Platform & Client Engagement

Mike Lough  
Kent Murrell  
John Reder  
John Schraer  
Nicole Slonaker  
Chris Wills

## Architects

Joe Mirus  
Frank Menke



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