Our Sepsis Journey: Evaluation of Implementation of Artificial Intelligence in the Emergency Department

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Disclosures

- *Adventist Health has a minority financial interest in Mednition*

Who we are

Adventist Health is a faith-based, $4.8 billion nonprofit integrated health system that is leading a 21st-century well-being movement. Together, we are transforming the healthcare experience with an innovative yet timeless whole-person focus on physical, mental, spiritual and social well-being.

Adventist Health serves more than 80 communities on the West Coast and Hawaii through 23 hospitals, 400+ clinics, home care agencies, hospice agencies and joint venture retirement centers in both rural and urban communities. We also serve people and communities around the world through Blue Zones, a pioneer in improving the health of entire cities and communities through a systemic and environmental approach to well-being.

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Care Redesign – Sepsis Care Bundle

- National sepsis admission rate is approximately 6% of total admissions[3]
- Nationally Sepsis mortality is among the highest, 16.6 to 30 percent[10]
- Early recognition and intervention equals better outcomes[4]
- Delay in diagnosis occurs in 30% of patients[6]

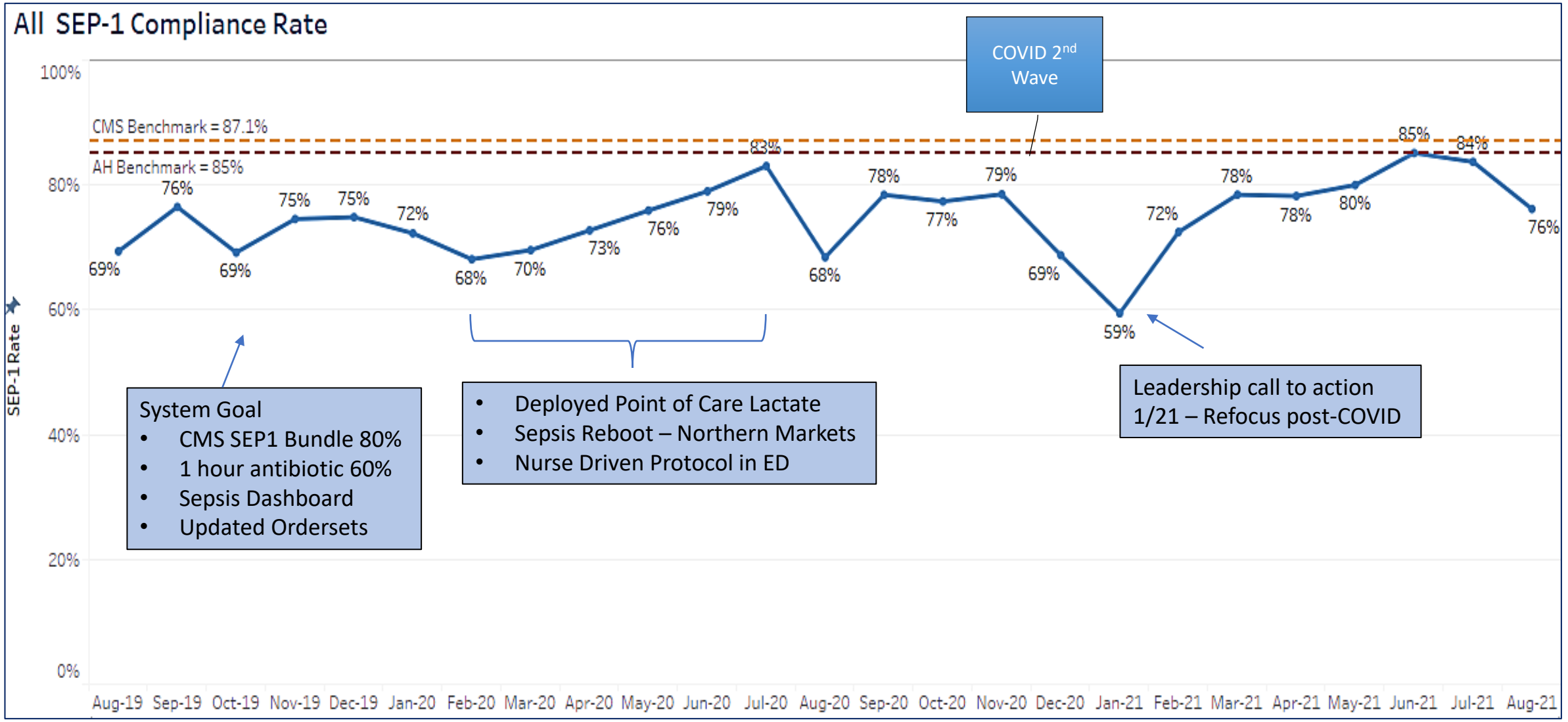
82 %

82 Percent of Sepsis Patients Present to the Emergency Department at Adventist Health

10%

Sepsis Diagnosis makes up 10% of all admitted patients at Adventist Health

Adventist Health System SEP-1 Bundle Compliance



Timeframe: August 2019 to August 2021
Source: CMS abstracted cases

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Care Redesign – System Sepsis Bundle

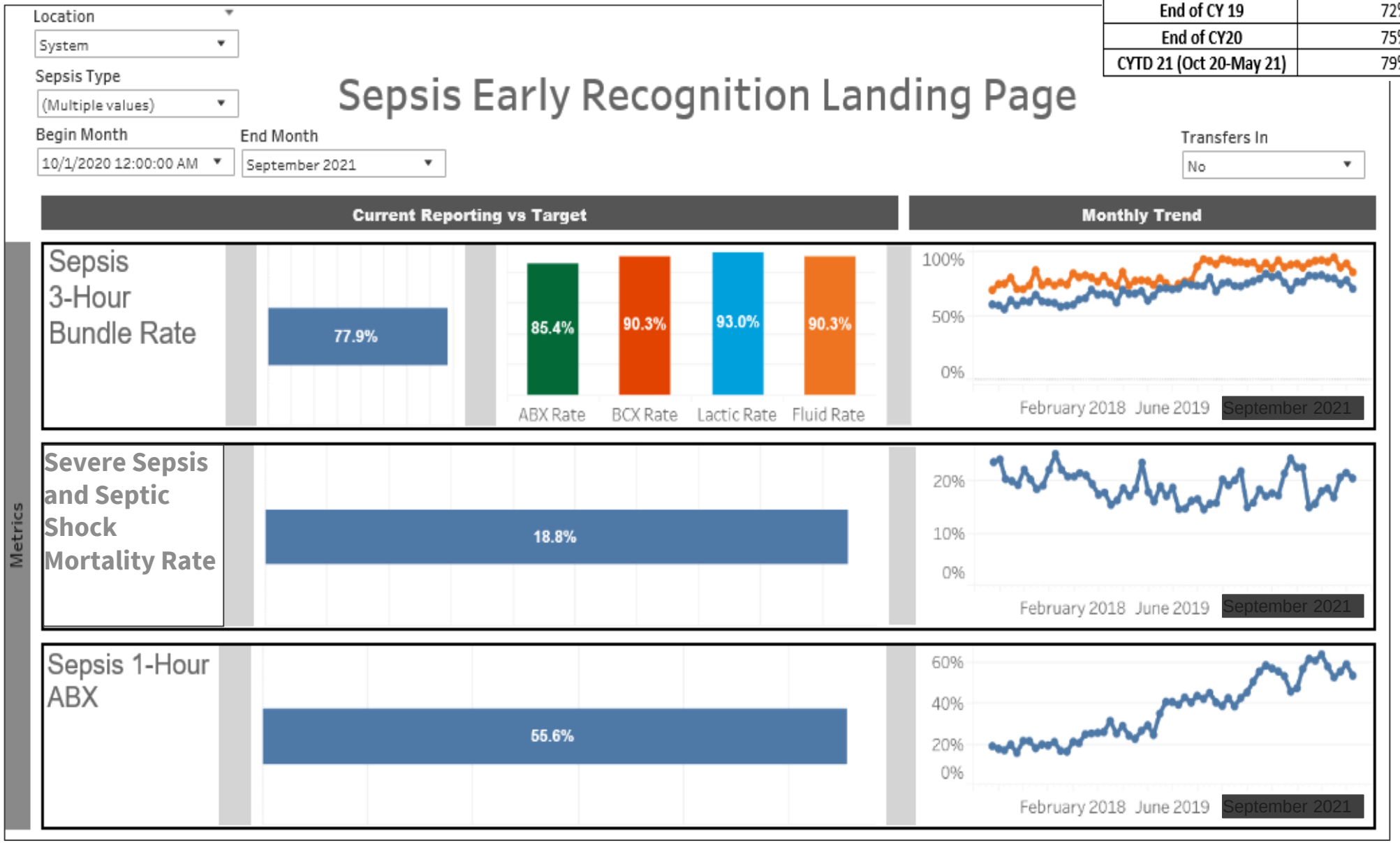
- Sepsis Dashboard – Real-time feedback - 2019
- Standardized - Sepsis orderset that aligns with Centers for Medicare and Medicaid (CMS) SEP-1 Bundle treatment requirements - 2019
- Developed - Lactate order rules with smart logic that aligns with the CMS Sepsis Bundle - 2020
- Optimized - EHR sepsis alerts to align with CMS SEP-1 requirements - 2021
- Added – Began testing KATE Sepsis Artificial Intelligence at large hospital (September 2021)

Systemwide Goal – 2019

- 80% CMS SEP-1 Bundle Compliance
- 60% of patients to receive an antibiotic in 1 hour for severe sepsis and septic shock

• Initial Success

System Goals	Sepsis Bundle Compliance	Abx within 1 HR
End of CY 18	63%	N/A
End of CY 19	72%	32.3%
End of CY20	75%	44.4%
CYTD 21 (Oct 20-May 21)	79%	55.7%



Introduction to KATE

by Mednition

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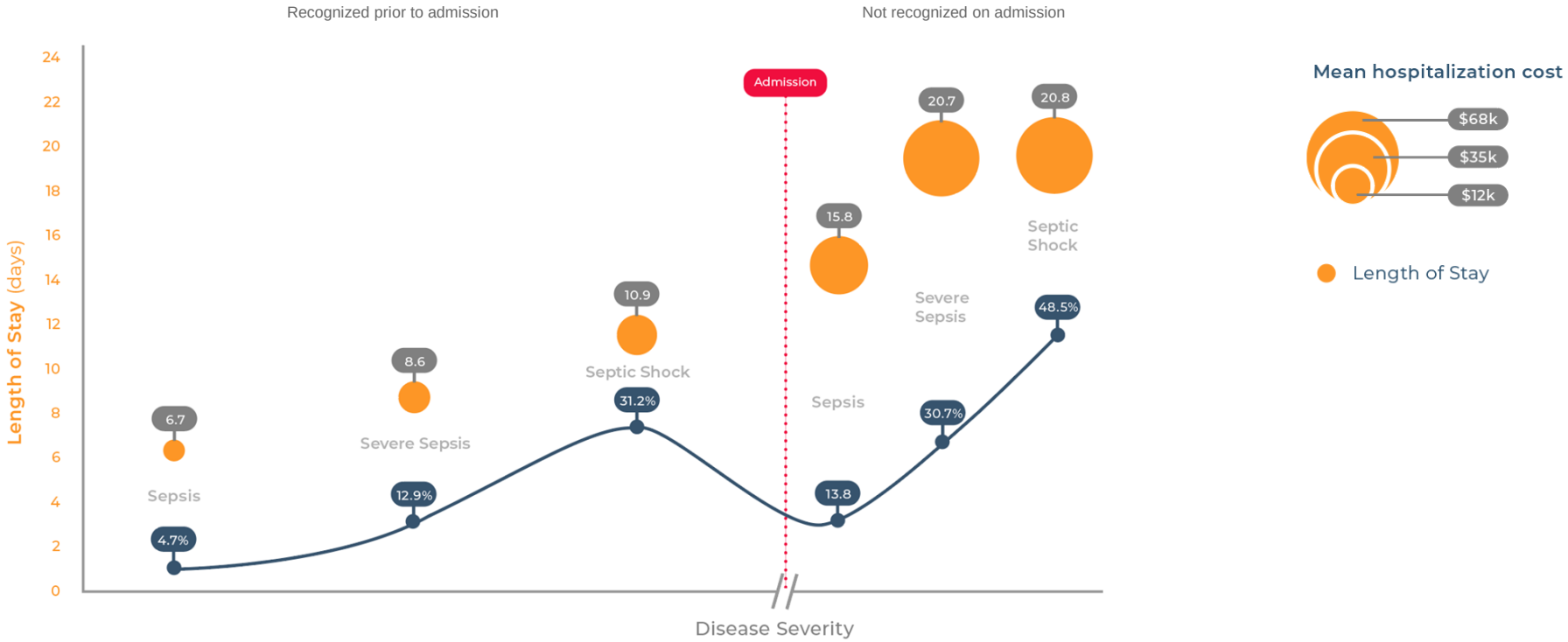
Delayed Sepsis Recognition costs lives

#1 Cause of Hospital Deaths (35%)

#1 Cause of Hospital Readmissions (20%)

#1 Inpatient Cost ($27 Billion / Year)

Sepsis Severity: LOS, Mortality, and Mean Hospitalization Costs



Source:Sepsis Alliance, Solving Sepsis, DRIVe-BARDA

Paoli, Carly J. PharmD, MPH; Reynolds, Mark A. PhD; Sinha, Meenal MBA; Citlin, Matthew PharmD; Crouser, Elliott MD Epidemiology and Costs of Sepsis in the United States. An Analysis Based on Timing of Diagnosis and Severity Level. Critical Care Medicine: December 2018 - Volume 46 - Issue 12 - D 1889-1897 doi: 10.1097/CCM.0000000000003342

Sepsis cases Recognized (present) on Admission (n=2.4M) and Not Recognized (present) at Admission (n=0.3M) for patients with sepsis without organ dysfunction, severe sepsis, and septic shock respectively.

KATE Sepsis Recognition at Triage

Metric	2 SIRS + Source	KATE	Difference
Sensitivity	42.4%	**79.9%**	**+ 37.5%**
Specificity	96.2%	**92.3%**	**- 3.9%**
AUC	0.69	**0.94**	**+ 0.25**

n=520,023 ED visits, 9,624 with Sepsis Diagnosis, 8 hospital sites

Link to Sepsis Alliance 2021 Presentation

Link to preprint Sepsis Research Study

"KATE is catching patients with sepsis at the door that would have been otherwise missed."

Dr. Stephen Liu, ED Medical Director
Adventist Health White Memorial

KATE: Substantial Improvement of Sepsis Detection at Triage *(prior to labs)*

Current State: 2 SIRS + Source of Infection

	Predicted no sepsis	Predicted sepsis
Pt does not have sepsis	95.76% 49,998	4.24% 2,215
Sepsis diagnosed	60.84% 477	**39.16%** 307

KATE Sepsis Screening Tool

	Predicted no sepsis	Predicted sepsis
Pt does not have sepsis	93.06% 48,591	6.94% 3,622
Sepsis diagnosed	29.08% 228	**70.92%** 556

Typical Single Site Historical data analysis pre-KATE installation;
52,997 patients 2020-2021

Early sepsis intervention starts at the front door

Real patient scenario

24/7 Clinical Risk Monitoring

KATE
by Mednition

Nurse:
Not High Risk
(ESI 4)

19 year old female. “pt complains of throat pain and swelling for last 2 days and has had increased mucus production.she took tylenol at noon.

HR: 136 RR: 28 BP: 153/94 T: 39.4 SpO2:98%

Nurse Reassess:
High Risk
(ESI 2)
& Initiate Sepsis Protocol

Entire Medical Record
(600+ features)

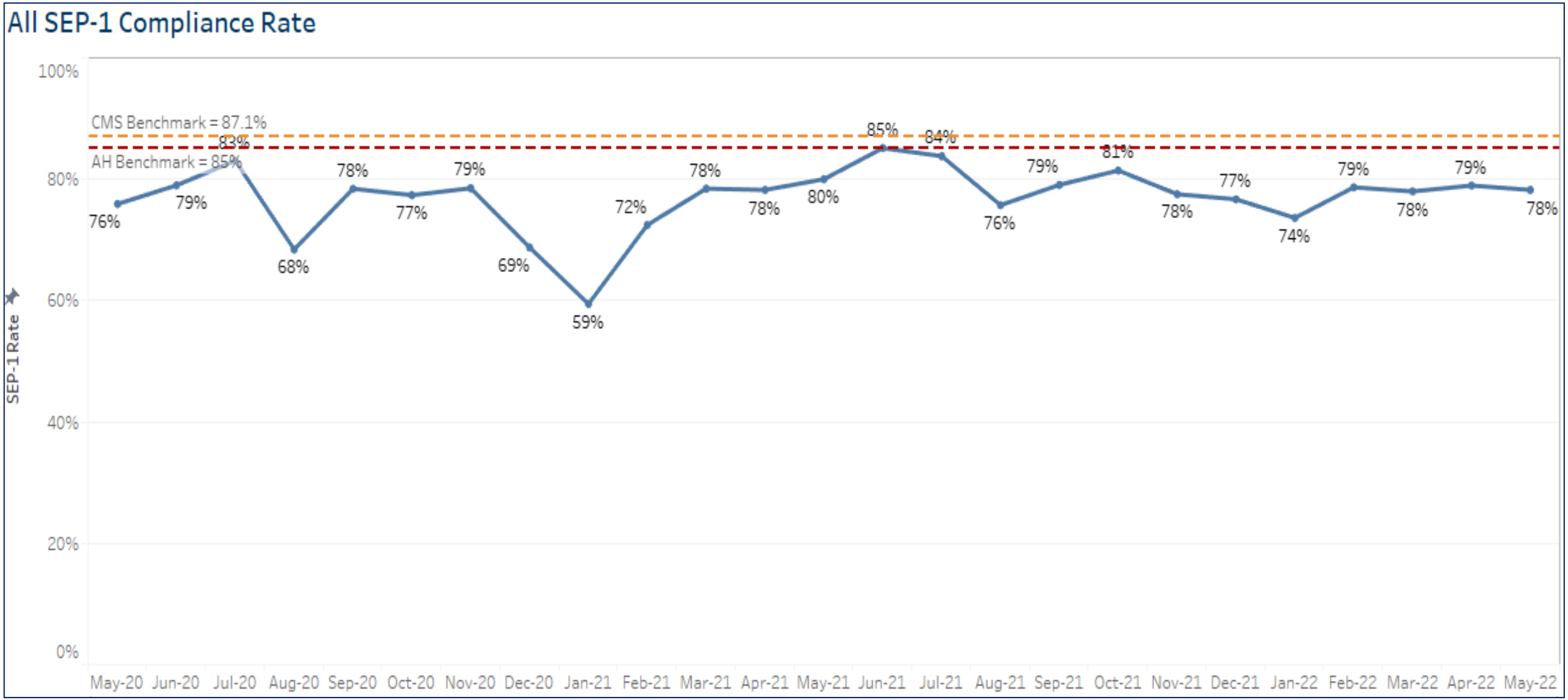
Next Steps on the Sepsis Journey

Why are some facilities more consistent than others?

What is the impact of limited staff, travelers, and less experienced staff?

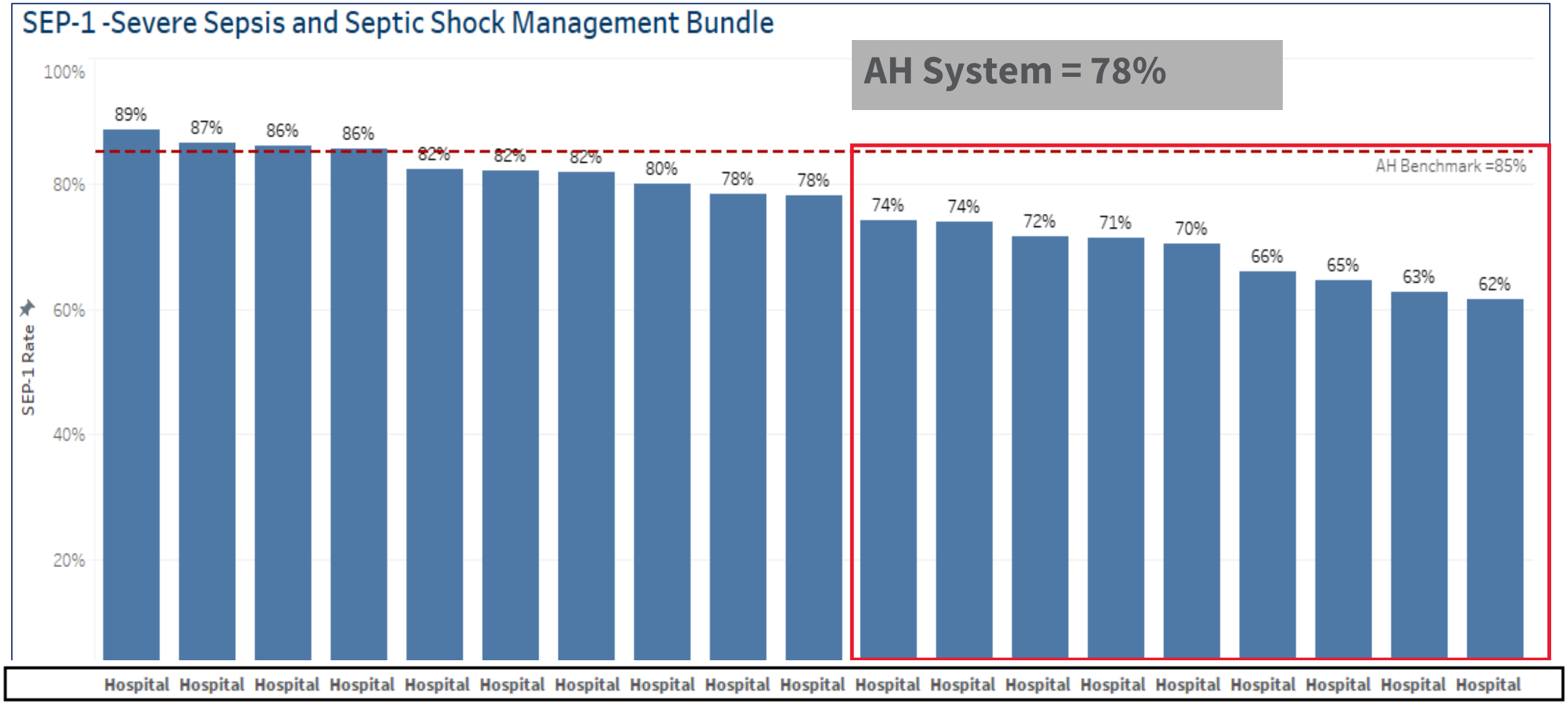
Can technology be leveraged to improve consistency?

AH System SEP-1 Bundle Compliance May 2020 to May 2022



Timeframe: May 2020 to May 2022
Source: CMS abstracted cases

SEP-1 Bundle Compliance Rate – October 2021 - May 2022



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Evaluation of Impact of Artificial Intelligence at Triage -Cohort

Pilot Hospital

>48,000 ED Encounters in 2021

Admission Rate 30%

Hospital A:

>52,000 ED Encounters in 2021

Admission Rate 20%

Hospital B:

>36,000 ED Encounters in 2021

Admission Rate 20%

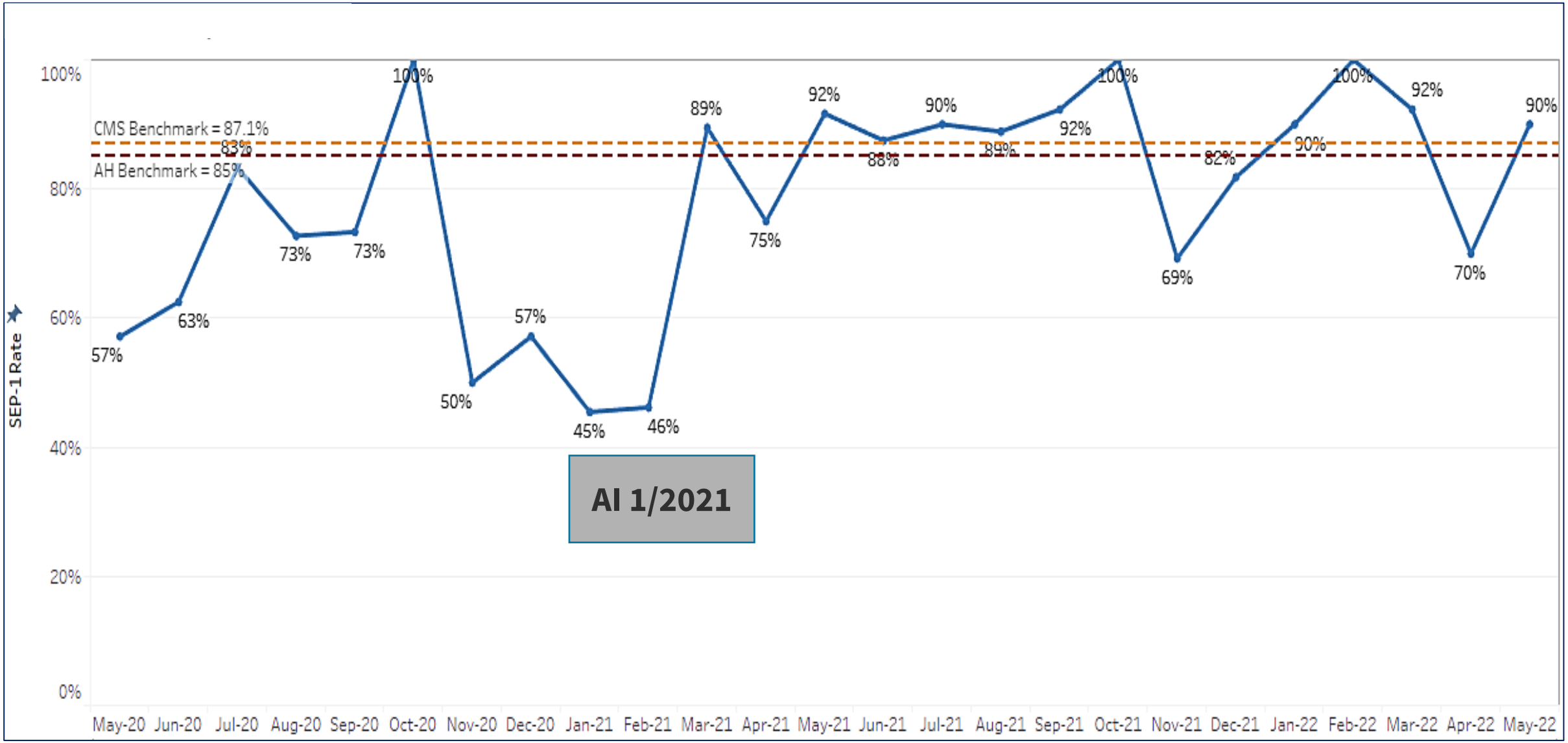
Goal- Assess Impact of AI technology on:

1. SEP-1 Bundle compliance
2. Time to first intervention

Evaluation Timeframe:
June 2020 to Nov 2020
June 2021 to Nov 2021

Definition:
CMS Sepsis SEP-1

Hospital A



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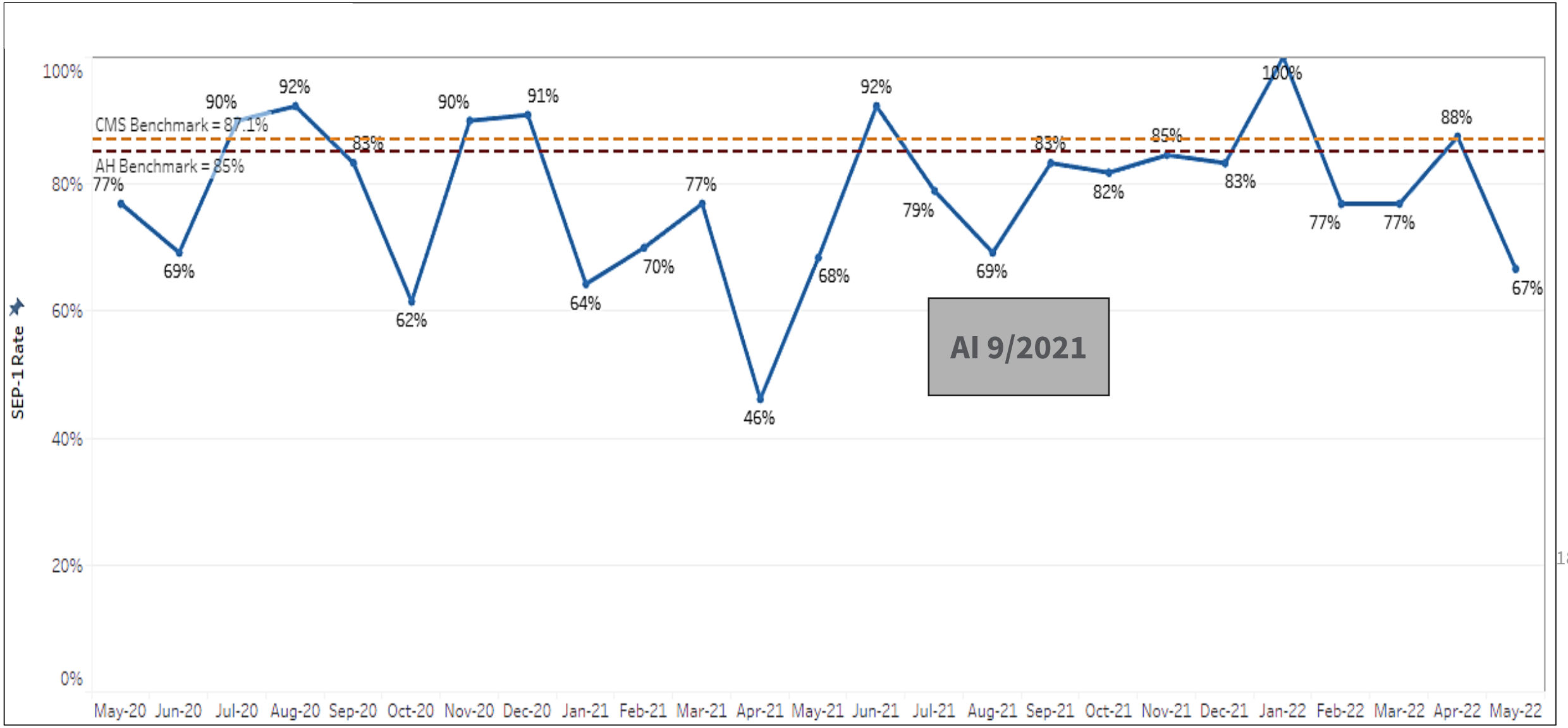
Hospital B



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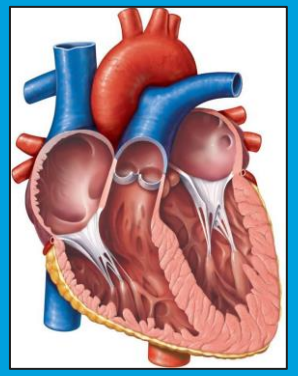
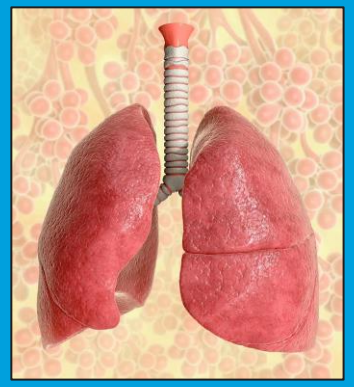
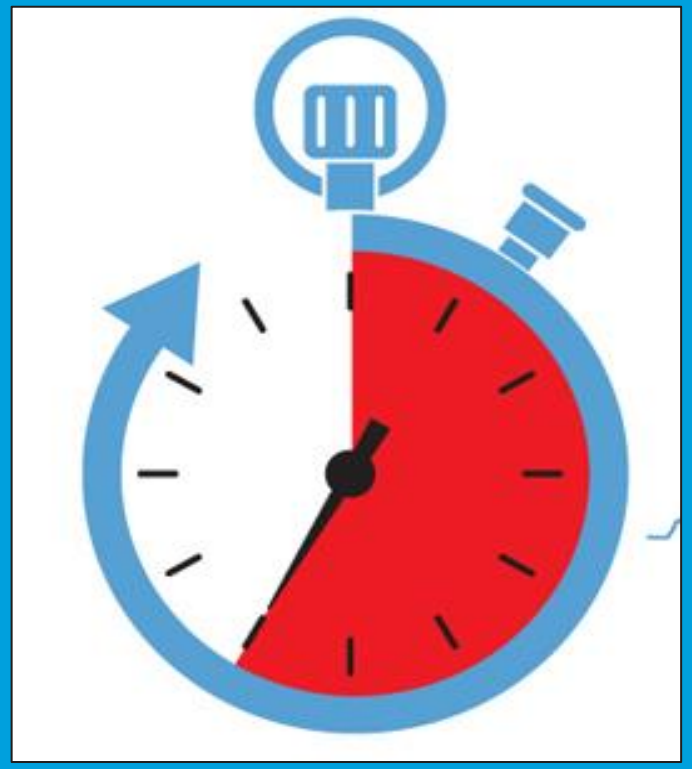
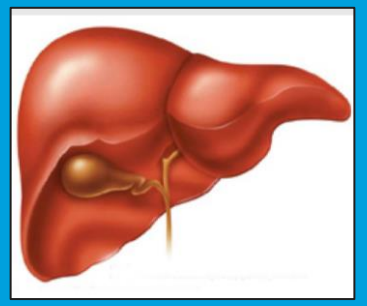
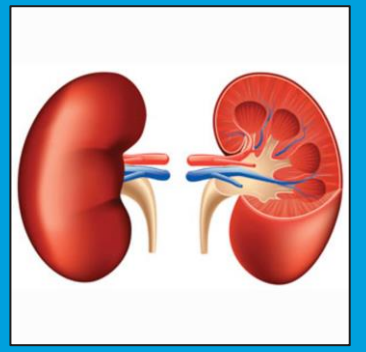
Every Minute Counts!

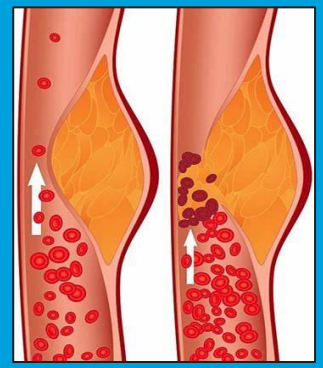












Promising Outcomes

Sepsis Alert Analysis

1. Native Alert Fired in 89% of POA Severe Sepsis and Septic Shock
2. KATE Sepsis Alert Fired in 73% of Cases
3. Why KATE?

Native alert – Delayed Notification

- Median time to fire 120 minutes
- 94% of Native alerts fire after clinical intervention

KATE fires at the time of Triage

- Time to first intervention improved by 27.7% both sites *(p < .001)*

CMS SEP-1 Bundle Compliance Improvement

- Hospital A = 13%*
- Hospital B = 2.3%

*Statistically significant at the 90% confidence interval p = .0996; N = 67/73

Adventist Health Case Study: Augment Clinical Teams

+62%

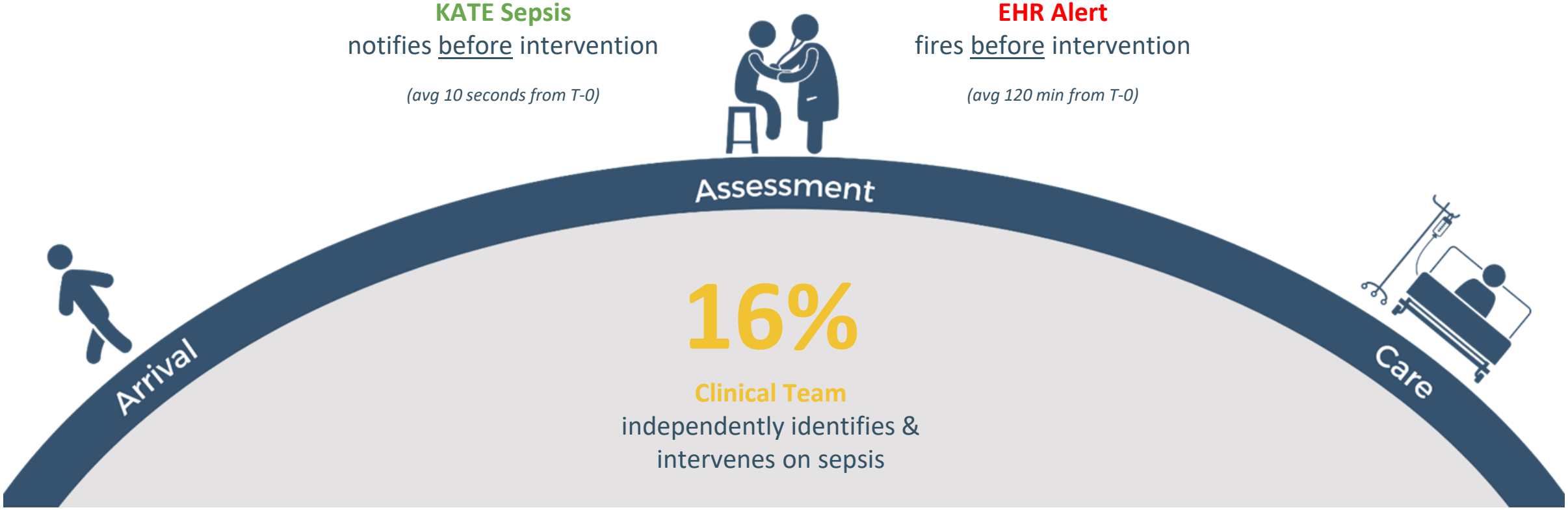
KATE Sepsis
notifies before intervention

(avg 10 seconds from T-0)

+6%

EHR Alert
fires before intervention

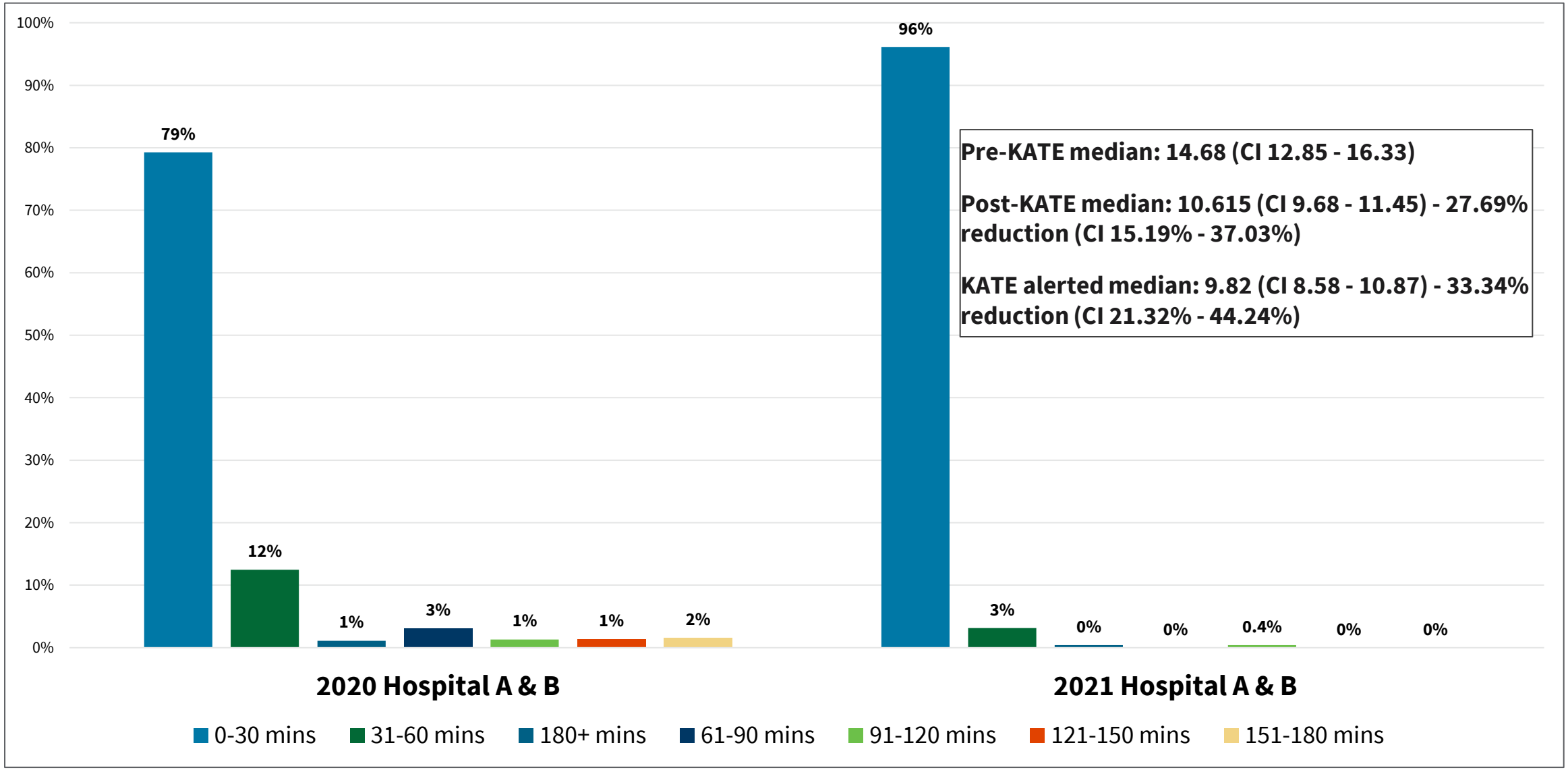
(avg 120 min from T-0)



16%

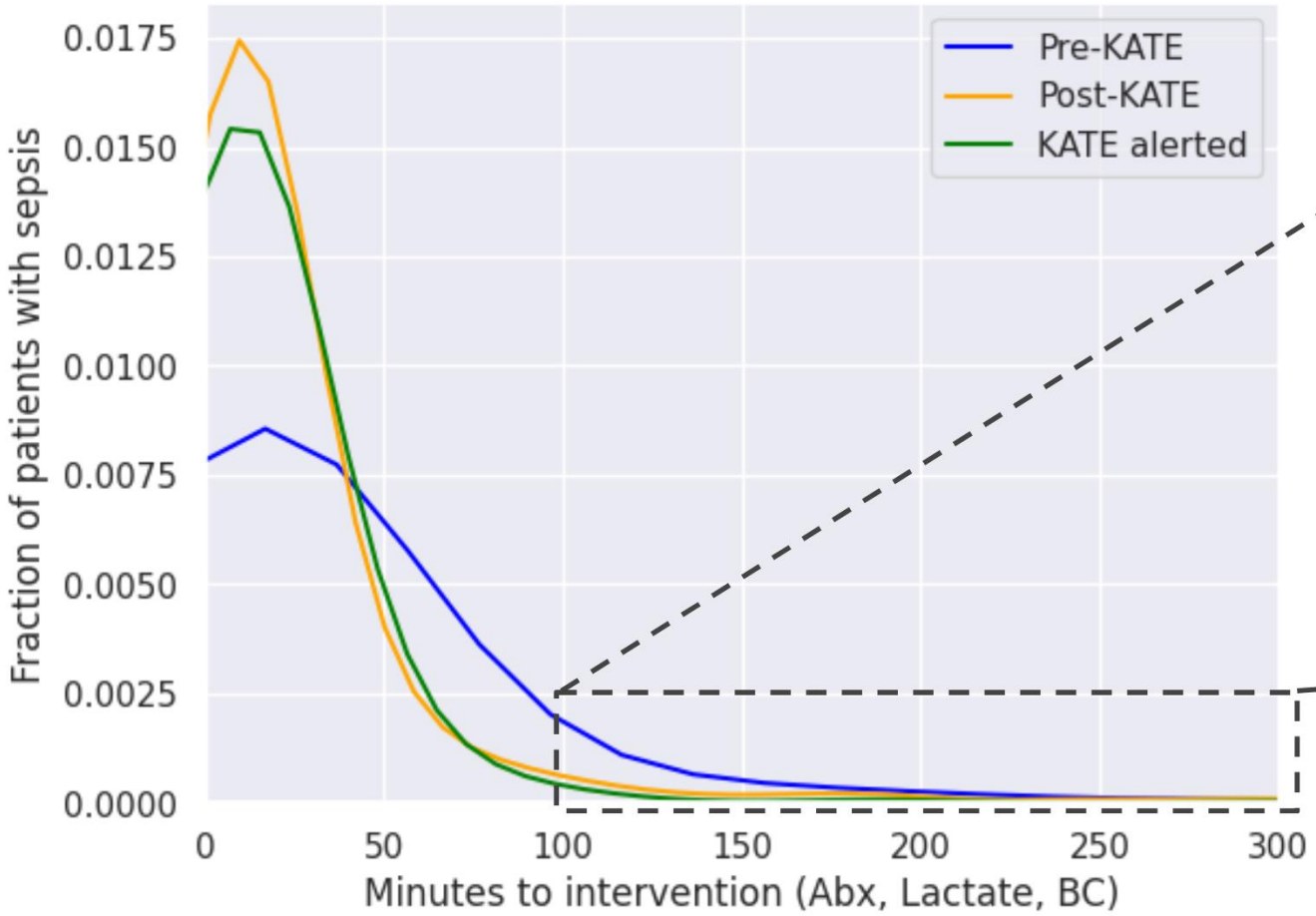
Clinical Team
independently identifies &
intervenes on sepsis

Statistically Significant Changes in Time to First Intervention in Early Adopter Hospitals

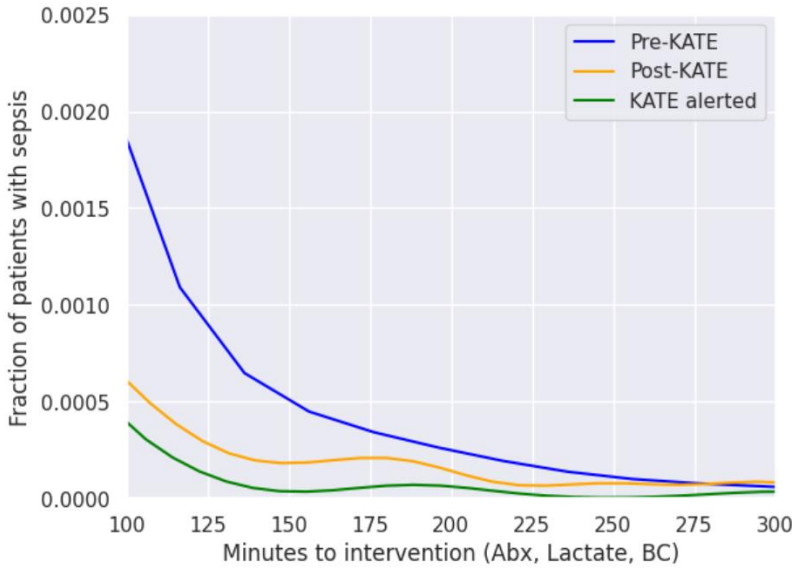


Pre and Post KATE Time to Intervention

Post-KATE increased rapid intervention <50 min



Post-KATE reduced long time to intervention outliers



Hospitals A & B, 5/2020-5/2022 n=1,626 patients with Sepsis Dx POA

Best Practice and Collaboration with Technology

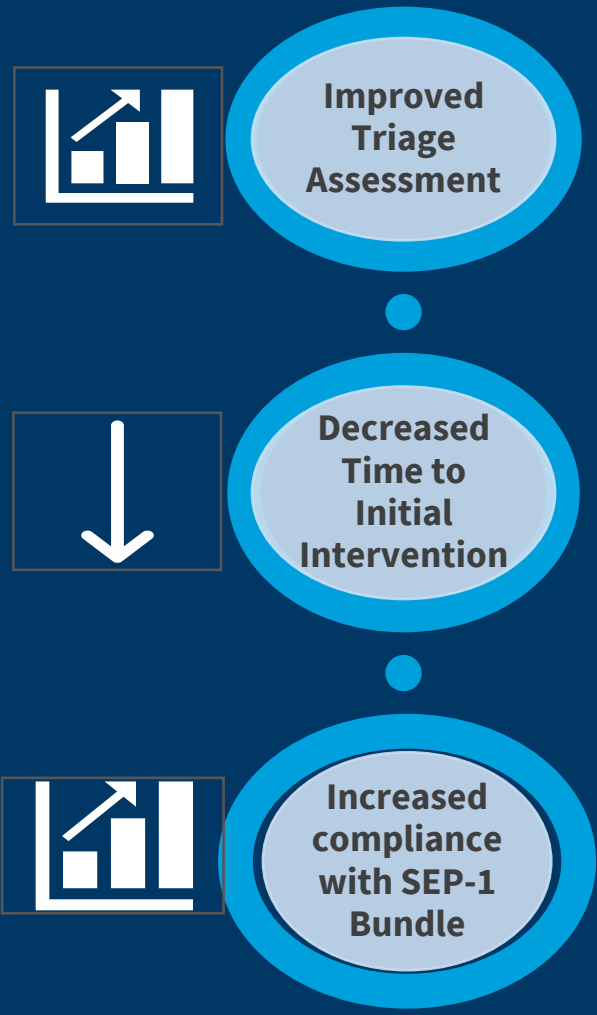
Adventist Health Sepsis Care Redesign Bundle

- Executive Leadership Support
- Standard Ordersets
- Real-Time Data
- Leverage Electronic Record – Rules and Alerts
- Point of Care Lactate
- System Subject Matter Expert

KATE by Mednition

Artificial Intelligence

In two early adopter Hospitals



Next Steps

Complete system-wide evaluation of best practice compliance

Update standard sepsis best practice tools based on learnings from the Evaluation

Define standard use of KATE

Questions

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Appendix

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