Managing the Patient with the ABCDEF Bundle

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Presenter Disclosure Information

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organization listed below.

Company Name	*Relationship*
Teleflex	Clinical Consultant

ABCDEF Bundle

- Why do we need the bundle?
- What comprises the bundle?
- The supporting evidence
- Barriers to bundle adherence

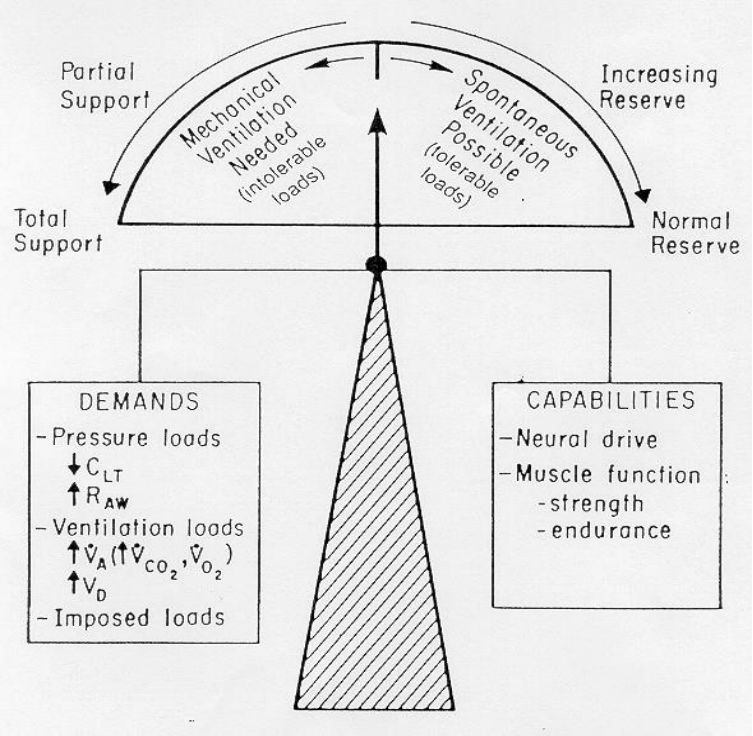
Why do we need a "Bundle"?

- Ultimate outcome from MV is
  - 67% liberated
    - 55-60% on first try
    - 25-30% require 2-5 tries
    - 5-10% require many tries
  - 28% die
  - 5% remain dependent
- Question: Is this the best we can expect?

Schmidt, et al. AJRCCM 2017; 195:115
Penuelas, et al. AJRCCM 2011;184:430

Ventilator dependency has 2 major causes

- Patient is too sick
  - Load-capacity imbalance
- "Iatrogenesis"
  - Recognition issues
  - Management issues (Vent, drugs, "whole" patient)



Ventilator dependency can be iatrogenic

- Failure to recognize discontinuation potential
- Imposed loading:
  - insufficient support
  - insensitive/unresponsive triggers
  - flow dys-synchrony
  - cycle dys-synchrony
- Unnecessary sedation:
  - Kress, et al. (2000) demonstrated that sedation protocols reduce ventilator time

Can Evidence Based Guidelines Improve This?

Kress, et al. N Engl J Med 2000;342:1471

What is the Bundle?

- Complex multicomponent bundle of evidence-based practices associated with shorter duration of mechanical ventilation and improved physical function in the adult population:
  - Awakening and breathing coordination
  - Delirium
  - Early exercise/mobility

ABCDEF Bundle

- A – **Assessment/Prevention/Management of Pain**
- B - **B**oth SAT and SBT
- C – **C**hoice of Sedation and Analgesia
- D – **D**elirium Assessment/Prevention/Management
- E - **E**arly Mobility and Exercise
- F – **F**amily Engagement and Empowerment

Assessment/Prevention/Management of Pain

- Barr, et al. CCM 2013; 41:263
  - American College of Critical Care Medicine sought to revise the guidelines from 2002
  - 20 person multidisciplinary task force
  - Quality of each recommendation was ranked as high (A), moderate (B) or low (C)
  - Strength of each recommendation was ranked as strong (1) or weak (2) and either in favor of (+) or against (-) an intervention

Evidence Grades

Level of Evidence	Quality of Evidence	Type of Evidence	Definition
A	High	High quality RCT	Further research is unlikely to change our confidence in the estimate of effect.
B	Moderate	RCT with significant limitations (downgraded)[b], or high-quality OS (upgraded)[c]	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
C	Low	OS	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

RCT = randomized controlled trial; OS = observational study.

[a]Adapted from Guyatt et al (40).

[b]RCTs with significant limitations: 1) study design limitations (planning, implementation bias); 2) inconsistency of results; 3) indirectness of evidence; 4) imprecision of results; 5) high likelihood of reporting bias.

[c]High-quality OS: 1) large magnitude of treatment effect; 2) evidence of a dose-response relationship; 3) plausible biases would decrease the magnitude of an apparent treatment effect.

Strength of recommendations: *recommendations only*

- *Either strong (1) , weak (2), or none (0)*
- *Either in favor of an intervention (+) or against an intervention (-)*

Barr, et al. CCM 2013; 41:263-306

Assessment/Prevention/ Management of Pain

PAIN AND ANALGESIA

1. ICU patients routinely experience pain at rest and with ICU care (B). Pain in cardiac surgery patients, especially women, is poorly treated (B). Procedural pain is common in ICU patients (B).
2. Perform routine pain assessment in all patients (1B). In motor intact patients unable to self report, we suggest using behavioral pain scales rather than vital signs to assess pain (2C). The BPS and CPOT are the most valid and reliable behavioral pain scales (B). Vital signs should only be used as a cue for further pain assessment (2C).
3. For non-neuropathic pain, use intravenous opioids as first line analgesic therapy (1C); use non-opioid analgesics to reduce opioid side effects (1C); and use either gabapentin or carbamazepine in conjunction with intravenous opioids for neuropathic pain (1A).
4. Suggest preemptively treating procedural pain (2C), especially chest tube removal (1C).
5. Use thoracic epidural analgesia for abdominal aortic surgery (1B), and suggest also using for traumatic rib fractures (2B). No evidence guides the use of lumbar epidural analgesia for abdominal aneurysm surgery (0A), or thoracic epidural analgesia for either intrathoracic or nonvascular abdominal surgical procedures (0B). No evidence guides the use of regional vs. systemic analgesia in medical ICU patients (0).

Barr, et al. CCM 2013; 41:263

Pain Scales

BPS -Behavioral Pain Scale

ITEM	SCORE
FACIAL EXPRESSION	1 2 3 4
UPPER LIMBS	1 2 3 4
COMPLIANCE WITH VENTILATOR	1 2 3 4

Score Range 3 – 12. Significant pain = BPS >5

CPOT – Critical Care Pain Observation Tool

INDICATOR	SCORE	
FACIAL EXPRESSION	Relaxed, neutral Tense Grimacing	0 1 2
BODY MOVEMENTS	Absence of movements Protection Restlessness	0 1 2
MUSCLE TENSION (evaluate by passive flexion and extension of upper extremities)	Relaxed Tense, rigid Very tense or rigid	0 1 2
COMPLIANCE WITH VENTILATOR (intubated patients) OR VOCALIZATION (extubated patients)	Alarms not activated; easy ventilation Coughing but tolerating Fighting ventilator Talking in normal tone or no sound Sighing, moaning Crying out, sobbing	0 1 2 0 1 2

CPOT range = 0 – 8; CPOT >2 is significant

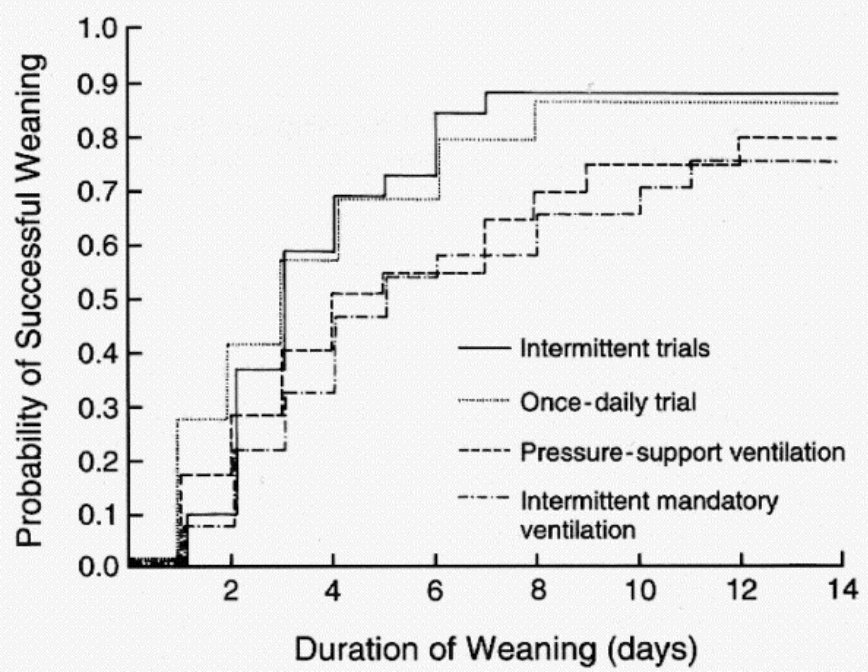
ABCDEF Bundle

- A – **A**ssessment/Prevention/Management of Pain
- B - **Both SAT and SBT**
- C – **C**hoice of Sedation and Analgesia
- D – **D**elirium Assessment/Prevention/Management
- E - **E**arly Mobility and Exercise
- F – **F**amily Engagement and Empowerment

Both SAT and SBT

- Sedation mismanagement (both over and under) compromises liberation attempts
  - Barr, et al. CCM 2013; 41: 263
- SAT
  - Kress, et al. NEJM 2000; 342:1471
  - Girard, et al. Lancet 2008; 371:126
- SBT best way to identify those ready for liberation
  - Ely, et al. NEJM 1996; 335:1864
  - MacIntyre, et al. Chest 2001; 120 (6 Suppl): 375S
  - Schmidt, et al. AJRCCM 2017; 195:115

SAT and SBT



Daily SBT's led to extubation:

- 3 X more quickly than IMV
- 2X more quickly than PSV

Esteban et al. NEJM 1995; pp 335-350.

"Formal discontinuation assessments for patients receiving mechanical ventilation for respiratory failure should be performed during spontaneous breathing. The tolerance of SBTs lasting 30 to 120 min should prompt consideration for permanent ventilator discontinuation."

Evidence (Grade A)

Chest 2001; 120 (6 Suppl): 375S

"*For acutely hospitalized patients ventilated >24 h, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5–8 cm H2O) rather than without (T-piece or CPAP)."*

Evidence – moderate certainty

Schmidt, et al. AJRCCM 2017; 195:115

SAT and SBT

- Kress, et al. NEJM 2000; 342:1471.
  - 128 adult pts
  - Daily sedation interruption vs continuous sedation
  - Duration of MV
    - 4.9 days intervention group
    - 7.3 days control group

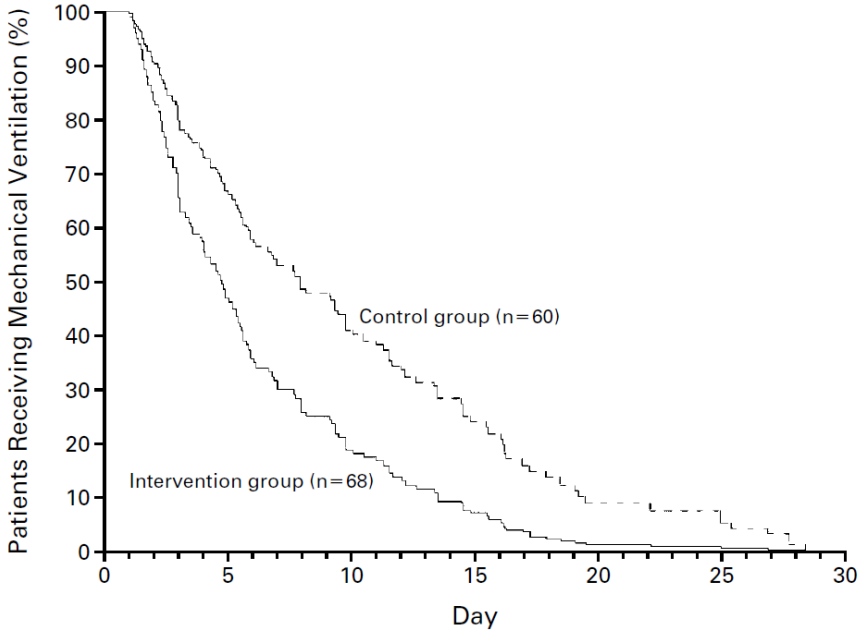


Figure 1. Kaplan–Meier Analysis of the Duration of Mechanical Ventilation, According to Study Group.

SAT and SBT

- Girard, et al. Lancet 2008; 371:126
  - 336 MV pts
  - SAT paired with SBT vs sedation per usual with SBT

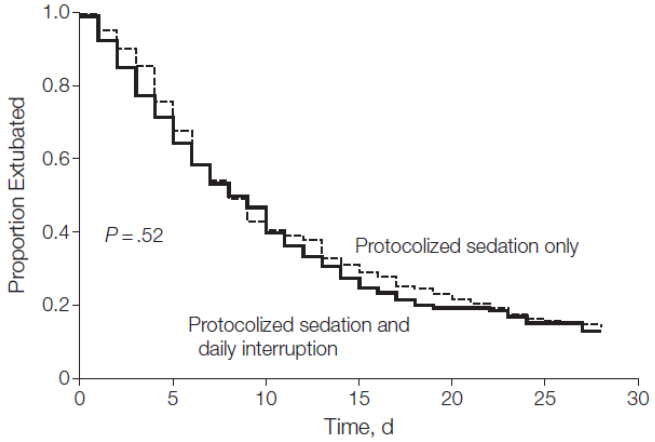
	Intervention group (n=167)	Control group (n=168)	p value
Ventilator-free days*			
Mean	14·7 (0·9)	11·6 (0·9)	0·02
Median	20·0 (0 to 26·0)	8·1 (0 to 24·3)	
Time to discharge (days)			
From intensive care	9·1 (5·1 to 17·8)	12·9 (6·0 to 24·2)	0·01
From hospital	14·9 (8·9 to 26·8)	19·2 (10·3 to NA)†	0·04
28-day mortality	47 (28%)	58 (35%)	0·21
1-year mortality	74 (44%)	97 (58%)	0·01
Duration of brain dysfunction (days)			
Coma	2 (0 to 4)	3 (1 to 7)	0·002
Delirium	2 (0 to 5)	2 (0 to 6)	0·50
RASS at first successful SBT	−1 (−3 to 0)	−2·5 (−4 to 0)	0·0001
Complications			
Any self-extubation	16 (10%)	6 (4%)	0·03
Self-extubation requiring reintubation‡	5 (3%)	3 (2%)	0·47
Reintubation‡	23 (14%)	21 (13%)	0·73
Tracheostomy	21 (13%)	34 (20%)	0·06

Data are mean (SD), n (%), or median (IQR). RASS=Richmond agitation-sedation scale. SAT=spontaneous awakening trial. SBT=spontaneous breathing trial. *Ventilator-free days from study day 1 to 28. †Greater than 25% of patients in the SBT group remained in the hospital at study day 28. ‡Reintubation within 48 hours of extubation.

SAT and SBT

- Mehta, et al. JAMA 2012; 308:1985.
  - 423 MV pts
  - Protocolized sedation/daily interruption vs Protocolized sedation only
  - Daily interruption did not reduce the duration of MV or ICU LOS

Figure 2. Kaplan-Meier Curves for Time to Successful Extubation



No. at risk						
Protocolized sedation only	209	146	72	49	34	23
Protocolized sedation and daily interruption	214	140	81	42	28	16

ABCDEF Bundle

- A – **A**ssessment/Prevention/Management of Pain
- B - **B**oth SAT and SBT
- C – **Choice of Sedation and Analgesia**
- D – **D**elirium Assessment/Prevention/Management
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- F – **F**amily Engagement and Empowerment

Choice of Sedation and Analgesia

Statement	Recommendation
Maintaining lighter levels of sedation is associated with improved outcomes	1B
The RASS and SAS scales are the most valid and reliable instruments to assess adequacy and depth of sedation depth	B
Use brain function monitors to assess seadation in paralyzed pts but only use as adjuncts in unparalyzed pts	2B 1B
Use EEG monitoring to monitor non-convulsive seizure activity for pts at risk of siezures, titrate burst suppression therapy for pts with elevated intracranial pressure	1A
Use daily sedation interruption or titrate sedation to maintain light levels of sedation	1B
Use sedation protocols and daily checklists for management of pain, agitation and delirium	1B

Barr, et al. CCM 2013; 41: 263

Choice of Sedation and Analgesia

RASS - Richmond Agitation & Sedation Scale

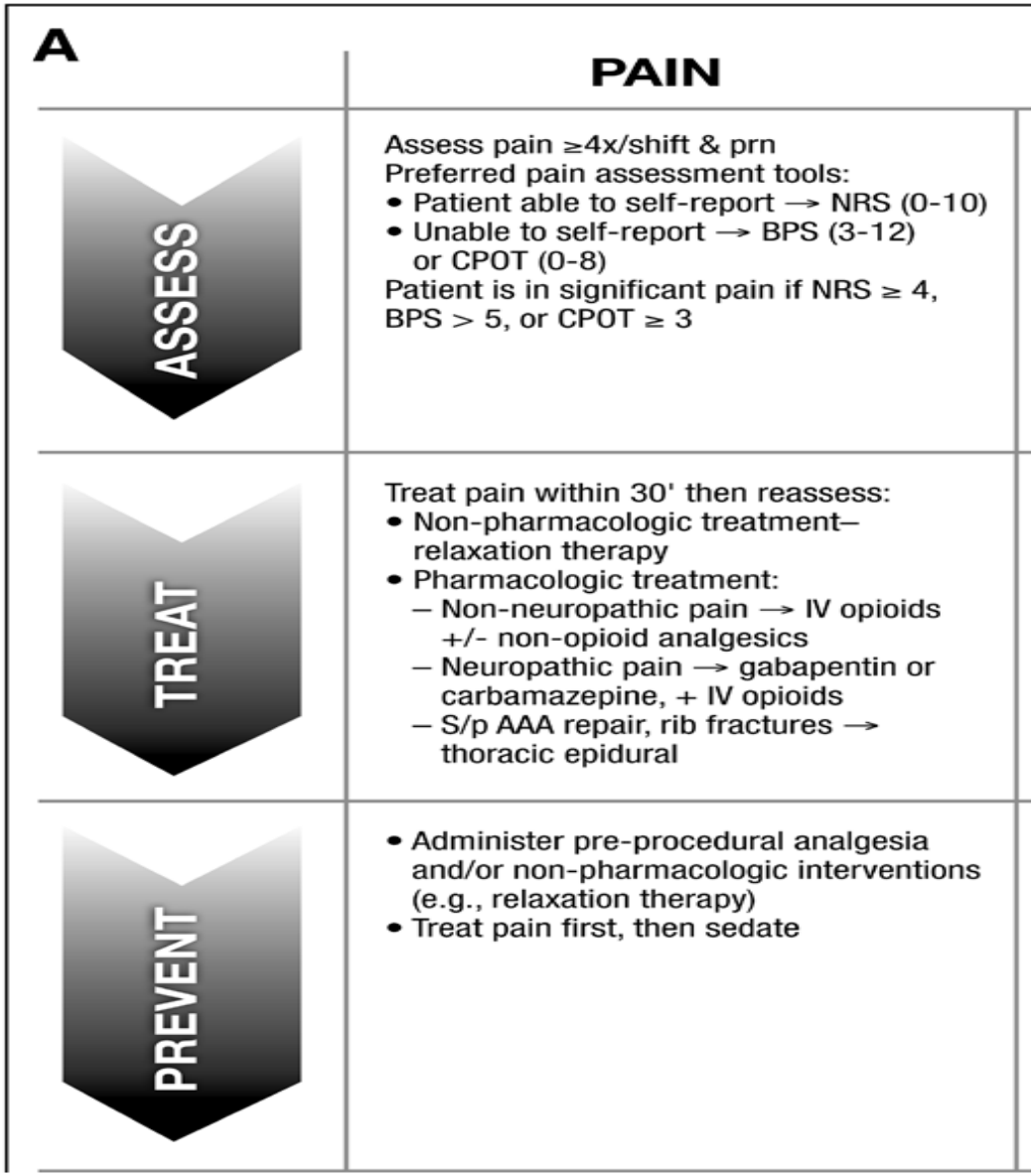
Richmond Agitation-Sedation Scale

Score	Term	Description
+4	Combative	Overtly combative or violent and an immediate danger to staff
+3	Very agitated	Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff
+2	Agitated	Frequent nonpurposeful movement or patient ventilator dyssynchrony
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	
-1	Drowsy	Not fully alert but has sustained (> 10 seconds) awakenings, with eye contact, to voice
-2	Light sedation	Briefly (< 10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, but any movement to physical stimuli
-5	Unarousable	No response to voice or physical stimulation

SAS - Sedation Agitation Scale

Score	State	Behaviors
7	Dangerous agitation	Pulls at ET tube, climbs over bedrail, strikes at staff, thrashes side to side
6	Very agitated	Does not calm despite frequent verbal reminding, requires physical restraints
5	Agitated	Anxious or mildly agitated, attempts to sit up, calms down to verbal instructions
4	Calm and cooperative	Calm, awakens easily, follows commands
3	Sedated	Difficult to arouse, awakens to verbal stimuli or gentle shaking but drifts off
2	Very sedated	Arouses to physical stimuli but does not communicate or follow commands
1	Unarousable	Minimal or no response to noxious stimuli, does not communicate or follow commands

Choice of Sedation and Analgesia



A	PAIN
ASSESS	Assess pain ≥4x/shift & prn Preferred pain assessment tools: • Patient able to self-report → NRS (0-10) • Unable to self-report → BPS (3-12) or CPOT (0-8) Patient is in significant pain if NRS ≥ 4, BPS > 5, or CPOT ≥ 3
TREAT	Treat pain within 30' then reassess: • Non-pharmacologic treatment– relaxation therapy • Pharmacologic treatment: – Non-neuropathic pain → IV opioids +/- non-opioid analgesics – Neuropathic pain → gabapentin or carbamazepine, + IV opioids – S/p AAA repair, rib fractures → thoracic epidural
PREVENT	• Administer pre-procedural analgesia and/or non-pharmacologic interventions (e.g., relaxation therapy) • Treat pain first, then sedate

ABCDEF Bundle

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Delirium

- Increased mortality in adult ICU patients (A)
- Prolonged ICU and hospital LOS in adult ICU patients (A)
- The development of post-ICU cognitive impairment (B)

Barr, et al. CCM 2013; 41: 263

Delirium

- Risk factors:
  - preexisting dementia
  - history of hypertension and/or alcoholism
  - a high severity of illness at admission
  - coma is an independent risk factor
  - conflicting data surround the relationship between opioid/sedation use and the development of delirium in adult ICU patients

Delirium

- Prevention:
  - Routinely monitor for delirium (1B)
    - CAM-ICU
    - ICDSC
  - Early mobilization (+1B)
  - Promote sleep by optimizing the environment (1C)
  - Stop any medication that increases the risk of delirium

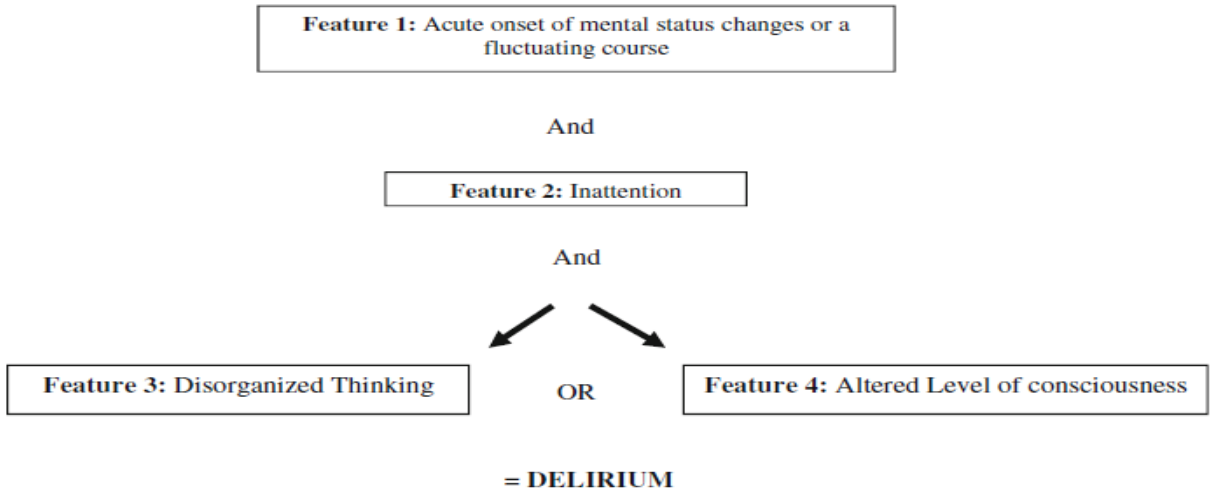

Fig. 2 Confusion Assessment Method for the ICU (CAM-ICU). The diagnosis of delirium requires the presence of acute onset of changes or fluctuations in the course of mental status (*feature 1*) and inattention (*feature 2*), plus either disorganized thinking (*feature 3*) or an altered level of consciousness. (Adapted from Ely et al. [3])

Table 1 Intensive Care Delirium Screening Checklist (ICDSC)

Patient evaluation	
Altered level of consciousness (A–E)	A: No response, score: none B: Response to intense and repeated stimulation (loud voice and pain), score: none C: Response to mild or moderate stimulation, score 1 D: Normal wakefulness, score: 0 E: Hypervigilance, rated as abnormal level of conciousness, score: 1
Inattention	Difficulty in following a conversation or instructions. Easily distracted by external stimuli. Difficulty in shifting focuses. Any of these scores 1 point
Disorientation	Any obvious mistake in time, place or person scores 1 point
Hallucinations–delusion–psychosis	The unequivocal clinical manifestation of hallucination or of behavior probably due to hallucination or delusion. Gross impairment in reality testing. Any of these scores 1 point
Psychomotor agitation or retardation	Hyperactivity requiring the use of additional sedative drugs or restraints in order to control potential danger to oneself or others. Hypoactivity or clinically noticeable psychomotor slowing. Any of these scores 1 point
Inappropriate speech or mood	Inappropriate, disorganized or incoherent speech. Inappropriate display of emotion related to events or situation. Any of these scores 1 point
Sleep/wake cycle disturbance	Sleeping less than 4 h or waking frequently at night (do not consider wakefulness initiated by medical staff or loud environment). Sleeping during most of the day. Any of these scores 1 point
Symptom fluctuation	Fluctuation of the manifestation of any item or symptom over 24 h scores 1 point
Total score (0–8)	

Ouimet, et al. Intensive Care Med 2008; 34:1907

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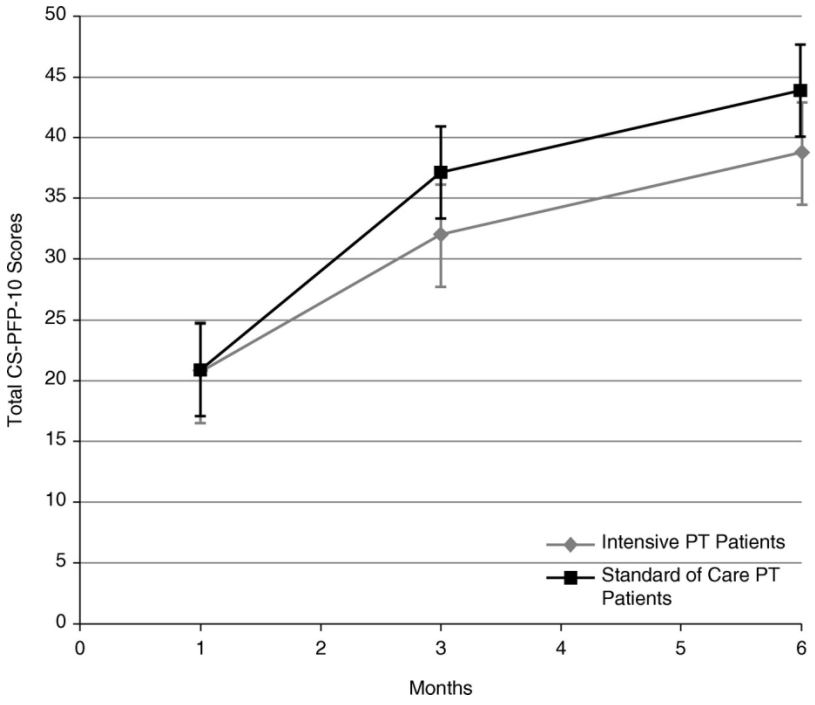
Early Mobility and Exercise

- ICU acquired weakness is real, impacts liberation outcome and is multifactorial
  - Disuse, drugs, nutrition, disease
  - Kalb. NEJM 2014; 371:287
- Early aggressive mobility may improve outcomes
  - Schweikert, et al. Lancet 2009; 373: 1874

Early Mobility and Exercise

- May not be for everyone
  - Moss, et al. AJRCCM 2016; 193:1101
    - 120 acute respiratory failure pts who required MV ≥ 4 days
    - Early physical therapy programs may benefit patients with acute respiratory failure; however, their proper duration and intensity is currently unknown.



Keep in mind that activity can stress ICU patients

- Bourdin, et al. Respir Care 2010; 55:400.
  - 20 ICU pts and early mobilization

Table 2. Mean Changes in Physiologic Variables After Each Intervention

Variable and Intervention	Mean Change	95% Confidence Interval	P*
Heart Rate (beats/min)			
Chair-sitting	–3.5	–6.5 to –0.4	.03
Walking	6.9	2.6 to 11.1	.002
Tilting-up with arms unsupported	14.6	10.8 to 18.4	< .001
Tilting-up with arms supported	12.4	7.0 to 17.9	< .001
Respiratory rate (breaths/min)			
Chair-sitting	–1.4	–2.6 to 0.1	.03
Walking	5.9	3.8 to 8.0	< .001
Tilting-up with arms unsupported	5.5	3.6 to 7.3	< .001
Tilting-up with arms supported	2.6	–0.4 to 5.7	.09
Mean Arterial Pressure (mm Hg)			
Chair-sitting	–2.13	–4.7 to 0.42	.10
Walking	0.9	–3.9 to 5.8	.70
Tilting-up with arms unsupported	0.3	–3.6 to 4.2	.87
Tilting-up with arms supported	8.9	1.8 to 16.0	.01
Transcutaneously Measured Oxygen Saturation (%)			
Chair-sitting	0.5	0.0 to 1.0	.07
Walking	–1.4	–2.2 to –0.5	.001
Tilting-up with arms unsupported	–0.9	–1.7 to –0.2	.001
Tilting-up with arms supported	–1	–2.2 to 0.2	.10

Early mobility and exercise – careful!

- Risks include:
  - Desaturation
  - Falls
  - Pt-ventilator dyssynchrony
  - Accidental extubation
  - Cardiovascular changes
  - Loss of vascular access

Early mobility and exercise

- Monitoring is key:
  - Adler, et al. Cardiopul Physical Therapy J 2012; 23:5

Table 3. Criteria for Terminating a PT/ OT Mobilization Session as Summarized from the Literature

Heart Rate: • > 70% APMHR • > 20% decrease in resting HR • < 40 beats/ minute; > 130 beats/ minute • New onset dysrhythmia • New anti-arrhythmia medication • New MI by ECG or cardiac enzymes	Pulse Oximetry/ SpO_2: • > 4% decrease • < 88%- 90%
Blood Pressure: • SBP > 180 mmHg • > 20% decrease in SPB/ DBP; orthostatic hypotension • MAP < 65 mmHg; >110 mmHg • Presences of vasopressor medication; new vasopressor or escalating dose of vasopressor medication	Mechanical Ventilation: • $F_IO_2 \geq 0.60$ • PEEP ≥ 10 • Patient-ventilator asynchrony • MV mode change to assist-control • Tenuous airway
Respiratory Rate: • < 5 breaths/ minute; > 40 breaths/ minute	Alertness/ Agitation and Patient symptoms: • Patient sedation or coma – RASS ≤ -3 • Patient agitation requiring addition or escalation of sedative medication; RASS >2 • Patient c/o intolerable DOE • Patient refusal
PT=physical therapy, OT=occupational therapy, HR= heart rate, RR=respiratory rate SPo2=saturation of peripheral oxygen, MI=myocardial infarction, ECG=electrocardiogram BP=blood pressure, SBP/DBP=systolic/diastolic blood pressure, MAP=mean arterial blood pressure FiO2=fraction of inspired oxygen, Peep=positive end expiratory pressure, MV=mechanical ventilation APMHR=age predicted maximum heart rate, RASS=Richmond Agitation Sedation Scale, DOE=dyspnea on exertion	

Early Mobility and Exercise

- Hodgson, et al. Crit Care 2014;18:658
  - Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults

	Low risk of an adverse event. Proceed as usual according to each ICU's protocols and procedures.
	Potential risk and consequences of an adverse event are higher than green, but may be outweighed by the potential benefits of mobilization. The precautions or contraindications should be clarified prior to any mobilization episode. If mobilized, consideration should be given to doing so gradually and cautiously.
	Significant potential risk or consequences of an adverse event. Active mobilization should not occur unless specifically authorized by the treating intensive care specialist in consultation with the senior physical therapist and senior nursing staff.

Suncoast Pulmonary Symposium

RESPIRATORY CONSIDERATIONS	IN-BED EXERCISES	OUT-OF-BED EXERCISES
Intubation		
Endotracheal tube [a]		
Tracheostomy tube		
Respiratory parameters		
Fraction of inspired oxygen		
≤ 0.6		
> 0.6		
Percutaneous oxygen saturation		
≥ 90%		
< 90% [b]		
Respiratory rate		
≤ 30 bpm		
> 30 bpm		
Ventilation		
Mode HFOV		
PEEP		
≤ 10 cmH_2O		
> 10 cmH_2O		
Ventilator dysynchrony [c]		
Rescue therapies		
Nitric oxide		
Prostacyclin		
Prone positioning [d]		

a

Cardiovascular Considerations	In-bed exercises	Out-of-bed exercises
Blood pressure		
Intravenous antihypertensive therapy for hypertensive emergency [a]	🔴	🔴
MAP [b]:		
Below target range and causing symptoms	🔺	🔴
Below target range despite support (vasoactive and/or mechanical)	🔺	🔴
Greater than lower limit of target range while receiving no support or low level support	🟢	🟢
Greater than lower limit of target range while receiving moderate level support	🔺	🔺
Greater than lower limit of target range on high level support	🔺	🔴
Known or suspected severe pulmonary hypertension	🔺	🔺
Cardiac arrhythmias		
Bradycardia:		
Requiring pharmacological treatment (e.g., isoprenaline) or awaiting emergency pacemaker insertion	🔴	🔴
Not requiring pharmacological treatment and not awaiting emergency pacemaker insertion	🔺	🔺
Transvenous or epicardial pacemaker:		
Dependent rhythm	🔺	🔴
Stable underlying rhythm	🟢	🟢

b

Any stable tachyarrhythmia:		
Ventricular rate >150 bpm	🔺	🔴
Ventricular rate 120 to 150 bpm	🔺	🔺
Any tachyarrhythmia with ventricular rate < 120 bpm	🟢	🟢
Devices		
Femoral IABP [c]	🟢	🔴
ECMO:		
Femoral [c] or subclavian (not single bicaval dual lumen cannulae)	🟢	🔴
Single bicaval dual lumen cannulae inserted into a central vein	🟢	🔺
Ventricular assist device	🟢	🟢
Pulmonary artery catheter or other continuous cardiac output monitoring device	🟢	🔺
Other cardiovascular considerations		
Shock of any cause with lactate >4mmol/L	🔺	🔺
Known or suspected acute DVT/PE	🔺	🔺
Known or suspected severe aortic stenosis	🟢	🔺
Cardiac ischemia (defined as ongoing chest pain and/or dynamic EKG changes)	🔺	🔴

IABP = intra-aortic balloon pump; ECMO = extracorporeal membrane oxygenation; bpm = beats per minute; MAP = mean arterial pressure; DVT = deep vein thrombosis; PE = pulmonary embolus.

[a] This may be a yellow (pause) for in-bed activities if the blood pressure is within target range as documented by the medical team.

[b] Experienced ICU practitioners were considered to have good judgment about the impact of cardiovascular instability and low, medium or high levels of hemodynamic support, on the ability to exercise. However, in the case of uncertainty or lack of experience, it is recommended that the decision to mobilize a patient is discussed with appropriate experienced ICU staff. The target mean arterial pressure is determined by the treating ICU team.

[c] Cycling and hip flexion may be contraindicated in the leg where the IABP/ECMO is inserted. If so, in-bed exercises may need to be modified to limit hip flexion.

NEUROLOGICAL CONSIDERATIONS	IN-BED EXERCISES	OUT-OF-BED EXERCISES
Level of consciousness		
Patient drowsy, calm or restless (e.g., RASS -1 to +1)		
Patient lightly sedated or agitated (e.g., RASS -2 or +2)		
Patient unrousable or deeply sedated (e.g., RASS <-2)		
Patient very agitated or combative (e.g., RASS >+2)		
Delirium		
Delirium tool (e.g., CAM-ICU) –ve		
Delirium tool +ve and able to follow simple commands		
Delirium tool +ve and not able to follow commands		
Intracranial pressure		
Active management of intracranial hypertension, with ICP not in desired range		
Intracranial pressure monitoring without active management of intracranial hypertension		
Other neurological considerations		
Craniectomy		
Open lumbar drain (not clamped)		
Subgaleal drain		
Spinal precautions (pre-clearance or fixation)		
Acute spinal cord injury		
Subarachnoid haemorrhage with unclipped aneurysm		
Vasospasm post-aneurysmal clipping		
Uncontrolled seizures		

RASS = Richmond Agitation Assessment Scale; CAM-ICU = confusion assessment method for the ICU.

OTHER CONSIDERATIONS	IN-BED EXERCISES	OUT-OF-BED EXERCISES
Surgical		
Unstable/unstabilized major fracture Pelvic Spinal Lower limb long bone		
Large open surgical wound Chest/sternum[a] Abdomen[a]		
Medical		
Known uncontrolled active bleeding		
Suspicion of active bleeding or increased bleeding risk[b]		
Patient is febrile with a temperature exceeding acceptable maximum despite active physical or pharmacological cooling management		
Active hypothermia management		
Other considerations		
ICU-acquired weakness		
Continuous renal replacement therapy (including femoral dialysis catheters)		
Venous and arterial femoral catheters		
Femoral sheaths		
All other drains and attachments, e.g., Nasogastric tube Central venous catheter Pleural drain Wound drain Intercostal catheter Urinary catheter		

[a] Patients with large open wounds who have a prolonged stay in ICU may be able to commence mobilization after consultation with the treating surgeon.

[b] The suspicion of active bleeding is not just about bleeding risk, but the likelihood of an adverse event that will be compounded by an increased bleeding risk, e.g. fall or line displacement.

Early Mobility and Exercise

- Outcomes
  - Hester, et al. CCM 2017;45:1037
    - investigate a progressive mobility program in a neurocritical care population
      - 1118 pre period
      - 731 post period
      - 796 sustained period

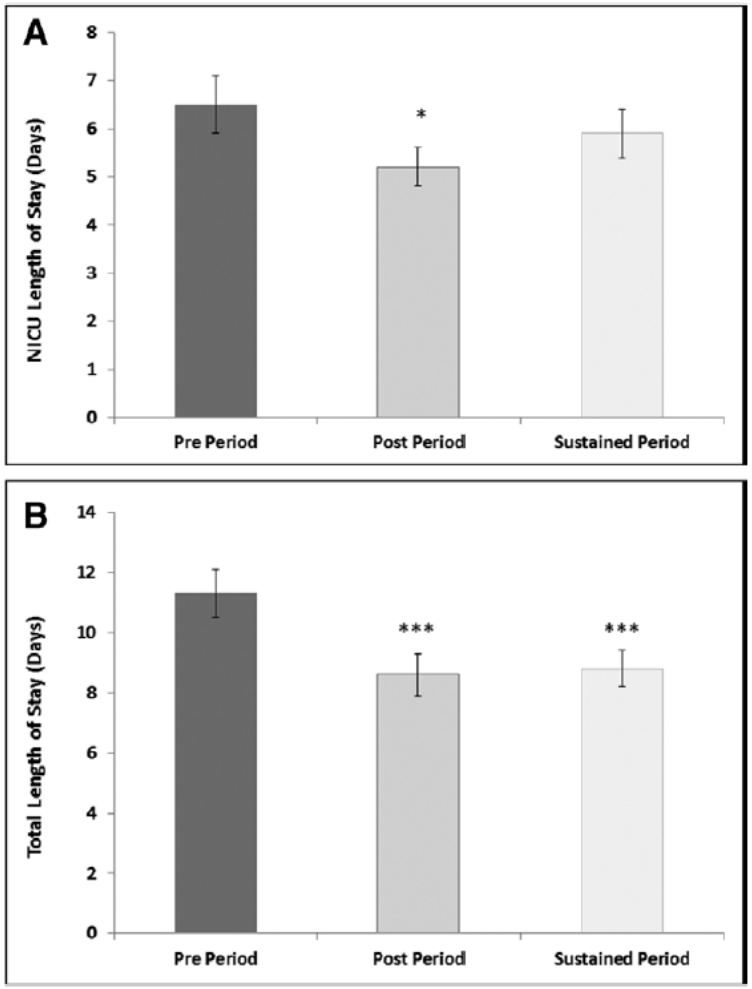


Figure 1. Mean neuro-ICU (NICU) (**A**) and total length of stay (**B**) across each study period. *Error bars* represent 95% CIs. *p* values for comparisons with preintervention period: $^{*}p < 0.05$, $^{***}p < 0.001$.

Suncoast Pulmonary Symposium

Hester, et al.

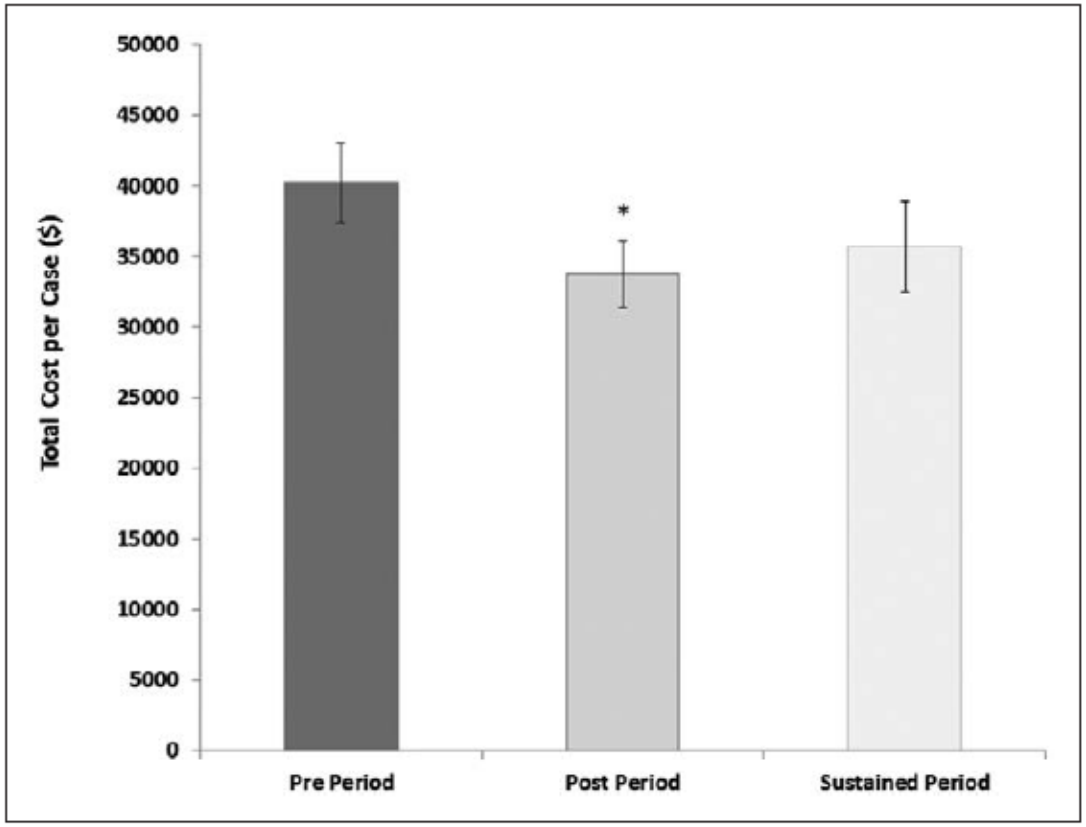


Figure 2. Mean total cost per case (adjusted for inflation relative to preintervention period) across each study period. *Error bars* represent 95% CIs. *p* values for comparisons with preintervention period: $^{*}p < 0.05$.

ABCDEF Bundle

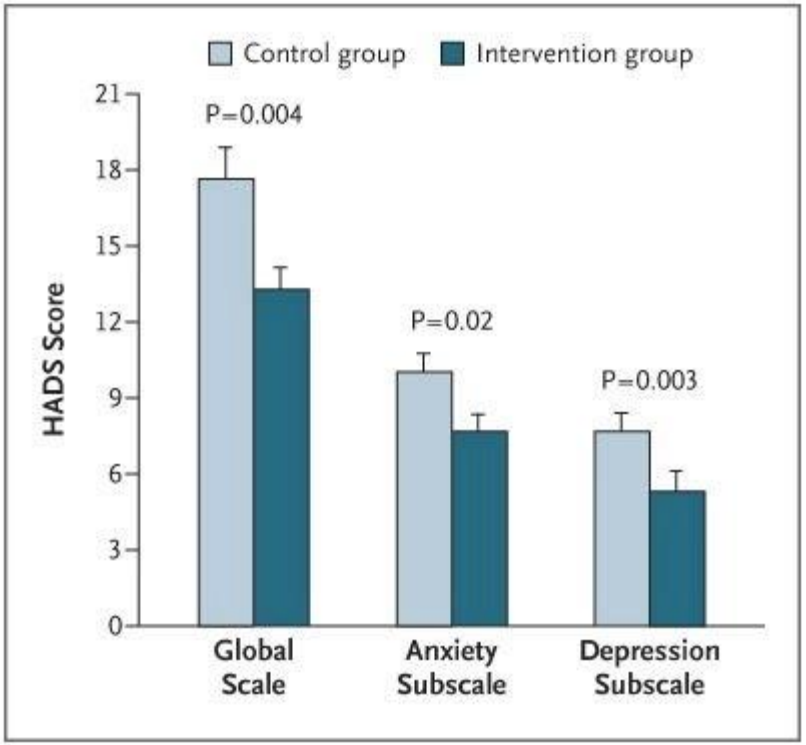
- A – **A**ssessment/Prevention/Management of Pain
- B - **B**oth SAT and SBT
- C – **C**hoice of Sedation and Analgesia
- D – **D**elirium Assessment/Prevention/Management
- E - **E**arly Mobility and Exercise
- F – **Family Engagement and Empowerment**

Family Engagement and Empowerment

- Relatively new concept addressing role of communication and family engagement to improve outcomes (both patients AND families).
  - Cameron, et al. NEJM 2016; 374:1831
- May be particularly important in end-of-life situations
  - Lautrette, et al. NEJM 2007;365:469

Family Engagement and Empowerment

- Lautretter, et al. NEJM 2007;365:469
  - Prospective study of family members of 126 patients dying in 22 ICUs in France randomly assigned to the intervention format or to the customary end-of-life conference



Bundle Outcomes

- Balas, et al. CCM 2014; 42:1024
  - Eighteen-month, prospective, cohort, before-after study
  - Five adult ICUs, one step-down unit, and one oncology/hematology special care unit located in a 624-bed tertiary medical center.
  - Two hundred ninety-six patients (146 prebundle and 150 postbundle implementation), Interventions: Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility bundle.

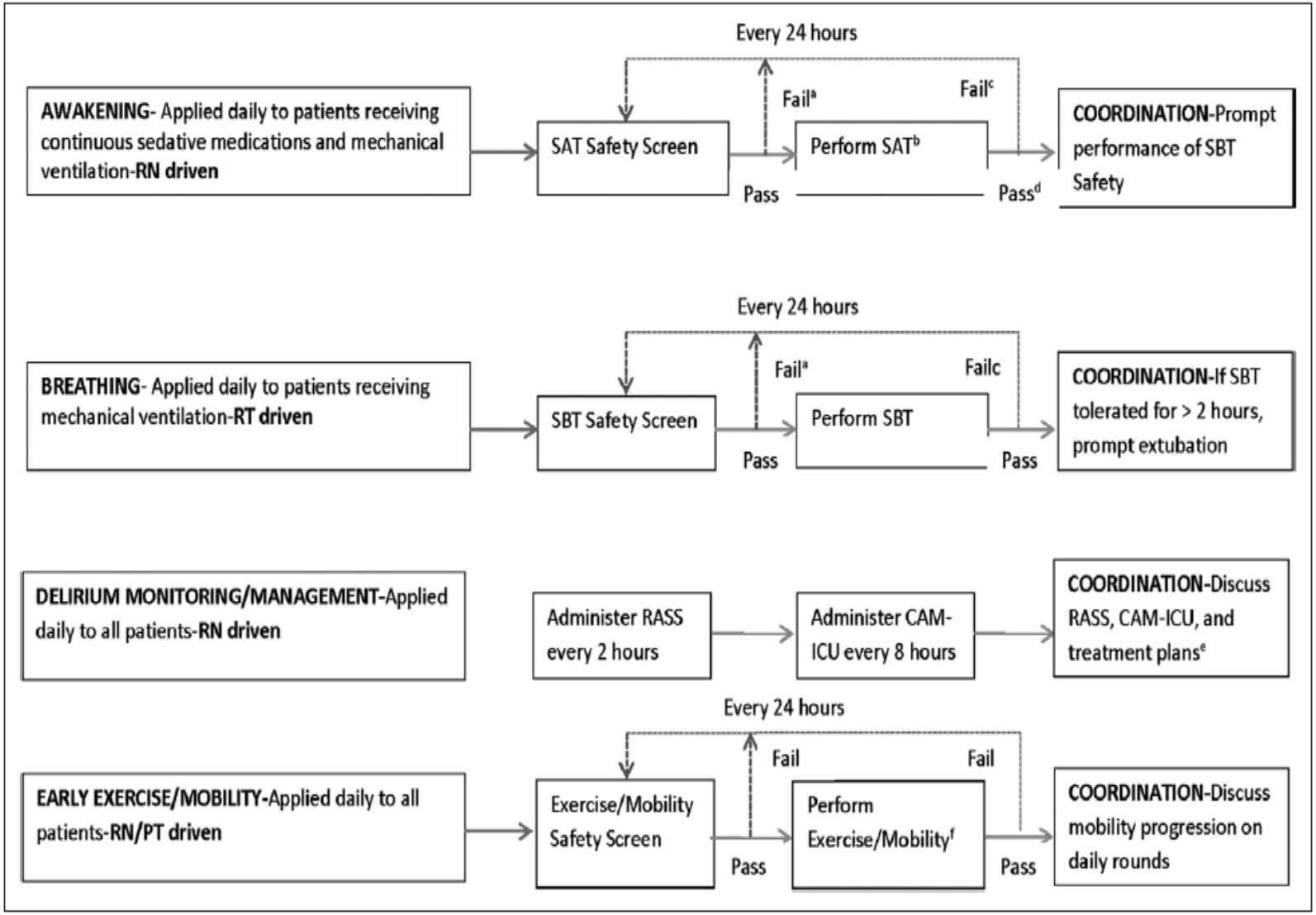

Every 24 hours
AWAKENING- Applied daily to patients receiving continuous sedative medications and mechanical ventilation-RN driven
SAT Safety Screen
Fail[a]
Perform SAT[b]
Fail[c]
Pass
Pass[d]
COORDINATION-Prompt performance of SBT Safety
Every 24 hours
BREATHING- Applied daily to patients receiving mechanical ventilation-RT driven
SBT Safety Screen
Fail[a]
Perform SBT
Failc
Pass
Pass
COORDINATION-If SBT tolerated for > 2 hours, prompt extubation
DELIRIUM MONITORING/MANAGEMENT-Applied daily to all patients-RN driven
Administer RASS every 2 hours
Administer CAM-ICU every 8 hours
COORDINATION-Discuss RASS, CAM-ICU, and treatment plans[e]
Every 24 hours
EARLY EXERCISE/MOBILITY-Applied daily to all patients-RN/PT driven
Exercise/Mobility Safety Screen
Fail
Perform Exercise/Mobility[f]
Fail
Pass
Pass
COORDINATION-Discuss mobility progression on daily rounds

TABLE 3. Effectiveness Outcomes of ABCDE Bundle Implementation

ABCDE Bundle Component Outcome	Pre-ABCDE Bundle ($n = 146$)	Post-ABCDE Bundle ($n = 150$)	Unadjusted p	Adjusted Odds Ratio	Adjusted p
Awakening and breathing coordination[a]					
Ventilator-free days[a]					
Mean (SD)	15 (11.4)	18 (10.6)			
Median (IQR)	21 (0–25)	24 (7–26)	0.04		
Delirium monitoring/management					
Delirium anytime, *n* (%)	91 (62.3)	73 (48.7)	0.02	0.55[b] (0.33–0.93)	0.03
Duration of delirium, days, median (IQR)	3 (1–6)	2 (1–4)	0.52		
Percent ICU days spent delirious, median (IQR)	50 (30–64.3)	33.3 (18.8–50)	0.003		
Coma anytime, *n* (%)	41 (28.1)	43 (28.7)	0.91	1.00[b]	0.99
Coma days, median (IQR)	2 (1–4)	2 (1–5)	0.35		
Percent ICU days spent in coma, median (IQR)	25 (18.2–44.4)	25 (12.5–42.9)	0.89		
Richmond Agitation-Sedation Scale Score, mean (SD)	0.02 (1.4)	−1.03 (1.2)	0.38		
Early exercise/mobility					
Mobilized out of bed anytime in ICU, *n* (%)	70 (48)	99 (66.0)	0.002	2.11[b] (1.30–3.45)	0.003
28-day mortality[c]					
Hospital mortality (ICU and post-ICU), *n* (%)	29 (19.9)	17 (11.3)	0.04	0.56[b] (0.28–1.10)	0.09
ICU mortality, *n* (%)	24 (16.4)	14 (9.3)	0.07		
Time to discharge[d] (d)					
From ICU, median (IQR)	5 (3, 8)	4 (3, 5)	0.21	1.16[e] (0.89–1.50)	0.27
From hospital, median (IQR)	13 (9, 15)	11 (9, 13)	0.99	1.01[e] (0.77–1.31)	0.96
Residence at hospital discharge,[f] *n* (%)					
Home	51 (44)	60 (45.1)	0.86		
Nursing home	9 (7.8)	8 (6)			
Skilled nursing facility	13 (11.2)	16 (12)			
Rehabilitation center	29 (25)	27 (20.3)			
Home with hospice	1 (0.9)	2 (1.5)			
Hospice center	2 (1.7)	4 (3)			
Swing bed/other hospital	8 (6.9)	6 (4.5)			
Other	3 (2.6)	10 (7.5)			
Change in residence for those who came from home[g], *n* (%)	72 (61)	72 (54.6)	0.30	1.16[b] (0.66–2.03)	0.60

Barriers to Bundle Adherence

1. Patient-related barriers (CFIR outer setting)
• Lack of patient cooperation
• Patient instability and patient safety concerns (hemodynamics, treatment-related adverse events, physiologic patient issues)
• Patient status issues (ie, diarrhea, fatigue, leaking wound, patient weight or size, confusion/agitation, imminent death)
2. Clinician-related barriers (CFIR characteristics of individuals)
• Lack of knowledge and awareness about protocol
• Lack of conceptual agreement with guidelines
• Lack of self-efficacy and confidence in implementing protocol
• Clinician preference for autonomy (resistance to change, expectation of nurse)
• Staff and patient safety concerns
• Perception that rest equals healing
• Reluctance to follow protocol (previous execution associated with negative outcomes)
• Lack of confidence that protocol will improve workflow or improve patient outcomes
• Perceived workload (hard work)
• Staff attitude and lack of buy-in
• Safety of tubes, catheters, and wires
3. Protocol-related barriers (CFIR intervention characteristics)
• Unavailable or cumbersome to use protocols
• Unclear protocol criteria and agreement or discomfort with guidelines
• Protocol development cost (time and money to develop)
• Learning curve (possibility for clinician to test guideline and observe other clinicians using the guideline easily)
• Lack of clarity as to who is responsible, steps needed to take, and expected standards for protocol implementation
• Lack of confidence in evidence supporting protocol and guideline developer
• Lack of confidence in reliability of screening tools
4. ICU contextual barriers (CFIR inner setting)
• Culture (safety culture)
• Interprofessional team care coordination, communication, and collaboration barriers
• Lack of leadership/management
• Interprofessional clinician staffing, workload, and time
• Lack of interprofessional team support and training/expertise
• Physical environment, equipment, and resources
• Staff turnover
• Low prioritization and perceived importance
• Competing priorities and need for further planning
• Scheduling conflicts (ie, patient off unit, at dialysis, procedure)

ABCDE = Awakening and Breathing Coordination, Delirium, and Early exercise/mobility bundle; CFIR = Consolidated Framework for Implementation Research.

Costa, et al. Crit Care 2017; 152:304

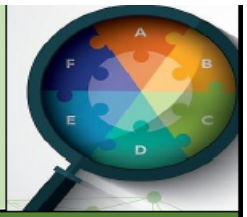
Unintended Consequences of Mandatory Protocols

- PS weaning – can delay SBT (Chest 2001; 120 (6 Suppl): 375S)
- Must have f/Vt < 105 - can delay extubation (Crit Care Med. 2006;34:2530)
- Waiting for SAT completion (or failure to complete) may delay or prevent SBT or extubation

Summary

ICU LIBERATION
LIBERATION, AWAKENING, RESTORATION
www.iculiberation.org

Improve Patient Comfort, Safety, and Outcomes



PAD SYMPTOMS	ASSESSMENT & MONITORING TOOLS	CARE IMPROVEMENT ABCDEF BUNDLE
PAIN	**NRS:** Numeric Rating Scale **BPS:** Behavioral Pain Scale **CPOT:** Critical Care Pain Observation Tool	**A**ssess, Prevent, and Manage Pain **B**oth Spontaneous Awakening Trials and Spontaneous Breathing Trials **C**hoice of Sedation **D**elirium: Assess, Prevent and Manage **E**arly Mobility and **E**xercise **F**amily Engagement and Empowerment
AGITATION	**RASS:** Richmond Agitation Sedation Scale **SAS:** Sedation Agitation Scale	
DELIRIUM	**CAM-ICU:** Confusion Assessment Method for ICU **ICDSC:** Intensive Care Delirium Screening Checklist	

Summary

- Proper implementation of the ABCDEF bundle can result in reduced time on the ventilator, less delirium, and more time spent out of bed.

- Concerns still exist relating to barriers to implementation and perhaps inappropriate protocols.