

# Early Progressive Mobility: Impacting Short and Long Term Outcomes



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# Disclosures

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# Learning Objectives

At the completion of this activity, the participant will be able to:

1. Identify and discuss key in-bed and out of bed mobility techniques to successfully achieve your early mobility protocol to improve patient outcomes.
2. Overcoming barriers and feeling empowered to own patient mobility within your unit.

# Impact of Immobility

- Increase atelectasis and risk for VAP/HAP
- Fluid shifts, cardiac deconditioning and orthostatic intolerance
- Pressure ulcers from shear, friction, moisture and pressure risk factors
- 74% of patients developed delirium during hospital stay & at 3 months 40% had global cognition scores 1.5 SD below population mean
- ICU patients up to 5 years experience severe weakness & deficits in self care, poor quality of life & readmission.
- One day of bed rest requires two weeks of reconditioning to restore baseline muscle strength

Reddy, M, et al. JAMA, 2006; 296(8): 974-984  
Convertino V, et al. Med Sci Sports Exercise, 1997;29:191-196

Fortney SM, et al. *Physiology of bedrest (Vol 2)*. New York: Oxford University Press. 1996.

Pandharipande, PP. et al. N Engl J Med;369:1306:1316

Herridge MS, et al. N Engl M, 2011;364(14):1293-304

# ICU-Acquired Weakness (ICUAW)

## Definition:

- Syndrome of generalized limb weakness that develops while the patient is critically ill and for which there is no alternative explanation other than the critical illness itself.<sup>1</sup> Average Medical Research Council Scale (MRC) score <4 across all muscles tested.

## Incidence:

- 25% of patients with prolonged mechanical ventilation will develop ICUAW<sup>1</sup>
- Est 75,000 pts in US, 1 million worldwide

## Caused By:<sup>1</sup>

- Critical illness polyneuropathy and myopathy
- Combination

1. Fan E, et al. *Am J Respir Crit Care Med*. 2014 Dec 15;190(12):1437-46.  
2. Hermans G, et al. *Crit Care*. 2008;12:238.

# ICU-Acquired Weakness (ICUAW)

## Risk factors:

- Severe Sepsis<sup>1</sup>
- Duration of mechanical ventilation<sup>1,4</sup>
- ICU LOS<sup>5</sup>
- Systemic inflammatory response syndrome<sup>2</sup>
- Multiple organ failure<sup>2,4</sup>
- Immobility<sup>2</sup>
- Use of corticosteroids/neuromuscular blockers<sup>2,3,5</sup>

## Negative impact:<sup>1,2</sup>

- Prolong mechanical ventilation
- Reoccurring respiratory failure & VAP
- Increased ICU and hospital length of stay
- Increase mortality

1. Fan E, et al. *Am J Respir Crit Care Med*. 2014 Dec 15;190(12):1437-46.

2. Kress JP et al. *N Engl J Med*, 2014;370:1626-1635

3. Hermans G, et al. *Crit Care*. 2008;12:238.

4. De Jonghe B, et al. *Crit Care Med*. 2007;35(9):2007-2015.

5. Needham DM, et al. *Am J of Respir and Crit Care Med*. 2014;189(10):1214-1224

# Outcomes of Early Mobility Programs

- ↓ incidence of VAP
- ↓ time on the ventilator
- ↓ days of sedation
- ↓ incidence of skin injury
- ↓ delirium
- ↑ ambulatory distance
- Improved function

Staudinger t, et al. Crit Care Med, 2010;38.

Abroung F, et al. Critical Care, 2011;15:R6

Morris PE, et al. Crit Care Med, 2008;36:2238-2243

Pohlman MC, et al. Crit Care Med, 2010;38:2089-2094

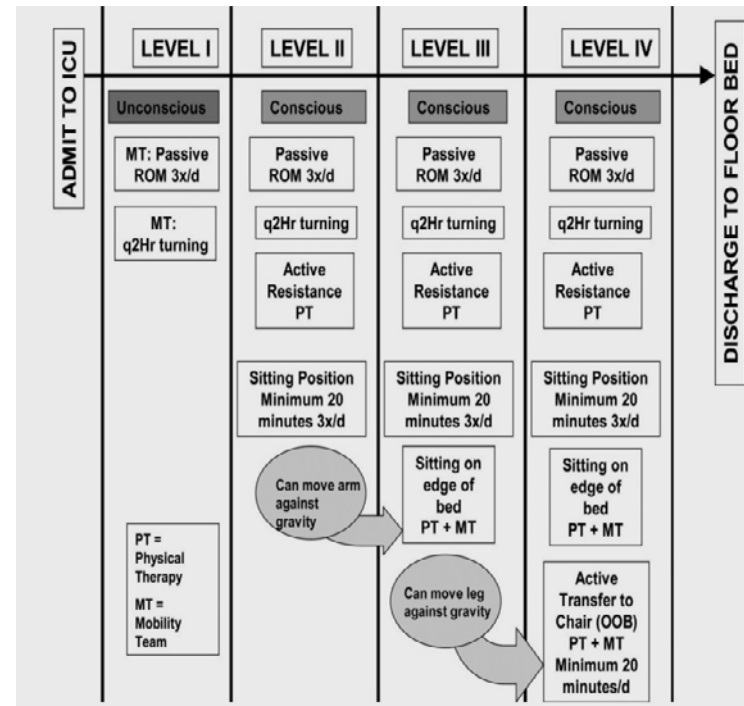
Schweickert WD, et al. Lancet, 373(9678):1874-82.

Thomsen GE, et al. CCM 2008;36:1119-1124

Winkelman C et al, CCN,2010;30:36-60

# Early Mobility Protocol: Impacting Outcomes

- Morris, et al, conducted a prospective cohort study to determine the impact of early mobility therapy using a team on patients who were mechanically ventilated with respiratory failure
- The control group received standard passive ROM and turning (n=165)
- The study group received low-impact mobility by a team (n=165)
  - Therapy initiated within 48 hours of mechanical ventilation
  - Therapy 7 days/week until ICU discharge
  - Mobility team included 1 ICU nurse, 1 physical therapist, and 2 nursing assistants





# Early ICU Mobility Therapy

## Results

- Baseline characteristic similar in both groups
- Protocol group:
  - Received as least 1 PT session vs. usual care (80% vs. 47%,  $p \leq .001$ )
  - Out of bed earlier (5 vs. 11 days,  $p \leq .001$ )
  - Reduced ICU LOS (5.5 days vs. 6.9 days,  $p=.025$ )
  - Reduced Hospital LOS ( 11.2 days vs. 14.5 days,  $p =.006$ )
  - No adverse outcomes;
    - Most frequent reason for ending mobility session was patient fatigue
  - Cost
    - Average cost per patient was \$41,142 in the protocol group
    - Average cost per patient was \$44,302 in the control group

# Early Physical and Occupational Therapy in Mechanically Ventilated Patients

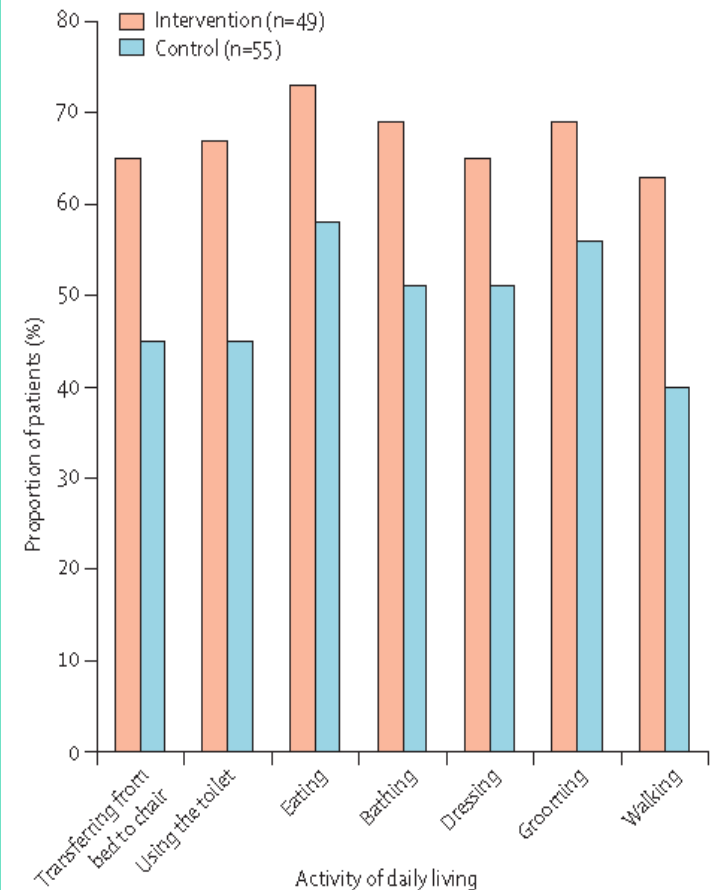
- Prospective randomized controlled trial from 2005-2007
- 1161 screen, 104 patients mechanically ventilated < 72hrs, functionally independent at baseline met criteria
- Randomized to:
  - early exercise of mobilization during periods of daily interruption of sedation (49 pts)
  - daily interruption of sedation with therapy as ordered by the primary care team (55 pts)
- Primary endpoint: number of patients returning to independent functional status at hospital discharge able to perform activities of daily living and walk (independently)

# Early Physical and Occupational Therapy in Mechanically Ventilated Patients

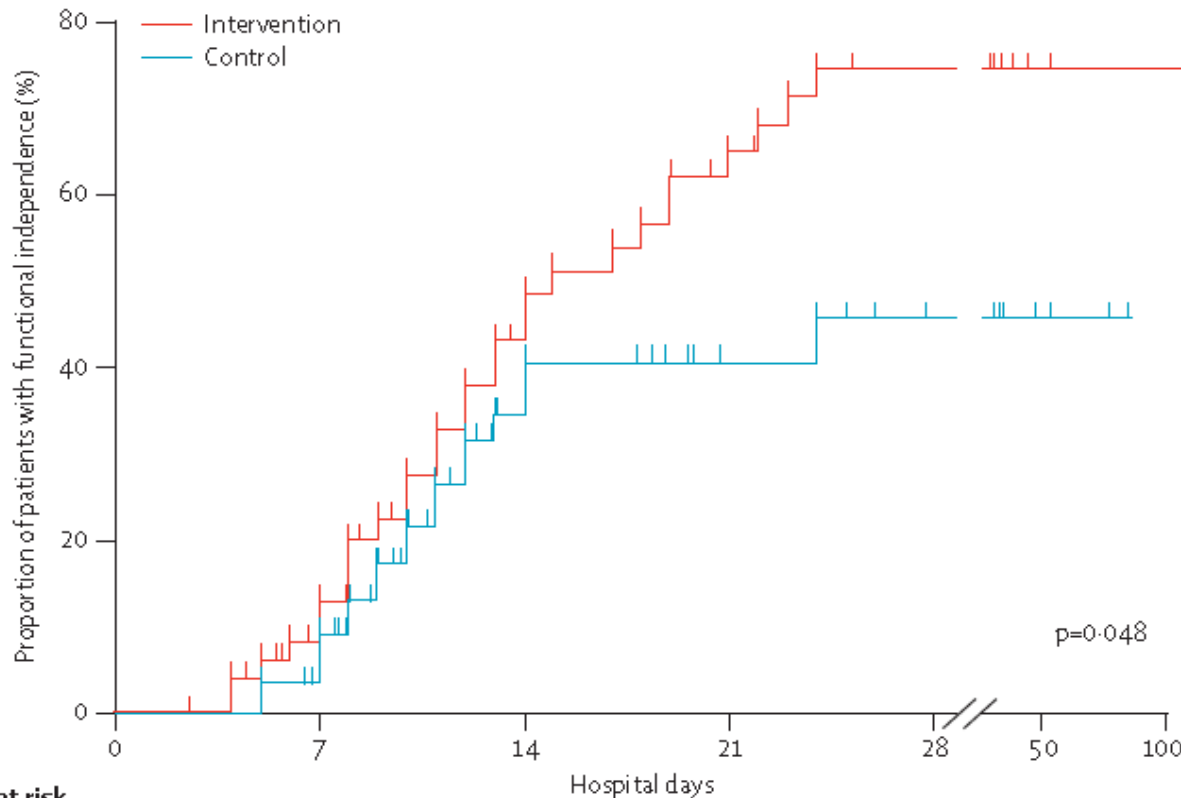
	Intervention (n=49)	Control (n=55)	p value
Time from intubation to first PT/OT session (days)	1.5 (1.0-2.1)	7.4 (6.0-10.9)	<0.0001
Independent ADLs total at ICU discharge	3 (0-5)	0 (0-5)	0.15
Independent ADLs total at hospital discharge	6 (0-6)	4 (0-6)	0.06
MRC examination score at hospital discharge	52 (25-58)	48 (0-58)	0.38
Hand-grip strength at hospital discharge (kg-force)	39 (10-58)	35 (0-57)	0.67
Greatest walking distance at hospital discharge (m)	33.4 (0-91.4)	0 (0-30.4)	0.004
Time from intubation to milestones achieved (days)			
Out of bed	1.7 (1.1-3.0)	6.6 (4.2-8.3)	<0.0001
Standing	3.2 (1.5-5.6)	6.0 (4.5-8.9)	<0.0001
Marching in place	3.3 (1.6-5.8)	6.2 (4.6-9.6)	<0.0001
Transferring to a chair	3.1 (1.8-4.5)	6.2 (4.5-8.4)	<0.0001
Walking	3.8 (1.9-5.8)	7.3 (4.9-9.6)	<0.0001

Data are median (IQR). ADLs=activities of daily living. ICU=intensive care unit. MRC=Medical Research Council. PT/OT=physical therapy and occupational therapy. MRC examination scale 0-60.

**Table 4: Function and muscle strength outcomes according to study group**



# Early Physical and Occupational Therapy in Mechanically Ventilated Patients



## Number at risk

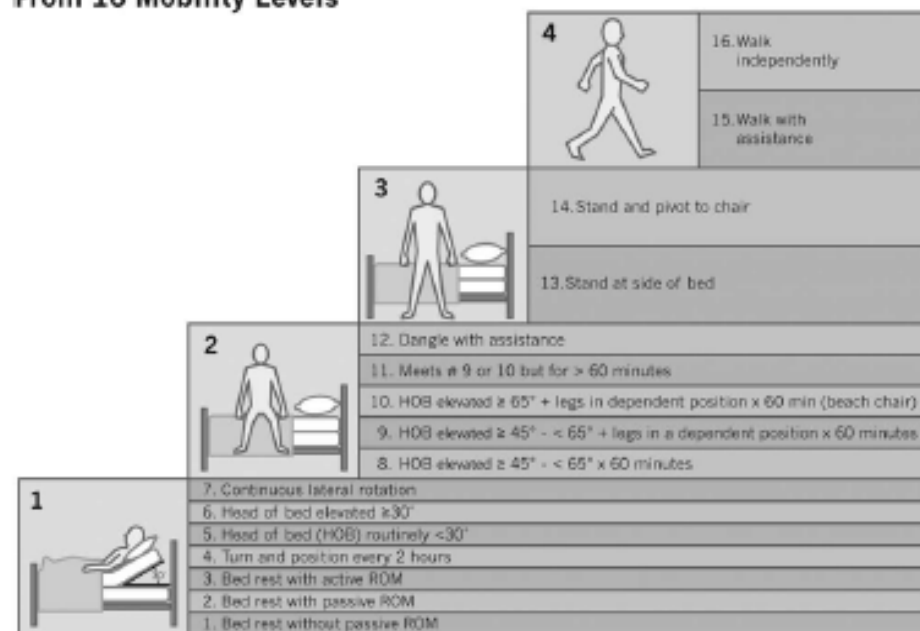
	0	7	14	21	28	50	100
Control	55	51	21	13	9	4	0
Intervention	49	40	21	13	8	2	1

- Safe
- Well tolerated
- ↓ duration of delirium
- ↑ VFD
- Functional independence at discharge 59% protocol group vs. 35% in control arm

# Protocol Driven Mobility Program: Impacting Neuro ICU Outcomes

- Pre-post intervention study
- Large academic NICU
- 637 patients
  - 260 pre
  - 377 post
- Intervention: Early Progressive Mobility Protocol
  - Exclusion criteria
  - Readiness criteria
  - Started on admission
  - Encourage to use ICU bed features & lifts to assist
  - Protocol place at bedside

## Four Progressive Mobility Milestones From 16 Mobility Levels



GGF © 2014

# Protocol Driven Mobility Program: Impacting NICU Outcomes

Multivariate analysis done to control for group differences:

Factor	Adjusted Model Mean (SEM)		p
	Preintervention	Postintervention	
Acute Physiology and Chronic Health Evaluation III score <sup>b</sup>	59.0 (2.64)	58.7 (2.54)	0.90
Length of stay			
Hospital, d (sd)	15.16 (0.96)	10.21 (1.04)	< 0.001
Neurologic ICU, d (sd)	7.37 (0.68)	4.75 (0.64)	< 0.001
Psychologic factors			
Depression, mean (sd)	0.76 (0.22)	0.51 (0.22)	0.12
Anxiety, mean (sd)	0.69 (0.21)	0.42 (0.21)	0.088
Hostility, mean (sd)	0.38 (0.14)	0.27 (0.14)	0.31
Combined, mean (sd)	1.80 (0.50)	1.21 (0.48)	0.11
Factor	Postintervention Odds Ratio (95% CIs)		p
Highest mobility achieved			
> Level 7 <sup>c</sup>	1.63 (1.16, 2.33)		0.005
3 levels <sup>d</sup>	1.92 (1.43, 2.58)		< 0.001
4 levels <sup>e</sup>	1.78 (1.32, 2.41)		< 0.001
Mortality, 30 d	0.96 (0.58, 1.59)		0.87
Discharge home	1.53 (1.03, 2.27)		0.033
Deep vein thrombosis	1.90 (1.00, 3.60)		0.05
Deep vein thrombosis <sup>f</sup>	1.73 (0.95, 3.15)		0.072
Deep vein thrombosis <sup>g</sup>	1.52 (0.83, 2.80)		0.18

**A**

**AWAKE/PAIN  
ASSESSMENT**

**B**

**BREATHE**

**C**

**CHOICE OF  
SEDATION**

**D**

**DELIRIUM**

**E**

**EARLY MOBILITY**

**F**

**FAMILY**

# ABCDE Bundle Reduces Ventilation, Delirium & ↑OOB

- 18 month, prospective, cohort, before-after study
- 5 adult ICU's, 1 step down, 1 oncology unit
- Compared 296 patients (146 pre-bundle) & 150 post bundle)
- Intervention: ABCDE
- Measured:
  - For mechanical ventilation patients (187) examined ventilator free days
  - All patients examined incidence of delirium, mortality, time to discharge and compliance with the bundle



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 <sup>a</sup>					
Ventilator-free days <sup>a</sup>					
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 <sup>b</sup> (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 <sup>b</sup>	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 <sup>b</sup> (1.30–3.45)	0.003
28-day mortality <sup>c</sup>					
Hospital mortality (ICU and post-ICU), n (%)	29 (19.9)	17 (11.3)	0.04	0.56 <sup>b</sup> (0.28–1.10)	0.09
ICU mortality, n (%)	24 (16.4)	14 (9.3)	0.07		
Time to discharge <sup>d</sup> (d)					
From ICU, median (IQR)	5 (3, 8)	4 (3, 5)	0.21	1.16 <sup>c</sup> (0.89–1.50)	0.27
From hospital, median (IQR)	13 (9, 15)	11 (9, 13)	0.99	1.01 <sup>c</sup> (0.77–1.31)	0.96

# Driving Change

- Gap analysis
- Build the Will
- Protocol Development

Structure



- Make it Prescriptive
- Overcoming barriers
- Daily Integration

Process

Outcomes



# International Survey of Early Mobilization Practices: Where Do We Stand

- Surveyed directors of medical and mixed medical surgical ICUs in 4 countries
- Institutions selected a random
- Results
  - 833 ICUs (US 396; France 151, UK 138, Germany 148)
  - 27% reported having a formal EM protocol
  - 21% have adopted him practices without a protocol
  - 52% have not adopted EM practices
  - EM protocols applied to both ventilated and non-ventilated upon ICU admission
  - Factors associated with EM protocol
    - presence of multidisciplinary rounds (US)
    - written daily goals (US)
    - Sedation protocol (US)

# Early Mobility

## Progressive Mobility:

Planned movement in a sequential manner beginning at a patient's current mobility status and returning them to baseline & includes:

- Head elevation
- Manual turning
- Passive & Active ROM
- Continuous Lateral Rotation Therapy/Prone Positioning
- Movement against gravity
- Physiologic adaptation to an upright/leg down position (Tilt table, Bed Egress)
- Chair position
- Dangling
- Ambulation

# The Mobility Initiative

- Objective
  - To create a progressive mobility initiative that will help ICU teams to address key cultural, process and resource opportunities in order to integrate early mobility into daily care practices.
- Methods
  - Multi-center implementation of key clinical interventions
  - An evidence-based, user-friendly progressive mobility continuum was developed, lead by the Clinical Nurse Specialist faculty
  - Implementation plan: process design, culture work & education
  - 130 patients/3120 prospectively collected hourly observations
  - Qualitative and quantitative data collected
    - 15 process and 5 outcome metrics
  - Results reported as cohort and unit specific data



# Determining Readiness

- Perform Initial mobility screen w/in 8 hours of ICU admission & daily or q shift

- $\text{PaO}_2/\text{FiO}_2 \geq 250$
- $\text{Peep} < 10$
- $\text{O}_2 \text{ Sat} \geq 90\%$
- RR 10-30
- No new onset cardiac arrhythmias or ischemia
- $\text{HR} > 60 < 120$
- $\text{MAP} > 55 < 140$
- $\text{SBP} > 90 < 180$
- No new or increasing vasopressor infusion
- $\text{RASS} \geq -3$

← Patient Stable, Start at Level II & progress

→ Patient is unstable, start at Level I & progress

# ICU Mobility Score (IMS)

- Strong interrater reliability
- Easy to use

ICU Mobility Scale.

Classification	Definition
0 Nothing (lying in bed)	Passively rolled or passively exercised by staff, but not actively moving
1 Sitting in bed, exercises in bed	Any activity in bed, including rolling, bridging, active exercises, cycle ergometry and active assisted exercises; not moving out of bed or over the edge of the bed
2 Passively moved to chair (no standing)	Hoist, passive lift or slide transfer to the chair, with no standing or sitting on the edge of the bed
3 Sitting over edge of bed	May be assisted by staff, but involves actively sitting over the side of the bed with some trunk control
4 Standing	Weight bearing through the feet in the standing position, with or without assistance. This may include use of a standing lifter device or tilt table
5 Transferring bed to chair	Able to step or shuffle through standing to the chair. This involves actively transferring weight from one leg to another to move to the chair. If the patient has been stood with the assistance of a medical device, they must step to the chair (not included if the patient is wheeled in a standing lifter device)
6 Marching on spot (at bedside)	Able to walk on the spot by lifting alternate feet (must be able to step at least 4 times, twice on each foot), with or without assistance
7 Walking with assistance of 2 or more people	Walking away from the bed/chair by at least 5 m (5 yards) assisted by 2 or more people
8 Walking with assistance of 1 person	Walking away from the bed/chair by at least 5 m (5 yards) assisted by 1 person
9 Walking independently with a gait aid	Walking away from the bed/chair by at least 5 m (5 yards) with a gait aid, but no assistance from another person. In a wheelchair bound person, this activity level includes wheeling the chair independently 5 m (5 yards) away from the bed/chair
10 Walking independently without a gait aid	Walking away from the bed/chair by at least 5 m (5 yards) without a gait aid or assistance from another person

# Progressive Mobility Continuum

**START HERE**

Includes complex, intubated, hemodynamically unstable and stable intubated patients; may include non-intubated

Includes intubated, non intubated hemodynamically stable/stabilizing, no contraindications

**LEVEL I**

**LEVEL II**

**LEVEL III**

**LEVEL IV**

**LEVEL V**

RASS -5 to -3

RASS -3 & up

RASS -1 & up

RASS 0 & up

RASS 0 & up

**Goal:** clinical stability;  
passive ROM

**Goal:** upright sitting;  
increased strength and  
moves arm against gravity

**Goal:** Increased trunk  
strength, moves leg  
against gravity and  
readiness to weight bear

**Goal:** stands w/ min.  
to mod. assist, able to  
march in place,  
weight bear and  
transfer to chair

**Goal:** Increase  
distance in ambulation  
& ability to perform  
some ADLs

PT consultation prn  
OT consultation prn

PT: Active Resistance  
Once a day, strength  
exercises  
  
OT consultation prn

PT x 2 daily  
OT consult for ADL's

PT x 2 daily & OT x1  
daily

**ACTIVITY:**

- Q 2 hr turning  
\*Passive /Active ROM  
3x/d
- HOB 45° X 15 min.
  - HOB 45°, Legs  
in dependant  
position X 15 min.
  - HOB 65°, Legs  
in dependant  
position X 15 min.
  - Step (3) & full  
chair mode  
X20 min. 3X/d  
Or  
Full assist into cardiac  
chair 2X/day

**ACTIVITY:**

- Self or assisted  
Q 2 hr turning
- Sitting on edge of  
bed w/RN, PT, RT  
assist X 15 min.
  - Progressive bed  
sitting Position  
Min.20 min. 3X/d  
Or  
Pivot to chair  
position 2X/d

**ACTIVITY:**

- Self or assisted  
Q 2 hr turning
- Bed sitting Position  
Min.20 min. 3X/d;
  - Sitting on edge of  
bed; stand w/ RN,  
PT, RT assist
  - Active Transfer to  
Chair (OOB) w/  
RN/PT/RT assist  
Min. 3X/d

**ACTIVITY:**

- Self or assisted  
Q 2 hr turning
- Chair (OOB) w/  
RN/PT/RT assist  
Min. 3X/day
  - Meals consumed  
while dangling on  
edge of bed or in  
chair

**ACTIVITY:**

HOB ≥ 30°  
\*Passive ROM 2X/d  
performed by RN, or  
UAP

CLRT/Pronation  
initiated if patient  
meets criteria based  
on institutional  
practice  
OR  
Q 2 hr turning

Tolerates  
Level I  
Activities

Tolerates  
Level II  
Activities

Tolerates  
Level III  
Activities

Tolerates  
Level IV  
Activities

Ambulate  
progressively longer  
distances with less  
assistance x2 or  
x3/day with  
RN/PT/RT/UAP

**For each position/activity change allow 5-10 minutes for equilibration before determining the patient is intolerant**

**\*\*\*If the patient is intolerant of current mobility level activities, reassess and place in appropriate mobility level\*\*\***

Perform Initial mobility  
screen w/in 8 hours of ICU  
admission  
Reassess mobility level at  
least every 24 hours  
(Recommended at shift Δ)

Refer to the following  
criteria to assist in  
determining mobility level

- o PaO<sub>2</sub>/FiO<sub>2</sub> ≥ 250
- o Peep <10
- o O<sub>2</sub> Sat ≥ 90%
- o RR 10-30
- o No new onset cardiac  
arrhythmias or ischemia
- o HR >60 <120
- o MAP >55 <140
- o SBP >90 <180
- o No new or increasing  
vasopressor infusion
- o RASS ≥ 3

NO

YES

Start at  
level I\*

Start at  
level II and  
progress\*

**\*Mobility is the responsibility of the RN, with the assistance from the RT's Unlicensed Assistive Personnel and PT/ OT. PT and OT may assist the team with placement to the appropriate mobility level of activity, always prioritizing patient and provider safety. Placement is based on clinical judgment.**



# Progressive Mobility: Use of Technology to In-Bed & Out of Bed Mobility



Journey to tolerating upright position, turning, tilt, sitting, standing and walking and out of bed chair sitting can occur quicker through the use of technology



“Even if you are on the right track, you will get run over if you just sit there.”

*Will Rogers*

# Early Mobility:

Can We Do It?

Is it Safe?



# Safety

- > 1 % adverse events during 1449 sitting, standing and walking sessions with patients on ventilators.
- Underwent daily sedation interruption followed by PT & OT daily until achieving physical function independence
  - Safety events occurred in 16% of all sessions
    - Loss of 1 arterial line, 1 nasogastric tube, 1 rectal tube
  - Therapy was stopped on 4% of all sessions for vent asynchrony, agitation, or both
  - Delirium present 53% of the time during therapy sessions

# Barriers to Early Mobility (John Hopkins)

Needham, D et.al. Top Stroke Rehab, 2010;17(4):271-281

<b>Barrier</b>	<b>Strategy to Overcome Barrier</b>
Lack of leadership	<ul style="list-style-type: none"><li>• Overall leader</li><li>• Champion from every discipline</li></ul>
Lack of staffing and equipment	<ul style="list-style-type: none"><li>• Obtain dedicated full-time OT and PT</li><li>• Purchase two wheelchairs</li></ul>
Lack of knowledge and training	<ul style="list-style-type: none"><li>• Educated the multidisciplinary team regarding rationale for early mobility</li><li>• Created simple guidelines</li><li>• Cross train staff</li></ul>
Lack of physician referrals	<ul style="list-style-type: none"><li>• Project coordinator screen patients</li><li>• Project coordinator prompted physicians for early consultation</li></ul>
Oversedation	<ul style="list-style-type: none"><li>• Interdisciplinary education from continuous infusion to as needed boluses</li><li>• Screening with RASS</li></ul>
Delirium	<ul style="list-style-type: none"><li>• Screening for delirium</li><li>• Minimize use of drugs associated with delirium</li></ul>
Perceive pain and discomfort	<ul style="list-style-type: none"><li>• Assess pain using validated tool/administer meds</li></ul>
Safety	<ul style="list-style-type: none"><li>• PT OT insured securement of devices</li><li>• Untangle lines and tubes before therapy</li></ul>
Physiologic instability	<ul style="list-style-type: none"><li>• Created guidelines for screening</li><li>• Change event mode an increased FiO2 prior to activity</li></ul>

# Hemodynamic Instability

???

Is it a Barrier to  
Positioning?

# The Role of Hemodynamic Instability in Positioning<sup>1,2</sup>

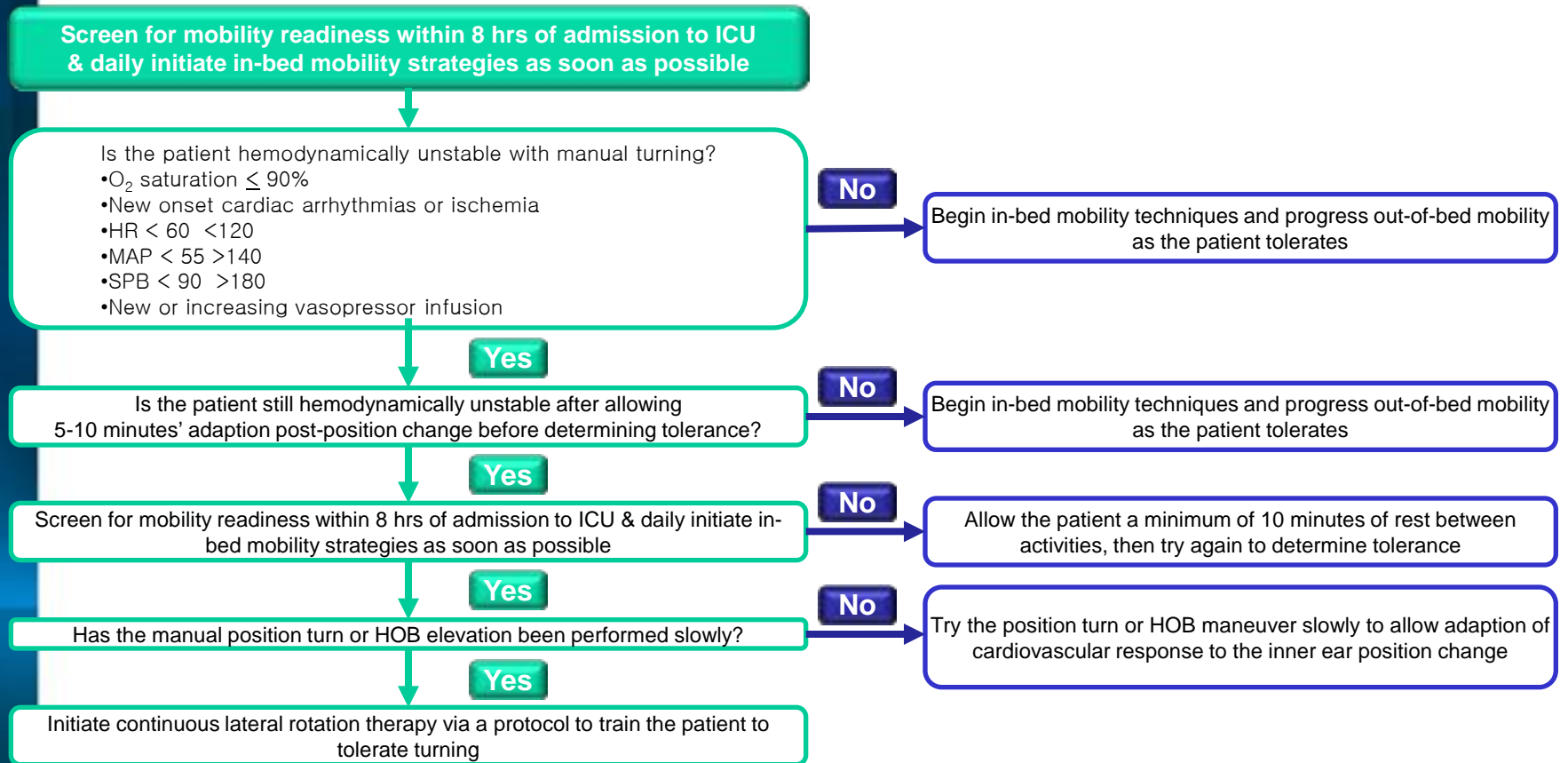
- Lateral turn results in a 3%-9% decrease in SVO<sub>2</sub>, which takes 5-10 minutes to return to baseline
- Appears the act of turning has the greatest impact on any instability seen
- Minimize factors that contribute to imbalances in oxygen supply and demand
- Factors that put patients at risk for intolerance to positioning:<sup>3</sup>
  - Elderly
  - Diabetes with neuropathy
  - Prolonged bed rest
  - Low hemoglobin and cardiovascular reserve
  - Prolonged gravitational equilibrium

1. Winslow EH, et al. *Heart Lung*. 1990;19:557-561.

2. Price P. *Dynamics*. 2006;17:12-19.

3. Vollman KM. *Crit Care Nurs Q*. 2013;36:17-27

# Decision-Making Tree for Patients Who Are Hemodynamically Unstable With Movement<sup>1,2</sup>



HOB=head of bed; HR=heart rate; MAP=mean arterial pressure; SPB=systolic blood pressure.

Vollman KM. *Crit Care Nurse*. 2012;32:70-75.

Vollman KM. *Crit Care Nurs Q*. 2013;36:17-27.



# It Takes a Village For Sustainability

## 1. Necessary Components for Early Rehab

- Buy-in
- Multiple disciplines
- Team communication
- Opinion leader
- Individual discipline champion
- Dedicated rehab personnel
- Equipment
- Sedation practice
- Administrative funding

## 2. Implementation Strategies

- Team center approach
- Staff education
- Strength & quality of evidence

## 3. Perceived Barriers

- Increase workload
- Safety concerns

## 4. Positive Outcomes

- Improved patient outcomes
- Staff satisfaction
- Changed culture
- Financial savings



# Be Courageous

We all are responsible for the safety of our patients and ourselves.....Own the Issues

- “If not this, then what??”
- “If not now, then when?”
- “If not me, then who??”