The Application of Telemedicine (tele-ICU) to ED, Stepdown, RRT, and Progressive Care Units – Clinical and Financial Benefits

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No conflicts of interest

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Objectives

- Understand that telemedicine can achieve clinical and financial benefits for acute care across a large healthcare system utilizing implementation science
- Recognize that the success of telehealth is determined less by what technologies you have and more by how you use them
- Realize that the tele-ICU is a facilitator of change management as much as an “intervention”

Value is created not by what technology you have but how you use the technology that you have

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Advocate Critical Care

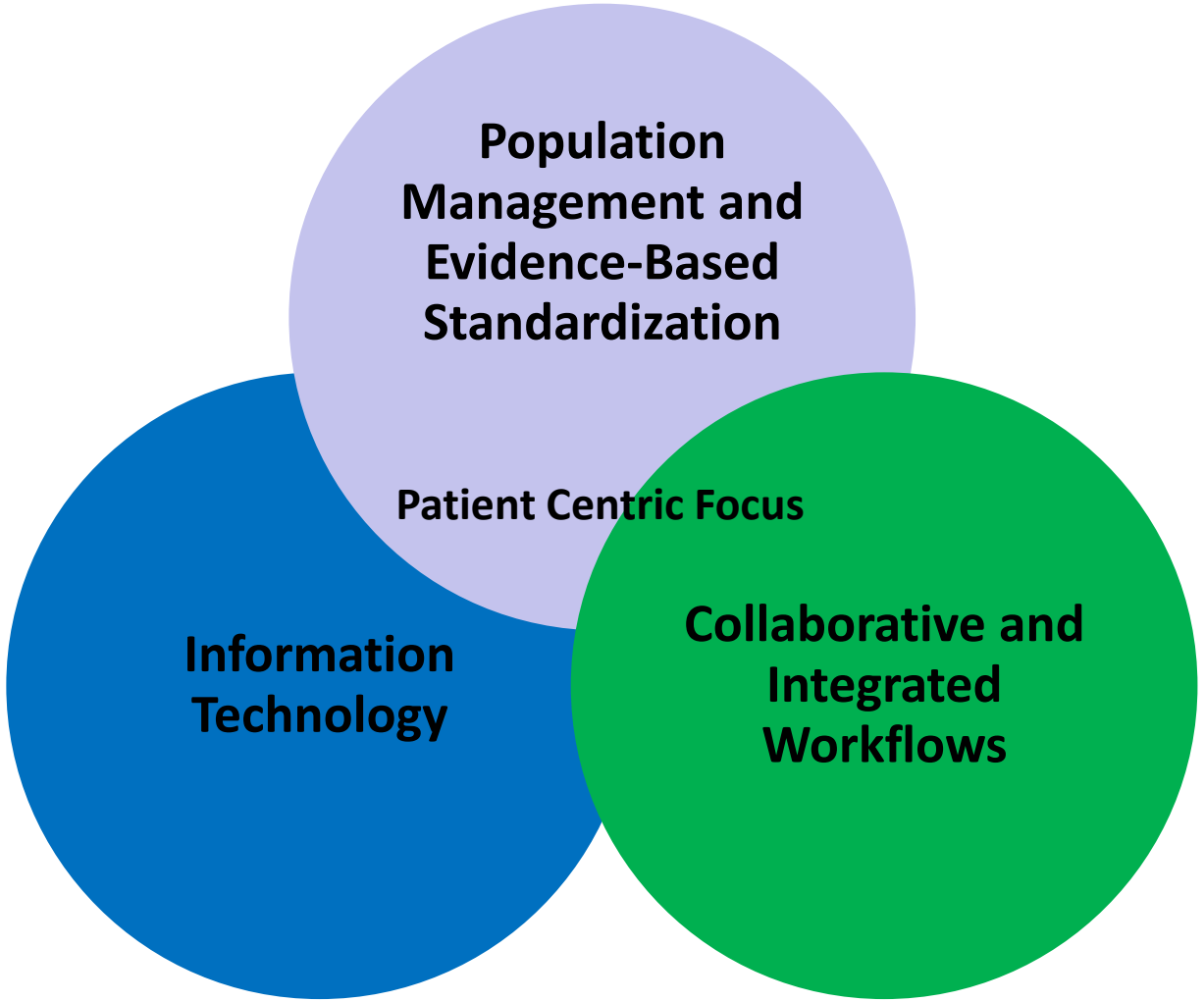
- 10 hospitals / Five Level One Trauma Centers
- 16 ICUs
- AdvocateAurora eICU = 764 beds
- Advocate legacy = 424 beds
  - 312 Critical Care beds (plus three Outreach programs = 104 additional beds)
  - eMobile carts in the ED (N = 7)
  - Critical Access Hospital with eMobile cart
- > 6000 physicians / > 100 Intensivists
- 24,140 ICU Admissions with APACHE Predictions in 2017
  - Ventilator days: 25,986 on 8,199 cases
  - Total direct costs for days while the patients were treated in the ICU (excluding ED and OR costs) were approximately $200M or 17% of direct costs for inpatients
- eIntensivist and eRN coverage 24/7/365 with board certified critical care physicians

Aurora Critical Care

- 15 Hospitals
- 18 ICUs
- 2 Outreach customers = 35
- Aurora legacy eICU = 320 beds
- eIntensivist and eRN coverage 24/7/365 with board certified care physicians
- ED Triage program separate from eICU
- Telestroke program at single hospital

eIntensivist Workstation

Transformation to Integrated Care



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Variance in Practice of Tele-ICU

- Technology
- Types of ICUs
- Bedside intensivist staff model
- Bedside documentation/CPOE availability
- Remote center staffing patterns
- Qualifications of providers
- Hours of Operation
- Buy-in by bedside clinicians
- Adherence to best practices
- Use of quality and safety information
- Intensivist handover of their patients
- Community v. Tertiary Facility
- Teaching v. Non-teaching

What Does Tele-ICU do to Improve Quality?

- Disease Management
  - Acute interventions
  - Patient surveillance for proactive intervention
- “Population Management” – Best Practices
- Support Individual Unit Special Needs – Process flow variability through “gap analysis”
- Education
  - Resident eRounds
  - Nurse Mentoring
- Leveraging the technology in other care settings

Opportunities that can leverage Telemedicine

- “AHA” moments
- Data demonstrating Opportunities for Improvement
- Serious Safety events
- Gap analysis
- Evidence–based practice
- Individual ICU requests leading to successes that can be disseminated
- Lessons learned from other population management successes

Factors that reduce variation in care

- Surveillance
- Every Patient, Every Day
- Consistent Evidence-Based Practice
- Timely Interventions
- Risk Adjusted Data
- Horizontal Integration
- Vertical Integration

Data, data, data,….

- W. Edward Deming
  - “In God we trust; all others bring data.”
  - “Without data, you're just another person with an opinion.”
  - “If you can't describe what you are doing as a process, you don't know what you're doing.”

Year over Year Improvements

ICU Detailed Clinical Outcomes Summary

Advocate **APACHE IVa**

**Obtained from Quarterly Detailed Clinical Outcomes Reports*

Annual

System	2014Q4 - 2015Q3	2015Q4 - 2016Q3	2016Q4 - 2017Q3
P-A ICU Mortality (Lives Saved)	828	1203	1288
P-A ICU LOS (ICU Days Saved)	22792	29837	30250
P-A Vent Days (Fewer Vent Days)	5718	6793	7621

2017 Safety & Quality Accomplishments

Area of Focus	Initiative	Financial Impact
eICU®	Improvements in quality of patient care	68 ICU lives saved (mortality ratio went from 0.44 to 0.42). Increase of 413 ICU days, with an additional expenditure of $181K (ICU LOS ratio went from 0.62 to 0.63). Decrease of 259 ICU vent days, with a cost avoidance of $168K (vent ratio went from 0.78 to 0.77).

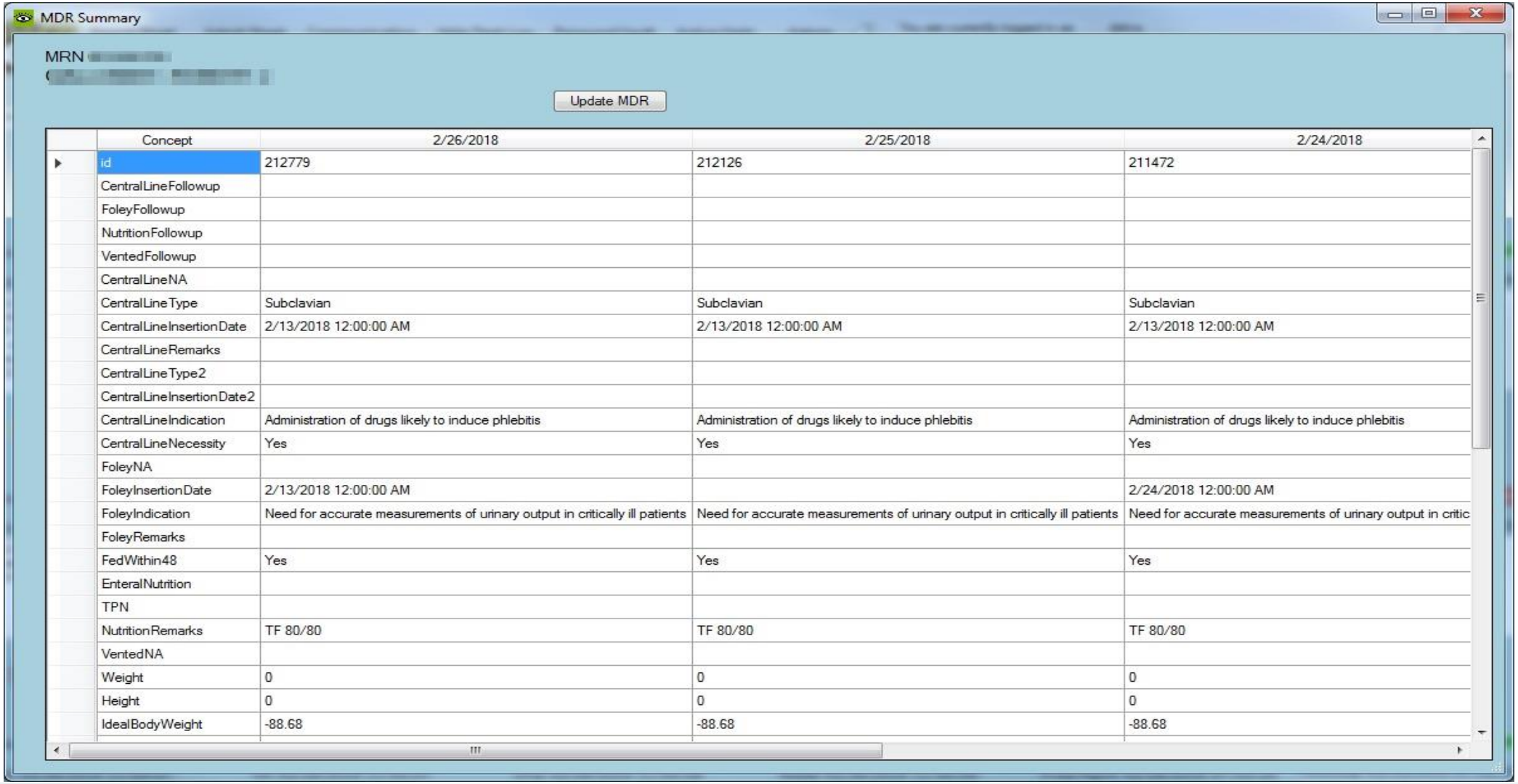
Who is your Customer: Define Your “Population”

- Patients
- Physicians
- RNs
- Regulatory Reporting Requirements
- Administration

Implementation Alternatives

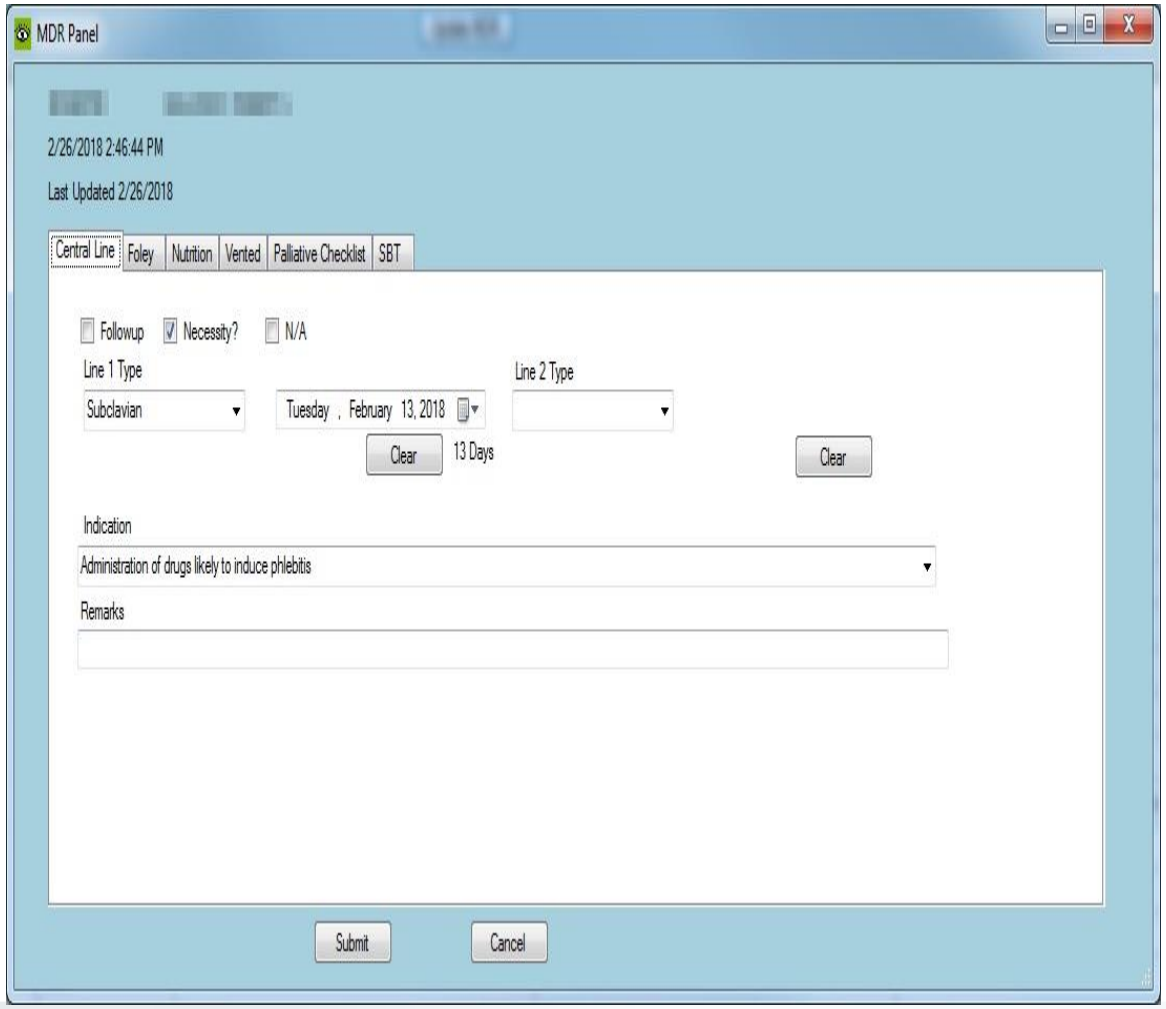
- **Pilot in one or two units**
  - Pros:
    - Allows testing and modification of the tool (PDSA)
    - Manageable for the eICU staff during learning curve
    - May recruit sites with high need for that particular initiative to volunteer for pilot
  - Cons:
    - Limited population
    - Still requires education and roll out to other sites if successful
    - Variances by type of ICU
    - Delays in achieving the benefits
- **Roll out across the entire system at once**
  - Pros:
    - Big Bang theory – everyone gets it on day one
    - Depending on initiative, may help prevent a safety event
  - Cons:
    - All sites may not perceive initiative as beneficial in the absence of data to demonstrate efficacy

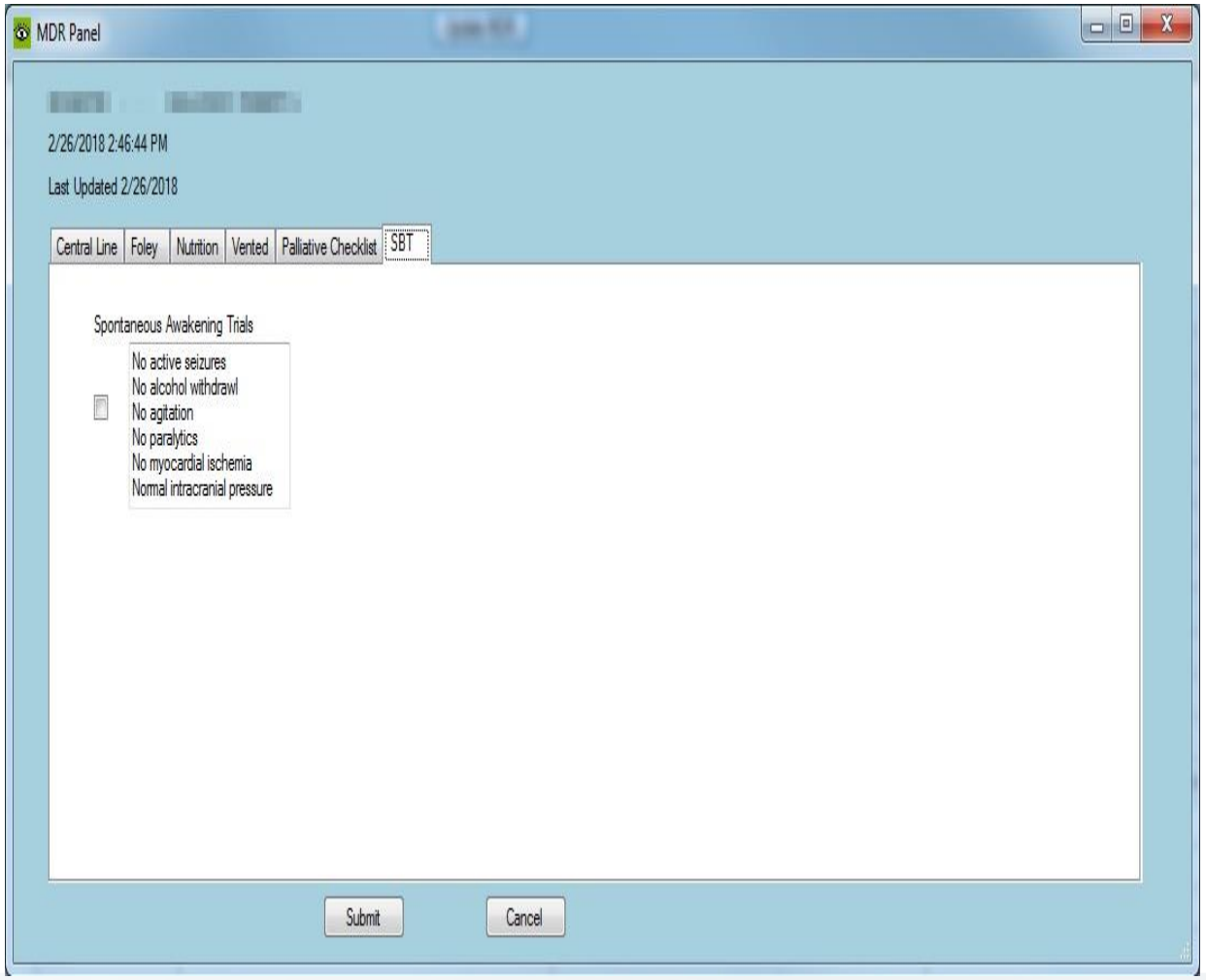
Multidisciplinary Round Checklist



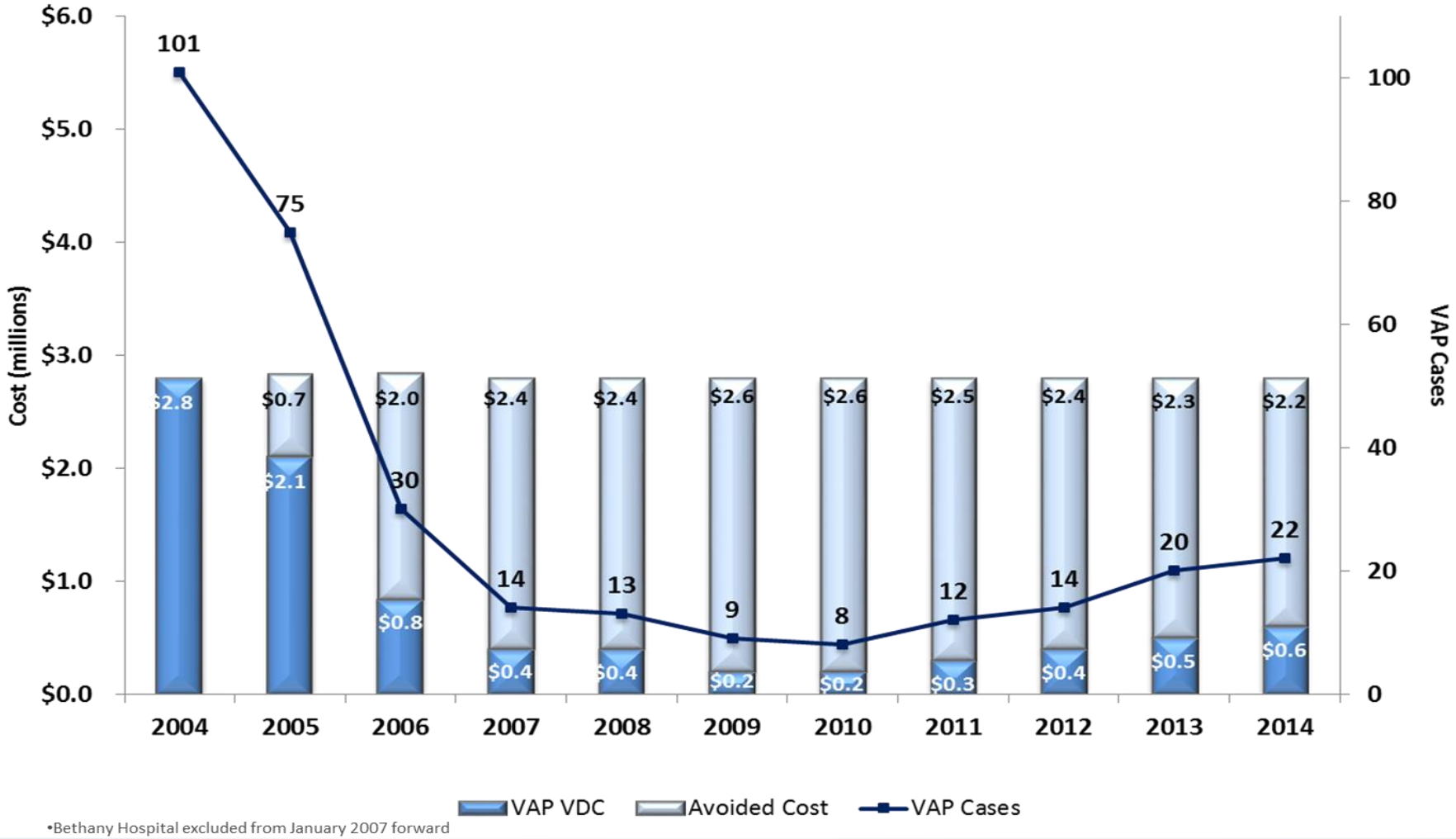
Concept	2/26/2018	2/25/2018	2/24/2018
id	212779	212126	211472
CentralLineFollowup			
FoleyFollowup			
NutritionFollowup			
VentedFollowup			
CentralLineNA			
CentralLineType	Subclavian	Subclavian	Subclavian
CentralLineInsertionDate	2/13/2018 12:00:00 AM	2/13/2018 12:00:00 AM	2/13/2018 12:00:00 AM
CentralLineRemarks			
CentralLineType2			
CentralLineInsertionDate2			
CentralLineIndication	Administration of drugs likely to induce phlebitis	Administration of drugs likely to induce phlebitis	Administration of drugs likely to induce phlebitis
CentralLineNecessity	Yes	Yes	Yes
FoleyNA			
FoleyInsertionDate	2/13/2018 12:00:00 AM		2/24/2018 12:00:00 AM
FoleyIndication	Need for accurate measurements of urinary output in critically ill patients	Need for accurate measurements of urinary output in critically ill patients	Need for accurate measurements of urinary output in critic
FoleyRemarks			
FedWithin48	Yes	Yes	Yes
EnteralNutrition			
TPN			
NutritionRemarks	TF 80/80	TF 80/80	TF 80/80
VentedNA			
Weight	0	0	0
Height	0	0	0
IdealBodyWeight	-88.68	-88.68	-88.68

Multidisciplinary Round Checklist Report



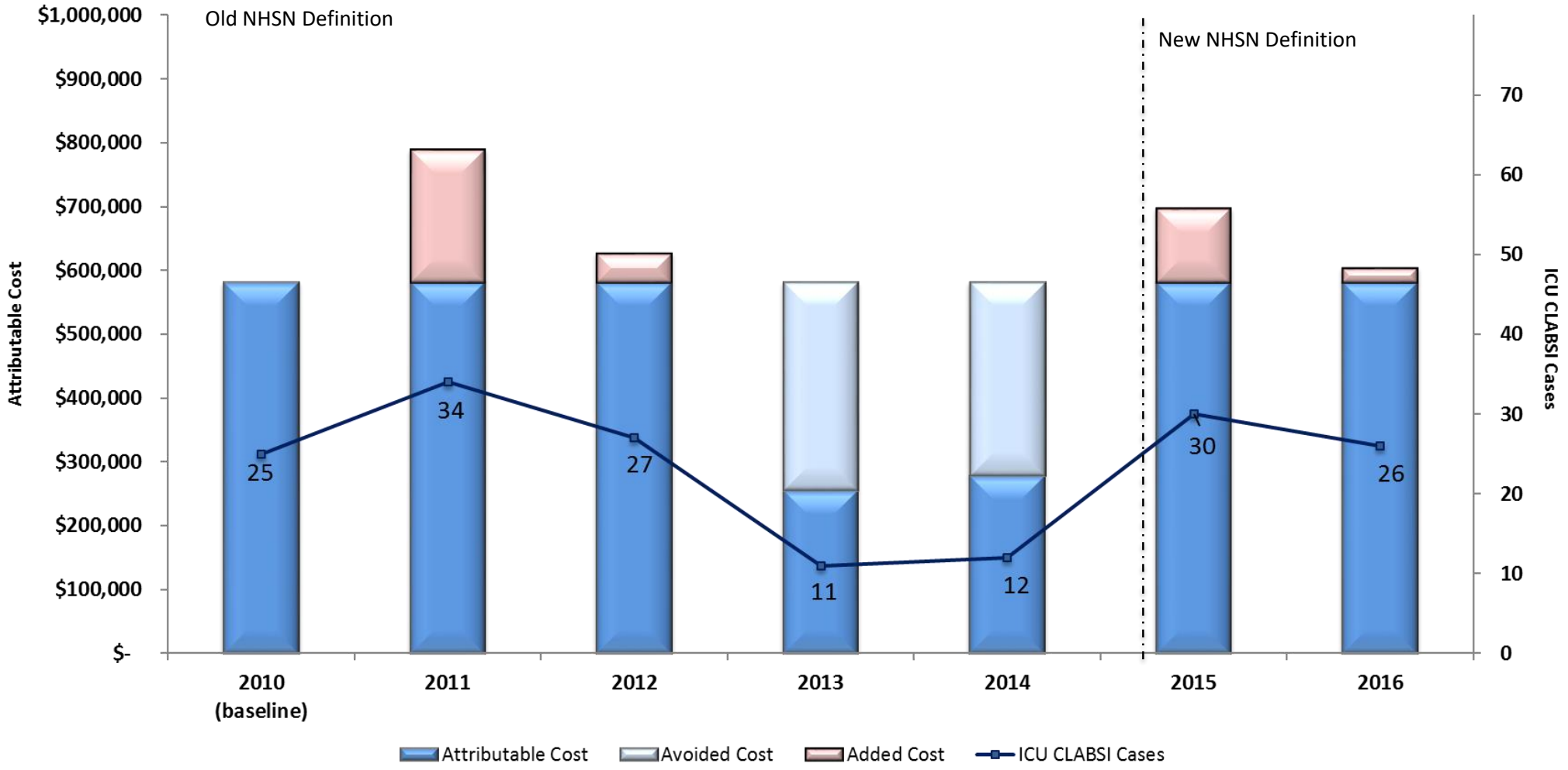


ICU VAP: Avoided Cost Trend



- Bethany Hospital excluded from January 2007 forward
- BroMenn Medical Center included starting in 2010
- Sherman Hospital included starting in 2013
- Data represents Adult ICU units only

ICU CLABSI: Attributable Cost Trend



*Attributable Cost estimates based on https://www.cdc.gov/HAI/pdfs/hai/Scott_CostPaper.pdf
•Sherman Hospital included starting in 2013
•Data represents Adult ICU units only

Leveraging the Technology in Other Care Settings

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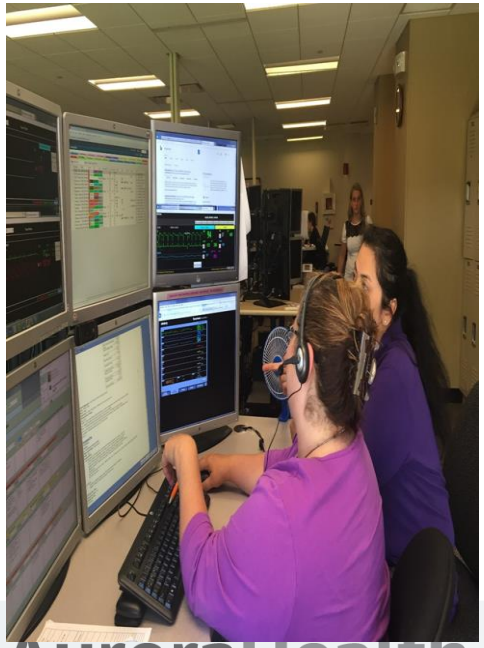
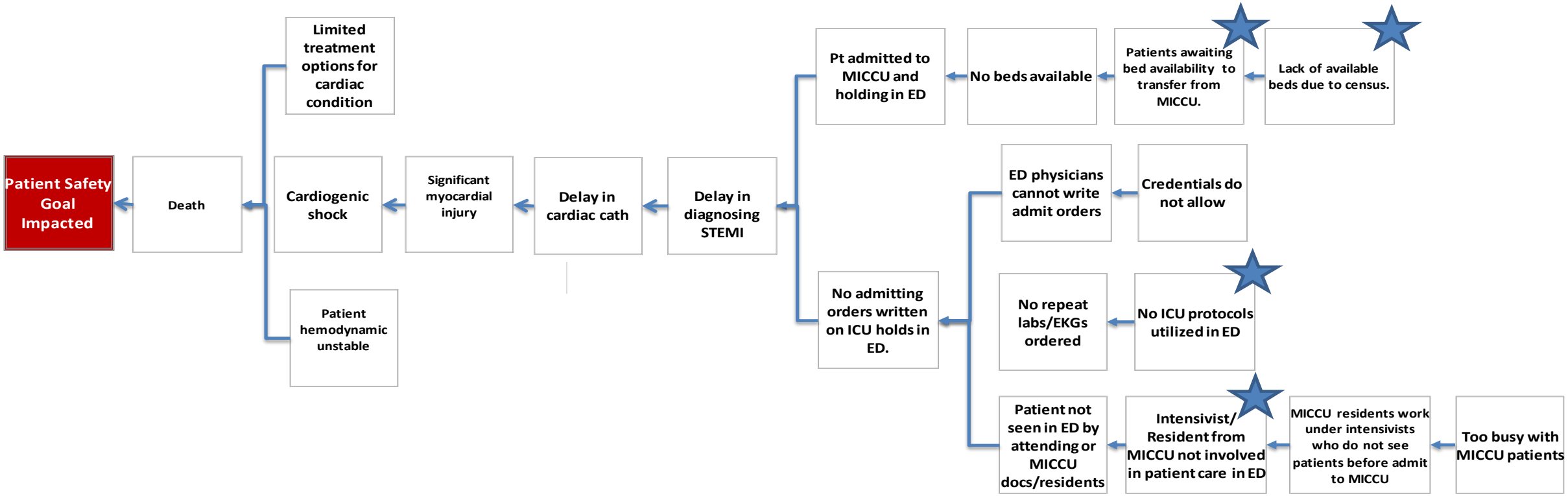
Patient Safety Story

- An elderly patient was admitted to the ED with shortness of breath and a decision was made to admit to ICU. While boarding in ED due to lack of ICU bed availability, the patient continued to deteriorate, suffered a cardiac event and ultimately expired.
- A Root Cause Analysis (RCA) ensued with at least four areas of opportunity for improvement identified
- Corrective action resulted in the implementation of four eCareMobile carts, definition of new work flows for ICU boarders including the handover process and continuous patient monitoring (unique in the ED for ICU overflow monitoring)

  Ongoing PDSA revealed an opportunity to utilize change management of both the IT and clinical processes



Cause Map Opportunities for Improvement



MICU Admission Boarding in ED Workflow

MICU patient in ED, MICU bed needed

Physician places ICU bed request after "Dr. Done"

Bed request to Bed Board

ED notified by bed board that ICU bed not available

(MICU bed not available if less than 2 open beds)

Desk clerk places patient into "ICU Virtual Hold Bed" ECC5, ECC6, ECC8, ECC9

Patient is admitted as Inpatient status

ED RN notifies ED Attending Physician and/or ED Resident that patient is placed on Cart

eCare Mobile Cart activated & eAlert button pressed by ED RN

ED RN staff notifies eICU RN of admission and provides report:

1. Name
2. Patient ID (MRN)
3. Diagnosis
4. Attending Intensivist
5. ED room number
6. Virtual Unit Admit Date/Time

After report is received the eRN will call the MICU to inform them of the boarding eMobile cart patient
MICU charge RN 41-8558

eICU HCA admits patient into eCareManager
Verifies lab and trended vital signs, enters height, weight and other data per eICU process. Notifies eRN and ePhysician of admission.

ED staff enters MRN, Pt Name (Last, First) on monitor

Hand-over (Follow Communication Workflow)

eICU → Physician / RN

Intensivist

ED → Attending / Resident / RN

- ED Physician or Resident calls eICU attending to review case
- ED RN calls eICU RN to discuss case
- eICU Intensivist writes brief summary note in chart (Update and summary note to be written as an addendum to the original note)

eICU Clinician camera assesses patient upon notification

eICU Intensivist writes summary note on chart every shift to provide better handover

ED notifies eICU of transfer to MICU bed by eAlert button or phone call

eRN calls MICU RN to handover the patient only if update needs to be provided.
Note: ED RN will provide full report.

eICU intensivist writes brief summary note upon transfer to MSDU and provides hand-over to Attending Physician.

Original Date: 2016.12.20 Modified: 2018.2.27

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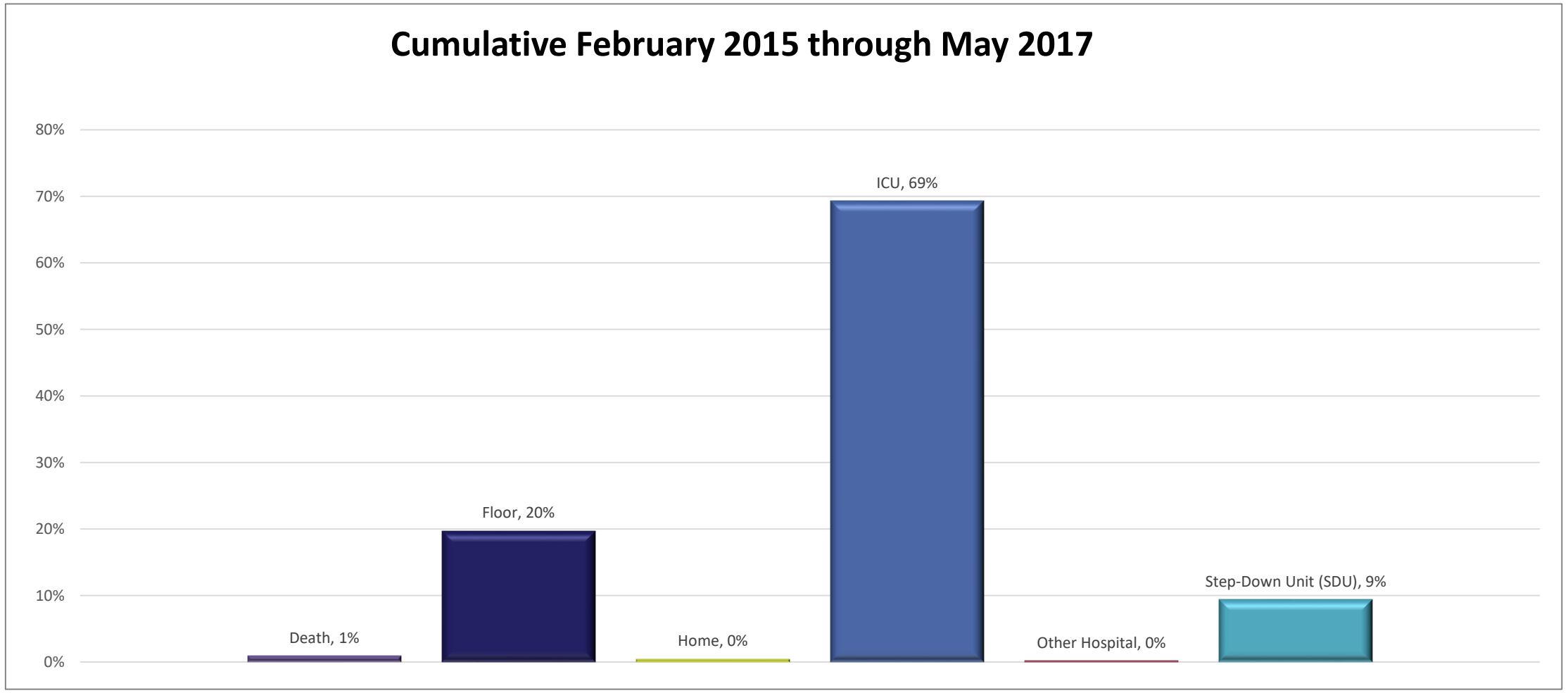
eMobile Cart Percent by Unit Discharge Location



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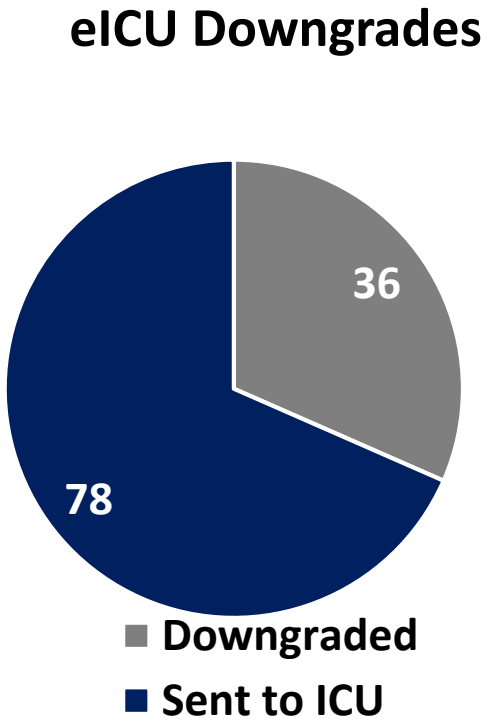
ED Collaboration Results

- **ICU LOS** similar excluding outliers
  (95% CI -0.8-0.5, p=0.65)
  - eICU 3.2 days
  - Non-eICU 3.0 days

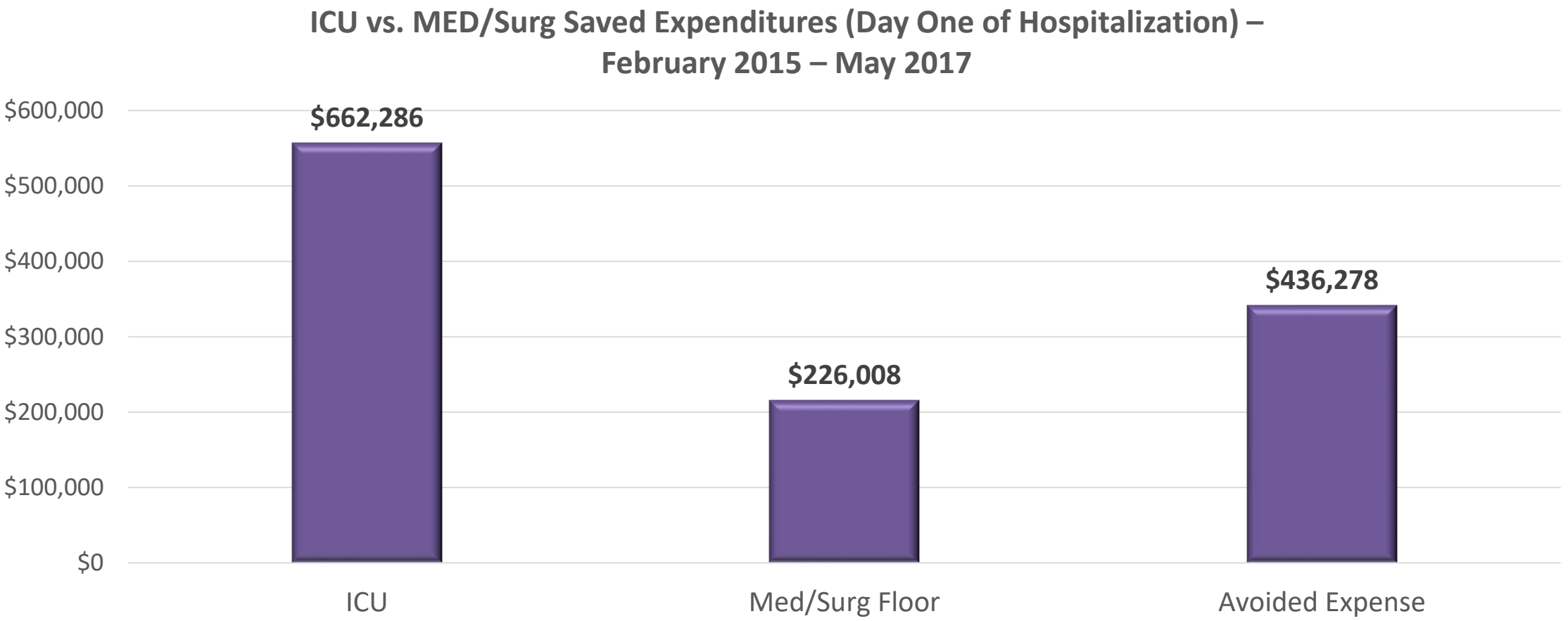
- **Hospital LOS** less in eICU excluding outliers
  (95% CI 0.6-2.8, p=0.0023)
  - eICU 5.2 days
  - Non-eICU 6.9 days

- **Mortality** less in the eICU group
  Odds ratio [OR], 0.18 [95% CI 0.07-0.52], p=0.0012
  - eICU 4.4%
  - Non-eICU 19.8%



Downgrades resulted in **$436K** in avoided expense

CMC ED eMobile Cart Data



Other Benefits:

- No additional Patient Safety events for ICU/ED boarders
- Shorter LOS indicates improved throughput
- Now covering Step Down boarders as of 7/24/17

MSDU Admission Boarding in ED Workflow

MSDU patient in ED, MSDU bed needed

ED Physician calls Admitting PMD and obtains Critical Care Pulmonologist Consult

ED Physician calls Critical Care Pulmonologist about consult

ED Physician places MSDU bed request and "Dr. Done"

Bed request to Bed Board

ED notified by bed board that MSDU bed not available for >2 hours

ED RN calls bedside Critical Care Pulmonologist for admission orders

Desk clerk places patient into "ICU Virtual Hold Bed" ECC5, ECC6, ECC8, ECC9

Patient is admitted as Inpatient status

ED RN notifies ED Attending Physician and/or ED Resident that patient is placed on Cart

eCare Mobile Cart activated & eAlert button pressed by ED RN

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1. Name
2. Patient ID (MRN)
3. Diagnosis
4. Attending Intensivist
5. ED room number
6. Virtual Unit Admit Date/Time

After report is received the eRN will call the unit to inform them of the boarding eMobile cart patient
MSDU charge RN 41-8559

eICU HCA admits patient into eCareManager
Verifies lab and trended vital signs, enters height, weight and other data per eICU process.
Notifies eRN and ePhysician of admission.

ED staff enters MRN, Pt Name (Last, First) on monitor

Hand-over (Follow Communication Workflow)

- ED Physician or Resident calls eICU attending to review case
- ED RN calls eICU RN to discuss case
- eICU Intensivist writes brief summary note in chart

eICU Clinician camera assesses patient upon notification

eICU Intensivist writes summary note on chart every shift to provide better handover.
(Update and summary note to be written as an addendum to the original note)

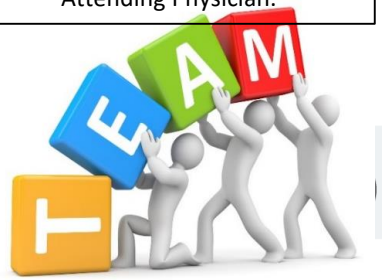
eICU Attending to contact Critical Care Pulmonologist on case to review management:

- As needed for questions
- Change in patient's status requiring either an upgrade to the MICU or a downgrade to the floor/telemetry.
- AND at the time of hand-off when MSDU bed assigned to Patient

ED notifies eICU of transfer to MSDU bed by eAlert button or phone call

eRN calls MSDU RN to handover the patient only if update needs to be provided.
Note: ED RN will provide full report.

eICU intensivist writes brief summary note upon transfer to MSDU and provides hand-over to Attending Physician.



Original Date: 2016.12.20 Modified: 2018.2.27

eICU Handoff to MSDU

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Original Date: 2016.12.20 Reviewed: 2017.12.14

MSDU Unit Discharge – Rolling 12 months

Report Date 8/6/18

eMobile Cart System Report Rolling 12 Mos

**CMC-ECC- MSDU started on 7/24/17*

MSDU Boarder	(Multiple Items)
Count	

2017 & 2018

Hosp-Unit	Month 8/2017	9/2017	10/2017	11/2017	12/2017	1/2018	2/2018	3/2018	4/2018	5/2018	6/2018	7/2018	Grand Total
CMC-ECC-MSDU	26	19	20	20	38	45	29	33	58	29	37	17	371
Grand Total	**26**	**19**	**20**	**20**	**38**	**45**	**29**	**33**	**58**	**29**	**37**	**17**	**371**

MSDU Boarder	(Multiple Items)
Unit Name	CMC-ECC-MSDU
Post-ED Cart Status	

2017 & 2018

Post ED status	Month 8/2017	9/2017	10/2017	11/2017	12/2017	1/2018	2/2018	3/2018	4/2018	5/2018	6/2018	7/2018	Grand Total
Downgrade	26.9%	15.8%	10.0%	50.0%	36.8%	33.3%	34.5%	33.3%	31.0%	31.0%	8.1%	17.6%	28.3%
ICU	0.0%	10.5%	30.0%	10.0%	18.4%	11.1%	6.9%	3.0%	8.6%	17.2%	5.4%	11.8%	10.5%
SDU	73.1%	73.7%	60.0%	40.0%	44.7%	55.6%	58.6%	63.6%	60.3%	51.7%	86.5%	70.6%	61.2%

MSDU Boarder	(Multiple Items)
AVG LOS(hrs)	

2017 & 2018

Hosp-Unit	Month 8/2017	9/2017	10/2017	11/2017	12/2017	1/2018	2/2018	3/2018	4/2018	5/2018	6/2018	7/2018	Avg
CMC-ECC-MSDU	8.36	5.66	5.65	8.83	9.24	8.68	8.73	7.71	11.73	7.35	5.70	7.73	8.36

* ***Downgrade*** *= less acute level of care*

* ***ICU*** *= patient deteriorated and became ICU status*

* ***SDU*** *= patient continued as SDU status*

eSepsis

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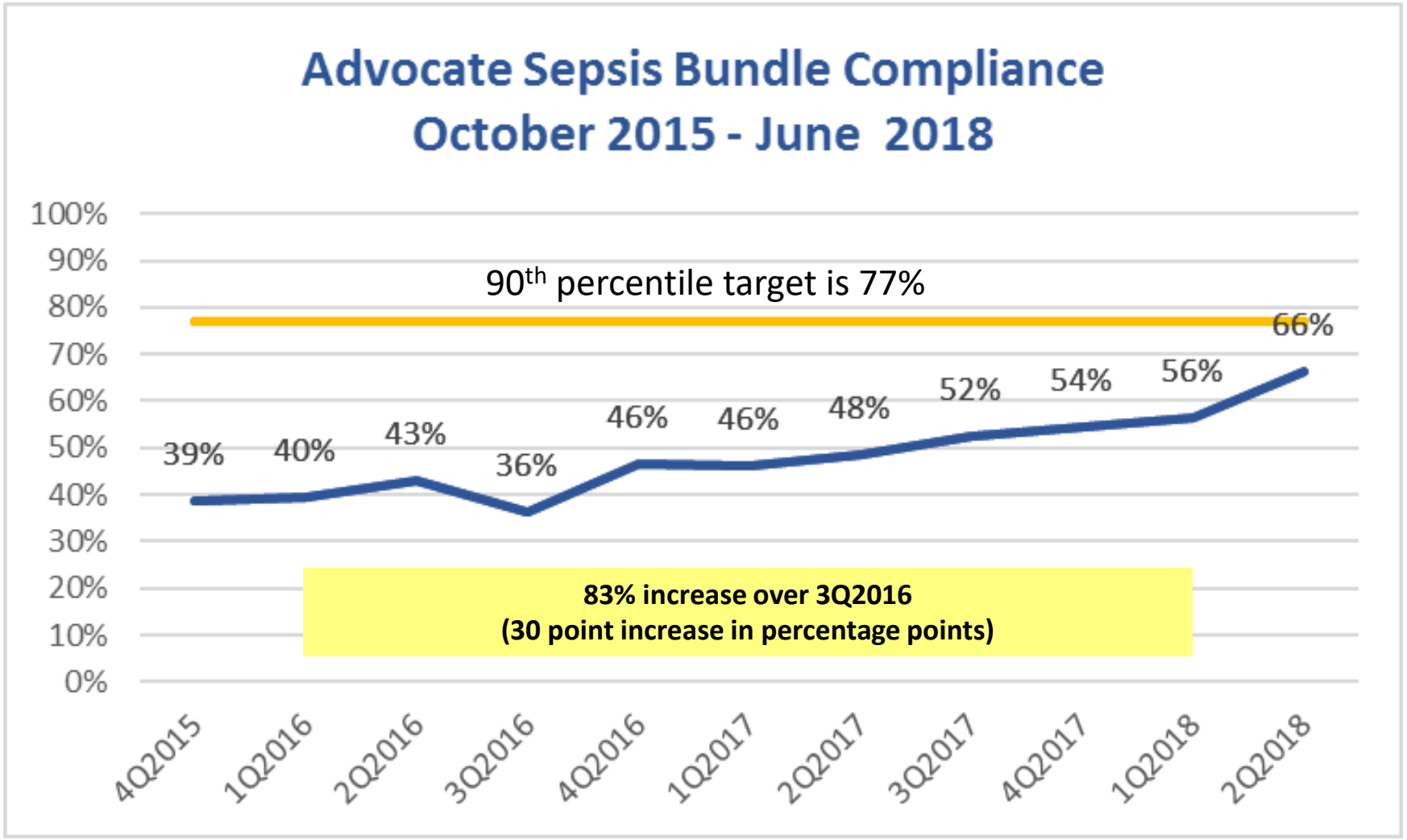

Advocate Sepsis Bundle Compliance
October 2015 - June 2018
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
90th percentile target is 77%
39%
40%
43%
36%
46%
46%
48%
52%
54%
56%
66%
83% increase over 3Q2016
(30 point increase in percentage points)
4Q2015
1Q2016
2Q2016
3Q2016
4Q2016
1Q2017
2Q2017
3Q2017
4Q2017
1Q2018
2Q2018

SIRS ALERTS

- Almost half of patients hospitalized on the wards developed SIRS at least once during their ward stay.
  - *Am J Respir Crit Care Med. 2015 Oct 15; 192(8): 958–964*

- SIRS does not equate with Sepsis

- SIRS Alerts are not specific and clinicians often do not even know what they are supposed to do with a SIRS Alert

SIRS ALERTS

- One of these alerts, created by the Cerner Corporation, is described in a recent publication in the *American Journal of Medical Quality*.[2] Its cloud-based system analyzes patient data in real-time as it enters the EMR and matches the data against the SIRS criteria. Based on 6,200 hospitalizations retrospectively reviewed, the alert fired for 817 patients (13 percent) meeting two or more SIRS criteria. Of these, 622 (76 percent) were either superfluous or erroneous, with the alert occurring either after the clinician had ordered antibiotics or in patients for whom no infection was suspected or treated. Of the remaining alerts occurring prior to action to treat or diagnose infection, most (89 percent) occurred in the emergency department, and a substantial number (34 percent) were erroneous.
- Therefore, based on the presented data, 126 of 817 SIRS alerts (15 percent) provided accurate, potentially valuable information. Unfortunately, another 80 patients in the hospitalized cohort received discharge diagnoses of sepsis despite never triggering the tool. Finally, these data only describe patients requiring hospitalization and not those discharged from the emergency department. We can only speculate regarding the number of alerts triggered on the diverse ED population not requiring hospitalization, as prior work has estimated infection constitutes no more than a quarter of patients with SIRS in the emergency department.[3] If such estimates hold true, the potential utility of such a SIRS-based tool drops below 5 percent.

Amland RC, Hahn-Cover KE. Clinical decision support for early recognition of sepsis. *Am J Med Qual*. 2014 Nov 10.
https://www.acepnow.com/article/focus-on-systemic-inflammatory-response-syndrome-can-interfere-with-early-sepsis-detection/

Alert Data – November 2017

Sepsis Alert Summary Report

Report Time Frame: 11/1/2017 - 11/30/2017

Encounter Type: DAY SURGERY/24 HR OBSERVATION, EMERGENCY ROOM, INPATIENT, NEWBORN, OUTPATIENT, RECURRING OUTPATIENT

Patient Age Category: 18 - 64, 65 - 79, 80+

OB Indicator: All

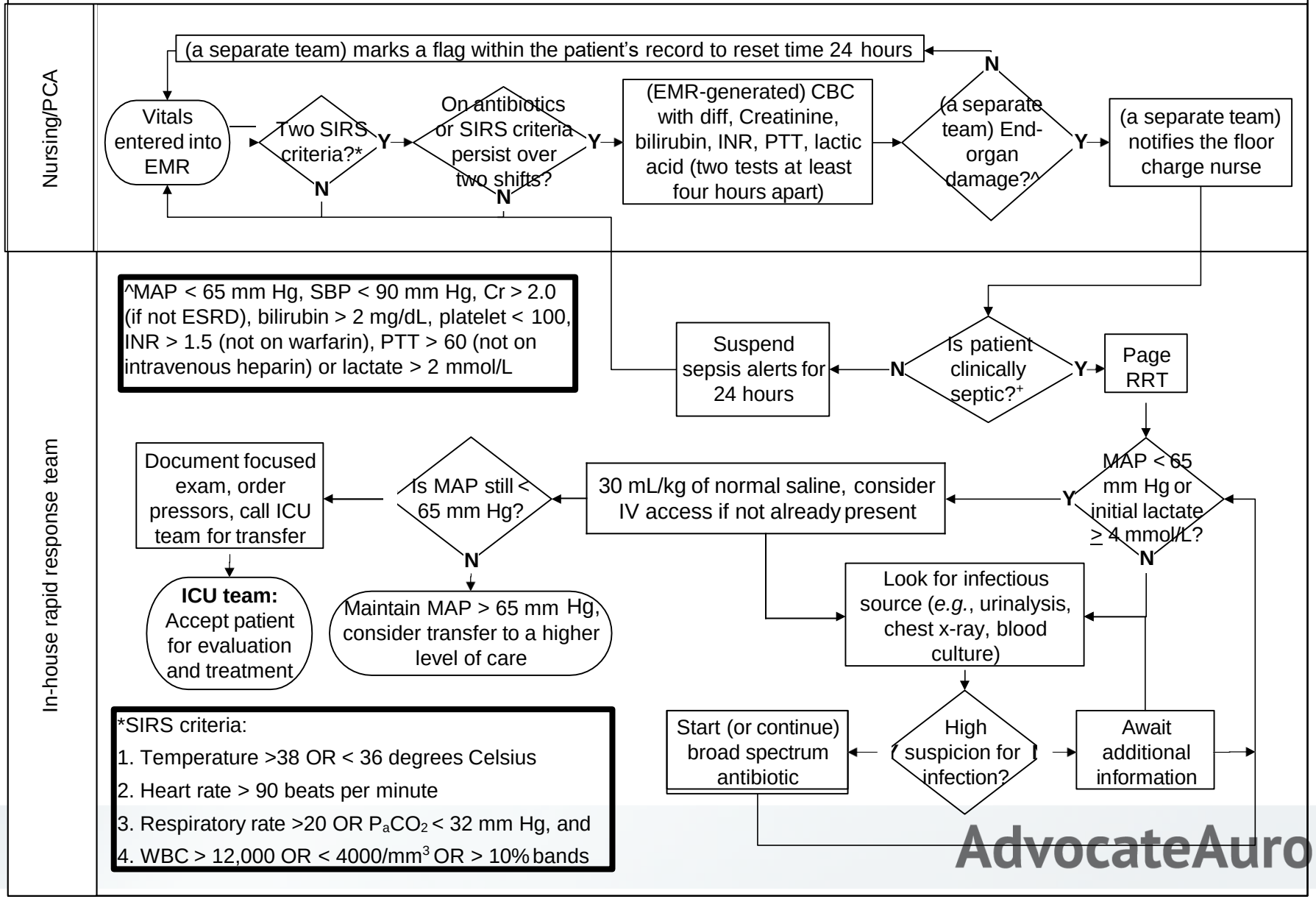
								SIRS Alerts		Sepsis Alerts	
Site	Unit	Highest Sepsis Level	# Patients	# SIRS Alerts	# Sepsis Alerts	Total # Alerts	Average # Alerts	# First SIRS Alerts	Average Time from Criteria Met to First SIRS Alert	# First Sepsis Alerts	Average Time from Criteria Met to First Sepsis Alert
SSH			536	1,929	2,250	3,642	7	329	5.7	150	2.4
	SSH 2EST		14	69	187	246	18	5	8.3	2	5.5
	SSH 2NOR		6	24	44	54	9	2	12.5	2	20.5
	SSH 2WPP										
	SSH 3NOR		10	52	158	157	16	2	25.5	3	2.0
	SSH 3SOU		14	143	273	376	27	4	282.4	6	3.1
	SSH 4EST		11	49	41	76	7	5	90.0	3	0.9
	SSH 4NOR										
	SSH 4SNF										
	SSH 4WST		2	10	0	10	5	2	9.5		
	SSH EEM		98	158	19	174	2	89	0.5	11	2.3
	SSH EMER		1	3	4	7	7			1	2.0
	SSH EMR		339	1,421	215	1,627	5	220	0.6	93	1.3
	SSH ICU		41	0	1,309	915	22			29	4.1
	SSH PACU										
	SSH PEDS										
			536	1,929	2,250	3,642	7	329	5.7	150	2.4

Total ED Patients & ICU Patients = 479

Remaining - rest of SSUB = 58 - alert St John's alerts for Nov 2017

Adult sepsis inpatient

Created May 2, 2017; Updated December 11, 2017



Three Possible Scenarios

Sepsis Alert Fires in EMR: EICU views

SEPSIS

- **Concern for Severe Sepsis or Septic Shock**
- **EICU recommends huddle patient at bedside**
- **Medical Alert: Sepsis Alert paged**
- **Sepsis Alert Response Team, Charge RN, and Bedside RN huddle patient at bedside**

No SEPSIS

- **No Concern for new onset Severe Sepsis or Septic Shock OR patient is already being treated appropriately**
- **No Huddle recommended by eICU**
- **Alert Suppressed by SSUB Clinician for 12 hours**

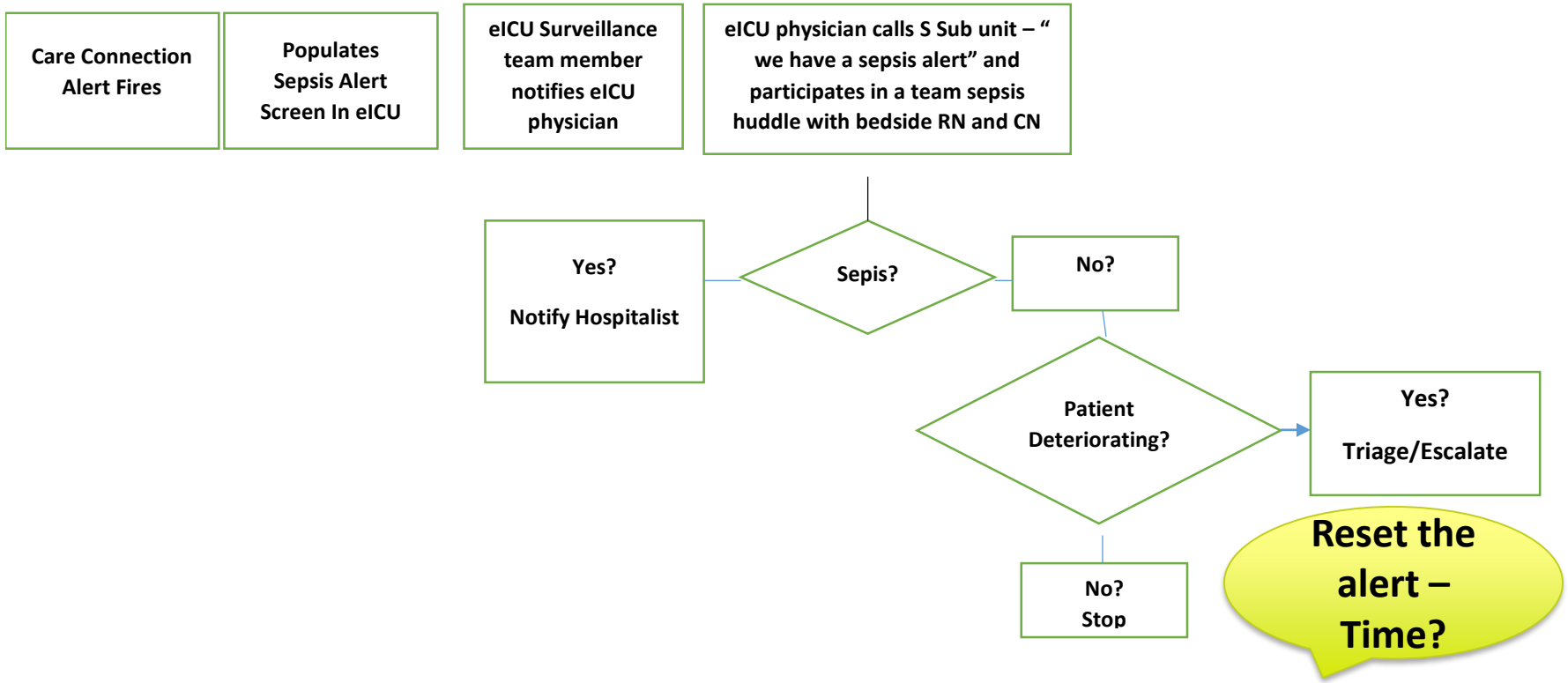
Something Else

- **No Concern for new onset Severe Sepsis or Septic Shock**
- **Concern noted for patient deterioration for another cause**
- **EICU recommends RRT response**

Future State – Scenario #1

eICU sees the Alert First

Scenario #1 – eICU aware first of Care Connection alert

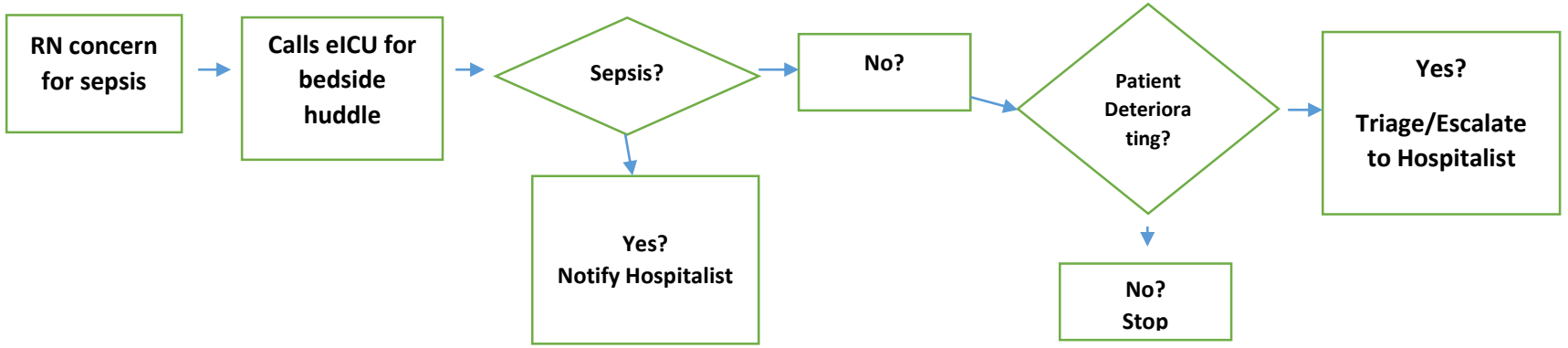


The Huddle Team or Wingman Concept is an evidence-based way to improve sepsis recognition

Future State – Scenario #2

The Concerned Nurse

- Scenario #2: South Sub RN suspects or has manually screened the patient for sepsis – no CareConnection alert and calls the eICU for a huddle



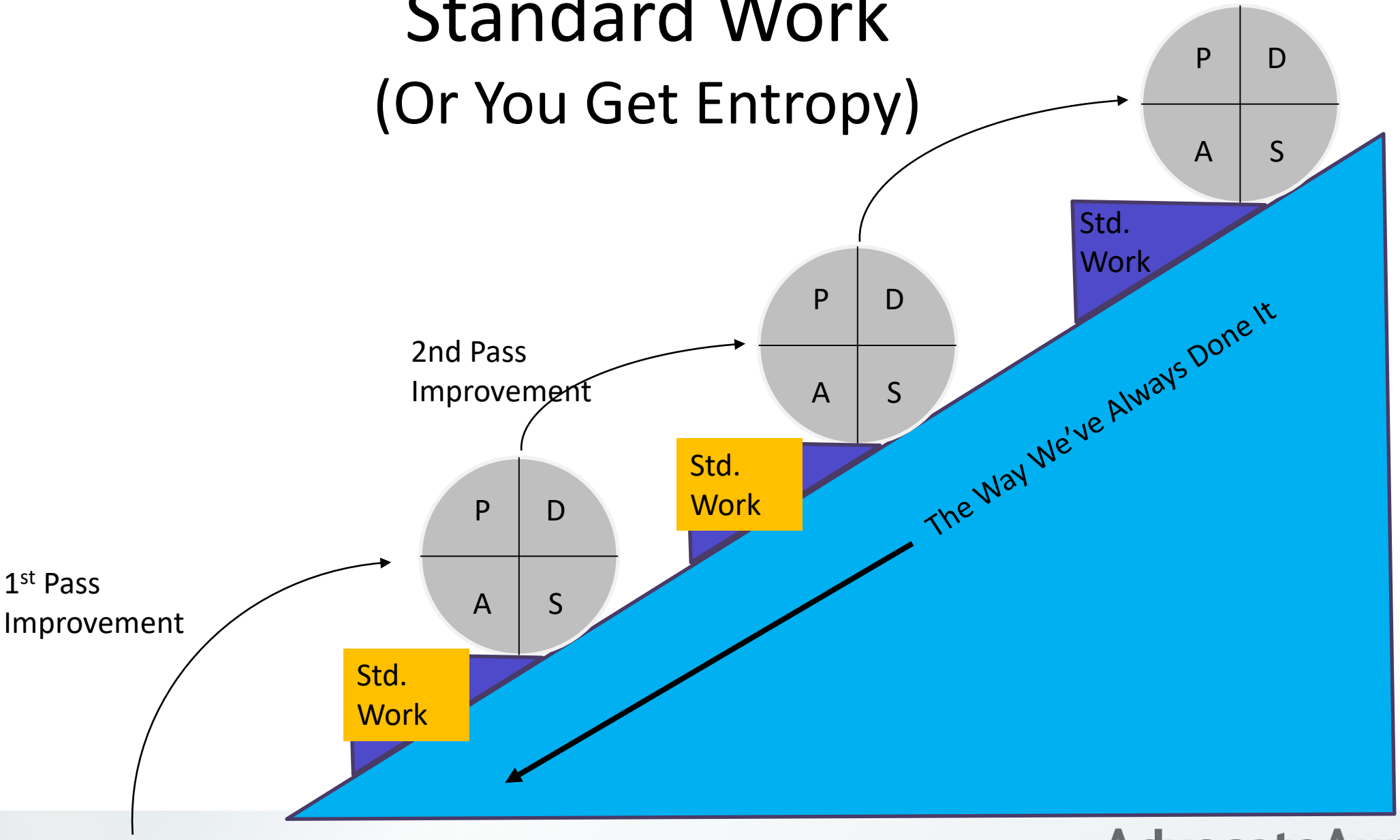
The Huddle Team or Wingman Concept is an evidence-based way to improve sepsis recognition

Medical Alert: Sepsis Alert

- **New Sepsis Alert Response Team** to evaluate and "huddle" patients at bedside to determine new onset Severe Sepsis or Septic Shock requiring Sepsis Bundle initiation
    - House Doctor
    - ICU RN
    - Lab

A Sepsis Response team will be paged by:
Calling 46-6100 and requesting Sepsis Alert to be paged. Identify patient room number.
Operator will overhead page **"Medical Alert: Sepsis Alert"** followed with patient room number

Standard Work
(Or You Get Entropy)



Debriefing Form

Completed by Team members participating in the Sepsis huddle to determine what went well and opportunities for improvement
Attach to Green huddle Sheet for collection by Unit Educators/Sepsis Coordinator

Impact of Telemedicine on Mortality, Length of Stay, and Cost Among Patients in Progressive Care Units: Experience From a Large Healthcare System*

Donna Lee Armaignac, PhD, APRN CNS-BC, CCNS, CCRN; Anshul Saxena, PhD; Muni Rubens, PhD; Carlos A. Valle, MSIT; Lisa-Mae S. Williams, MSN; Emir Veledar, PhD; Louis T. Gidel MD, PhD

TPCU intervention significantly decreased mortality in progressive care unit and hospital and progressive care unit length of stay despite the fact patients in TPCU were older and had higher disease severity, and risk of mortality. Increased postprogressive care unit hospital length of stay and total mean direct costs inclusive of telemedicine costs coincided with improved survival rates. Telemedicine intervention decreased overall mortality and length of stay within progressive care units without substantial cost incurrences.

Crit Care Med 2018; 46:728–735

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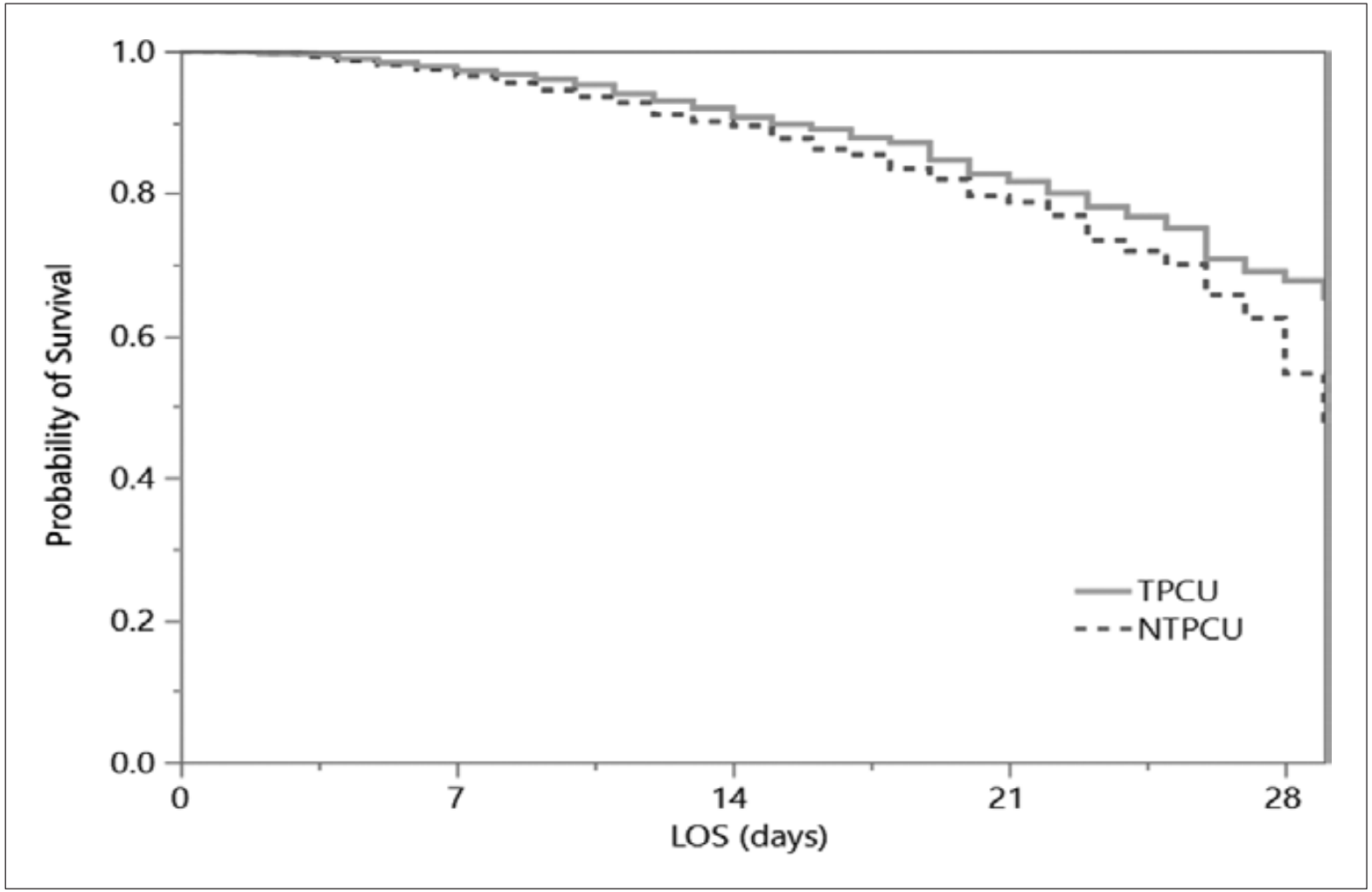

Survival curves for Cox proportional hazards model with telemedicine at progressive care unit (PCU) (TPCU) admission (solid line) and without telemedicine at PCU (NTPCU) admission (dotted line). LOS = length of stay.

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Crit Care Med 2018; 46:728–735

Incorporating eICU Infrastructure into Rapid Response

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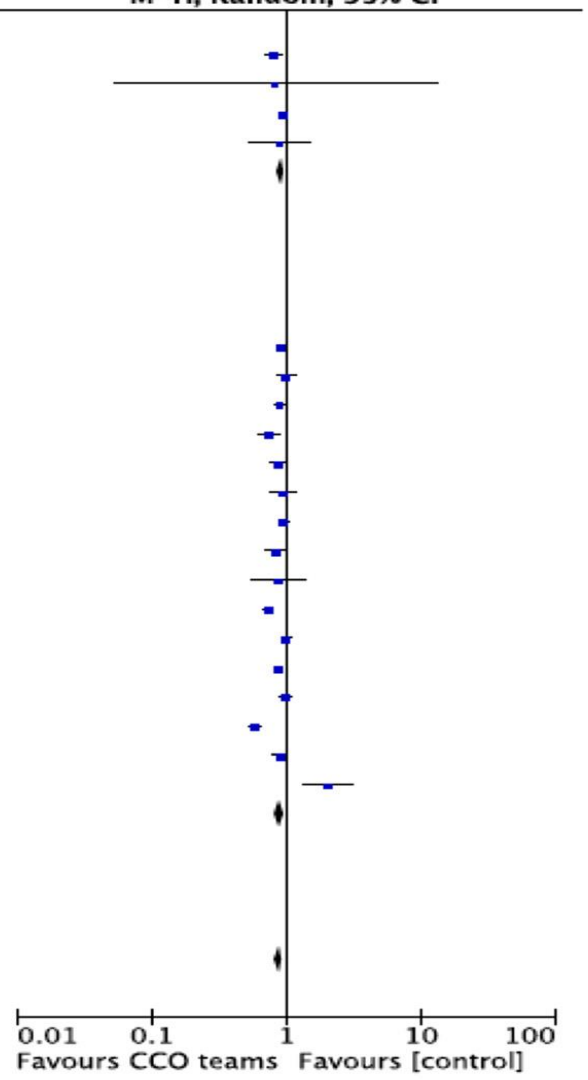
Study or Subgroup	Rapid Response Systems Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
1.1.1 Cluster RCT, CBA and ITS Studies						
Bristow	243	18338	535	32604	5.4%	0.81 [0.69, 0.94]
Hillman	1	622	1	517	0.1%	0.83 [0.05, 13.26]
Howell	1755	90045	1383	66496	6.7%	0.94 [0.87, 1.00]
Priestley	27	530	28	487	1.5%	0.89 [0.53, 1.48]
Subtotal (95% CI)		**109535**		**100104**	**13.6%**	**0.91 [0.85, 0.97]**
Total events	2026		1947			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.11$, df = 3 (P = 0.38); $I^2 = 3\%$						
Test for overall effect: Z = 2.70 (P = 0.007)						
1.1.2 Observational and Before After Studies						
Al-Qahtani	3191	157804	2214	98931	6.9%	0.90 [0.86, 0.95]
Baxter	400	11271	279	7820	5.4%	0.99 [0.86, 1.16]
Beitler	1086	79013	1194	77021	6.5%	0.89 [0.82, 0.96]
Bellomo	222	20921	302	21090	5.0%	0.74 [0.62, 0.88]
Buist	393	22847	380	19317	5.6%	0.87 [0.76, 1.01]
Campello	357	70850	94	17557	4.1%	0.94 [0.75, 1.18]
Chan	773	24978	780	24193	6.3%	0.96 [0.87, 1.06]
Dacey	402	17090	160	5667	4.9%	0.83 [0.70, 1.00]
Hayani	26	294	53	520	1.8%	0.87 [0.55, 1.36]
Jones	4070	104001	873	16246	6.7%	0.73 [0.68, 0.78]
Kenward	1054	53500	1070	53500	6.5%	0.99 [0.91, 1.07]
Konrad	1211	73825	3854	203892	6.7%	0.87 [0.81, 0.93]
Lim	583	34699	569	33360	6.0%	0.99 [0.88, 1.10]
Santamaria	551	74616	1174	91137	6.2%	0.57 [0.52, 0.63]
Shah	970	45125	390	16244	6.0%	0.90 [0.80, 1.01]
Simmes	89	2410	25	1376	1.9%	2.03 [1.31, 3.15]
Subtotal (95% CI)		**793244**		**687871**	**86.4%**	**0.88 [0.81, 0.95]**
Total events	15378		13411			
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 129.79$, df = 15 (P < 0.00001); $I^2 = 88\%$						
Test for overall effect: Z = 3.20 (P = 0.001)						
Total (95% CI)		**902779**		**787975**	**100.0%**	**0.88 [0.82, 0.94]**
Total events	17404		15358			
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 135.66$, df = 19 (P < 0.00001); $I^2 = 86\%$						
Test for overall effect: Z = 3.69 (P = 0.0002)						
Test for subgroup differences: $Chi^2 = 0.41$, df = 1 (P = 0.52), $I^2 = 0\%$						



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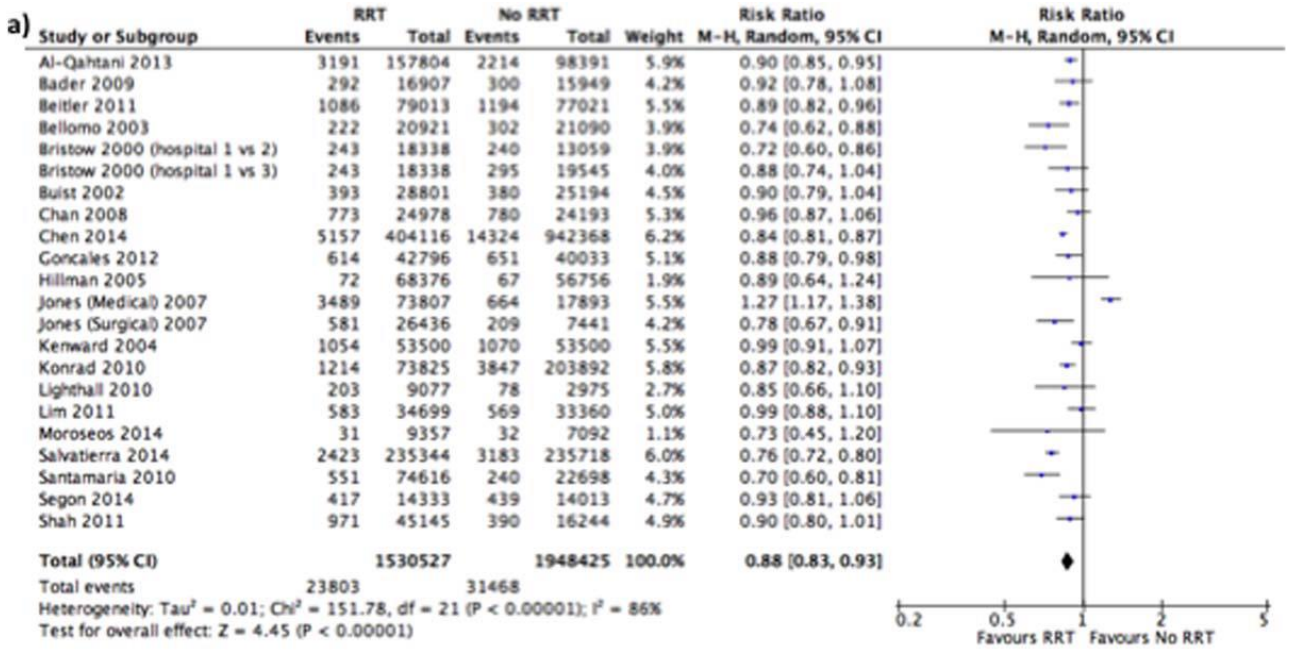
Maharaj et al. Critical Care (2015) 19:254



a) Forest plot of RRT/MET impact on in-hospital mortality. (b) Forest plot of RRT/MET impact on IHCA *(non-ICU*). Abbreviations: CI, confidence interval; M-H, Mantel-
Haenszel; MET, medical emergency team; RRT, rapid response team.

Of the 20 studies that reported **hospital mortality,** 9 favored RRT/METs, found no difference with RRT/METs, and 1 favored RRT/METs for surgical patients while favoring usual care (no RRT/MET) for medical patients. The pooled analysis demonstrated that implementation of RRT/METs was associated with a significant reduction in hospital mortality (RR 5 0.88, 95% confidence interval [CI]: 0.83-0.93).

Of the 20 studies that reported rates of **IHCA**, 12 favored RRT/METs and 8 found no difference with RRT/METs (Figure 2b). In the pooled analysis, RRT/METs were associated with a significant reduction in IHCA (RR 5 0.62, 95% CI: 0.55-0.69).

Most studies were performed in teaching hospitals; thus, the results may not be as applicable to community hospitals

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Solomon, Effectiveness of Rapid Response Teams on Rates of In-Hospital Cardiopulmonary Arrest and Mortality: A Systematic Review and Meta-analysis Journal of Hospital Medicine Vol 11 No 6 June 2016 (

Projecting Critical Care Beyond the ICU: An Analysis of Tele-ICU Support for Rapid Response Teams

Peter A. Pappas, MD, Luann Tirelli, James Shaffer, and Scott Gettings

In this study we sought to evaluate the ability of eMobile to support care administered by RRTs. Materials and Methods: A retrospective review evaluating mobile cart activations for RRT calls was performed. Data on mobile cart deployments were recorded over a 33-month period from January 2012 through September 2014. Results: …. The most common patient conditions were respiratory distress (n = 190, 33%), altered mental status (n = 137, 24%) and hypotension (n = 59, 10%). The most common interventions were medication orders (n = 231, 40%) and laboratory studies (n = 92, 29%). For 566 eMobile calls with documented dispositions, 189 patients (33%) were managed without ICU upgrade. No adverse patient outcomes were recorded involving eMobile. Compared with the RRT program in 2009, the last year before testing of eMobile began (2010–2011), addition of tele–critical care support for calendar years 2012 and 2013 increased projected cost avoidance from unnecessary ICU transfers by a mean of 66% above the 2009 baseline. For Fiscal Year 2014, a projected cost avoidance analysis for unnecessary ICU transfers including costs of information technology (IT) support demonstrated a return on investment up to $1.66 for every $1 invested in IT support. Conclusions: Mobile critical care coupled with RRT is clinically effective and can generate meaningful cost avoidance.

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The rapid response system should include team members with:

- Ability to diagnosis the clinical problem
- Ability to initiate therapy
- Appropriately triage patients to appropriate level of care
- Authority to transfer the patient to higher level of care
- A leader to coordinate team actions

Tele-RRT can provide

- An intensivist without pulling a physician away from elsewhere (esp ICU)
- An eIntensivist to fill the role of RRT team leader
- Real time access of an ICU attending to housestaff or nurses during the RRT
- Every RRT to be a teaching opportunity
- An intensivist to establish a differential diagnosis and direct the work up
- Triaging of patients –not all RRTs should be transferred to the ICU
- End of life discussion

Tele-RRT can provide cont'd

- Earlier initiation of critical care while waiting for transfer to ICU
- A longer period of observation to ensure stability for patients not transferred to ICU
- Support for simultaneously occurring RRTs
- Initiation of sepsis EGDT sooner (e.g. antibiotics within 1 hour)
- Appropriate documentation for CMS SEP-1 sepsis compliance
- A forum for "Huddles" during shifts to review the status of RRT patients that were not transferred to the ICU
- Avoid "deskilling" of ward staff
- Assess system safety deficiencies

Delayed transfer to the ICU has been shown to be associated with increased mortality.

Adverse outcomes associated with delayed intensive care unit transfers in an integrated healthcare system. J Hosp Med. 2012;7(3):224–230

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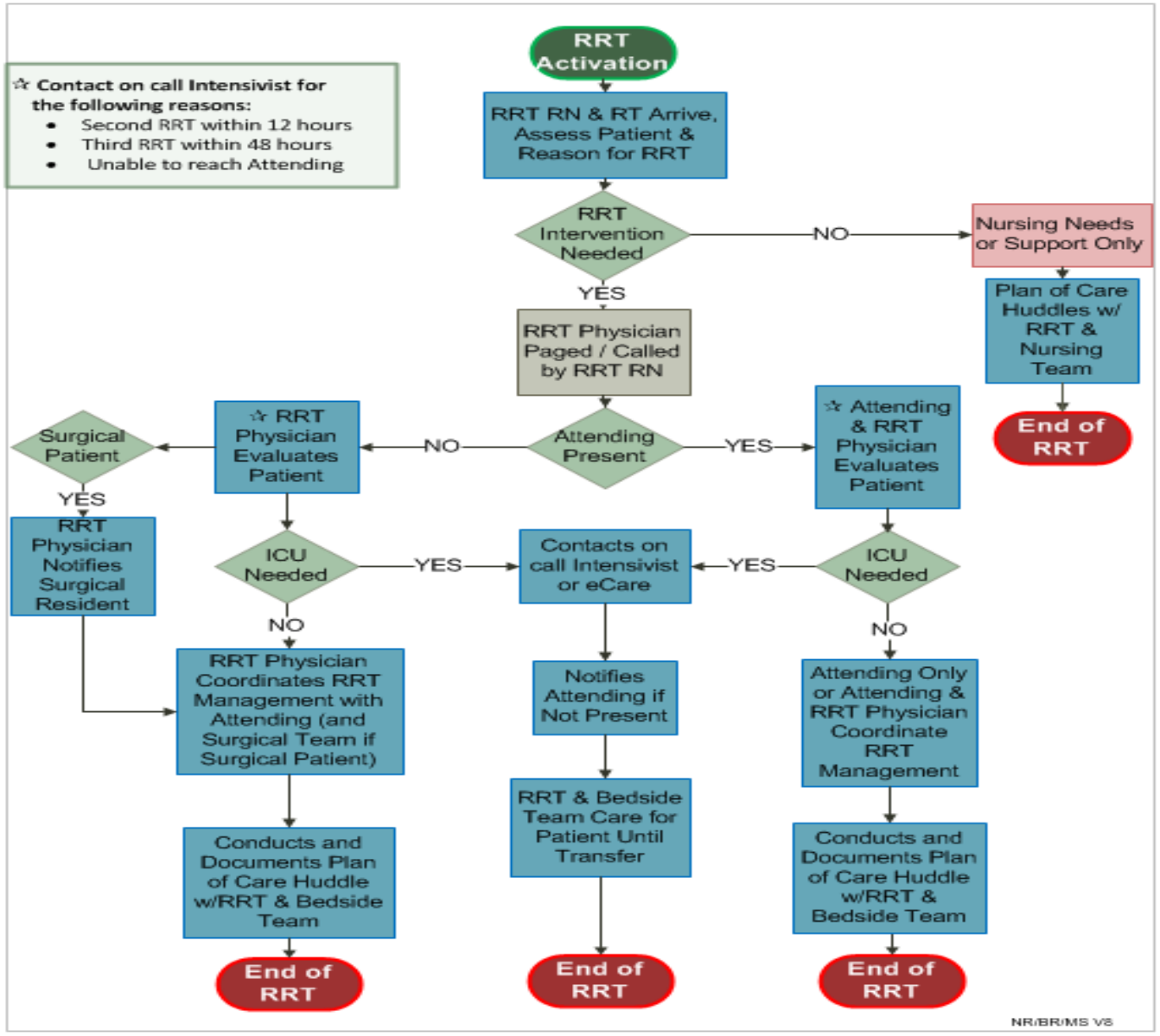
Different studies have used different criteria for activating RRT. Simple clinical judgement of nurses on the basis of subjective worry or general concern is a common trigger for RRT activation. The generic ‘worry’ significantly increased the RRT activation 35-fold when compared with activation based on vital signs. The number of RRT activations as a result of false positive calls has not been investigated

White, Rapid response teams in adult hospitals: time for another look? Intern Med J 2015; 45: 1211–20
Genardi, Revitalizing an established rapid response team. Dimens Crit Care Nurs 2008; 27: 104–9



Advocate eICU Mentorship Program

Need:

- Our sites identified that new RNs often feel under supported at the bedside and this program was developed to bridge the gap from novice to advanced beginner ICU RN

Results:

- To date (from 2012), >200 RNs have completed the program; 31 currently enrolled and 17 in pipeline
- Will be expanded to outreach partners and to two additional Advocate sites
- This program is utilized as part of the recruitment/retention strategy by our ICUs

Lessons Learned:

- Adapt the program based on feedback from each participant
- eRN staff requested additional education on mentor/precepting principles
- Adjust eRN schedule, for consistency in mentor, based on number of participants
- Instituted support pods in CORE to provide support to mentor/coach

Re-evaluate the process regularly

- Unanticipated discoveries
- Unforeseen outcomes
- Evolving medical literature
- Changes in EMR, technology, staffing,…

Objectives

- Understand that telemedicine can achieve clinical and financial benefits for acute care across a large healthcare system utilizing implementation science
- Recognize that the success of telehealth is determined less by what technologies you have and more by how you use them
- Realize that the tele-ICU is a facilitator of change management as much as an “intervention”

Thank You!
Questions

Contact:

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