PICU Up: Teaming up and Transforming to a Culture of Mobility for the Critically Ill Child

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September 12th, 2017

@SapnaKmd
@PICU_Up

#PedsICU
#ICURehab

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Disclosures/Research Support

- FAER Research in Fellowship Grant
- Institutional K12 (CTSA)
- Society for Anesthesia & Sleep Medicine (SASM)
- JHSPH Sommer Scholar
- ATS Early Career Award
- JHU Clinical Research Scholars
- Sleep Services of America
- PICU Up!™ Trademark

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Objectives

- Describe characteristics of sleep across the age spectrum in healthy & critically ill children
- Discuss the effects of sedatives and analgesics on sleep in the developing brain
- Define early mobilization and discuss the adult and pediatric literature
- Describe the interplay of sleep, sedation and delirium in team-based implementation of early mobilization initiatives

PICU UP!
Early Mobilization

The Patient Experience

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Post-intensive care syndrome=PICS

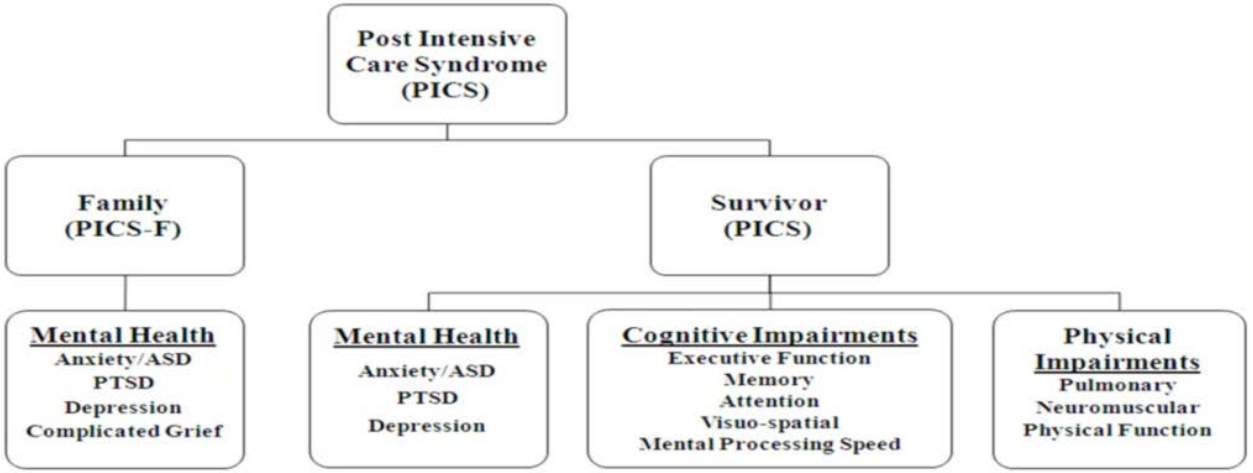
"THRIVE takes the proverbial baton, **leverages the principles espoused in the ABCDEF bundle championed within the ICU Liberation Initiative to mitigate long-term impairment, and focuses on life after critical illness.**

thrive

Improving long-term outcomes after discharge from intensive care unit: Report from a stakeholders' conference*

(Crit Care Med 2012; 40:502–509)

Dale M. Needham, MD, PhD; Judy Davidson, DNP, RN; Henry Cohen, PharmD; Ramona O. Hopkins, PhD;



http://www.sccm.org/Communications/Critical-Connections/Archives/Pages/Why-ICU-Clinicians-Need-to-Care-about-Post-Intensive-Care-Syndrome.aspx

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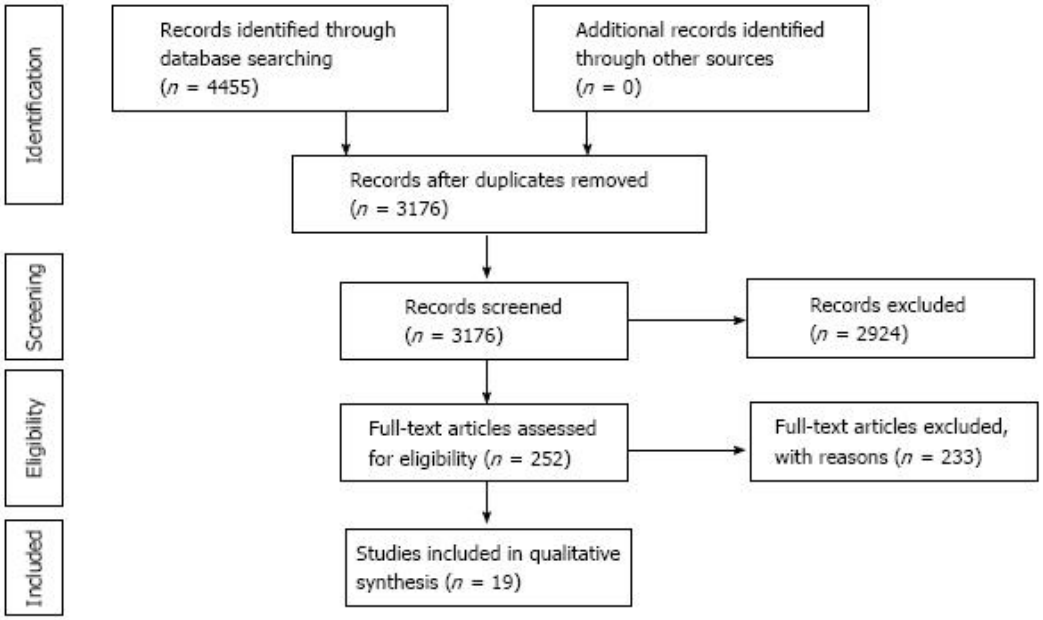
HOT OFF THE PRESS

SYSTEMATIC REVIEWS

Characteristics of postintensive care syndrome in survivors of pediatric critical illness: A systematic review

Elizabeth A Herrup, Beth Wieczorek, Sapna R Kudchadkar



"The synthesis revealed that, similar to adult ICU patients, a wide range of physical, neurocognitive and psychological morbidities occur in PICU patients after discharge."

WJCCM World Journal of Critical Care Medicine

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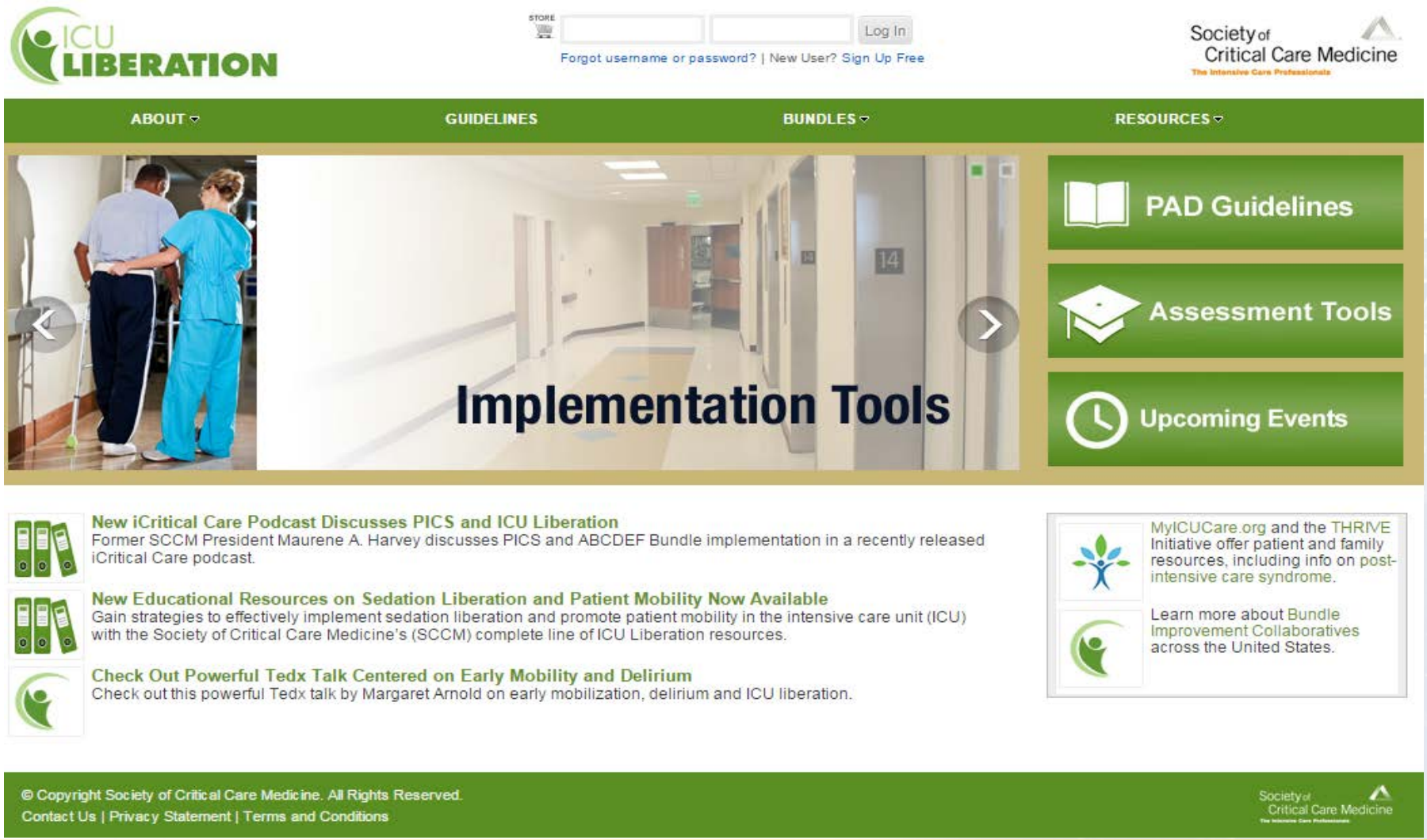
SCCM ICU Liberation Initiative
www.iculiberation.org



ICU Liberation Model: ABCDEF Bundle

Assess, prevent & manage pain

- CPOT or BPS to assess pain, insure adequate pain control
- Use of regional anesthesia and nonopioid adjuncts
- Analgesia-based sedation techniques with fentanyl

Both SAT & SBT

- Daily linked SAT and SBT
- Multidisciplinary coordination of care
- Faster liberation from MV

Choice of sedation

- Targeted light sedation when sedation necessary
- Avoidance of benzodiazepines
- Dexmedetomidine if high delirium risk, cardiac surgery, MV weaning

Delirium monitoring & management

- Routine CAM-ICU or ICDSC assessments
- Nonpharmacologic intervention, including sleep hygiene
- Dexmedetomidine or antipsychotic if hyperactive symptoms

Early mobility & exercise

- Physical and occupational therapy assessment
- Coordinate activity with SAT or periods of no sedation
- Progress through range of motion, sitting, standing, walking, ADLs

Family engagement & empowerment

- Reorientation, provision of emotional and verbal support
- Cognitive stimulation, participation in mobilization
- Participation in multidisciplinary rounds

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Adult Evidence for the ABCDEF

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Feature Articles

Effectiveness and Safety of the Awakening and Breathing Coordination, Delirium Monitoring/ Management, and Early Exercise/Mobility Bundle*

Michele C. Balas, PhD, RN, APRN-NP, CCRN[1]; Eduard E. Vasilevskis, MD, MPH[2,3,4]; Keith M. Olsen, PharmD, FCCP, FCCM[5,6]; Kendra K. Schmid, PhD[7]; Valerie Shostrom, MS[7]; Marlene Z. Cohen, PhD, RN, FAAN[8]; Gregory Peitz, PharmD, BCPS[5,6]; David E. Gannon, MD, FACP, FCCP[9]; Joseph Sisson, MD[9]; James Sullivan, MD[10]; Joseph C. Stothert, MD, PhD, FCCM, FACS[11]; Julie Lazure, BSN, RN[12]; Suzanne L. Nuss, PhD, RN[13]; Randeep S. Jawa, MD, FACS, FCCM[11]; Frank Freihaut, RRT[14]; E. Wesley Ely, MD, MPH, FCCM[1,4,15]; William J. Burke, MD[16]

"Critically ill patients managed with the Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility bundle spent three more days breathing without assistance, experienced less delirium, and were more likely to be mobilized during their ICU stay than patients treated with usual care" – Crit Care Med 2014

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What about the kids?

PICU UP!
Early Mobilization

Choice of Sedation

Family involvement

Spontaneous breathing trials

Delirium

Early mobilization

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Challenges in caring for critically ill children

- Heterogeneity in ages and development
- Children unable to understand or communicate basis and need for interventions
  - Danger of inadvertently removing life-saving modalities (endotracheal tube, vascular access)
  - Fear and anxiety contribute to physiologic changes and stress

Creating a healing environment for children in the hospital: It just makes sense!

- Optimizing pain and sedation mgmt.
- Optimizing sleep
- Optimizing a child's ability to communicate
- Minimizing risk factors for delirium
- Early mobilization

Expectation

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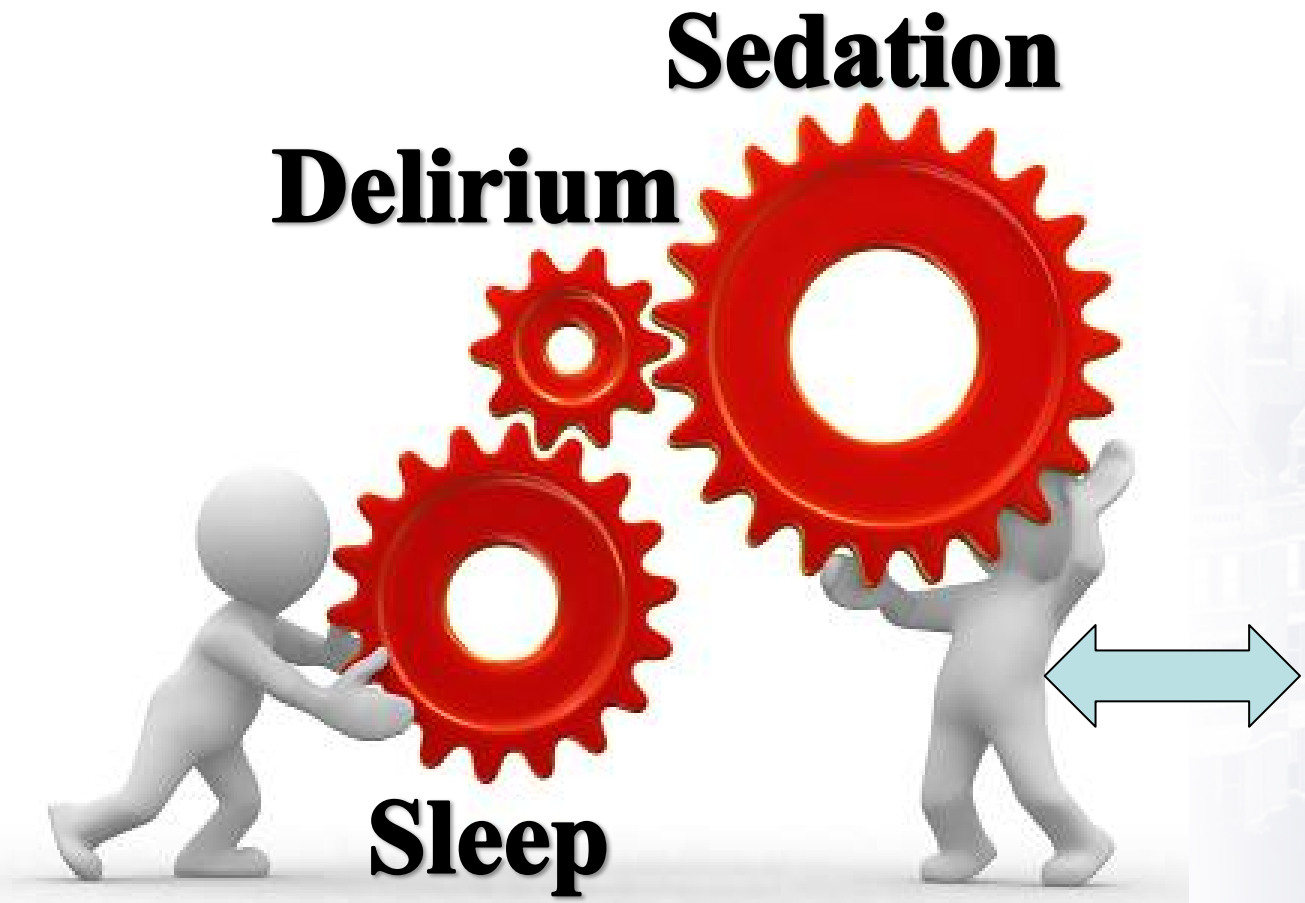
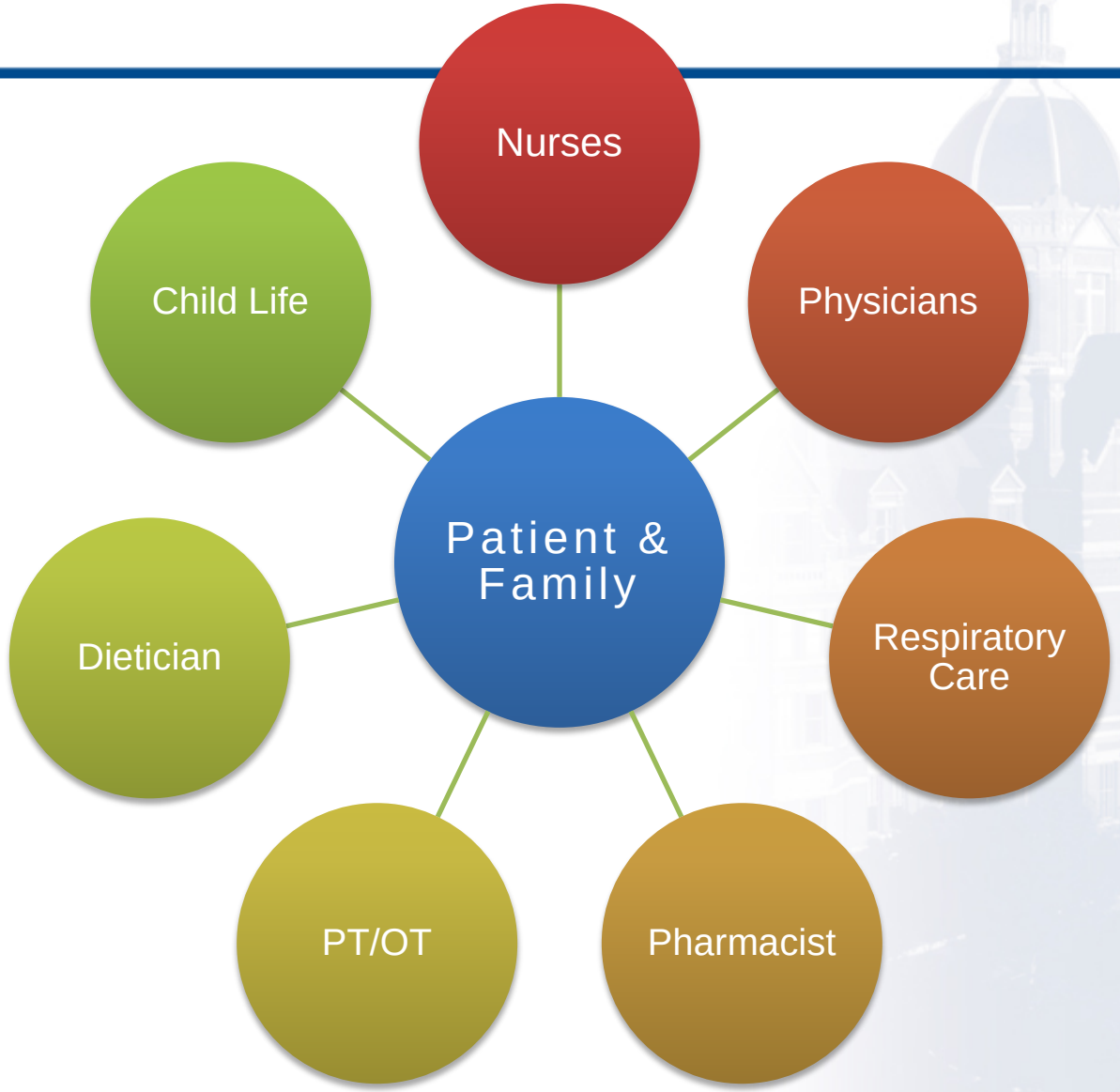
Reality: A complex interplay we can tackle



Early Mobilization

The Cost: Multiprofessional Collaboration to Promote Culture Change--It just makes sense!



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Fall 2013: Our PICU Culture

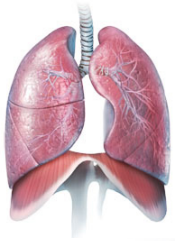
- Mechanically ventilated children oversedated
- High prevalence of benzodiazepine use and escalation
- PT/OT consultation often ordered by medical team >4 days into PICU admission
- Restraints
- Not screening for, diagnosing or treating delirium
- Benzos, diphenhydramine and narcotic being used to improve sleep

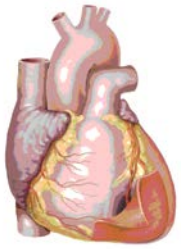
Goals

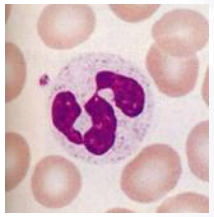
- Challenge the PICU paradigm that children must receive large doses of sedatives to tolerate PICU interventions
- Change the standard of care and confront an unmet and unrecognized need for sleep promotion
- Encourage hospital teams/staff to “buy in” to the risk factors for delirium and interventions to prevent it
- TRANSITION FROM A CULTURE OF IMMOBILITY TO MOBILITY

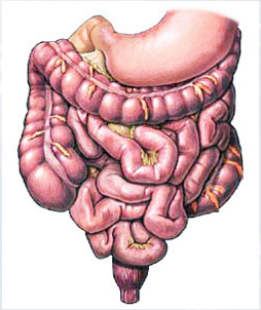
Why should we care about sleep in the hospital?

- Natural sleep is integral to physiologic homeostasis
  - Thermoregulation
  - Respiratory
  - Cardiovascular
  - Gastrointestinal
  - Immune defenses
  - Endocrine









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Sleep and the Developing Brain

"Broadly speaking, it might be argued that the most fundamental requirements for healthy growth and development in young children include:

a) Loving support and protection by parents/caretakers
b) Adequate nutrition, and
c) Adequate sleep"

-Ronald Dahl, *SLEEP* 2007

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Are they sleeping?

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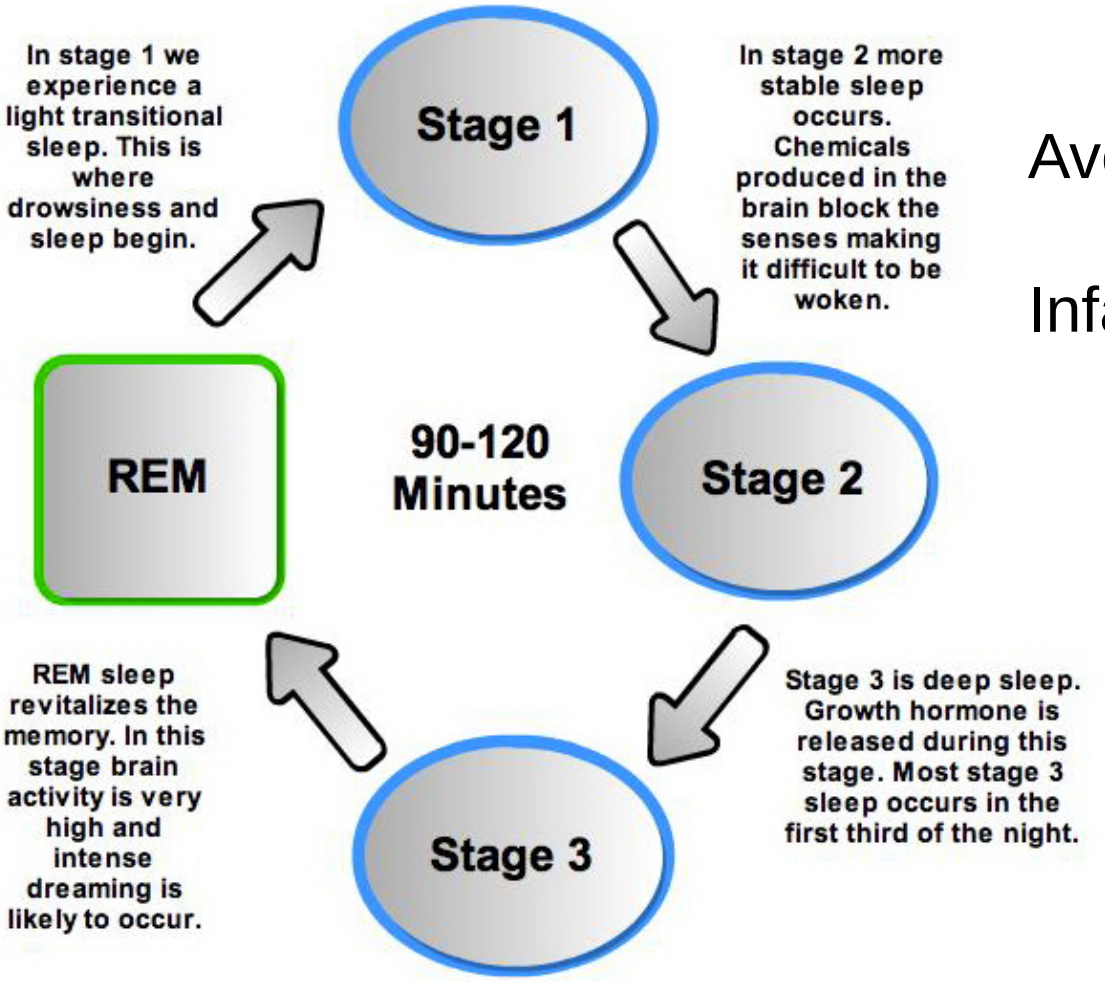
Sleep Stages



Average adult: 25% REM

Infants: Up to 80% REM

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Principle Concepts

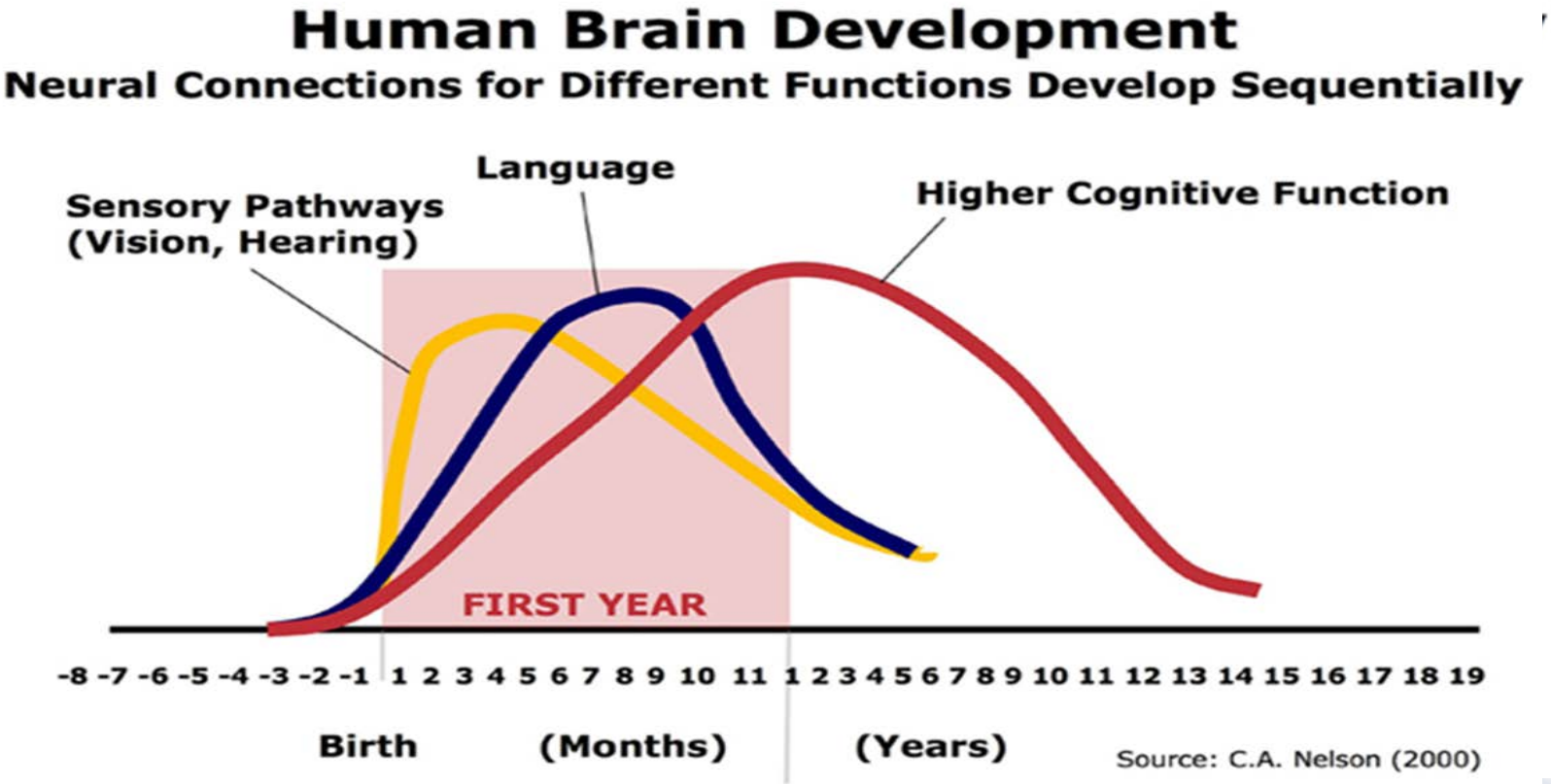
Sleep is necessary for:

- Neurosensory development
- Preservation of brain plasticity
- Learning and long term memory

- Evolution of sleep reflects the complex brain maturational process during infancy, childhood and adolescence

Sleep and the Developing Brain: Neurosensory, plasticity, long-term memory

Center on the Developing Child
HARVARD UNIVERSITY



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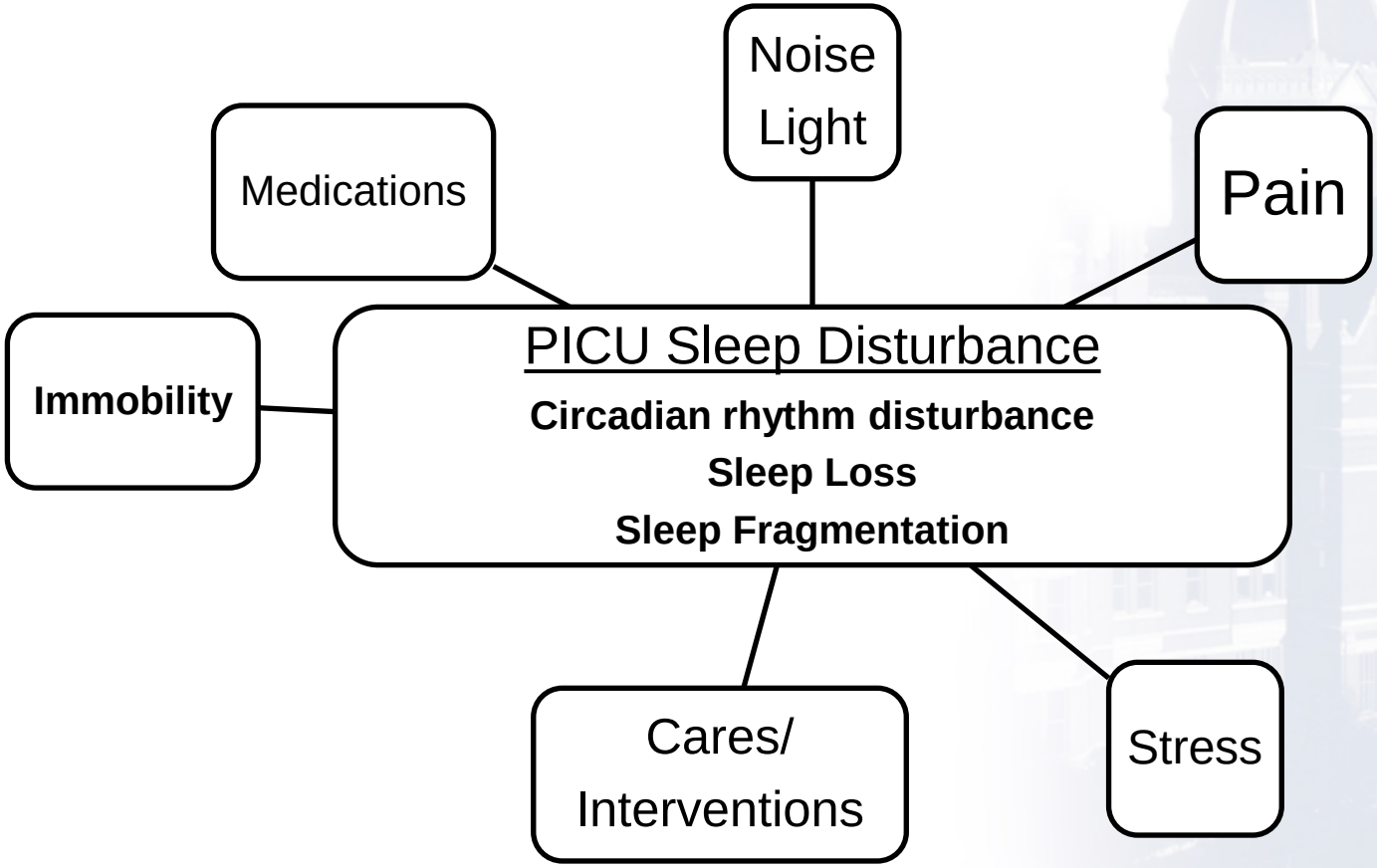
Hospital Sleep Disturbances



A vicious circle?

Physiologic dependence, prolonged hospital stay for withdrawal

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Hospital sleep is not a priority

Sleep of critically ill children in the pediatric intensive care unit: A systematic review

Sapna R. Kudchadkar [a,*], Othman A. Aljohani [a], Naresh M. Punjabi [b]

- Multitude of studies of sleep in the NICU
- Nine publications about sleep in the PICU
  - Four publications from same RCT
  - Two studies using subjective assessment (PSBOT)

Kudchadkar et al., Sleep Med Rev 2014

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Sedation, Sleep Promotion, and Delirium Screening Practices in the Care of Mechanically Ventilated Children: A Wake-Up Call for the Pediatric Critical Care Community

Sapna R. Kudchadkar, MD[1,2]; Myron Yaster, MD[1,2]; Naresh M. Punjabi, MD, PhD[3,4]

- 341 pediatric intensivists
- <15% aware of efforts to optimize sleep of critically ill children in their unit including any of following:
  - Noise reduction
  - Lighting
  - Earplugs/eyemasks

Crit Care Med 2014.

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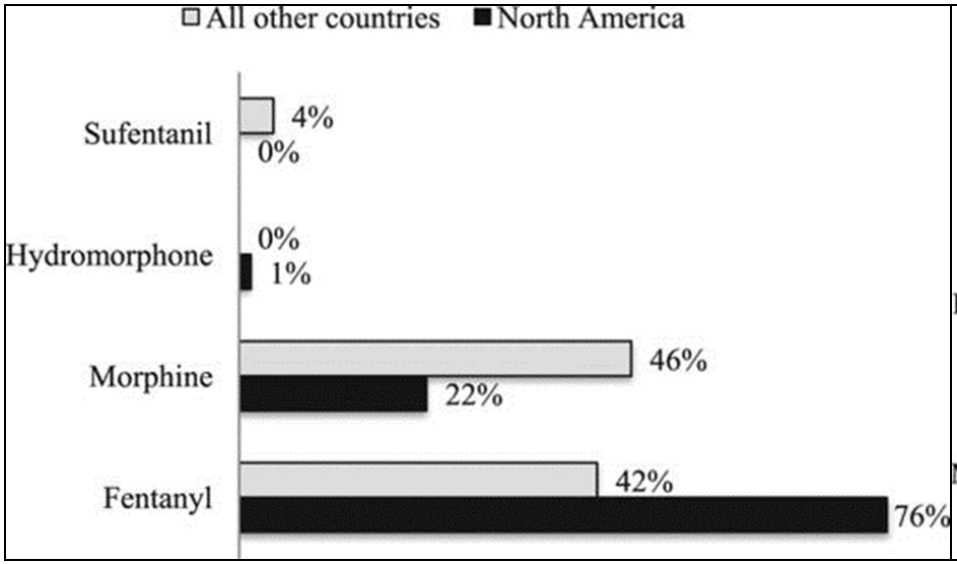
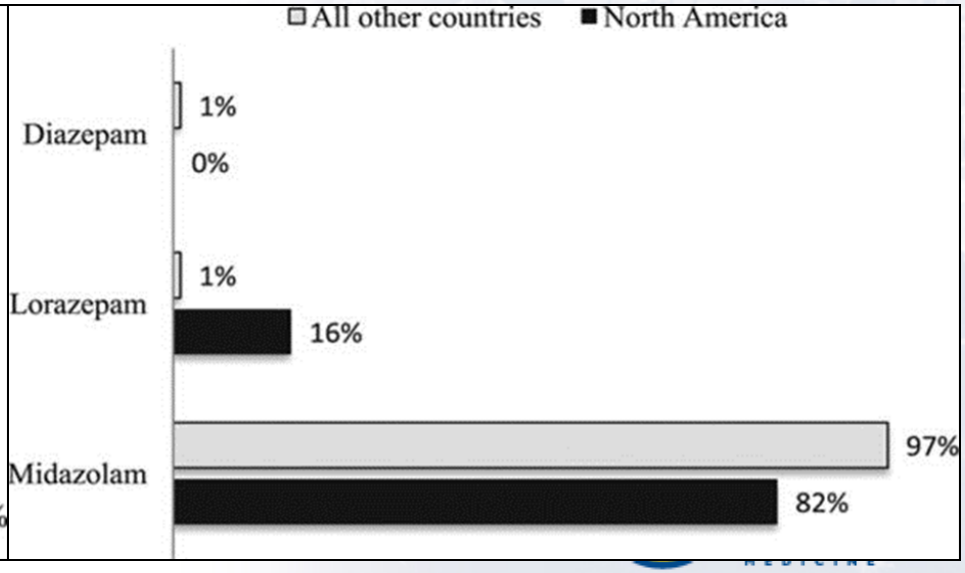
Pediatric Intensive Care and Sleep: Is it a priority?

- >85% use a combination of benzodiazepine and opioid for sedation in mechanically ventilated children
- <10% use dexmedetomidine





Kudchadkar et al. 2014, *Crit Care Med.*

What's wrong with opioids and benzodiazepines?

Table 5. Common ICU Medications and Their Effect on Sleep

Medication	Effect on Sleep	Possible Mechanism
Sedative/hypnotics		
Benzodiazepines	↑TST, ↓SWS, ↓REM, ↓W	GABA (type A) receptor stimulation
Propofol	↑TST, ↓W, ↓SL	GABA (type A) receptor stimulation
Dexmedetomidine	↑SWS, ↓SL, ↓REM	$Alpha_2$-agonist
Analgesics		
Opioids	↑W, ↓TST, ↓SWS, ↓REM	Mu-receptor stimulation
NSAIDs	↓TST, ↓SE	Prostaglandin synthesis inhibition

Benzodiazepines are the only independent risk factor for the development of delirium

Kudchadkar et al. Contemporary Critical Care 2009
Pandaripande, et al. J Trauma 2008

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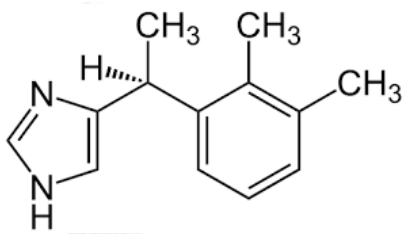
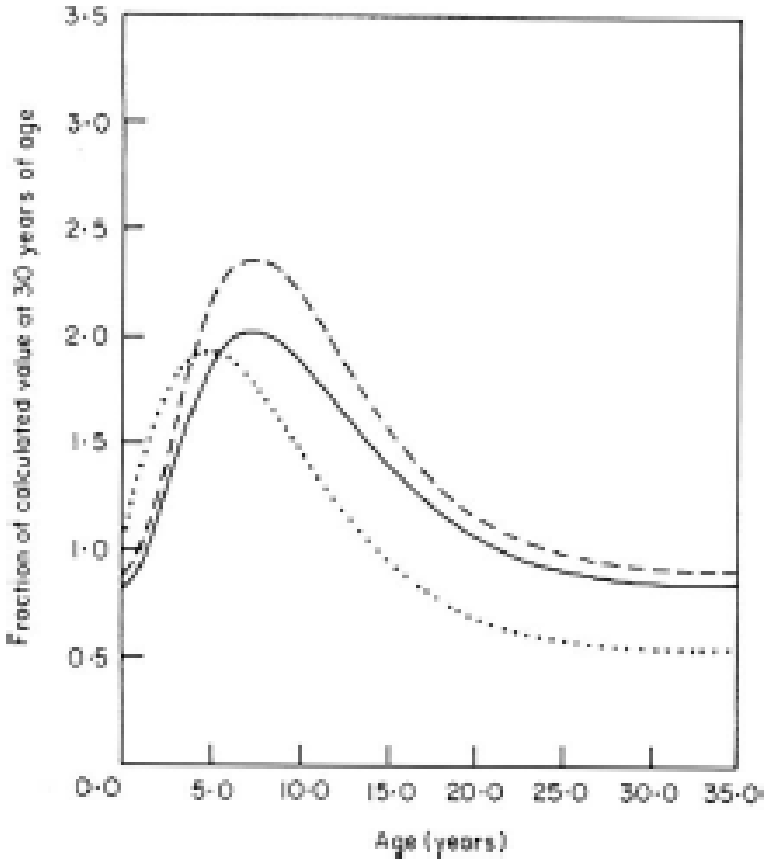
Dexmedetomidine



- <10% of all respondents use dexmedetomidine as a primary agent

- Dexmedetomidine most closely induces an EEG pattern consistent with natural sleep

Synaptic density, $CMRO_2$ and delta wave amplitude: parallels



Gamma distribution model of growth in childhood and decline in adolescence

..... synaptic density

---- delta wave amplitude

___cerebral metabolic rate

Changes in delta power are a reflection of synaptic pruning, brain maturation and reorganization

Feinberg et al, 1990. Journal of Theoretical Biology

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Temporal Characteristics of the Sleep EEG Power Spectrum in Critically Ill Children

Sapna R. Kudchadkar, MD[1]; Myron Yaster, MD[1]; Arjun N. Punjabi[2]; Stuart F. Quan, MD[3]; James L. Goodwin, PhD[4]; R. Blaine Easley, MD[5]; Naresh M. Punjabi, MD, PhD[6]

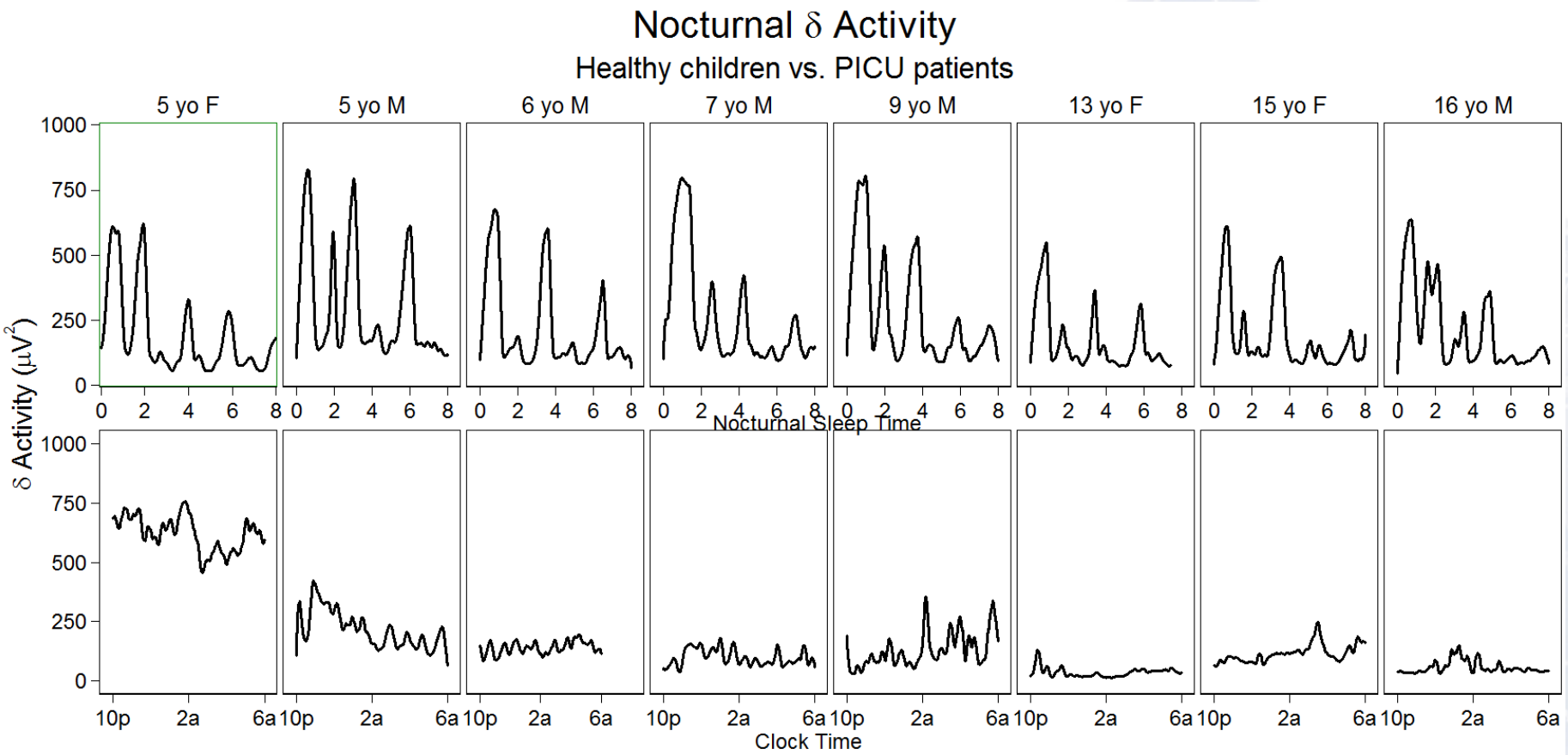
- 8 subjects from Pediatric ICU at Johns Hopkins
- All healthy, developmentally appropriate children prior to admission to hospital
- All receiving opioid and benzodiazepine for sedation during mechanical ventilation due to primary respiratory failure

JCSM Dec. 2015

Delta Activity

Temporal Characteristics of the Sleep EEG Power Spectrum in Critically Ill Children

Sapna R. Kudchadkar, MD[1]; Myron Yaster, MD[1]; Arjun N. Punjabi[2]; Stuart F. Quan, MD[3]; James L. Goodwin, PhD[4]; R. Blaine Easley, MD[5]; Naresh M. Punjabi, MD, PhD[6]



Graphs by age and gender-matched pair

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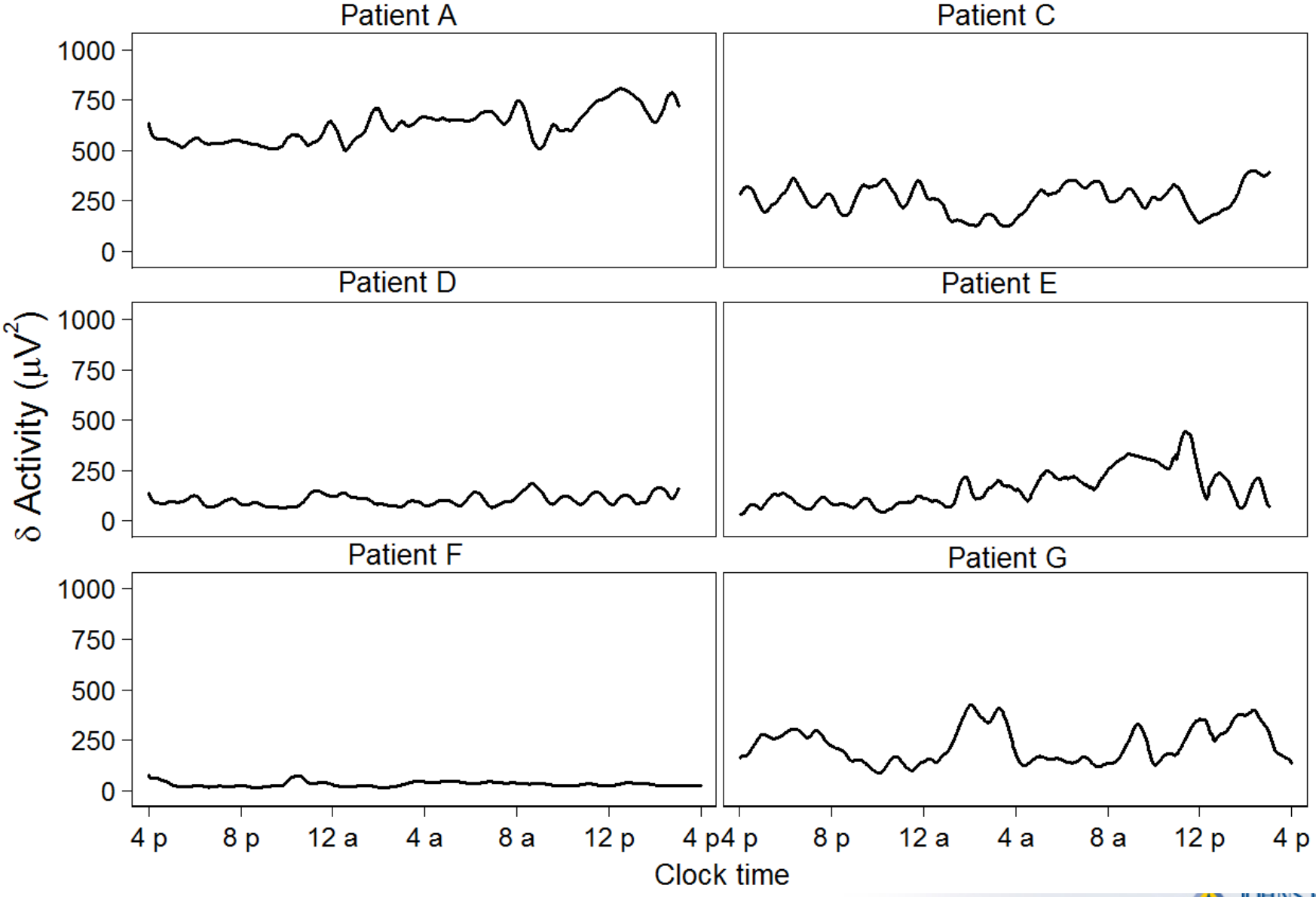
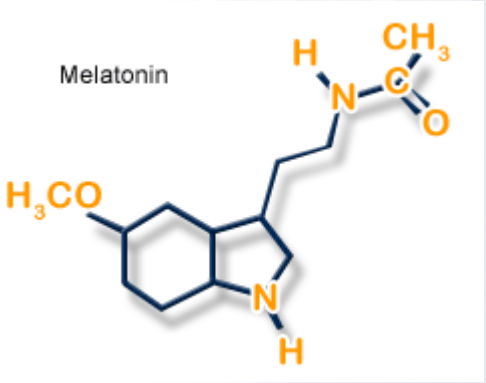
δ Activity over 24 hrs



Critical illness and the Circadian Rhythm: Melatonin

- Produced by the pineal gland
- Under control of circadian pacemaker of suprachiasmatic nuclei
- Peaks at 2 a.m., decreases to daylight levels by 8 a.m.
- Nocturnal melatonin suppression noted in ICU and post-operative patients



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Ongoing work

- What is the longitudinal evolution of sleep-wake patterns in children in the PICU and during recovery from critical illness?

SLEEP-WAKE CYCLES OF CRITICALLY ILL CHILDREN IN THE PEDIATRIC INTENSIVE CARE UNIT AFTER MAJOR SURGERY: AN ACTIGRAPHIC ANALYSIS

S.R. Kudchadkar[1], O.A. Aljohani[2], E.A. Jastaniah[1], N.M. Punjabi[3]; [1]Pediatr

- Prospective, observational study
  - All children 0-18 s/p major surgery admitted to the PICU
- Actigraphy initiated POD #1 and discontinued at hospital discharge

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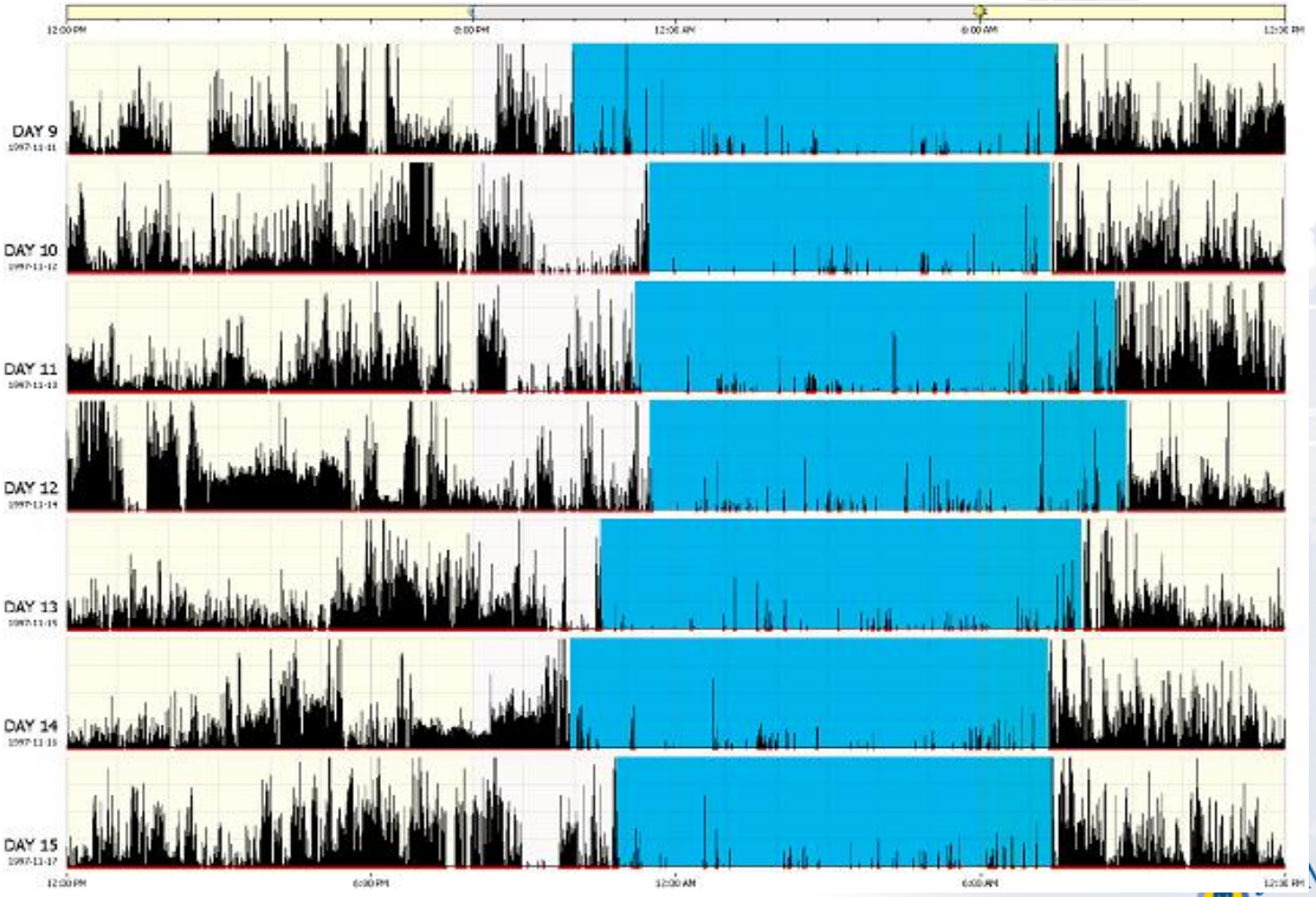
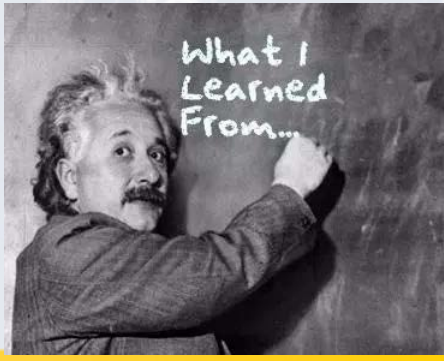
Actigraphy plot demonstrates normal sleep-wake cycles



What we've learned

- Evolution of sleep is a marker of brain development in childhood
- Sleep is severely fragmented in children admitted to the hospital
- Sleep disturbances during infancy and childhood may have negative effects on neurocognitive outcomes

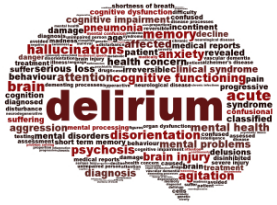


Sleep: On the causal pathway for delirium?

What is Delirium?- Key Features

- Disturbance in attention and awareness
- Disturbance in cognition, e.g. memory, disorientation, language, perception
- Develops over a short period of time and fluctuates throughout the day
- Disturbances are not better explained by a preexisting, established or evolving neurocognitive disorder and don't occur in the context of severely reduced level of arousal (coma)

– *American Psychiatric Association: DSM V, Washington, DC: p. 2013*



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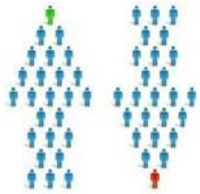
Incidence in the Adult ICU

- 60%-80% of mechanically ventilated patients
- 50%-70% of non-ventilated patients
- Hypoactive delirium = 44%
- Hyperactive delirium = 2%
- Mixed delirium = 54%

(Girard, 2008)



Outcomes

- 3 fold increase in 6-month mortality
  - 1 in 3 delirium survivors develop permanent cognitive impairment

Associated with…..

- New nursing home placement
  - Increased length of stay > 8.0 days
  - Increased mortality
  - Increased number of days on the ventilator

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Insight from half a century ago…

'The problem of delirium is far from an academic one. Not only does the presence of delirium often complicate and render more difficult the treatment of a serious illness, but also it carries the serious possibility of permanent irreversible brain damage'

-Engel & Romano, 1959

J Chronic Dis 1959
Trogrlic et al, Crit Care 2015

JOHNS HOPKINS MEDICINE

Why should we focus on sleep promotion and sedation optimization to prevent delirium?

- Low cost, non-invasive, and low risk: CULTURE CHANGE and INTERDISCIPLINARY COLLABORATION
- Lack of proven prophylactic agents to reduce delirium
- It just makes sense– especially for the developing brain!

What do we know about the interaction between sleep and delirium?

- Definitive relationship has not been established…but…
- Sleep disturbance can independently cause all features of delirium
- Metabolic waste is primarily removed from CNS during sleep (“glymphatic system”)
- Loss of rapid-eye movement sleep is associated with delirium
- Sleep-deprived patients are more likely to develop delirium than those who are not sleep-deprived

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What do we know about the interaction between sleep and delirium?

The Impact of Interventions to Improve Sleep on Delirium in the ICU: A Systematic Review and Research Framework*

Alexander H. Flannery, PharmD, BCCCP, BCPS[1,2]; Douglas R. Oyler, PharmD, BCCCP[1,2]; Gerald L. Weinhouse, MD[3]

Conclusions: Although sleep interventions seem to be a promising approach for improving delirium-related outcomes, studies are limited by bias issues, varying methodologies, and multiple confounders, making the evidence base for this conclusion limited at best. Future studies would benefit from a systematic approach to studying the link between sleep intervention and delirium-related outcomes, which is outlined in the context of reviewing the existing literature. (*Crit Care Med* 2016; 44:2231–2240)

- 10 studies included
- 6 demonstrated significant reduction in delirium incidence
- Most studies used subjective tools

Crit Care Med
Dec. 2016

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Sleep promotion interventions (bundled)

1. Minimize nighttime interventions
2. Noise reduction
3. Earplugs
4. Soothing music
5. Dim lights
6. Eye masks
7. Increased light exposure during daytime
8. Artificial light during daytime
9. Avoidance of deliriogenic meds
10. Minimize napping
11. Pharmacologic therapy (zolpidem, melatonin, antipsychotic)

The Impact of Interventions to Improve Sleep on Delirium in the ICU: A Systematic Review and Research Framework*

Alexander H. Flannery, PharmD, BCCCP, BCPS[1,2]; Douglas R. Oyler, PharmD, BCCCP[1,2]; Gerald L. Weinhouse, MD[3]

What about the kids?

Choice of Sedation

Family involvement

Spontaneous breathing trials

Delirium

Early mobilization

State of delirium screening in PICUs internationally: 2013

- **Only 2% of respondents reported delirium screening is performed for all mechanically ventilated patients once per shift**

- When asked which tools were being used for delirium, several listed withdrawal scales
  - Sophia Observation Scale
  - Withdrawal Assessment Tool-1 (WAT-1)

Crit Care Med 2014

Sedation, Sleep Promotion, and Delirium Screening Practices in the Care of Mechanically Ventilated Children: A Wake-Up Call for the Pediatric Critical Care Community

Sapna R. Kudchadkar, MD[1,2]; Myron Yaster, MD[1,2]; Naresh M. Punjabi, MD, PhD[3,4]

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But why? We have our own tools!
icudelirium.org

Pediatric Critical Care

Cornell Assessment of Pediatric Delirium: A Valid, Rapid, Observational Tool for Screening Delirium in the PICU*

Chani Traube, MD[1]; Gabrielle Silver, MD[2]; Julia Kearney, MD[3]; Anita Patel, MD[4]; Thomas M. Atkinson, PhD[5]; Margaret J. Yoon, MD[2]; Sari Halpert, MD[6]; Julie Augenstein, MD[4]; Laura E. Sickles, BA[7]; Chunshan Li, MA[8]; Bruce Greenwald, MD[1]

Crit Care Med 2014

RASS Score ____ (if -4 or -5 do not proceed)

Please answer the following questions based on your interactions with the patient over the course of your shift:

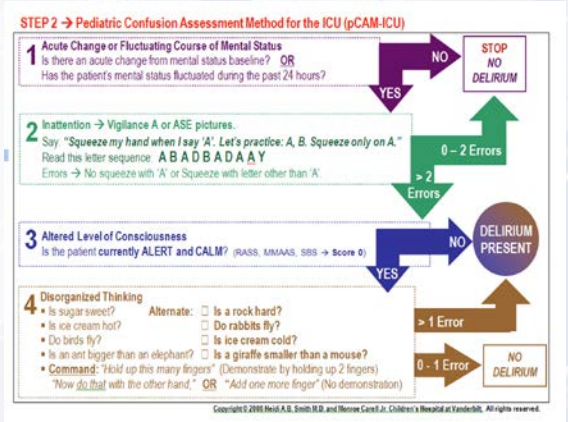
	Never 4	Rarely 3	Sometimes 2	Often 1	Always 0	Score
1. Does the child make eye contact with the caregiver?						
2. Are the child's actions purposeful?						
3. Is the child aware of his/her surroundings?						
4. Does the child communicate needs and wants?						
	Never 0	**Rarely 1**	**Sometimes 2**	**Often 3**	**Always 4**	
5. Is the child restless?						
6. Is the child inconsolable?						
7. Is the child underactive—very little movement while awake?						
8. Does it take the child a long time to respond to interactions?						
					TOTAL	

Figure 1. Cornell Assessment of Pediatric Delirium revised. RASS = Richmond Agitation and Sedation Scale.

Diagnosing delirium in critically ill children: Validity and reliability of the Pediatric Confusion Assessment Method for the Intensive Care Unit*

Heidi A. B. Smith, MD, MSci; Jenny Boyd, MD; D. Catherine Fuchs, MD; Kelly Melvin, MD; Pamela Berry, RN; Ayumi Shintani, PhD; Svetlana K. Eden, MS; Michelle K. Terrell, NP; Tonya Boswell, RN; Karen Wolfram, RN; Jenna Sopfe, MS; Frederick E. Barr, MD, MSci; Pratik P. Pandharipande, MD, MSci; E. Wesley Ely, MD, MPH

Crit Care Med 2011



The Preschool Confusion Assessment Method for the ICU: Valid and Reliable Delirium Monitoring for Critically Ill Infants and Children*

Crit Care Med 2016

JOHNS HOPKINS MEDICINE

Identifying Barriers to Delirium Screening and Prevention in the Pediatric ICU: Evaluation of PICU Staff Knowledge[1]

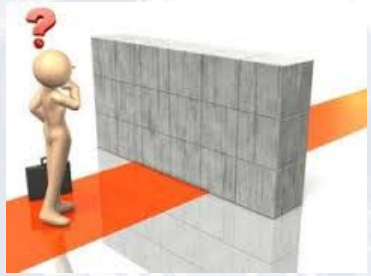
Melanie Cooper Flaigle DO[a], Judy Ascenzi RN, DNP[b], Sapna R. Kudchadkar MD[a,*]

Table 1 Survey answers

Survey item	Correct	Incorrect
1. Fluctuation between orientation and disorientation is not typical of delirium (FALSE)	96 (91.4%)	9 (8.5%)
2. Poor nutrition increases the risk of delirium (TRUE)	102 (97.1%)	3 (2.9%)
3. The GCS score is the best way to diagnose delirium in critically ill children (FALSE)	93 (88.6%)	12 (11.4%)
4. Hearing or vision impairment increases the risk of delirium (TRUE)	86 (81.9%)	19 (18.1%)
5. Delirium in children always manifests as a hyperactive, confused state (FALSE)	103 (98.1%)	2 (1.9%)
6. Benzodiazepines can be helpful in the treatment of delirium (FALSE)	65 (61.9%)	40 (38.1%)
7. Behavioral changes in the course of the day are typical of delirium (TRUE)	96 (91.4%)	8 (7.6%)
8. Patients with delirium will often experience perceptual disturbances (TRUE)	98 (93.3%)	6 (5.7%)
9. Altered sleep/wake cycle may be a symptom of delirium (TRUE)	104 (99%)	0
10. Symptoms of depression may mimic delirium (TRUE)	87 (82.9%)	17 (16.1%)
11. The greater the number of medications a patient is taking, the greater their risk of delirium (TRUE)	86 (81.9%)	18 (17.1%)
12. Delirium usually lasts several hours (FALSE)	59 (56.2%)	45 (42.8%)
13. A urinary catheter in situ reduces the risk of delirium (FALSE)	90 (85.7%)	14 (13.3%)
14. Gender has no effect on the development of delirium (FALSE)	37 (35.2%)	67 (63.8%)
15. Dehydration can be a risk factor for delirium (TRUE)	104 (99%)	0
16. Children generally do not remember being delirious (FALSE)	39 (37.1%)	65 (61.9%)
17. A family history of dementia predisposes a patient to delirium (FALSE)	72 (68.6%)	32 (30.4%)

Barriers to diagnosis

- Pathophysiology
  - Confusion with agitation, withdrawal, pain
- Absence of screening
- Tolerance of hypoactive state
- Sedation and pain management
  - Protocols? Consistent language?
- Focus on other organ systems
- Busy work flow
- If screening is positive– what's the next step?



Why should we *consistently* screen for delirium?

- Not just to diagnose delirium and treat it!

- “A positive delirium screen after several negative screens is a warning sign for impending badness” - Wes Ely, MD

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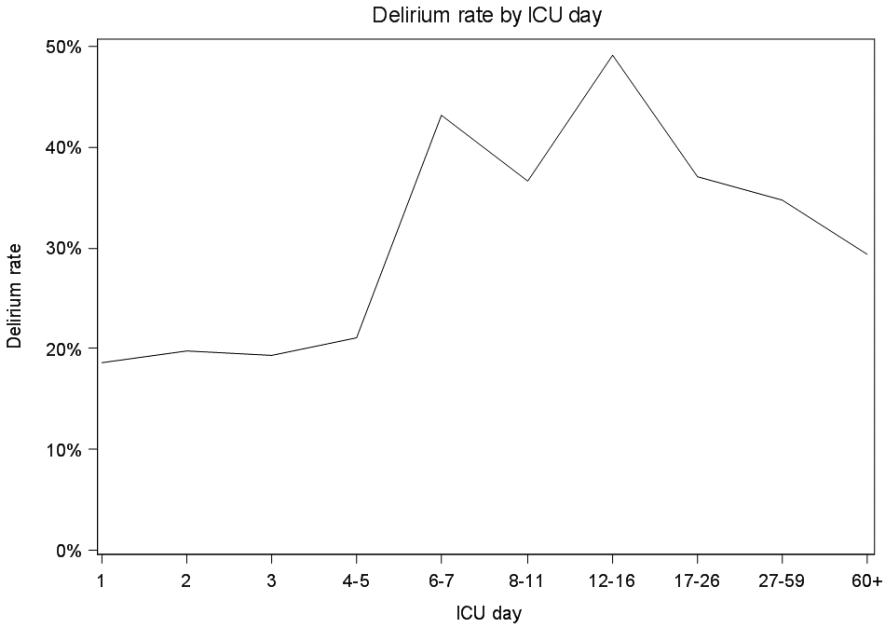
Delirium in Critically Ill Children: An International Point Prevalence Study*



Variable	Odds ratio (95% CI)
Age > 2 years	0.7 (0.5, 1.0)
Physical restraints	4.0 (2.0, 7.7)
Mechanical ventilation	1.7 (1.1, 2.7)
Narcotics	2.3 (1.5, 3.5)
Benzodiazepines	2.2 (1.5, 3.3)
Antiepileptics	2.9 (1.8, 4.8)
General anesthesia	0.4 (0.3, 0.8)
Vasopressors	2.4 (1.5, 3.8)

25% Delirium Prevalence
N=835, Traube et al, Crit Care Med 2017

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Feature Articles

HOT OFF THE PRESS

Delirium and Benzodiazepines Associated With Prolonged ICU Stay in Critically Ill Infants and Young Children*

TABLE 3. Risk Factors for Delirium Duration[a]

Risk Factors	Comparison	Incidence Rate Ratio (95% CI)	*p*
Age at enrollment (mo)[b]	37 vs 11	0.51 (0.35–0.76)	0.005
Cyanotic heart disease	Yes vs no	1.23 (0.72–2.10)	0.477
Pediatric Risk of Mortality score at enrollment[b]	10 vs 0	2.25 (1.28–3.94)	0.007
Sepsis or related condition at ICU admission	Yes vs no	1.05 (0.69–1.59)	0.823
Benzodiazepines (mg/kg/d)[b,c]	0.73 vs 0	2.47 (1.36–4.49)	0.005
Opioids (μg/kg/d)[c]	3.3 vs 0	0.70 (0.33–1.48)	0.410
Cardiovascular Sequential Organ Failure Assessment score	1 vs 0	0.96 (0.79–1.17)	0.691
Mechanical ventilation	Yes vs no	0.66 (0.37–1.16)	0.135
Lowest O_2 saturations	95 vs 87	1.03 (0.67–1.59)	0.516

Conclusions: Delirium is associated with a lower likelihood of ICU discharge in preschool-aged children. Benzodiazepine exposure is associated with the development and longer duration of delirium, and lower likelihood of ICU discharge. These findings

Smith HA et al. Crit Care Med September 2017

JOHNS HOPKINS MEDICINE

Noise pollution in the PICU: Can we make a difference?

Journal of Intensive Care Medicine
1-8

DOI: 10.1177/0885066617728030
journals.sagepub.com/home/jic
SAGE

Quality Improvement Initiative to Reduce Pediatric Intensive Care Unit Noise Pollution With the Use of a Pediatric Delirium Bundle

Yu Kawai, MD[1,2], Jeffrey R. Weatherhead, MD[2], Chani Traube, MD[3], Tonie A. Owens, MSN, RN[4], Brenda E. Shaw, RN, BSN[4], Erin J. Fraser, BSN[4], Annette M. Scott, MSN, RN[4], Melody R. Wojczynski, BSN[4], Kristen L. Slaman, BSN[4], Patty M. Cassidy, RN[4], Laura A. Baker, RN[4], Renee A. Shellhaas, MD[5], Mary K. Dahmer, PhD[2], Leah L. Shever, PhD, RN[6], Nasuh M. Malas, MD, MPH[7,8], and Matthew F. Niedner, MD[2]

Table 4. Effect of the Evening Bundle to Eliminate Delirium on Pediatric Intensive Unit Noise Levels.[a]

Occupied Rooms at Nighttime	Pilot Room (A), n = 210	Pilot Compliant Rooms (B), n = 162	Pilot Noncompliant Rooms (C), n = 48	Nonpilot Rooms (D), n = 1841	*P* Values (A) vs (D)	(B) vs (C)	(C) vs (D)
Hourly minimum	39.5 (37.5-55.0)	39.0 (37.0-55.0)	54.8 (46.8-58.0)	48.0 (39.0-51.7)	.03	<.01	<.01
Hourly average	45.3 (39.7-55.9)	44.1 (38.5-55.5)	56.9 (50.4-58.0)	51.2 (46.9-54.8)	<.01	<.01	<.01
Hourly maximum	64.0 (59.5-67.5)	63.0 (59.0-66.5)	67.0 (61.5-76.5)	63.0 (59.0-67.0)	.24	<.01	<.01

[a]Median decibels (interquartile range).

Where do we go from here?

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MEDICINE

Goals

- Challenge the PICU paradigm that children must receive large doses of sedatives to tolerate PICU interventions
- Change the standard of care and confront an unmet and unrecognized need for sleep promotion
- Encourage hospital teams/staff to “buy in” to the risk factors for delirium and interventions to prevent it

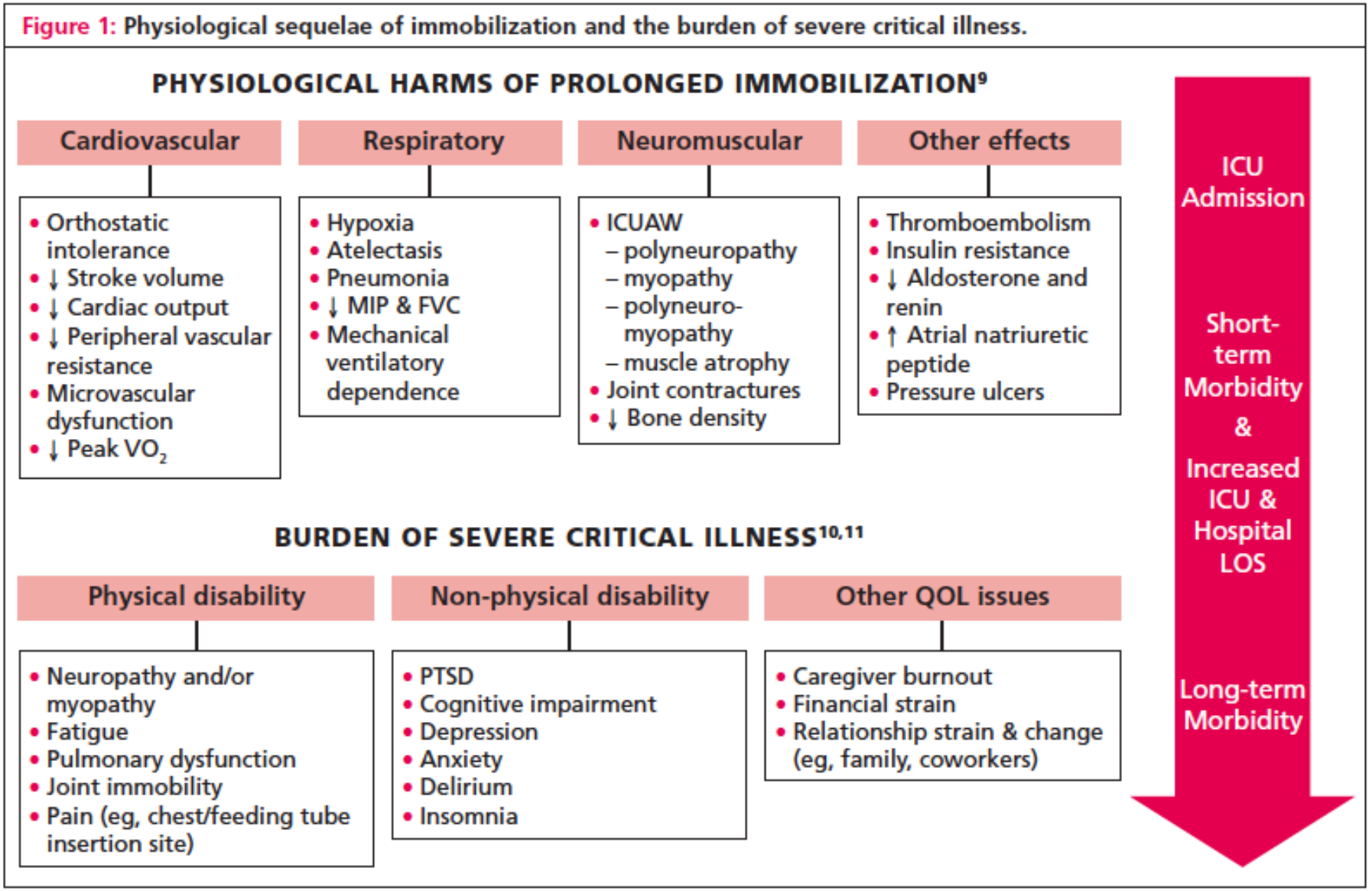
Creating a healing environment for children in the hospital

- Optimizing pain and sedation mgmt.
- Optimizing sleep
- Optimizing a child's ability to communicate
- Minimizing risk factors for delirium
- **Early mobilization**

Benefits of mobility

- Blood sugar homeostatsis
- Cardiovascular function
- Pulmonary function
- Decreases chronic inflammation
- Hormonal regulation
- Musculoskeletal & neuromuscular integrity
- Sleep/wake pattern
- Cognition
- Decreases depression

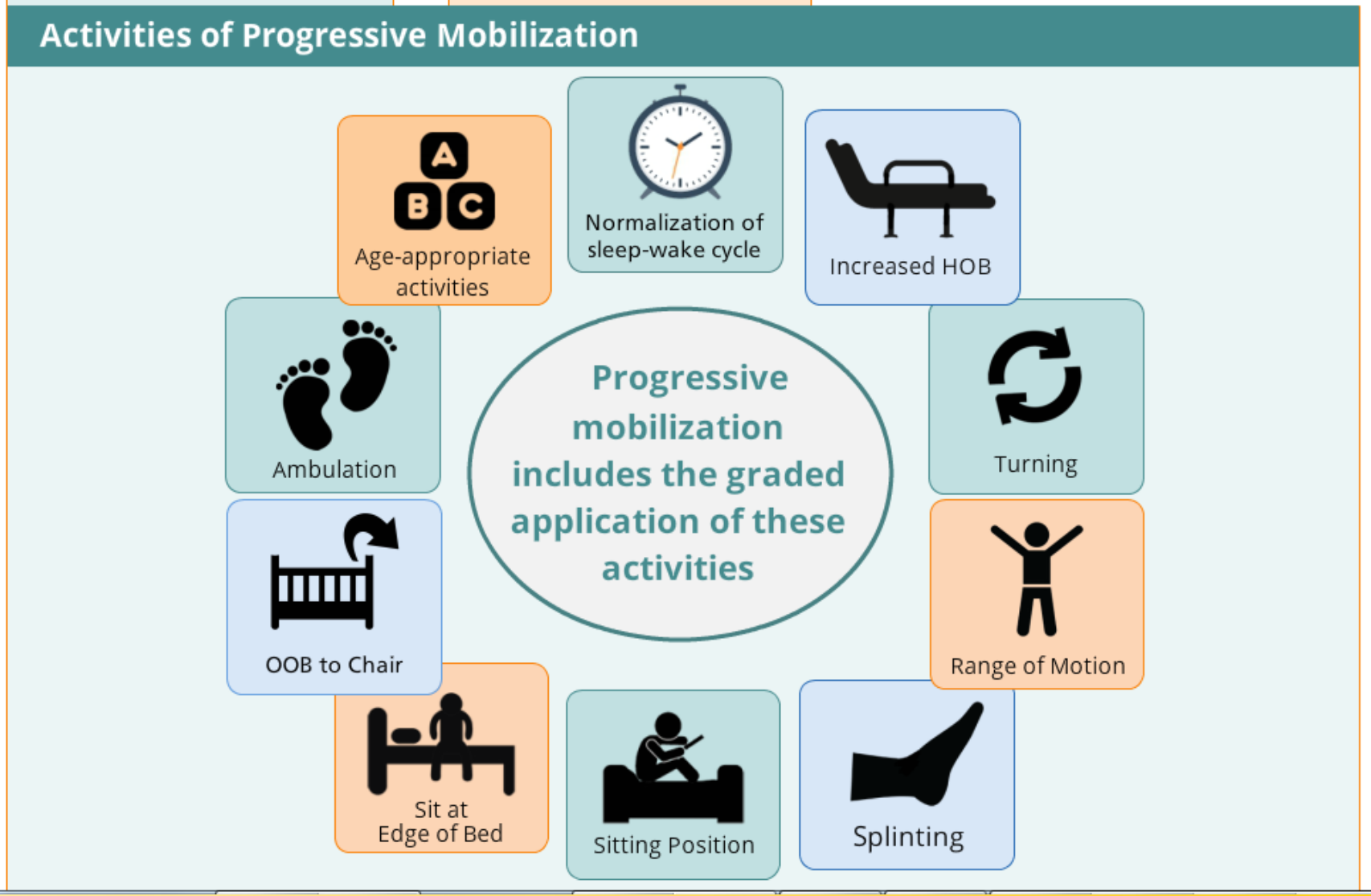
Consequences of IMMOBILITY



K Koo, K Choong, E Fan, Crit Care Rds 2011

What is Early Mobilization?

Two-step Process | Activities



ICU Liberation Model: ABCDEF Bundle

Assess, prevent & manage pain

- CPOT or BPS to assess pain, insure adequate pain control
- Use of regional anesthesia and nonopioid adjuncts
- Analgesia-based sedation techniques with fentanyl

Both SAT & SBT

- Daily linked SAT and SBT
- Multidisciplinary coordination of care
- Faster liberation from MV

Choice of sedation

- Targeted light sedation when sedation necessary
- Avoidance of benzodiazepines
- Dexmedetomidine if high delirium risk, cardiac surgery, MV weaning

Delirium monitoring & management

- Routine CAM-ICU or ICDSC assessments
- Nonpharmacologic intervention, including sleep hygiene
- Dexmedetomidine or antipsychotic if hyperactive symptoms

Early mobility & exercise

- Physical and occupational therapy assessment
- Coordinate activity with SAT or periods of no sedation
- Progress through range of motion, sitting, standing, walking, ADLs

Family engagement & empowerment

- Reorientation, provision of emotional and verbal support
- Cognitive stimulation, participation in mobilization
- Participation in multidisciplinary rounds

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Feature Articles

Effectiveness and Safety of the Awakening and Breathing Coordination, Delirium Monitoring/ Management, and Early Exercise/Mobility Bundle*

Michele C. Balas, PhD, RN, APRN-NP, CCRN[1]; Eduard E. Vasilevskis, MD, MPH[2,3,4]; Keith M. Olsen, PharmD, FCCP, FCCM[5,6]; Kendra K. Schmid, PhD[7]; Valerie Shostrom, MS[7]; Marlene Z. Cohen, PhD, RN, FAAN[8]; Gregory Peitz, PharmD, BCPS[5,6]; David E. Gannon, MD, FACP, FCCP[9]; Joseph Sisson, MD[9]; James Sullivan, MD[10]; Joseph C. Stothert, MD, PhD, FCCM, FACS[11]; Julie Lazure, BSN, RN[12]; Suzanne L. Nuss, PhD, RN[13]; Randeep S. Jawa, MD, FACS, FCCM[11]; Frank Freihaut, RRT[14]; E. Wesley Ely, MD, MPH, FCCM[1,4,15]; William J. Burke, MD[16]

"Critically ill patients managed with the Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility bundle spent three more days breathing without assistance, experienced less delirium, and were more likely to be mobilized during their ICU stay than patients treated with usual care" – Crit Care Med 2014

JOHNS HOPKINS MEDICINE

Early Mobilization in Adults

ICU-acquired weakness and cognitive deficits: occur quickly and resolve slowly

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Safety of early progressive mobility

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KEY REFERENCES: Laying the foundation for mobility for femoral catheters

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KEY REFERENCES: Laying the foundation for Nursing Progressive Mobility Program in ICU

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SCCM 2016:
www.iculiberation.org

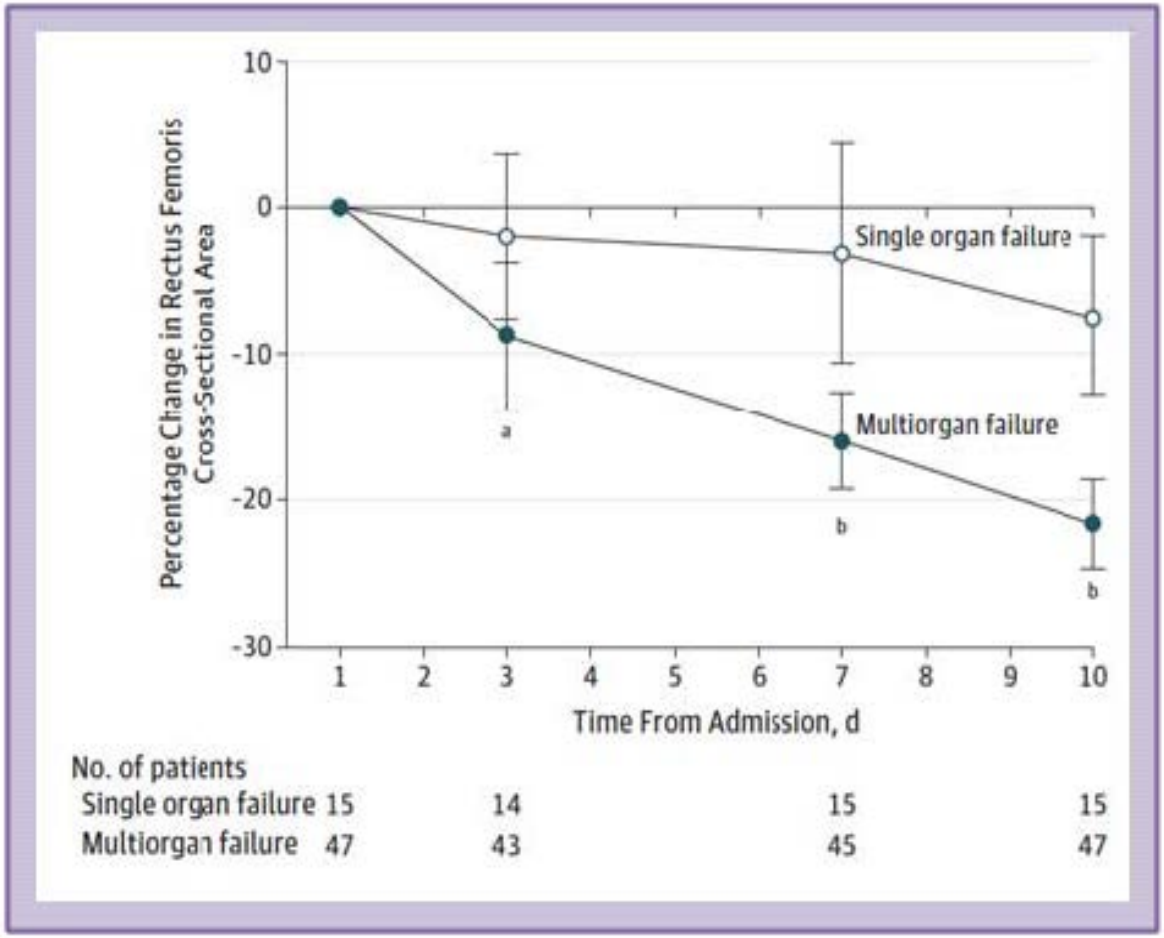
Weak patients have worse outcomes

- Increased duration of mechanical ventilation
  - Time of ventilation increases by 1-3 weeks
  - Most significant predictor of prolonged MV
- Longer ICU and hospital stay
- More likely to need re-intubation
- Less likely to go home at hospital discharge
- More likely to die in the hospital
- Experience delays in rehabilitation
  - Take longer to regain strength, walk, work
- Prolonged impairment in HRQOL and physical function

Leijten *JAMA* 1995; De Jonghe *JAMA* 2002; Hough *ICM* 2009; Ali *AJRCCM* 2008; Fan *CCM* 2013

Credit: Jolley & Hough 2015

Muscle wasting occurs quickly in the ICU



Puthucheary Z. *JAMA* 2013

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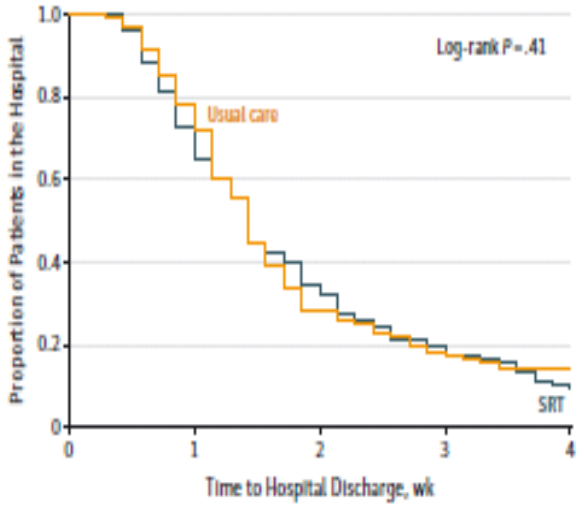
Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Standardized Rehabilitation and Hospital Length of Stay Among Patients With Acute Respiratory Failure

A Randomized Clinical Trial

Peter E. Morris, MD; Michael J. Berry, PhD; D. Clark Files, MD; J. Clifton Thompson, RN; Jordan Hauser, MS; Lori Flores, RN; Sanjay Dhar, MD; Elizabeth Chmelo, MS; James Lovato, MS; L. Douglas Case, PhD; Rita N. Bakhru, MD, MS; Aarti Sarwal, MD; Selina M. Parry, PhD; Pamela Campbell, RN; Arthur Mote; Chris Winkelman, PhD; Robert D. Hite, MD; Barbara Nicklas, PhD; Arjun Chatterjee, MD, MS; Michael P. Young, MD

Figure 2. Length of Stay for Patients With Acute Respiratory Failure Receiving SRT vs Usual Care



No. at risk					
SRT	150	102	44	22	10
Usual care	150	107	34	18	14

SRT indicates standardized rehabilitation therapy. Time zero indicates time of randomization.

- Standardized rehabilitation therapy did not decrease hospital length of stay among patients with acute respiratory failure

- Limitation: No sedation protocol- patients were unarousable on 15% of ventilator days.

JAMA 2016

JOHNS HOPKINS MEDICINE

Point Prevalence Study of Mobilization Practices for Acute Respiratory Failure Patients in the United States

Sarah Elizabeth Jolley, MD, MSc[1]; Marc Moss, MD[2]; Dale M. Needham, MD, PhD[3]; Ellen Caldwell, MS[4]; Peter E. Morris, MD[5]; Russell R. Miller, MD, MPH[6]; Nancy Ringwood, RN, BSN[7]; Megan Anders, MD[8]; Karen K. Koo, MD[9]; Stephanie E. Gundel, RD, CD[4]; Selina M. Parry, PhD[10]; Catherine L. Hough, MD, MSc[4]; on behalf of the Acute Respiratory Distress Syndrome Network Investigators

ARDS Network point prevalence study

- Population
  - Patients with acute or resolving respiratory failure
  - In ICU on January 15th or February 4th, 2014
  - 17 academic and community ARDS Network hospitals
- Data Collection:
  - In-person of all mobility events during the day
    - by PT/OT or RN, including passive and active mobility
  - Chart abstraction
    - Mobility events over 24 hours
    - Severity of illness
    - Level of sedation

Crit Care Med 2016

JOHNS HOPKINS MEDICINE

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- 32% of patient-days with any therapist-provided mobility intervention
- 16% of patient days with out-of-bed mobility
- 4% of patient days with ambulation
- Predictor of mobility progression: PT/OT involvement
- Negative predictors: ETT, delirium

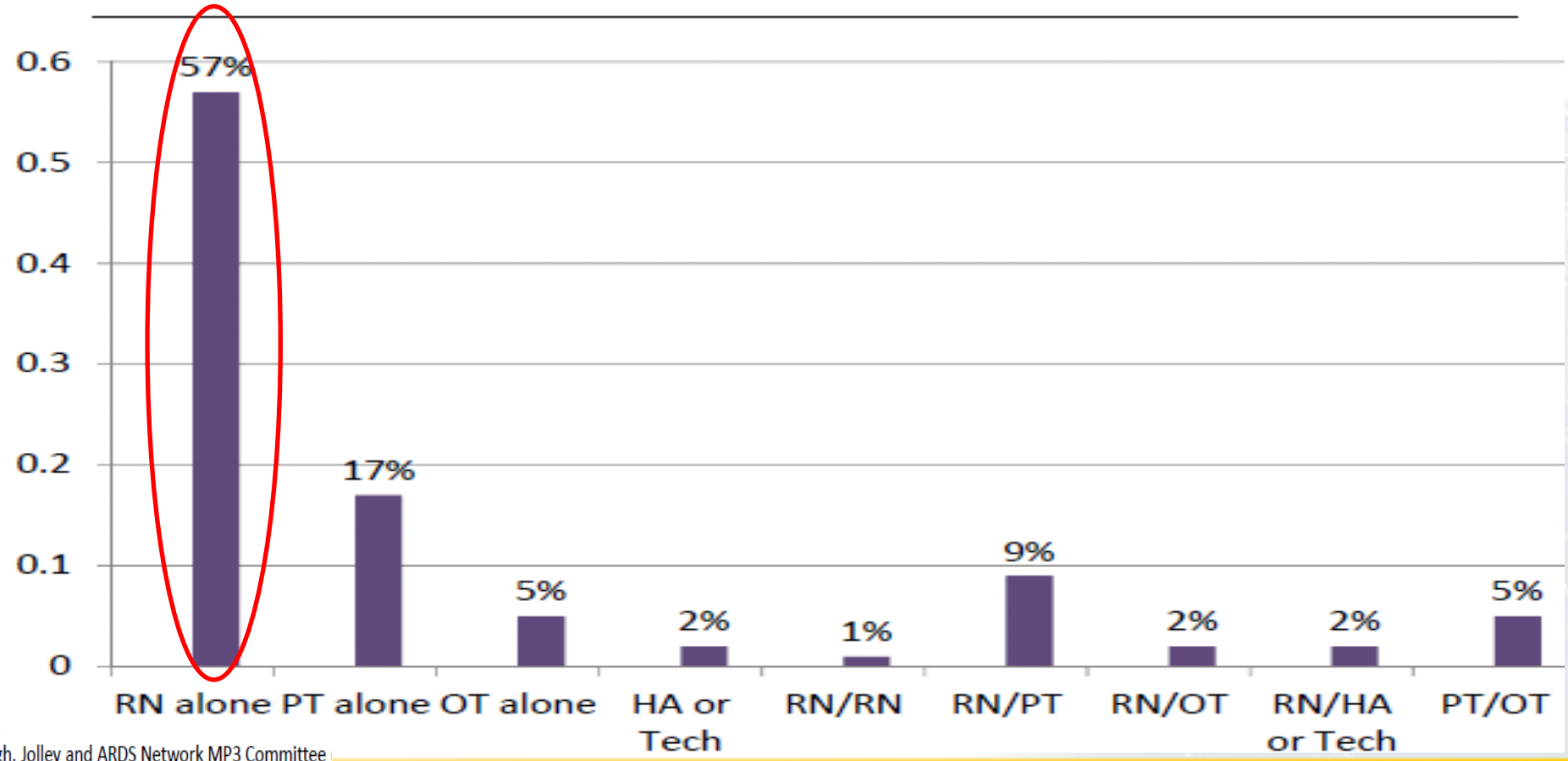
Crit Care Med 2016

JOHNS HOPKINS MEDICINE

Point Prevalence Study of Mobilization Practices for Acute Respiratory Failure Patients in the United States

Sarah Elizabeth Jolley, MD, MSc[1]; Marc Moss, MD[2]; Dale M. Needham, MD, PhD[3]; Ellen Caldwell, MS[4]; Peter E. Morris, MD[5]; Russell R. Miller, MD, MPH[6]; Nancy Ringwood, RN, BSN[7]; Megan Anders, MD[8]; Karen K. Koo, MD[9]; Stephanie E. Gundel, RD, CD[4]; Selina M. Parry, PhD[10]; Catherine L. Hough, MD, MSc[4]; on behalf of the Acute Respiratory Distress Syndrome Network Investigators

Most activity events performed by a solo RN



Hough, Jolley and ARDS Network MP3 Committee

Point Prevalence Study of Mobilization Practices for Acute Respiratory Failure Patients in the United States

Sarah Elizabeth Jolley, MD, MSc[1]; Marc Moss, MD[2]; Dale M. Needham, MD, PhD[3]; Ellen Caldwell, MS[4]; Peter E. Morris, MD[5]; Russell R. Miller, MD, MPH[6]; Nancy Ringwood, RN, BSN[7]; Megan Anders, MD[8]; Karen K. Koo, MD[9]; Stephanie E. Gundel, RD, CD[4]; Selina M. Parry, PhD[10]; Catherine L. Hough, MD, MSc[4]; on behalf of the Acute Respiratory Distress Syndrome Network Investigators

Conclusions: In a cohort of hospitals caring for acute respiratory failure patients, physical therapy/occupational therapy–provided mobility was infrequent. Physical therapy/occupational therapy involvement in mobility was strongly predictive of achieving greater mobility levels in patients with respiratory failure. Mechanical ventilation via an endotracheal tube and delirium are important predictors of mobility progression. (*Crit Care Med* 2016; XX:00–00)

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Retrospectoscope

Sedation, Sleep Promotion, and Delirium Screening Practices in the Care of Mechanically Ventilated Children: A Wake-Up Call for the Pediatric Critical Care Community*

Sapna R. Kudchadkar, MD[1,2]; Myron Yaster, MD[1,2]; Naresh M. Punjabi, MD, PhD[3,4]

Conclusions: The results highlight the heterogeneity in sedation practices among intensivists who care for critically ill children as well as a paucity of sleep promotion and delirium screening in PICUs worldwide. (*Crit Care Med* 2014; 42:1592–1600)

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Early Mobilization in Adults

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Pediatric Literature review

Early Mobilization in the Pediatric Intensive Care Unit: A Systematic Review

Beth Wieczorek[1] Christopher Burke[1] Ahmad Al-Harbi[1] Sapna R. Kudchadkar[2]

- Methods
  - All prospective and retrospective studies investigating early mobilization in the PICU
  - PubMed, CINAHL, Embase, no limiters
  - 1928 abstracts reviewed by 2 independent reviewers
  - 168 articles identified for full-text review
  - 59 included for data extraction with double data entry
  - 6 included in review

» JPIC 2015

Included Studies

Early Mobilization in the Pediatric Intensive Care Unit: A Systematic Review

Beth Wieczorek[1] Christopher Burke[1] Ahmad Al-Harbi[1] Sapna R. Kudchadkar[2]

- Melchers et al 1999: 30 severe TBI
- Jacobs et al 2001: 133 LTRs
- Andelic et al 2012: 61 severe TBI
- Abdulsatar et al 2013: 8 Wii boxing
- Hollander et al 2014: 14 VADS
- Schweitz & Van Aswegan 2013: Pectus

State of Practice

- Choong et al. (PCCM 2014 & CCM 2013)
  - Reported the therapy practices in Canadian PICUs
    - Retrospective
    - Rehab practices largely included chest physiotherapy
    - Barriers
      - » MD and PTs reporting - 66.7% reported having adequate knowledge
      - » MDs and PTs – 76.1% reported therapy/mobility important
    - Institutional barriers
      - » No practice guidelines
      - » Lack of champions/advocates
      - » Lack of MD order for therapy
  - Provider barriers
    - » Safety concerns
      - » Medical stability, risk of device dislodgement, presence of ETT
    - » Conflicting views regarding stability
    - » Slow to recognize when child was ready
    - » Limited staffing
    - » Poor communication re: readiness and goals

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Functional Recovery following Critical Illness in Children: the "Wee-cover" Pilot Study

Karen Choong, MB BCh, Samah Al-Harbi, MD, Katie Siu, MD, Katie Wong, BSc, Ji Cheng, MSc, Burke Baird, MD, David Pogorzelski, BSc, Brian Timmons, PhD, Jan-Willem Gorter, MD PhD, Lehana Thabane, PhD, and **Mary Khetani, ScD OTR Conducted on behalf of the Canadian Critical Care Trials Group**

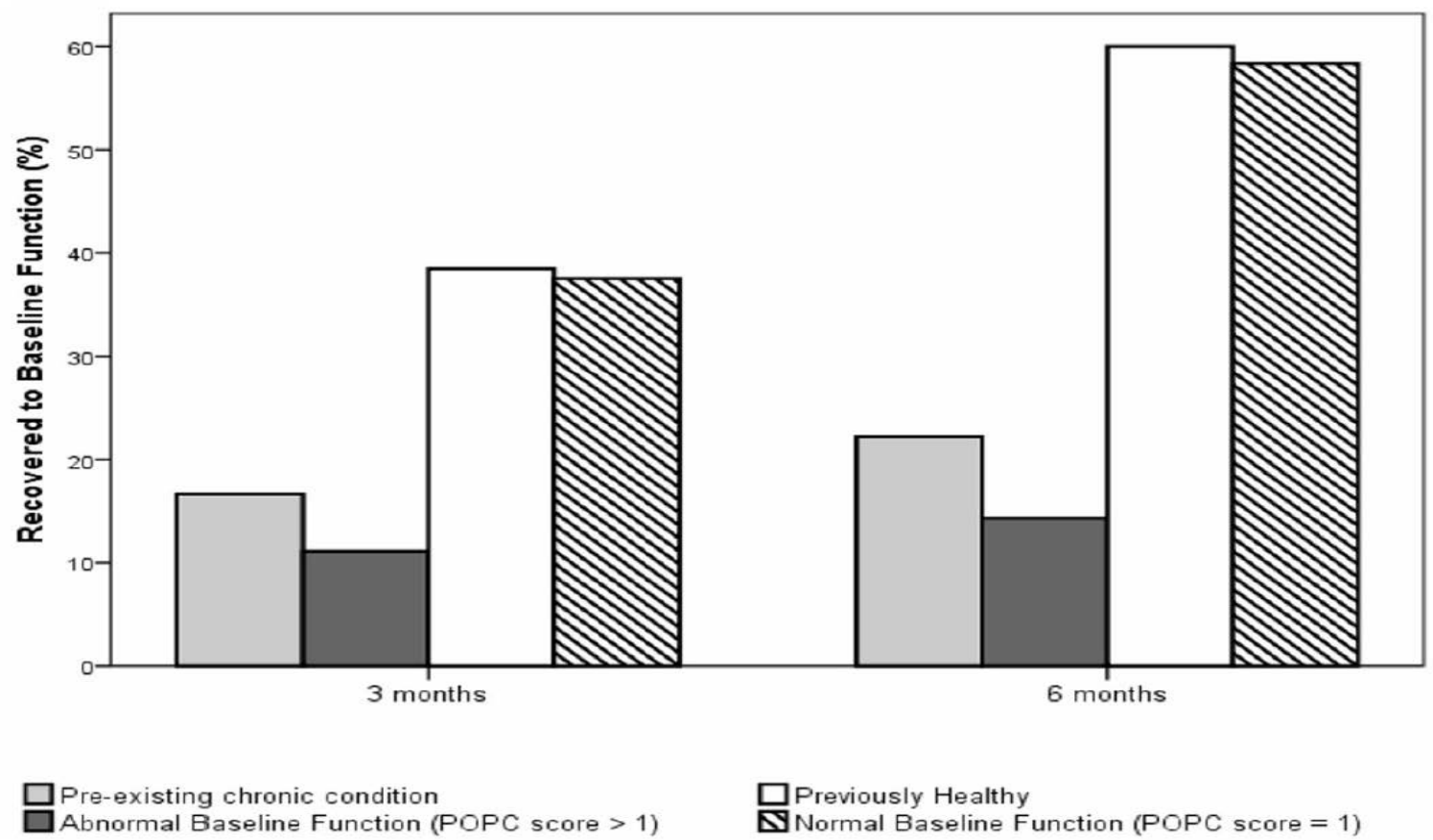

Figure 3. Proportion of patients recovering to baseline functional status at 3 and 6 months post PICU discharge

Baseline functional limitation was defined as patients with a Pediatric Overall Performance Category (POPC) score > 1.

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Recommendations from Literature Review

- Safe, feasible, positive outcomes when…
  - Unit culture
  - Barriers and facilitators
  - Protocols
  - Knowledge
  - Resources
  - Interdisciplinary collaboration
    - 2 or more individuals, different disciplines, working together, shared goals, patient outcomes

Fall 2013: Our PICU Culture

- Mechanically ventilated children oversedated
- High prevalence of benzodiazepine use and escalation
- PT/OT consultation often ordered by medical team >4 days into PICU admission
- Restraints
- Not screening for, diagnosing or treating delirium
- Benzos, diphenhydramine and narcotic being used to improve sleep

PICU Up!™: Early Rehabilitation and Progressive Mobility

- Structured and interdisciplinary program
- Integrated into the routine care of the critically ill child
- Outcomes
  - Provide a standardized mechanism to increase activity level
  - Improve patient outcomes
    - Lower rates of mobility associated complications
    - Decrease length of mechanical ventilation
    - Decrease length of stay
      - PICU
      - Hospital

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PICU Up! Task Force: Champions met weekly for one year

- Physicians
- Nurses
- Nurse practitioners
- Child Life Specialists
- Kennedy Krieger
- Respiratory Therapists
- Physical therapists
- Occupational therapists
- Speech and Language

One year process..

- Identify barriers
- Discuss solutions
- Create draft guidelines
- Pilot the process
- Create the learning module
- Implement!

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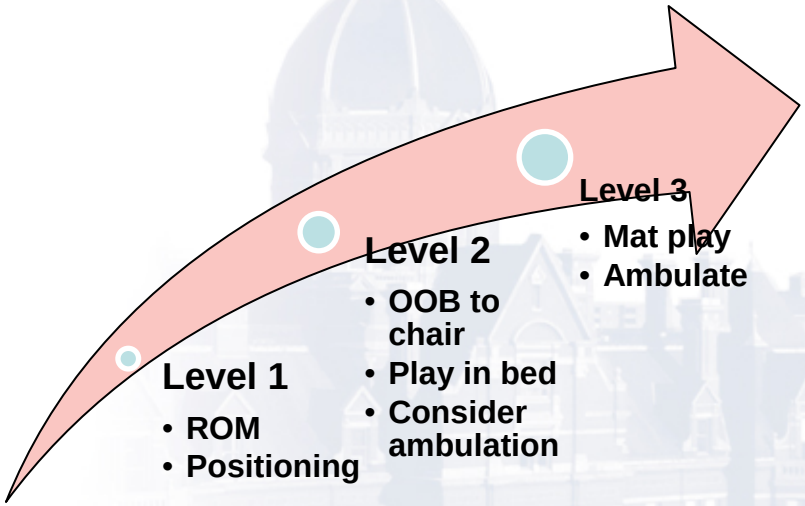
Program Development: PICU Up! Activity Levels

- Stratified: 3 levels
  - Objective clinical data
    - Severity of illness
    - Behavioral state
    - Premorbid history



- Each level associated with activities
- Criteria to pause activity and reassess
  - Changes in vital signs
  - Changes in LOC
  - Concern for device integrity
  - Behavioral issues

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Development of Unit-wide myLearning Module

Patient scenario compatible with delirium module

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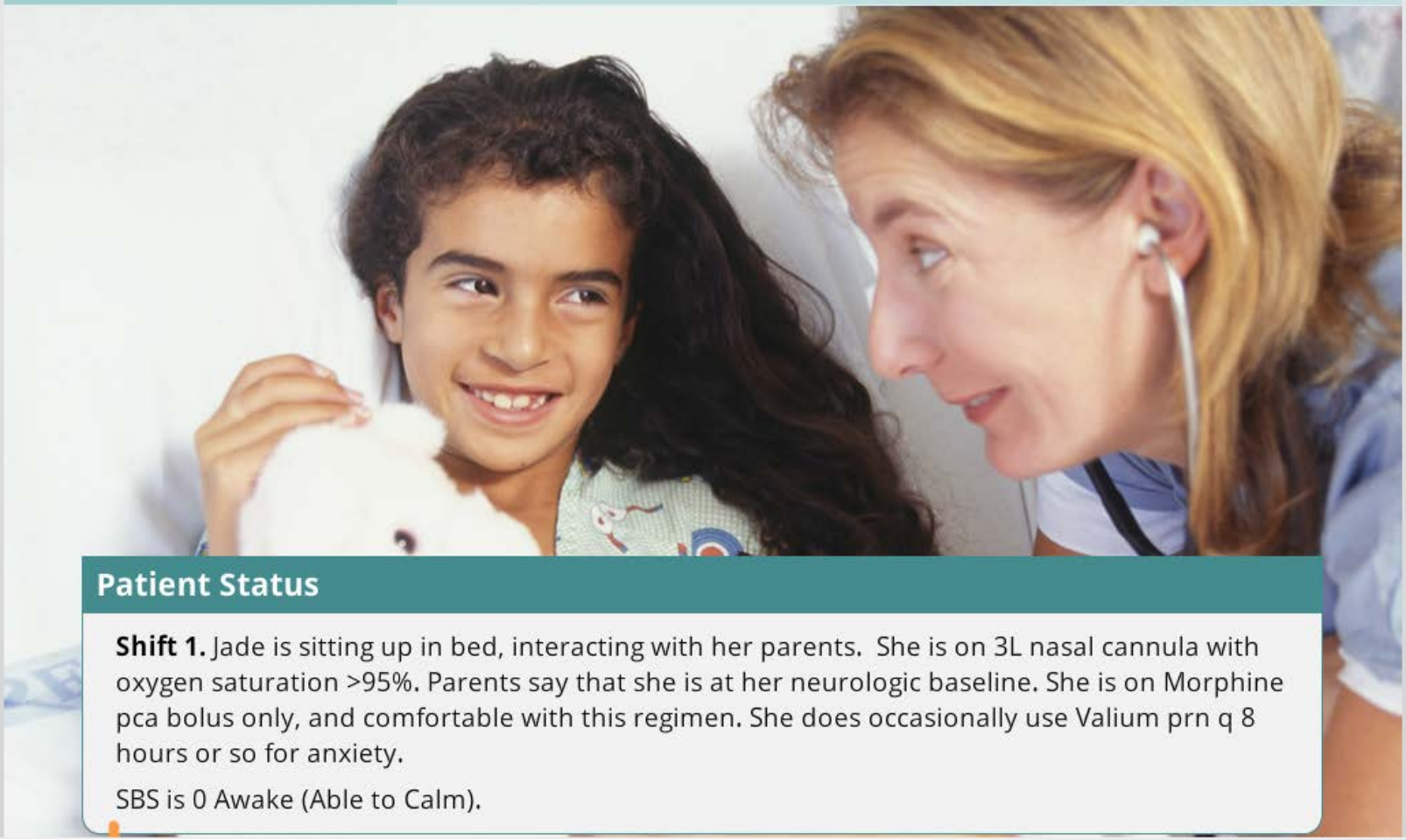
Shift-based patient scenario

Shift 1: 7am to 7pm

SBS Chart

Assess Patient



Patient Status

Shift 1. Jade is sitting up in bed, interacting with her parents. She is on 3L nasal cannula with oxygen saturation >95%. Parents say that she is at her neurologic baseline. She is on Morphine pca bolus only, and comfortable with this regimen. She does occasionally use Valium prn q 8 hours or so for anxiety.

SBS is 0 Awake (Able to Calm).

PICU Up! Levels

Step 1-Screening Process: Early Activity and Mobility Levels

These are the criteria for inclusion at each level of the screening process.

LEVEL 1: Parameters for Inclusion

- Intubated with FiO2 >60% *or*
- Intubated with PEEP > 8 *or*
- Intubated difficult airway *or*
- New tracheostomy *or*
- Acute neurological event *or*
- Sedated and SBS -3 to –2 *or*
- Vasopressor other than Milrinone

LEVEL 2: Parameters for Inclusion

- Intubated or tracheostomy with FiO2 ≤ 60% +/or PEEP ≤8 *and* SBS -1 to +3 *or*
- Noninvasive respiratory support with FiO2 > 60% *or*
- Dialysis/Renal Replacement Therapy *or*
- Femoral access

LEVEL 3: Parameters for Inclusion

- Non-invasive respiratory support with FiO2 ≤ 60% *or*
- Baseline pulmonary support *or*
- EVD cleared by NUS *and* SBS -1 to +3

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PICU Up! Activity Progression

Step 2-Activity Progression

Screening is followed by a progression of activities appropriate for the patient's level.

Activity Progression: Level 1

- Lights on/shades up by 0900
- Bed/bath/weight by 2300
- Lights dimmed/out by 2300 increase lighting as needed for cares/interventions
- TV limited to 30 min at a time. Goal of < 2 hours per day for children >2 yo
- HOB elevated ≥ 30°
- Turn q2h daytime and q4h at night
- Positioned in developmentally supportive position or as recommended by OT/PT
- OT consult by PICU day 3
- PT consult as needed

Activity Progression: Level 2

- Level 1 activities *plus*
- Positive touch for infants/toddlers
- Sitting up in bed TID
- Team to consider OOB to chair +/or ambulation
- OT/PT consult by PICU day 3
- Assess for difficulty with communication or phonation and consult SLP
- Assess for swallowing readiness in high risk children and consult SLP
- Assess need for daily schedule
- pCAM-ICU BID

Activity Progression: Level 3

- Level 1 and 2 activities *plus*
- OOB to chair TID or sitting up in bed TID if appropriate chair is not available
- Ambulate BID if trunk control present

Rest and Reassess

PICU065 Appendix B: Criteria to Pause PICU UP! Activity, Rest and Reassess

- Change in baseline HR by 20%
- Change in baseline BP by 20%
- Change in baseline RR by 20%
- Decrease in baseline SaO2 by 15%
- Increase in baseline FiO2 by 20%
- Increase in baseline ETCO2 by 20%
- Ventilator asynchrony
- CPAP/BiPAP asynchrony
- Respiratory distress
- New arrhythmia
- Hemodynamic concerns
- Change in mental status
- Concern for airway device, vascular access or EVD integrity
- Behavior interfering with safe activity

Exclusions…but no longer

Excluded from PICU UP! Levels and Activities	• ECMO • Open chest • Open abdomen • Unstable fracture • Medical orders specifying alternate activity

Program Evaluation

- Sample
  - Non-probability, convenience
  - Before/After implementation
    - July/August 2014 and July/August 2015
  - Inclusion criteria
    - Ages 1 day to 17 years
    - PICU LOS $\geq$ 3 days

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PICU Up!: Impact of a Quality Improvement Intervention to Promote Early Mobilization in Critically Ill Children

Beth Wieczorek, DNP, PNP-AC[1]; Judith Ascenzi, DNP, RN, CCRN[2]; Yun Kim, MS, OTR/L[3]; Hallie Lenker, PT, DPT, STAR/C[3]; Caroline Potter, MS, CCLS, CIMI[4]; Nehal J. Shata, MBBS[1]; Lauren Mitchell, MS, CCLS[4]; Catherine Haut, DNP, CPNP-AC,CCRN[5,6]; Ivor Berkowitz, MBBCh, MBA[1,7]; Frank Pidcock, MD[1,7]; Jeannine Hoch, MA, CCC-SLP[7]; Connie Malamed, MA[8]; Tamara Kravitz, MS[8]; Sapna R. Kudchadkar, MD[1,7]

Patient Characteristics

Table 3. Baseline Patient Characteristics

Characteristic	Pre-implementation (N=100)	Post-implementation (N=100)	*P* Value[a]
Age in months, mean (SD)	92.94 (68)	92.92 (66)	0.99
Weight in kg, mean (SD)	26.8 (19)	27.3 (22)	0.86
Gender			0.02*
Male, n	67	51	
Female, n	33	49	
Admission categories			0.26
Medical, n	58	50	
Surgical, n	42	50	
Intubated on admission	39	46	0.32
Pre-existing conditions			
Motor impairment, n	29	26	0.63
Intellectual disability, n	32	27	0.44
PRISM score, mean (SD)	4.9 (4.4)	5.4 (4.5)	0.36
PICU LOS, mean (SD)	6.8 (5.4)	7.6 (6.9)	0.34
PICU Up! level – day 3			0.79
1, n	7	11	
2, n	18	17	
3, n	64	60	
Excluded, n	11	12	

Outcomes

PICU Up!: Impact of a Quality Improvement Intervention to Promote Early Mobilization in Critically Ill Children

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- **Patient Characteristics:** Pre/post implementation sample similar in age, weight, reason for admission, premorbid processes, physiologic status as measured by PRISM scores and PICU LOS.
- **No adverse events including tube dislodgments and vascular device compromise**
- **Barriers**
  - ❖ Procedures
  - ❖ Change in patient condition
  - ❖ Equipment

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Results

PICU Up!: Impact of a Quality Improvement Intervention to Promote Early Mobilization in Critically Ill Children

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- 59% of children with OT consultation and session by PICU Day 3 after PICU Up! (44% pre; p=0.04)
- 66% with PT consultation vs. 54% (p=0.08)
- 82% of PICU patients had a PT session prior to discharge from PICU vs. 53% (p=0.02)
- Median number of mobilization activities per patient by day 3 doubled from 3 to 6
- No adverse events

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PICU Up! Outcomes

PICU UP!
Early Mobilization

TABLE 4. Early Mobilization Activities: First 3 Days of PICU Admission

Activity (No. of Children Participating in That Activity)	Preimplementation $n = 100$	Postimplementation $n = 100$	p[a]
In-bed activities (*n*)			
Passive range of motion	13	17	0.43
Passive bed positioning	41	47	0.39
Splinting	3	9	0.08
Active range of motion	2 (2)	2 (1)	0.99
Active bed positioning	26	57	< 0.001[b]
At least one bed activity	70	98	< 0.001[b]
Mobility activities (*n*)			
Sit edge of bed	6	11	0.20
Sit to stand	24	30	0.34
Transfer	48	46	0.77
Ambulate	15	27	0.04[b]
Play	6	3	0.78
Other	5	3	0.31
At least one mobility activity	63	76	0.05[b]

Barriers to Mobilization

TABLE 5. Barriers to Activities: First 3 Days of PICU Admission

No. of Times Barrier Reported	Preimplementation	Postimplementation	p^a
Barrier			< 0.001
Child refused	0	3	
Parent refused	1	3	
Test/study/procedure/surgery	19	10	
Patient condition	10	11	
Equipment availability	2	22	
Bed rest order	3	0	

[a]Fisher exact test used for analysis.

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Daily Safety Timeout: Accountability!

Are PT and/or OT consults ordered by Day 3 of admission?	Yes No
Delirium Screen: (patients ≥ 5 years)	+ / - n/a
Daily SBS Goal	SBS _____
Daily WAT Goal	WAT _____
PICU Up Level	Level_____
Is a communication device needed?	Yes No

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Breaking down the silos

Early Mobilization

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Take home points

- Consistency creates culture change!
- Cluster non-emergent interventions and optimize rehab and communication to promote wakefulness during the day!
- Minimize benzodiazepines and deliriogenic drugs–analgesia first, and…**start low, go slow!**
- Critically ill children CAN tolerate an endotracheal tube and communicate with us!
- Focus on non-pharmacologic therapy
- Push the envelope…safely!

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Celebrate all successes, big and small!

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ICU Delirium
and Cognitive Impairment Study Group

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Thank you!

PICU UP!
Early Mobilization

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