The Health Care Improvement Foundation
2018 Delaware Valley Patient Safety and Quality Award
Entry Form

1. **Hospital Name**

     University of Pennsylvania Healthsystem

2. **Title Of Initiative**

     ICU Liberation: Executing the ABCDEF Bundle Daily

3. **Abstract (Please limit this description to 250 words.)**

In many of the ICU's within this health organization, patients remain on ventilators longer than expected resulting in longer ICU LOS. Contributing factors include lack of standardized approaches for ventilator weaning and management of pain, agitation and delirium, inconsistent use of valid and reliable scales to target goals, and uncoordinated spontaneous awakening and breathing trials.

ICU Liberation is a term that describes an evidenced based practice promoting lighter sedation levels, ventilator weaning protocols, and a delirium-free, more awake and interactive ICU patient. ICU liberation is best achieved through implementation of the Society of Critical Care Medicine "ABCDEF" bundle. Our systems level critical care committee, including representation from four entities developed consensus around practice guidelines to support "ABCDEF" bundle implementation.

A novel computer program was created in collaboration with data scientists to continuously screen all mechanically ventilated patients for weaning readiness, wakefulness with sedation levels, and delirium status. This information is displayed in real-time on an ICU Board Display. Based on clinical decision support rules, the system alerts respiratory therapists via a phone text to peform a spontaneous awakening trial, and the nurse and provider are promoted through text alerts to stop or wean sedation.

Adherence to delirium assessment is > 90%, and sedation assessment is> 80%. More wakefulness is evident by sedation scores post alert being between -1 and -1.5. Continuous sedative reduction post alert is up to 60%. Seven ICUs have reductions in duration of delirium, and nine ICUs are showing reductions in baseline duration of mechanical ventilation.

4. **What were the goals of your initiative?**

     The goal of this ongoing quality and safety initiative is to implement an "ABCDEF" bundle across an entire healthsystem. The complete "ABCDEF" bundle is defined as follows: A-Awake and pain controlled, B-Breathing spontaneously through coordinated sedation and ventilator weaning trials, C-Choice of analgesics and sedatives, D-Delirium management, E-Early mobility and F-Family involvement. Primary outcomes of this work are to decrease the time patients spend on mechanical ventilation, decrease duration of delirium, and decrease ICU and Hospital LOS.

At the start of this work we knew it was imperative to overcome the obstacle of an imbedded culture where respiratory therapists assess mechanically ventilated ICU patients for spontaneous breathing trial readiness only once a day. This practice leads to delays in early extubation. Also, the spontaneous breathing trials are often uncoordinated with the clinical nurses who are titrating medications and for pain, agitation, and delirium, and often results in patients failing spontaneous breathing trials due to deep sedation levels.

In order to successfully leverage the EHR to create a novel program that facilitates implementation by rectifying many of the barriers to effective ventilator weaning, we needed to achieve practice consensus across 4 entities and 14 ICU's. Through the healthsystem critical care committee and individual working subcommittees, we developed a standardized evidence based ventilator weaning protocol, and a standardized approach to managing pain. agitation, and delirium using evidence based assessment tools.

Our work described in this quality award application is focused upon the A through D portion of the bundle. Next steps in the healthsystem are to focus on "E" and integrate early mobility into the ICU Board.

5. **What were the baseline data and the results of your initiative?**
Please see the appendices for baseline data.
The metrics are as follows:
1. Duration of mechanical ventilation (median days)
2. Duration of delirium (median days)
3. Nursing assessments for sedation/agitation
4. Nursing assessment for delirium
5. Sedation level (wakefulness) at time of spontaneous breathing trials alerts and within 8 hours post-alert
6. Proportion of continuous sedative and opioid infusion reduced following the spontaneous awakening trial alert

6. **Describe the interventions that were instrumental in achieving the results for your initiative.**
Interventions (please see figure 1-5 in the appendices section)
• Clinical team utilizes the systems guideline for management of pain, agitation, delirium in mechanically ventilated ICU patients
• Clinical nurses assess for delirium every 12 hours
• Clinical nurses assess for agitation/sedation every 4 hours
• Providers order the systems level ventilator liberation protocol
• ICU teams utilize the ICU Board showing real-time display of data, this is typically done through daily team huddles where the ICU team discusses ventilator liberation and sedation minimization

• For patients not meeting ventilator weaning readiness criteria, the parameters limiting weaning are conveniently displayed with icons that nudge providers when appropriate to wean support based on clinical decision support rules.

• Respiratory therapist adheres to the ventilator liberation protocol, performs SBT screening every am.

• Text alerts fire to clinical nurses, respiratory therapists, and providers 24 hours per day to inform of spontaneous breathing trial readiness. Clinicians are expected to respond within 2-hours of every alert.

7. Describe the key steps required to successfully replicate this initiative throughout the region. (Please limit this description to 100 words.)

The first step is to obtain information technology resources to build the "ICU Board". Then clinicians must work together to decrease unnecessary variation in their clinical practice by developing standardized approaches to patient care. For example, we developed systems consensus around pain, agitation, and delirium assessment tools. Without this critical first step, communication between the entire team would be inefficient. Next, the standardized approach should be transcribed into process maps in order to create ordersets and discreet data rows in the electronic medical record. These efforts eliminated unnecessary "noise" in the accuracy of the alerts and nudges.

8. Explain how the initiative demonstrates innovation (Please limit this description to 100 words.)

The innovation involves the work of data scientists and information technology experts to pull live parameters form the electronic health record into a real-time display of patient information for clinicians to use at the bedside. Then, using critical decision support via practice algorithms they created visual nudges that are incorporated onto the ICU Board display,and text alerts that are fired to clinicians to inform of spontaneous breathing readiness and sedation status. To help explain the intricate nature of this work, determination of spontaneous breathing trail readiness alone, requires 23 discreet data rows to create the nudges and text alerts.

9. How does this initiative demonstrate collaboration with other providers within the continuum of care? (Please limit this description to 100 words.)

Collaboration between clinicians, data scientists, data analysts, quality improvement specialists and administrators is critical. An important first step is for clinicians to come to a consensus regarding basic practice guidelines. This standardized approach is necessary for effective communication between all stakeholders, alignment with the electronic health record, the development of clinical decision support systems, the determination of metrics to evaluate success, and for the production of educational resources. The ICU Board display is in real time and available to all providers. Even without the text alerts, it provides a condensed quick snapshot of a patient's level progress in the ICU.

10. Explain ways in which senior leadership exhibited commitment to the initiative (Please limit this description to 100 words.)

The systems level critical care committee within our organization reports up to the systems level chief medical officer and chief nursing officer council. The support of this

senior leadership team has been integral to the healthsystem prioritization of this work, along with data scientist and information technology expert resource allocation. After go-live or the ICU Board, the systems CEO and COO visited various ICU's to observe the board in action and to show support and dedication to this work.
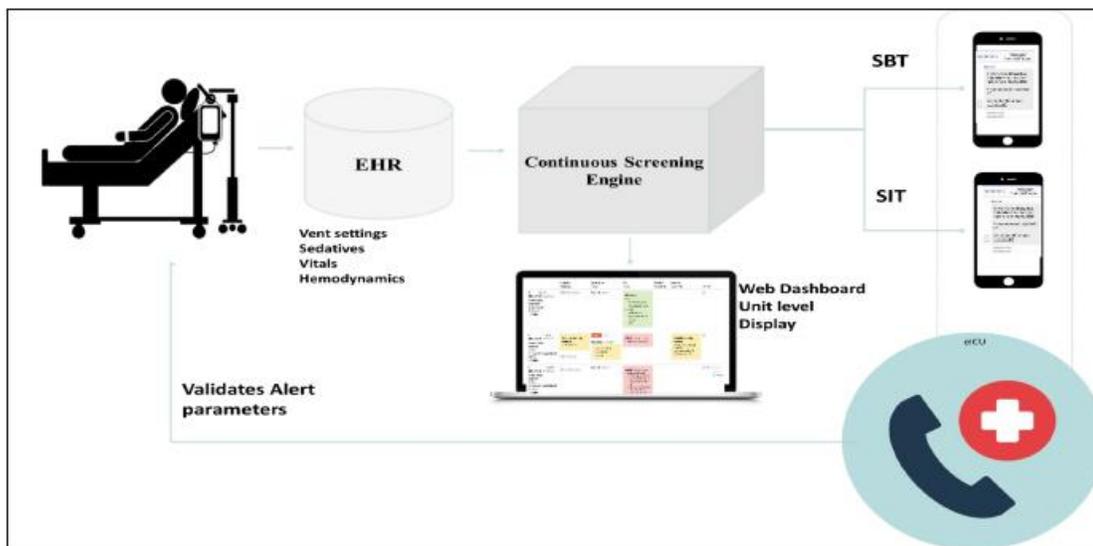
11. Appendices (i.e., tables and graphs)

Figure 1: The integration of the electronic health record into the production of the ICU Board Display and then into spontaneous awakening and spontaneously breathing readiness text alerts.
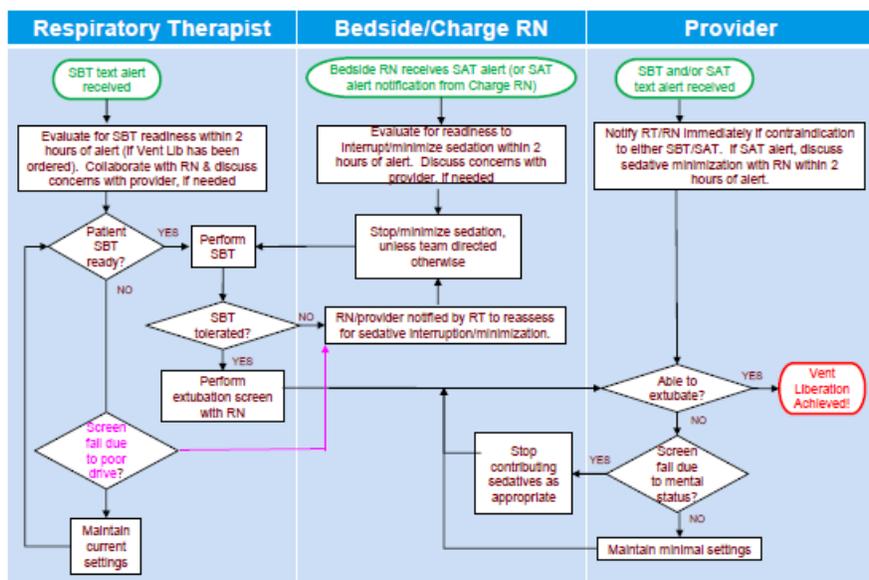
Figure 2: Process map showing team response to receiving the text alerts

SBT- Spontaneous breathing trial
SAT- Spontaneous awakening trial

4

Application – Electronic Dashboard

◆ **Awake**
  - RASS score
  - CAM-ICU
  - Continuous sedative/analgesic infusions
  - *Nudge to wean sedation*

◆ **Breathing**
  - Current ventilator settings
  - SBT readiness
  - *Nudge to wean oxygen*
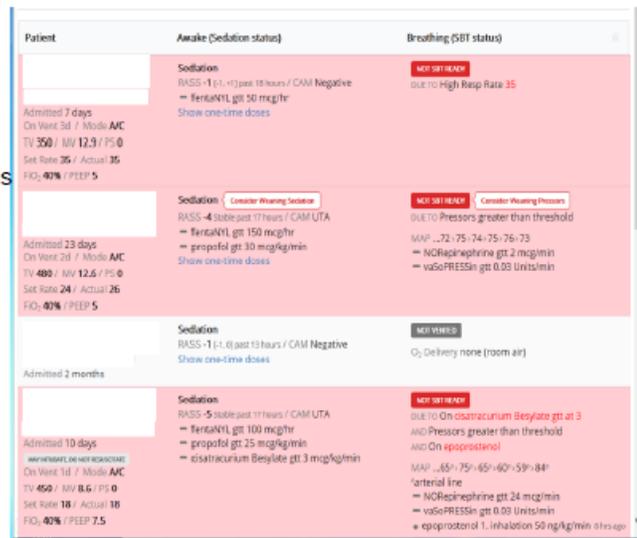 - *Nudge to wean PEEP*
  - *Nudge to wean vasopressors*

Figure 3: Example of the ICU Board display in action
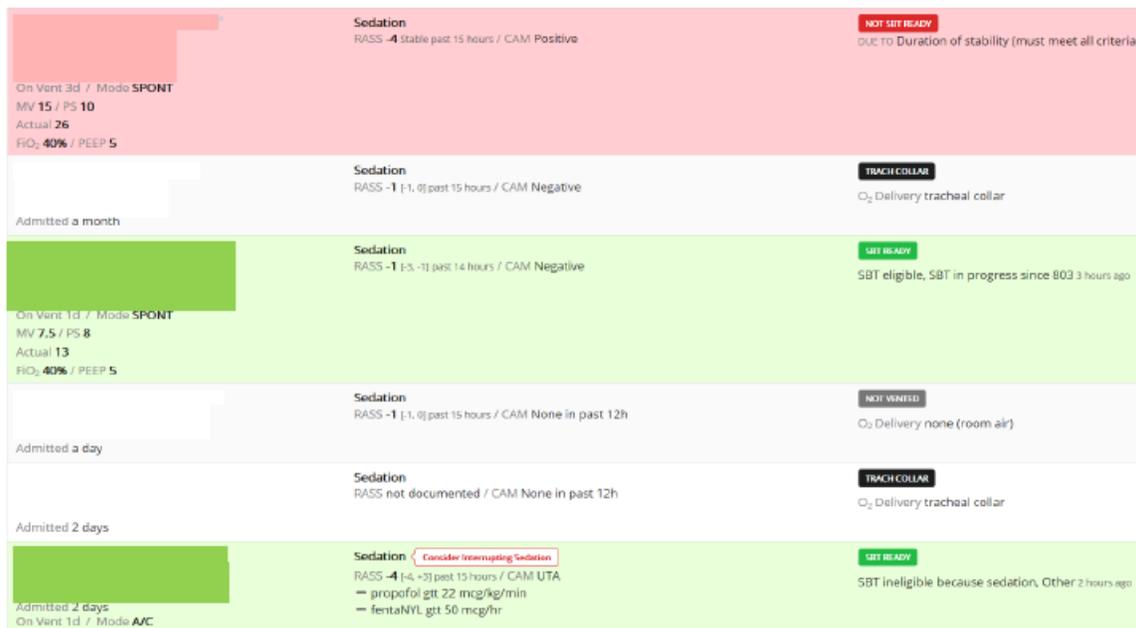
Figure 4: Example of the ICU Board display in action

Metrics

Metric	Unit Goals	Baseline
1. Median Vent Days	20% reduction from unit baseline	Median May 2017- February 2018
2. Nursing Delirium Assessment - CAM	90% Adherence	April 2017
3. Nursing Sedation/Agitation Assessment- RASS	90% Adherence	April 2017
4. Wakefulness: RASS at time of SAT* alerts	RASS = -1.0 (awake, comfortable)	Median Dec 2017 and Jan 2018
5. Alert responsiveness: Percent of patients with sedation reduction post spontaneous awakening trial (SAT) alert	20% increase from unit baseline	Median Dec 2017 and Jan 2018
6. Duration of Delirium	20% reduction from unit baseline	Median Dec 2017 and Jan 2018

Table 1: Metrics for ABCDEF Bundle

Mechanical Ventilation – Median Days for 14 Individual ICUs

	Baseline Mech Vent Days Median 5/17-2/18	Target 20% Reduction from Baseline	3/18	4/18	5/18	6/18
Entity #1						
ICU #1	2.1	1.7	2.33	1.79	1.74	2.02
ICU #2	1.3	1.1	0.90	1.17	0.97	1.78
ICU #3	0.5	0.4	.70	.55	.63	0.67
ICU #4	3.4	2.7	2.19	1.11	2.56	1.85
ICU #5	3.1	2.4	2.81	2.36	2.36	2.23
ICU #6	3.1	2.5	3.84	13.76	3.17	6.15
Entity #2						
ICU #7	0.5	0.4	0.83	0.59	0.59	0.73
ICU #8	1.2	1.0	2.03	0.77	0.74	3.43
ICU #9	2.6	2.1	5.11	0.63	7.37	1.14
ICU #10	2.4	1.9	1.49	2.22	2.60	1.32

	Baseline Mech Vent Days Median 5/17-2/18	Target 20% Reduction from Baseline	3/18	4/18	5/18	6/18
Entity #3						
ICU #11	0.5	0.4	.80	0.67	0.41	0.67
Entity #4						
ICU #12	1.1	0.9	3.6	1.3	.60	3.03
ICU #13	0.7	0.6	0.52	1.02	0.67	0.61
ICU #14	1.7	1.4	7.58	2.61	0.9	1.03

KEY:

- Median duration of mechanical ventilation already ≤ 0.5 days
- Lower than baseline but not at the 20% target reduction
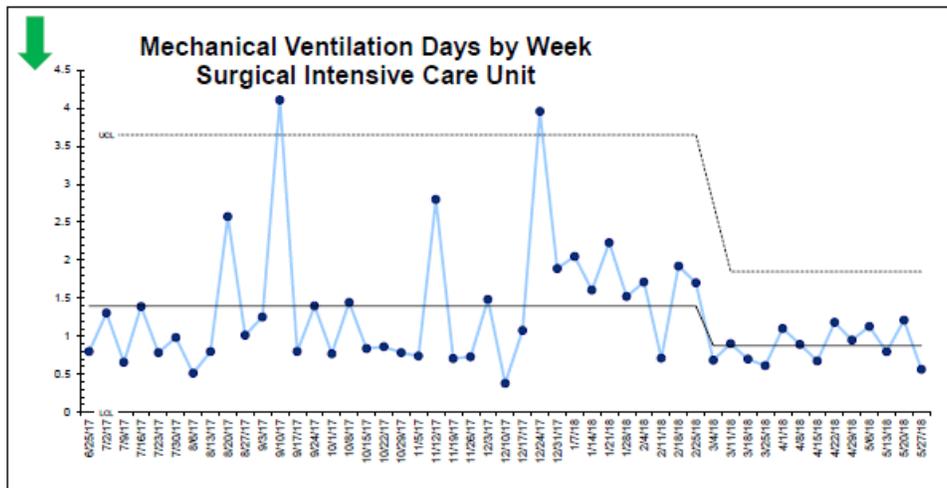- Achieved the 20% target reduction

Table 2: Duration mechanical ventilation (median days) for 14 individual ICU's in the healthsystem
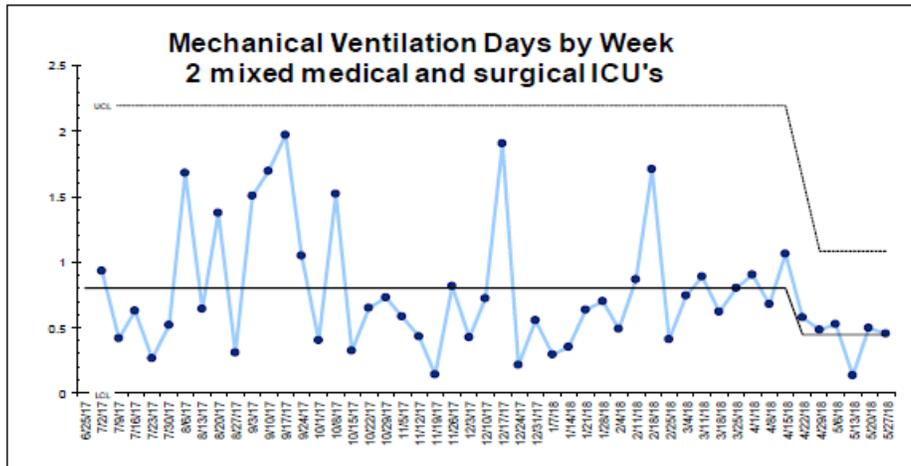
Medical ICUs # 4, 5, and 9
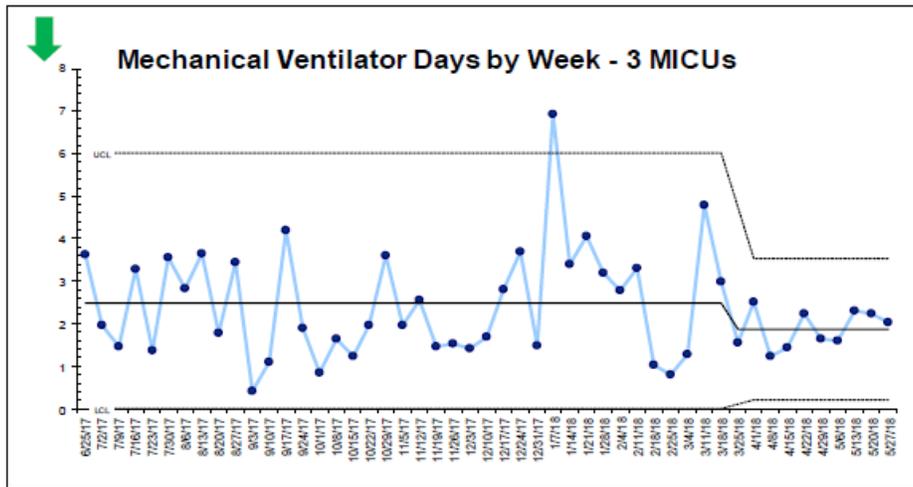
Graph 1: Control chart showing median days of mechanical ventilation for 3 MICUs in the healthsystem.
Evidence of decreased MV days from 2.5 to 1.9 starting March 25, 2018

Surgical ICU #2

Graph 2: Control chart showing median days of mechanical ventilation for 1 general SICU in the healthsystem.
Decreased MV days from 1.4 to 0.9 starting March 4, 2018

# Mixed Medical and Surgical ICUs #11 and 14

Graph 3: Control chart showing median days of mechanical ventilation for 2 mixed medical and surgical ICUs in the healthsystem. Trend towards decreased MV days from 0.8 to 0.4 starting April 22, 2018

ICUs # 7,8,9, and 10
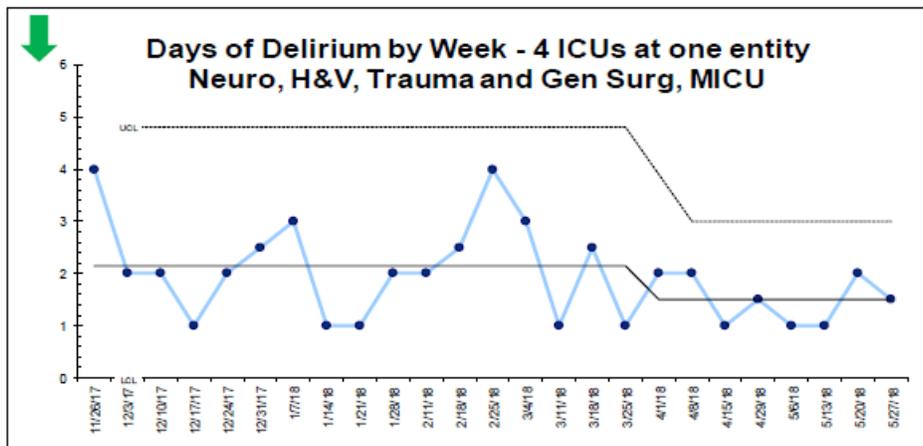
Graph 4: Control chart showing median days of delirium for 4 ICUs within one entity in the healthsystem. Decrease in days of delirium from 2.1 to 1.5 since April 1, 2018

ICUs # 2,4, and 5

Days of Delirium by Week - 3 ICU's at one entity
### General Surgical, MICU, Medical Cardiology
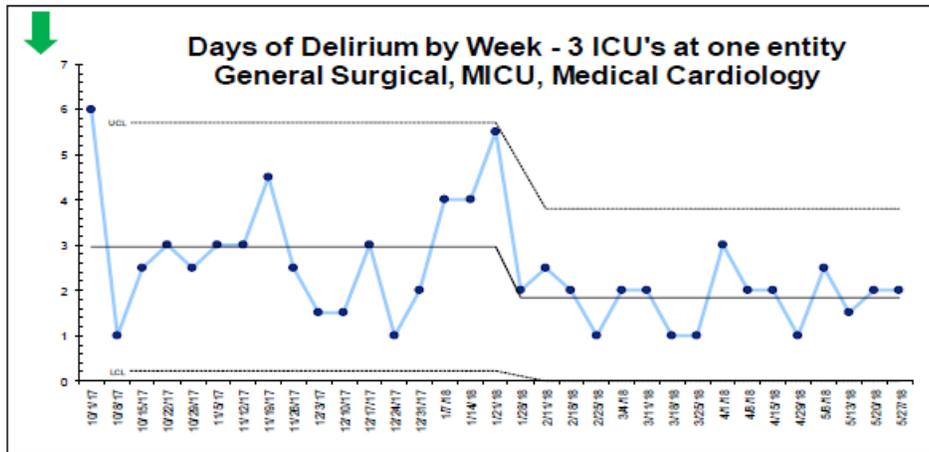
Graph 5: Control chart showing median days of delirium for 3 ICUs within one entity in the healthsystem.
Decrease in days of delirium from 3.0 to 1.8 since January 28, 2018

Monthly Average for 14 ICUs in Healthsystem

Adherence to delirium assessments 2X daily
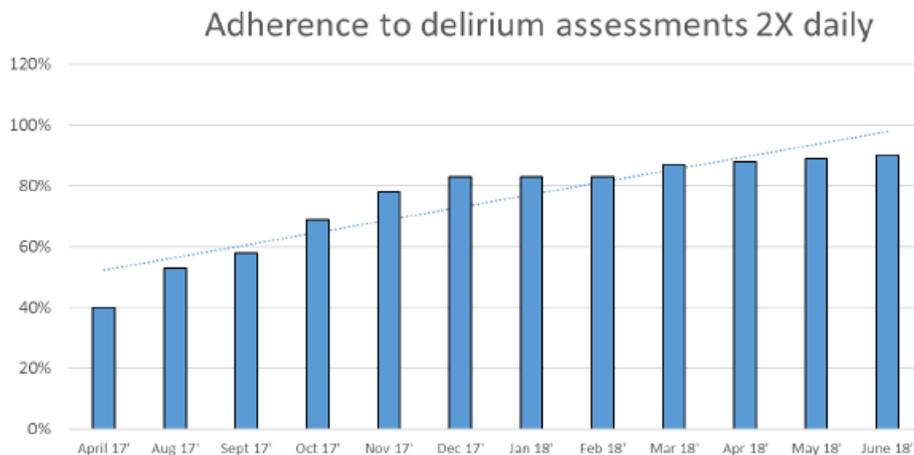
Graph 6: Adherence to nursing asssessment for delirium q 12 hours for all ICU patients

Monthly Average for 14 ICUs in Healthsystem

Adherence to Sedation/Agitation Assessment q 4 hours
Richmond Agitation Sedation Scale
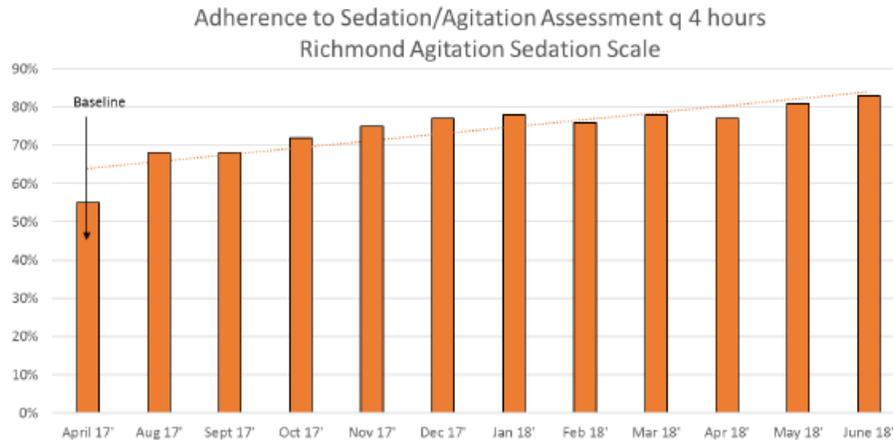
Graph 7: Adherence to nursing asssessment for sedation/agitation q 4 hours for all ICU patients

Sedation and Wakefulness

	12/17	1/18	2/18	3/18	4/18	5/18	6/18
Avg. RASS at time of SAT** alert	-2.42	-2.53	-2.41	-2.26	-2.33	-2.38	-2.45
Avg. Max RASS within 8-hrs post SAT alert	-1.26	-1.53	-1.31	-1.11	-1.38	-1.16	-1.18
% of patients with sedation reduction post alert	50%	50%	49%	57%	62%	57%	63%

Table 3: Richmond Agitation Sedation Scale (RASS) Scores at the time the nurse receives an alert that a patient is ready for A spontaneous breathing trial (SBT), but the patient is still receiving continuous infusions for sedation and/or pain management

**SAT= Spontaneous Awakening Trial
The alert fires when patient is ready for spontaneous breathing trial, is receiving continuous infusions, and RASS is (-1) or deeper

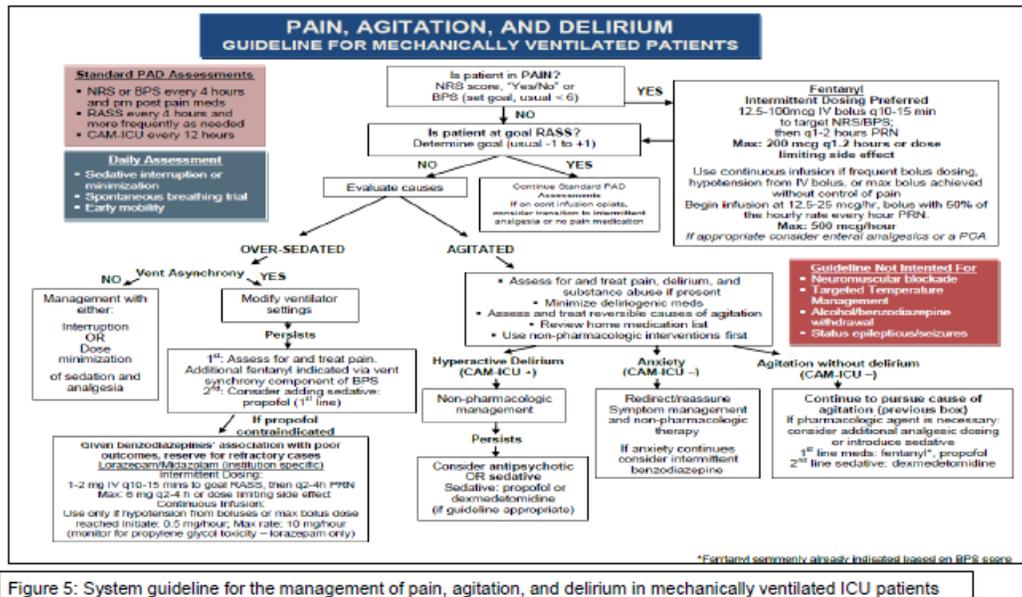# Pain, Agitation, and Delirium Guideline

Figure 5: System guideline for the management of pain, agitation, and delirium in mechanically ventilated ICU patients