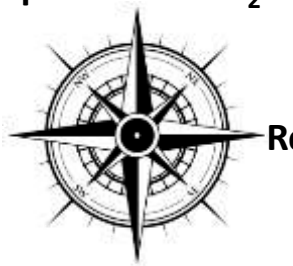
Prise en charge initiale du SDRA en 2019



Toute initiation de ventilation invasive avec sédation en réanimation

Vt autour de 6 ml/kg de poids prédit à la phase initiale en l'absence d'acidose métabolique profonde

Recherche systématique des critères diagnostiques de SDRA

SDRA confirmé

Vt autour de 6 ml/kg de poids prédit
Pplateau < 30 cmH2O
PEP > 5 cmH2O
Surveiller hypercapnie

P/F < 200 — PEP élevée si améliore oxygénation

P/F < 150 — Curarisation
Décubitus ventral

P/F < 80 — Discuter ECMO VV

Sévérité SDRA

Réévaluation des réglages et de la stratégie de prise en charge au moins toutes les 24h

ECMO veino-veineuse
- ❑ Si hypoxémie réfractaire ou ventilation protectrice non applicable
- ❑ A discuter avec un centre expert

Modalités de la curarisation : IVSE
- ❑ Précocement, dans les 48h du diagnostic

Modalités du décubitus ventral (DV)
- ❑ séance ≥ 16 heures, plusieurs séances

SDRA modéré ou sévère → Test PEP élevée (> 12 cmH_2O)
Utilisation PEP élevée si :
- ❑ Amélioration de l'oxygénation
- ❑ Sans dégradation significative de la compliance du système respiratoire et de l'hémodynamique
- ❑ Maintien Pplateau < 30 cmH_2O, monitorage continu

Critères du SDRA
- ❑ PaO_2/FiO_2 ≤ 300 mmHg
- ❑ PEP ≥ 5 cmH_2O
- ❑ Opacités bilatérales sur l'imagerie thoracique
- ❑ Non expliquées par défaillance ventriculaire gauche
- ❑ Évolution depuis moins de 7 jours

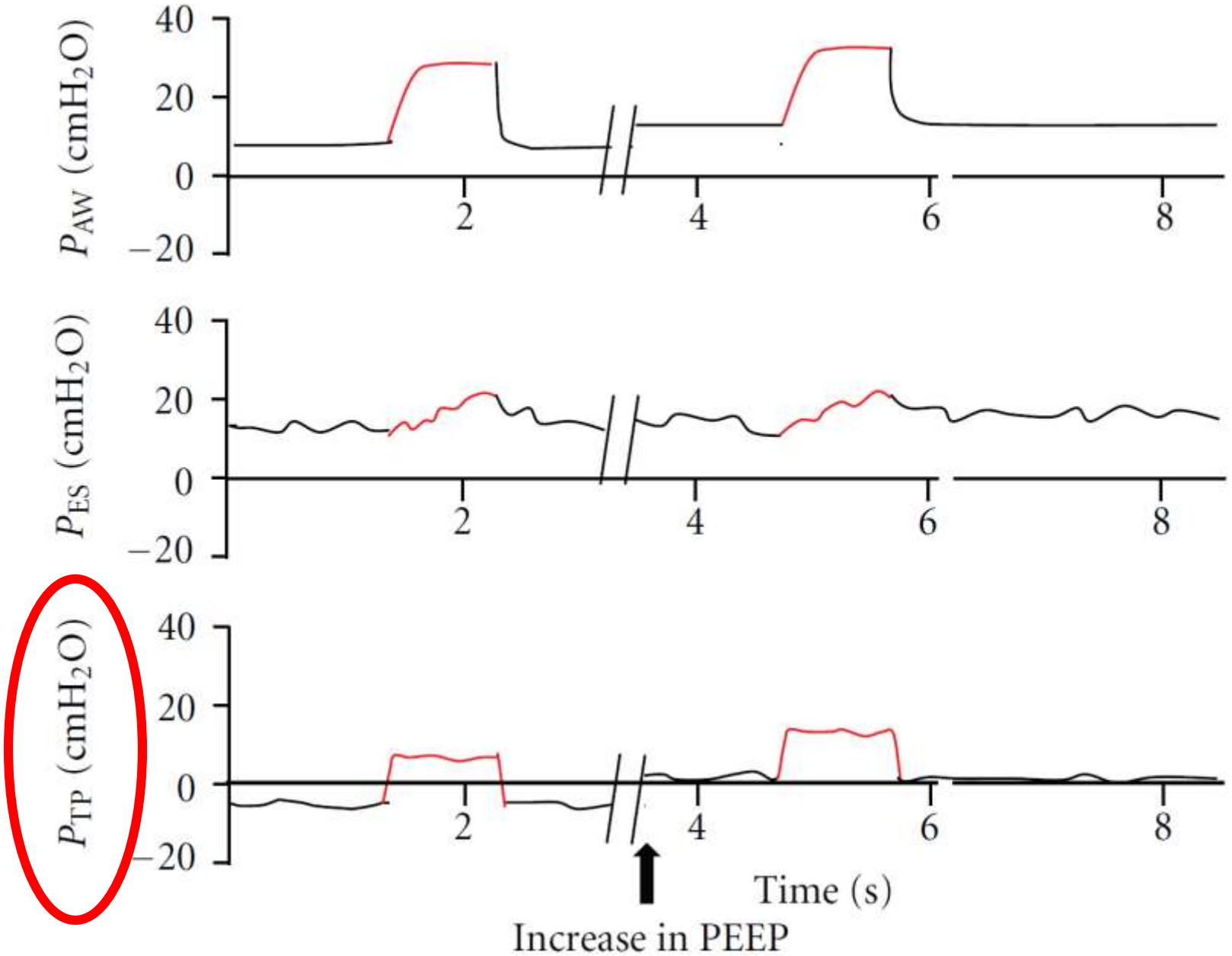
Traitement possible
- ➢ Monoxyde d'azote inhalé (iNO), si hypoxémie persistante en DV avant discussion de l'ECMO VV
- ➢ Ventilation spontanée après la phase aiguë avec Vt généré autour de 6 ml/kg sans dépasser 8 ml/kg

Pas de recommandation possible
- ➢ $ECCO_2R$
- ➢ Pression motrice
- ➢ Ventilation spontanée à la phase aiguë

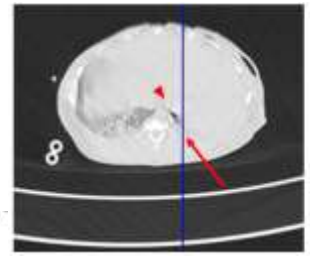
Probablement ne pas faire
- ➢ Manœuvres de recrutement systématiques

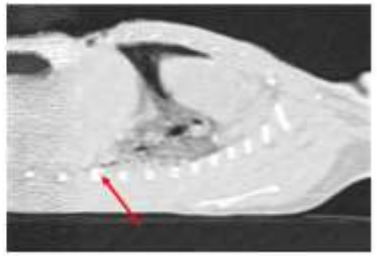
Ne pas faire
- ➢ HFOV

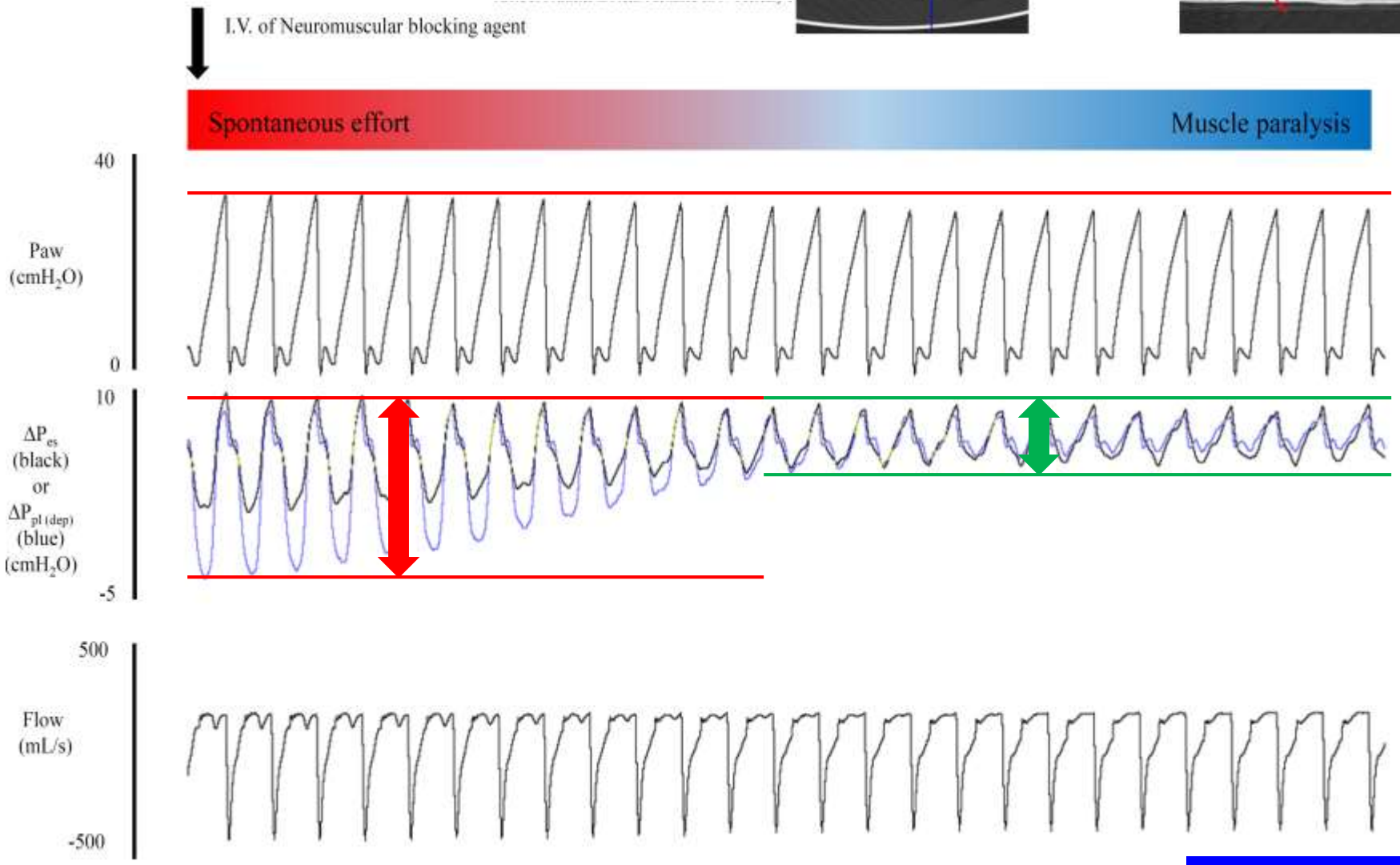
Risque d'ouverture-fermeture alvéolaire cyclique



Regional lung stress

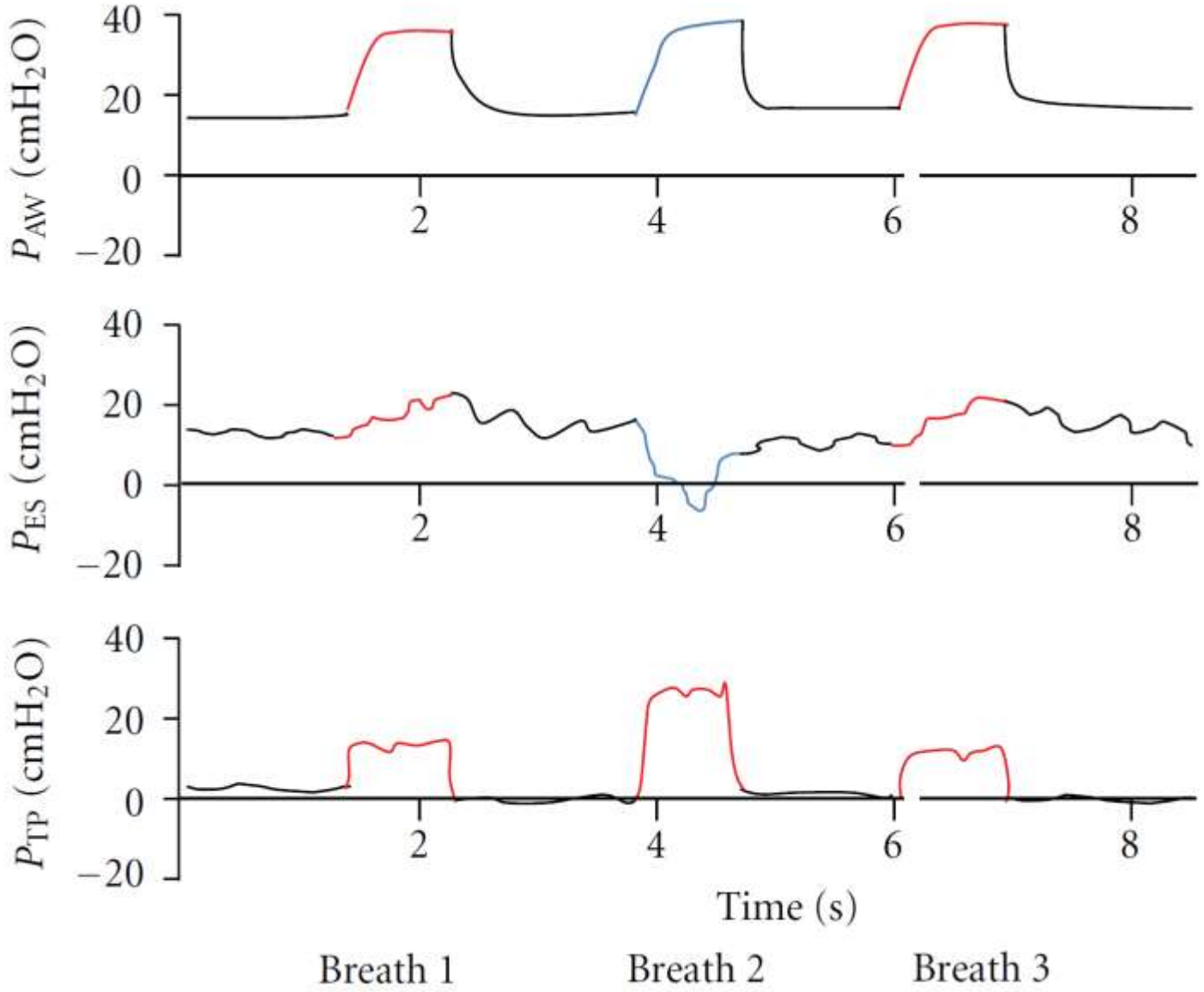


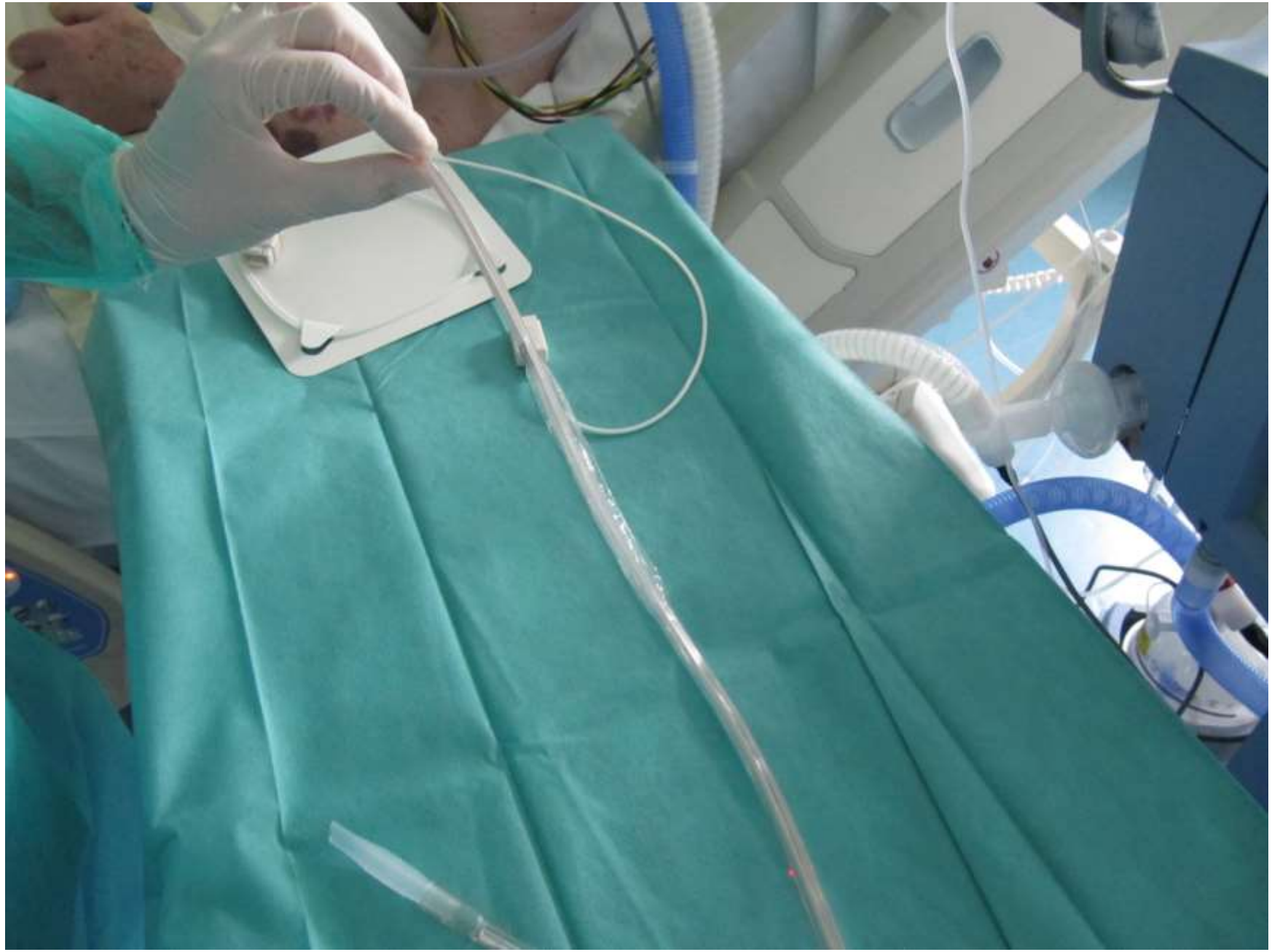




Yoshida *et al.* AJRCCM 2017

Risque de surdistension pulmonaire dans les modes en pression avec synchronisation





Δ PEEP et Δ P trans-pulmonaire

- Standardisation durant 3 jours

The primary end point of the study was arterial oxygenation, as measured by the ratio of PaO_2 to FIO_2 (PaO_2:FIO_2) 72 hours after randomization.

Esophageal-Pressure–Guided Group

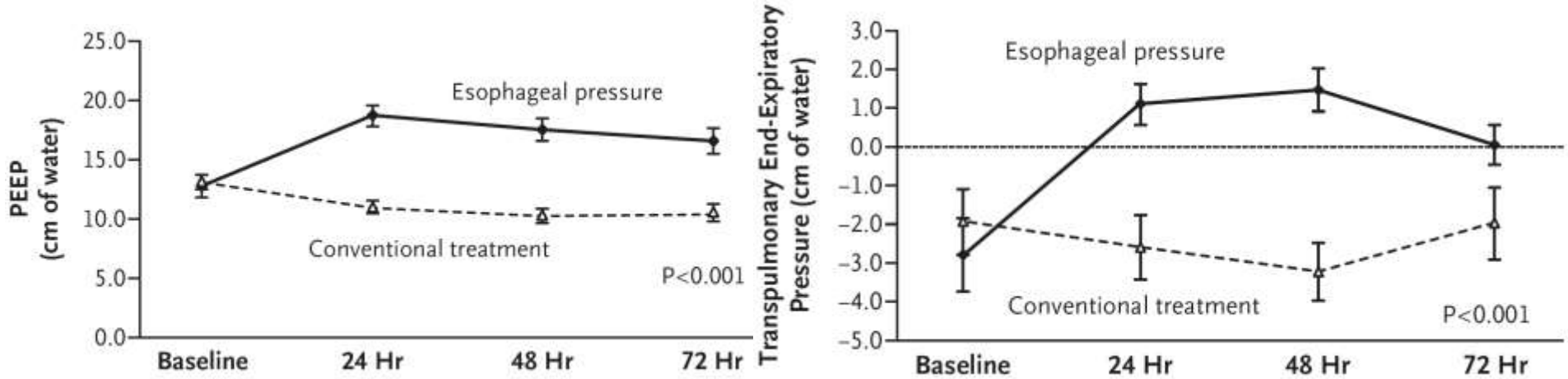
FIO_2	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0
P_{Lexp}	0	0	2	2	4	4	6	6	8	8	10	10

Control Group

FIO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	20–24

Objectifs: PTPexp entre 0-10 / PTPinsp < 25

Talmor *et al.* NEJM 2008



Treatment Group	Change in PEEP				
	−1 to −6 cm of Water	0 to 5 cm of Water	6 to 10 cm of Water	11 to 15 cm of Water	16 to 20 cm of Water
			no. of patients		
Esophageal-pressure–guided group	3	9	12	4	2
Control group	12	18	1	0	0

Talmor *et al.* NEJM 2008

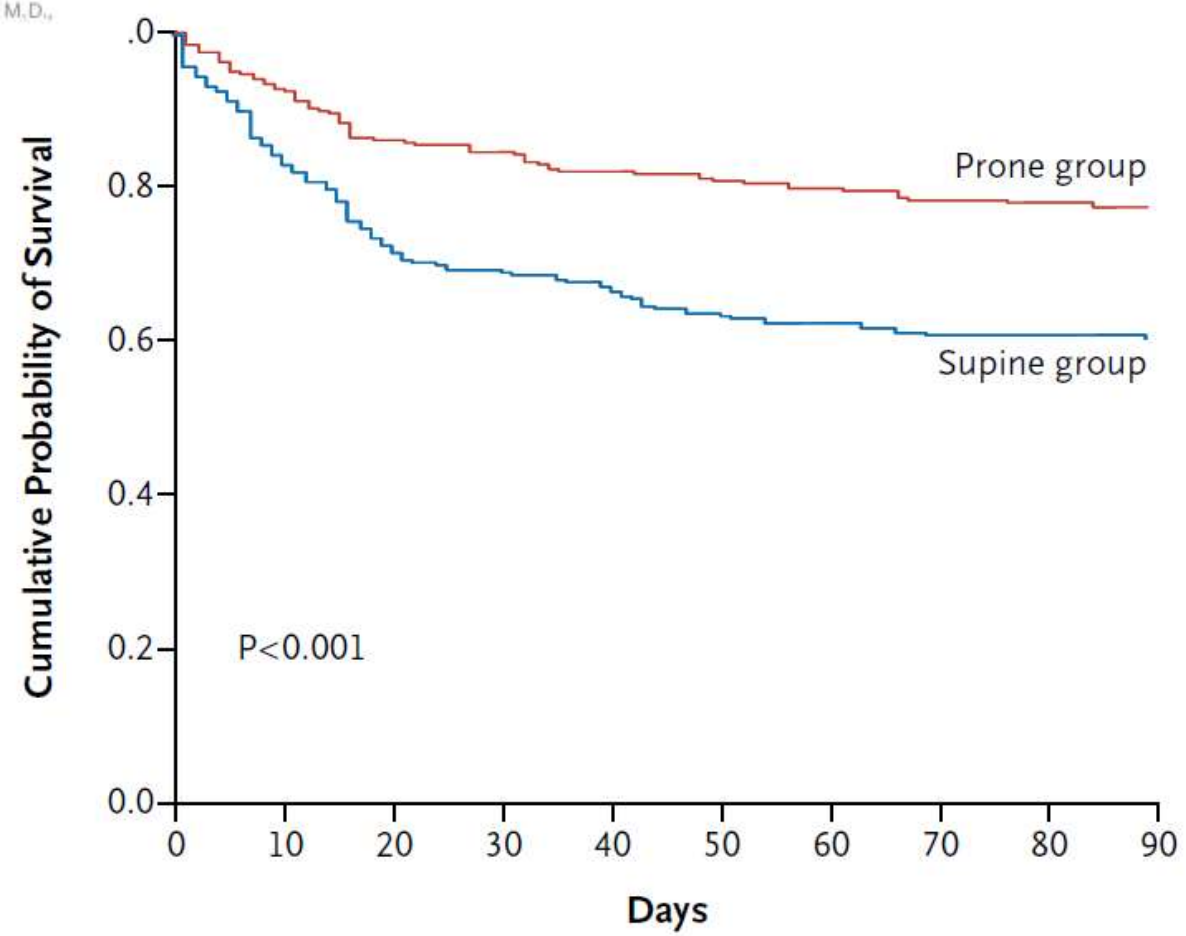
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

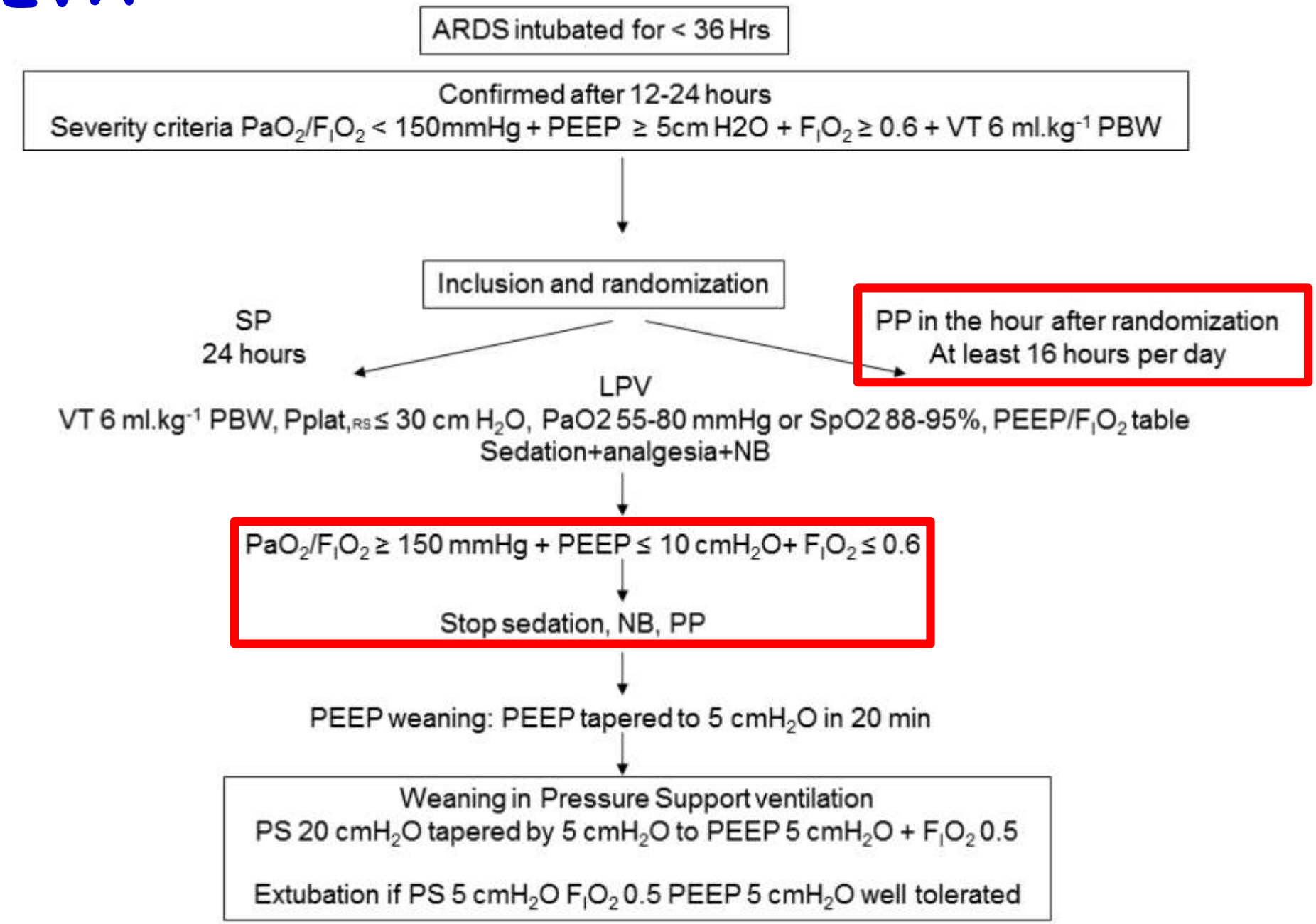
Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D., Arnaud Gacouin, M.D., Thierry Boulain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D., Sylvène Rosselli, M.D., Jordi Mancebo, M.D., Ph.D., Michel Sirodot, M.D., Gilles Hilbert, M.D., Ph.D., Christian Bengler, M.D., Jack Richecoeur, M.D., Marc Gainnier, M.D., Ph.D., Frédérique Bayle, M.D., Gael Bourdin, M.D., Véronique Leray, M.D., Raphaele Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D., for the PROSEVA Study Group*

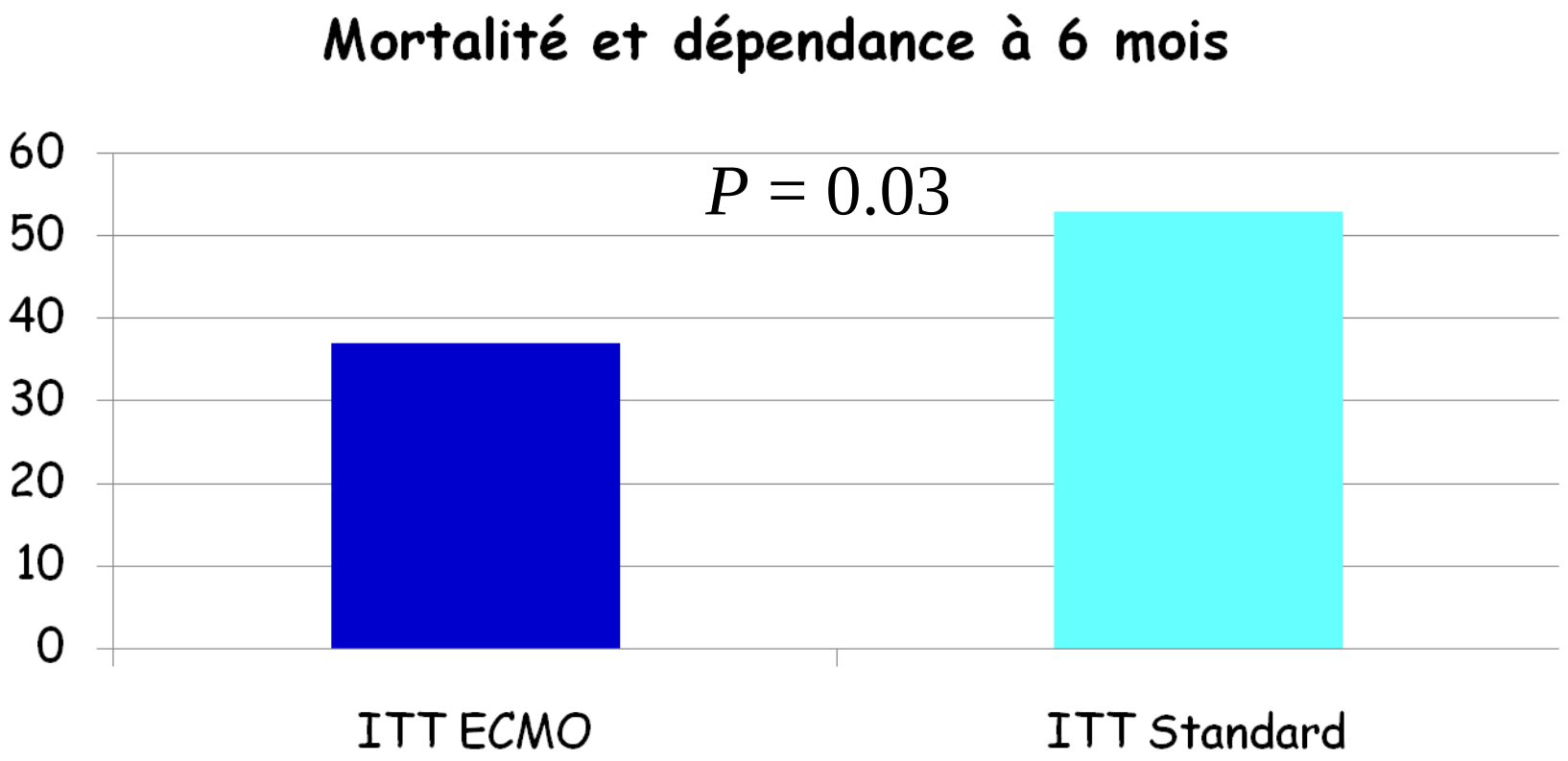
- Mean P/F ratio, 100 mmHg
- 4 sessions of PP (17±3 h)



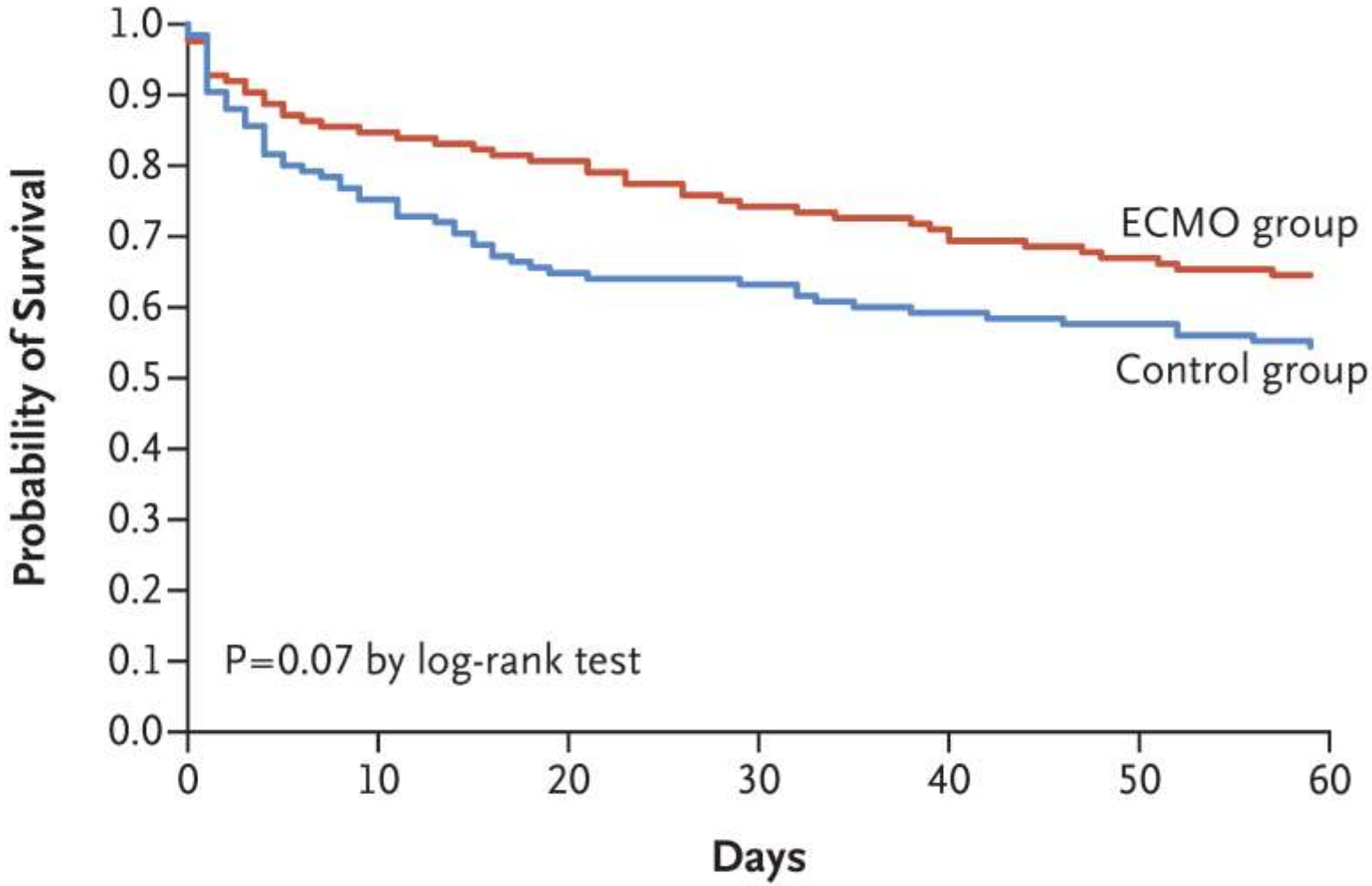
PROSEVA


ARDS intubated for < 36 Hrs
Confirmed after 12-24 hours
Severity criteria PaO_2/F_IO_2 < 150mmHg + PEEP ≥ 5cm H2O + F_IO_2 ≥ 0.6 + VT 6 $ml.kg^{-1}$ PBW
Inclusion and randomization
SP
24 hours
PP in the hour after randomization
At least 16 hours per day
LPV
VT 6 $ml.kg^{-1}$ PBW, $Pplat_{,RS}$ ≤ 30 cm H_2O, PaO2 55-80 mmHg or SpO2 88-95%, $PEEP/F_IO_2$ table
Sedation+analgesia+NB
PaO_2/F_IO_2 ≥ 150 mmHg + PEEP ≤ 10 cmH_2O+ F_IO_2 ≤ 0.6
Stop sedation, NB, PP
PEEP weaning: PEEP tapered to 5 cmH_2O in 20 min
Weaning in Pressure Support ventilation
PS 20 cmH_2O tapered by 5 cmH_2O to PEEP 5 cmH_2O + F_IO_2 0.5
Extubation if PS 5 cmH_2O F_IO_2 0.5 PEEP 5 cmH_2O well tolerated

Résultat



CESAR
Conventional Ventilation or ECMO for Severe Adult Respiratory Failure



No. at Risk							
ECMO	124	105	100	92	88	83	80
Control	125	94	81	79	74	72	69

Combes *et al.* NEJM 2018

pH <7.25 with a PaCO2 >60 mmHg for >6 hours (with respiratory rate increased to 35/minute) resulting from MV settings adjusted to keep Pplat ≤32 cm H2O

Endpoint	ECMO group (N = 124)	Control group (N = 125)	Absolute Risk Difference or Median Difference (95% CI) *
Day 60 mortality by inclusion criteria †			
Criteria #1 — no. died/ total no. (%)	1/5 (20)	1/11 (9)	10.9 (-25.0 to 56.9)
Criteria #2 — no. died/ total no. (%)	37/94 (39)	45/94 (48)	-8.5 (-22.4 to 5.7)

Combes *et al.* NEJM 2018

Table 2. Adverse Events Associated with ECMO in Adults with Respiratory Failure.*

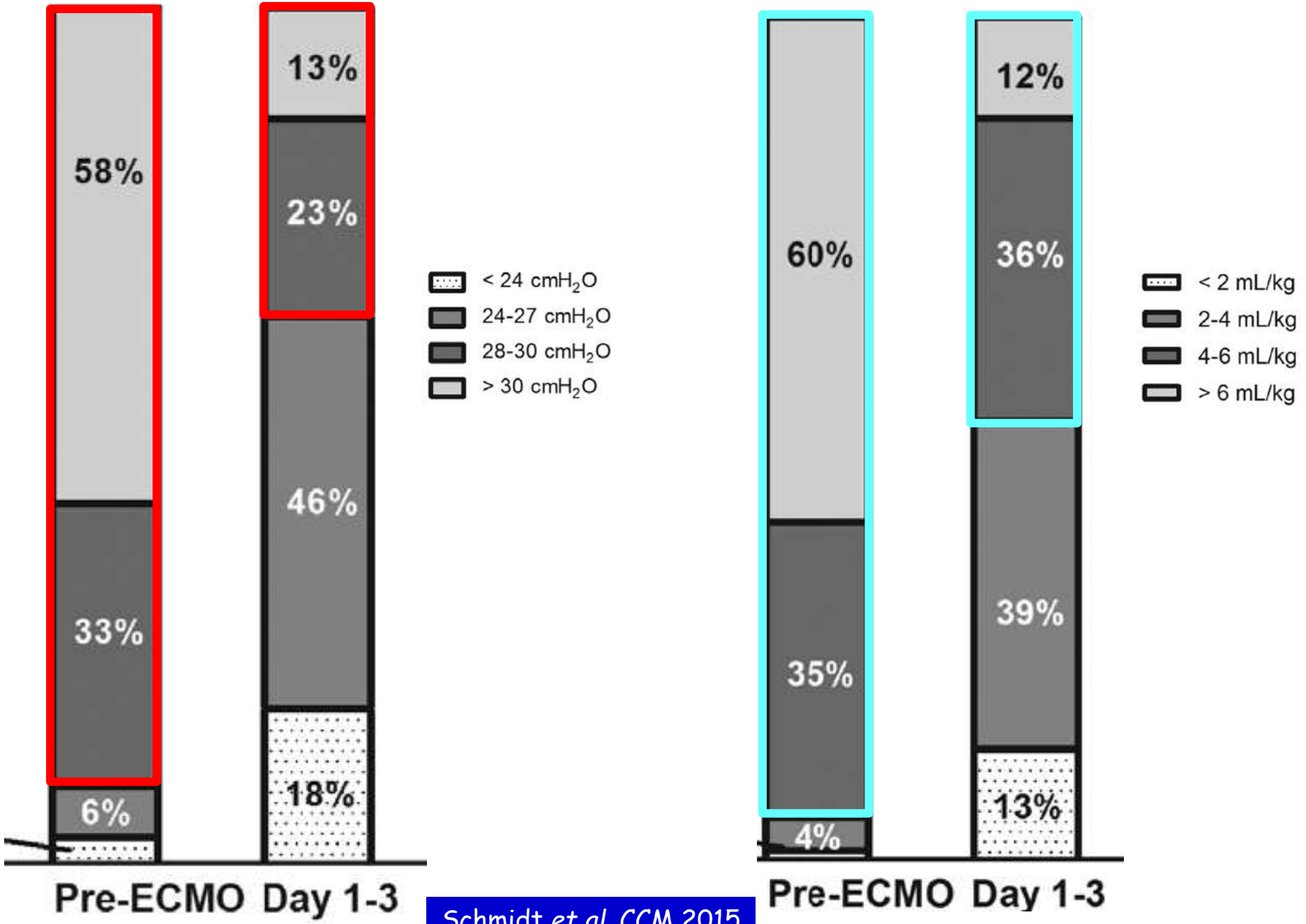
Event	Rate %
Directly related to the ECMO circuit	
Oxygenator failure	17.5
Blood clots	
Oxygenator	12.2
Other circuit	17.8
Cannula-related problems	8.4
Other mechanical complications	7.9
Not directly related to the ECMO circuit†	
Bleeding	
Surgical-site bleeding	19.0
Cannulation-site bleeding	17.1
Pulmonary hemorrhage	8.1
Gastrointestinal hemorrhage	5.1
Intracranial hemorrhage	3.8
Hemolysis	6.9
Disseminated intravascular coagulation	3.7
Culture-confirmed infection at any site (related or unrelated to ECMO)‡	21.3

From ELSO

Brodie & Bacchetta NEJM 2011

Combes *et al.* NEJM 2018

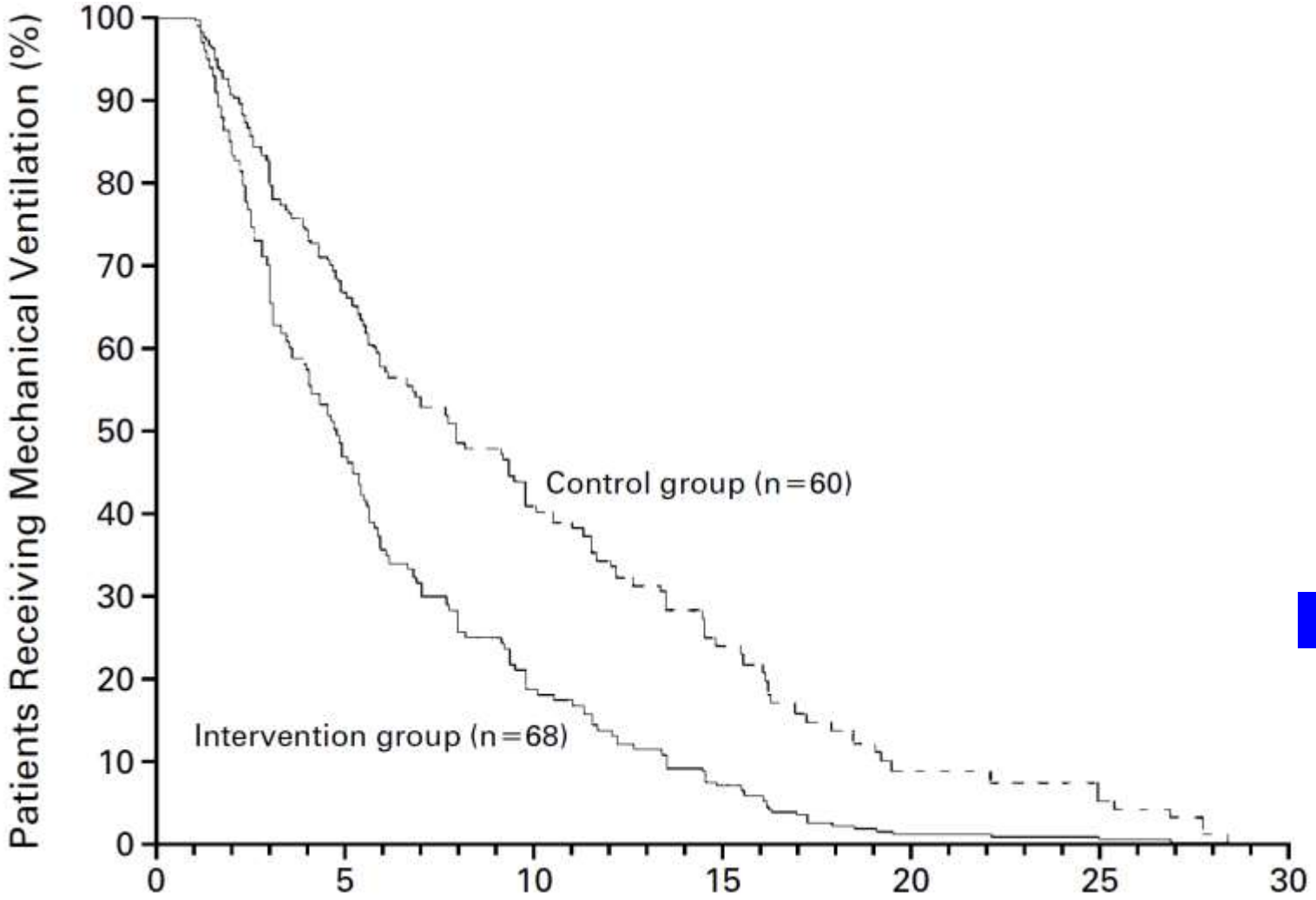
Event	ECMO Group (N=124)	Control Group (N=125)	Absolute Risk Difference (95% CI)*
	number (percent)		*percentage points*
Pneumothorax	18 (15)	16 (13)	2 (–7 to 10)
Thrombocytopenia†			
Any	50 (40)	40 (32)	8 (–4 to 20)
Severe	33 (27)	20 (16)	11 (0 to 21)
Hypothermia‡	28 (23)	27 (22)	1 (–9 to 11)
Bleeding			
Leading to transfusion	57 (46)	35 (28)	18 (6 to 30)
Massive§	3 (2)	1 (1)	2 (–2 to 6)
Cardiac rhythm disturbances	38 (31)	46 (37)	–6 (–18 to 6)
Cardiac arrest	24 (19)	22 (18)	2 (–8 to 12)
Stroke¶	3 (2)	8 (6)	–4 (–10 to 1)
Ischemic stroke	0	6 (5)	–5 (–10 to –2)
Hemorrhagic stroke	3 (2)	5 (4)	–2 (–7 to 3)
Massive stroke	2 (2)	1 (1)	1 (–3 to 5)



Schmidt *et al. CCM* 2015

Daily interruption

	Intervention Group (N=68)	Control Group (N=60)	P Value
	median (interquartile range)		
Duration of mechanical ventilation (days)	4.9 (2.5–8.6)	7.3 (3.4–16.1)	0.004



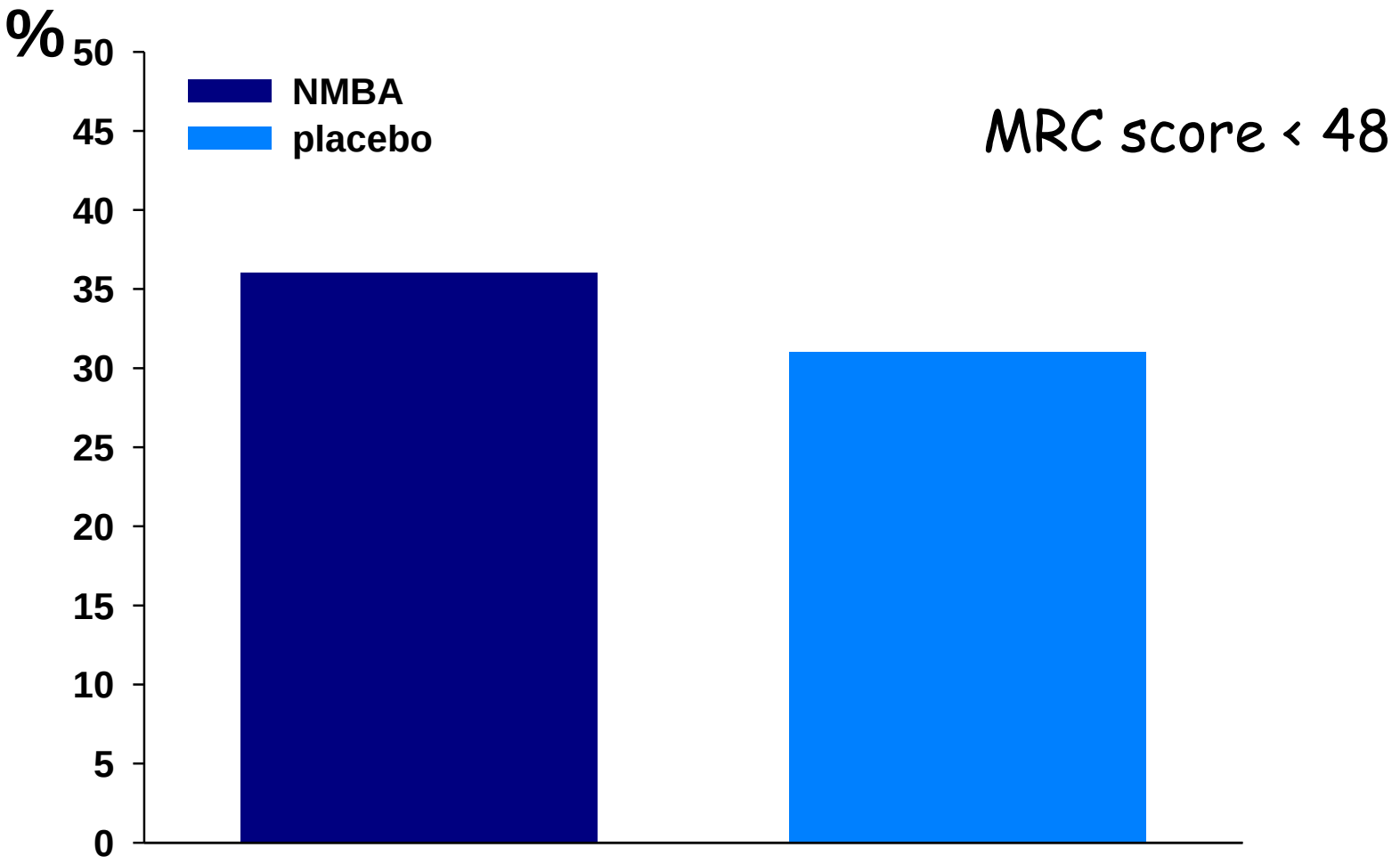
Kress *et al.* NEJM 2000

Intensive care unit (ICU)–acquired weakness

- Skeletal muscle wasting and weakness may result from
  - Muscle dysfunction
  - Loss of myosin
  - Frank myofiber necrosis (critical illness myopathy)
  - Axonal sensory-motor axonopathy (critical illness polyneuropathy)
  - Combination of both (critical illness neuromyopathy)

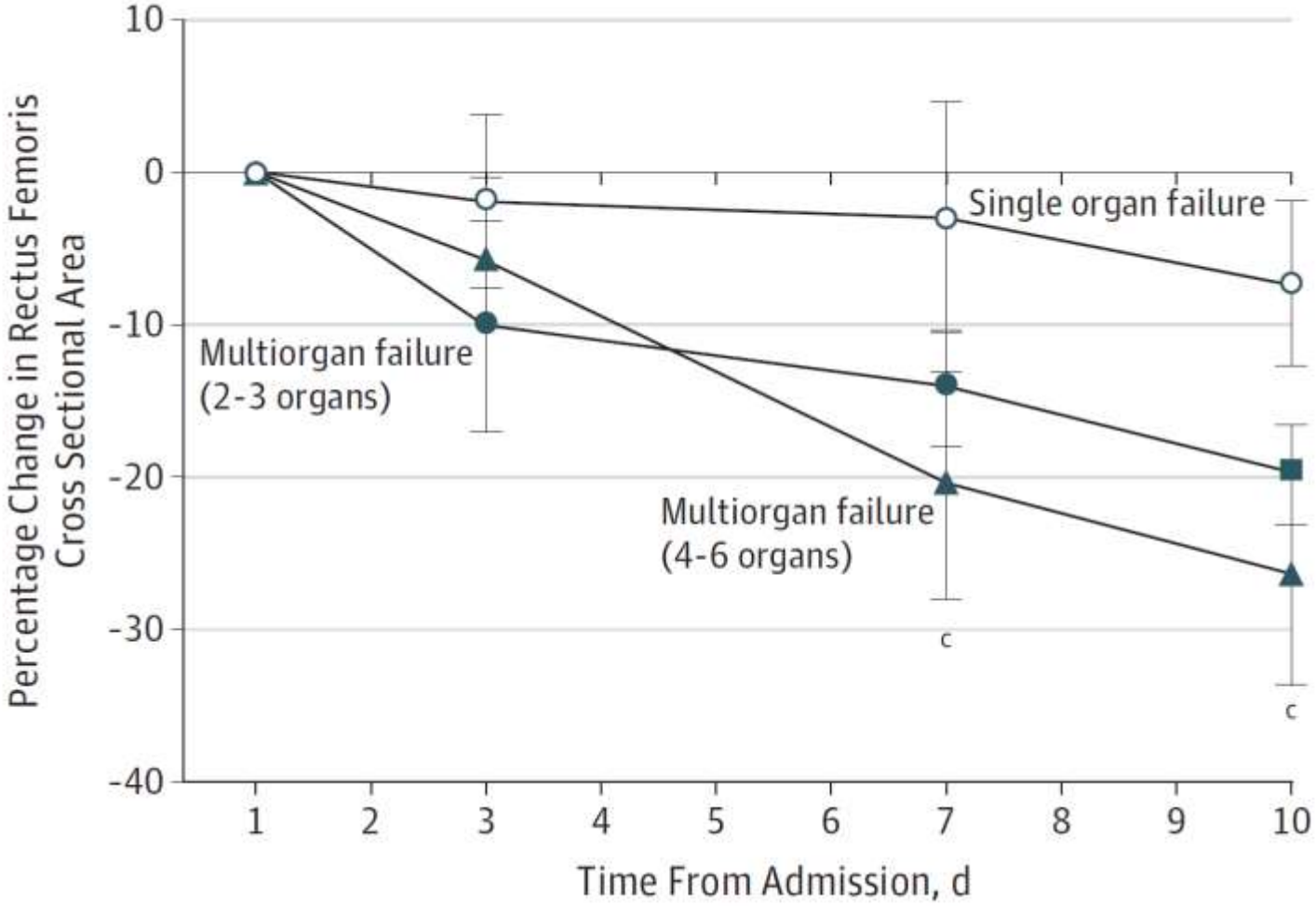
Walsh *et al.* Clin Chest Med 2014

ICU-acquired muscular paresis by ICU discharge

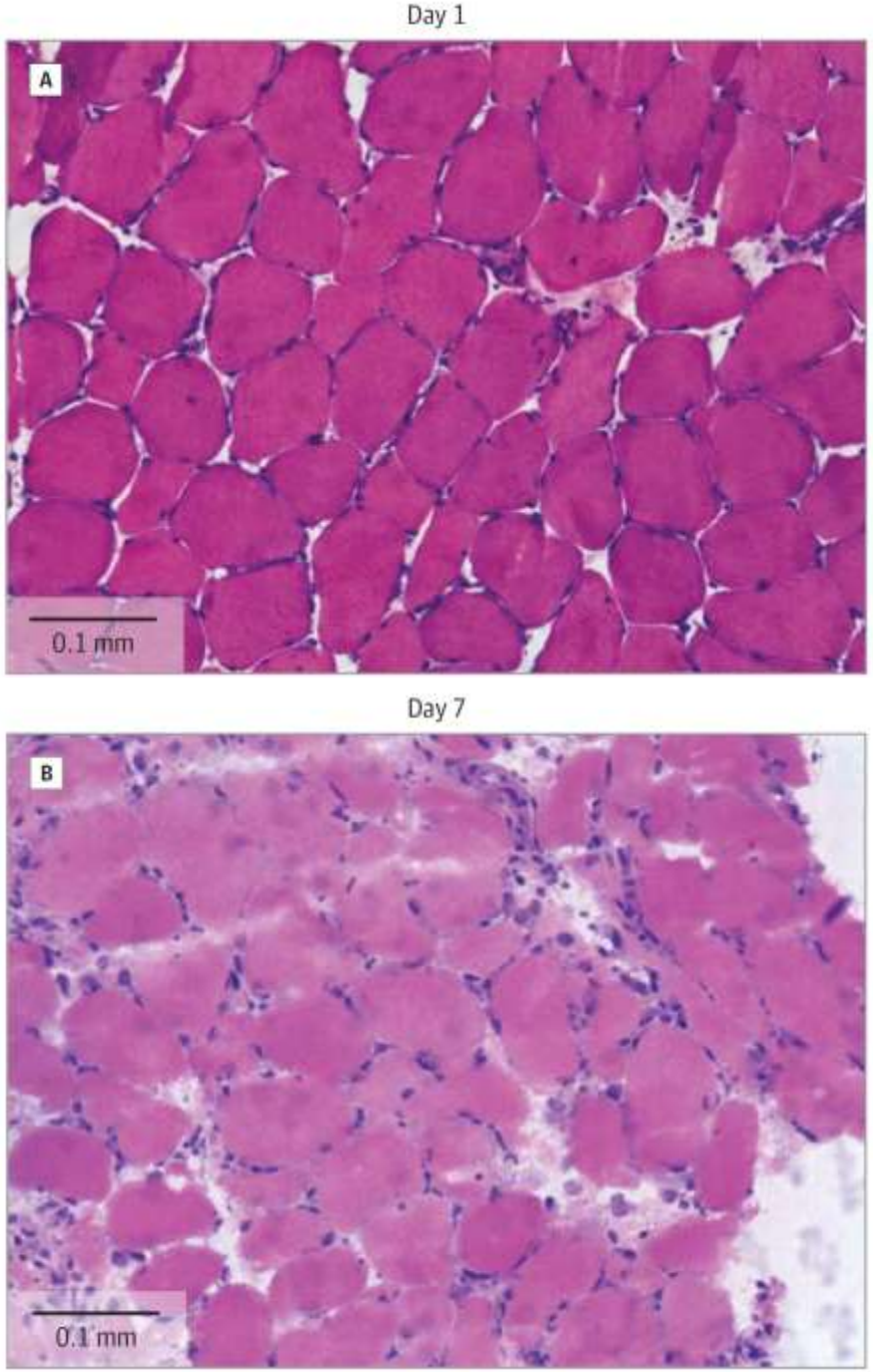


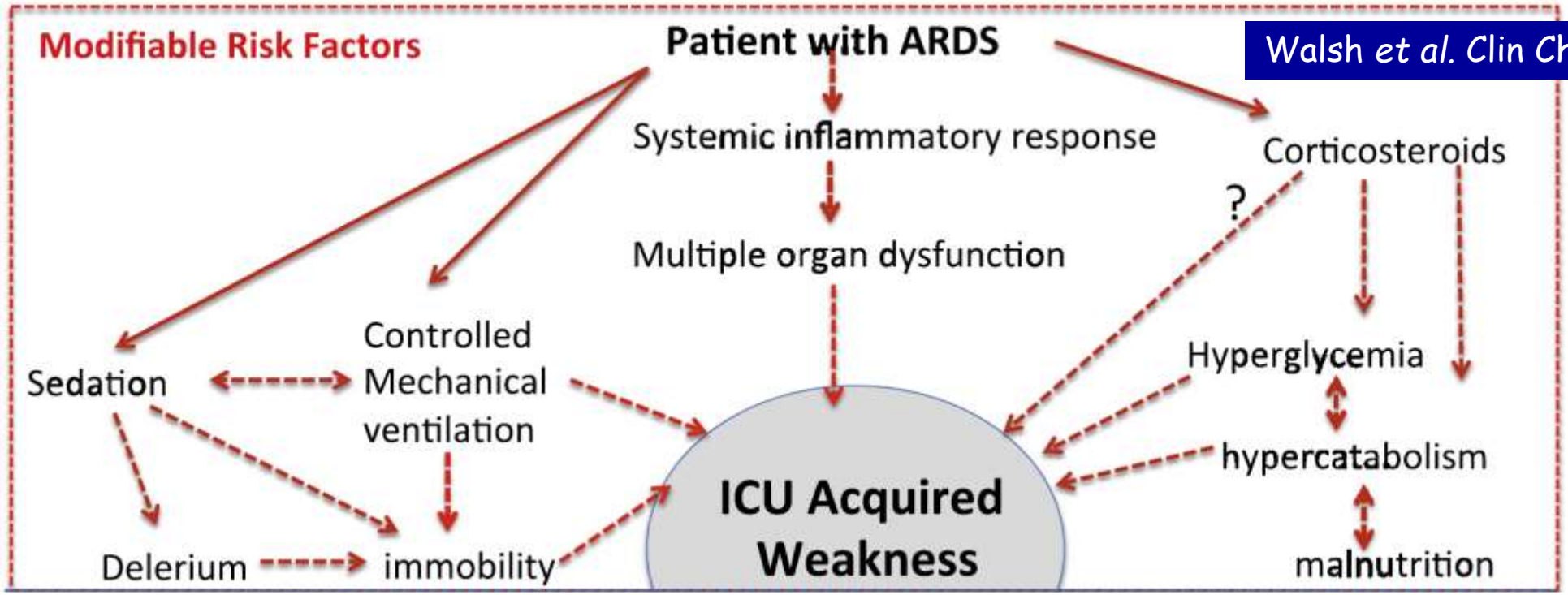
ACURASYS

Early muscle wasting



Puthucheary,*et al.* JAMA 2013





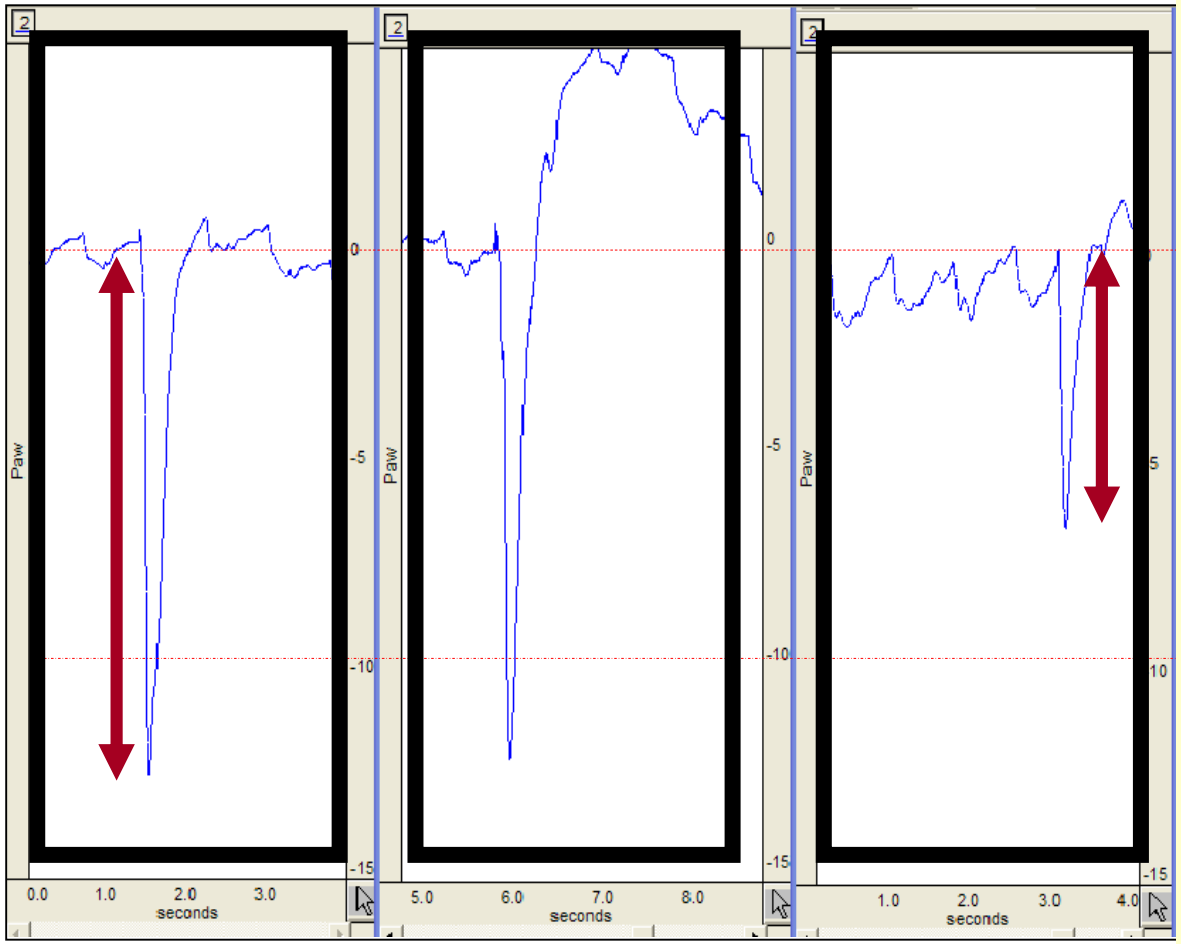
Walsh *et al.* Clin Chest Med 2014

with the courtesy of Pr Samir Jaber from Montpellier, France

Control Ventilation (diaphragm inactivity)

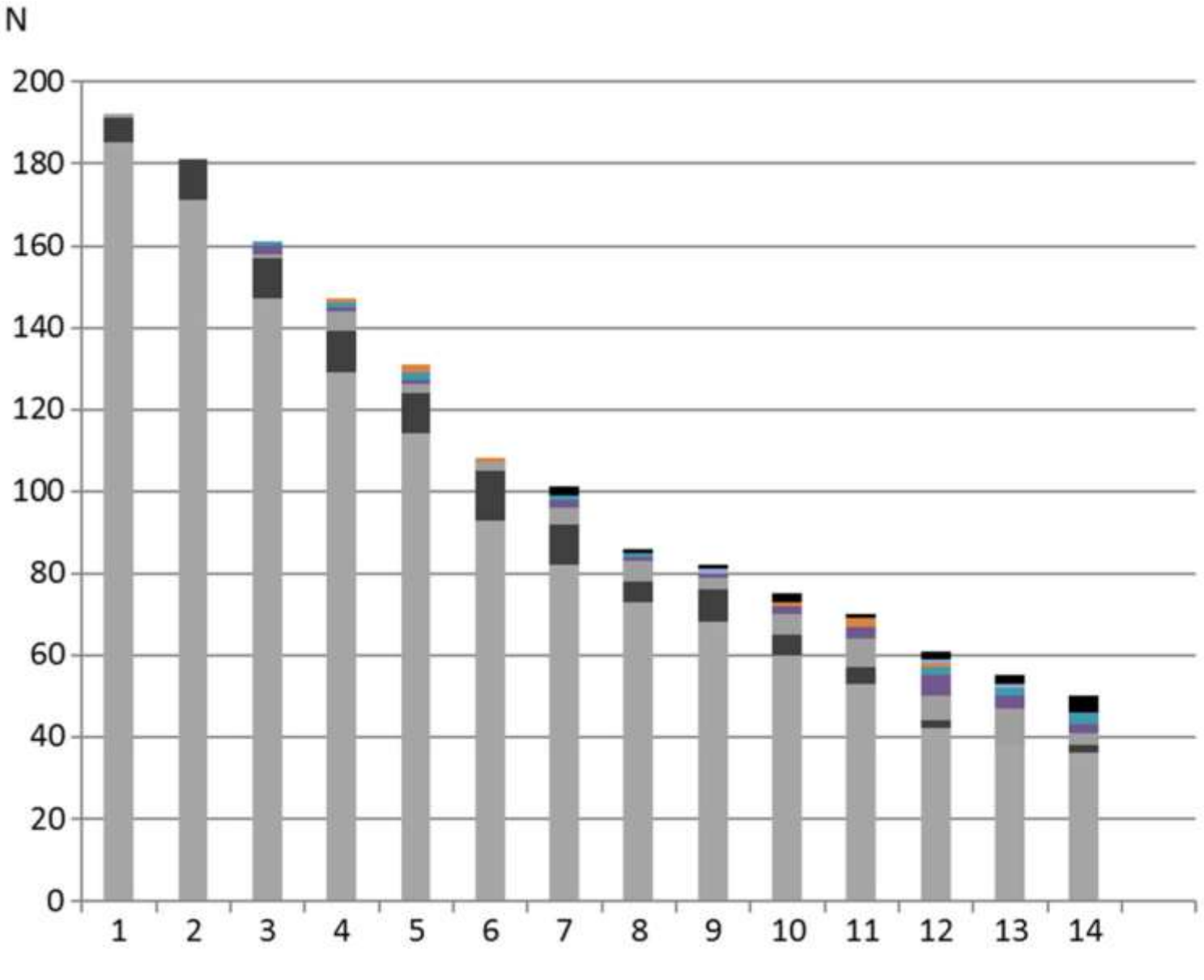
D0 ◄——————————————————————————► D10

D0 (baseline) **D3** **D7**



Twitch-P (cmH2O) **13.2** **12.9** **6.8**

Maximum level of activity in invasively ventilated patients



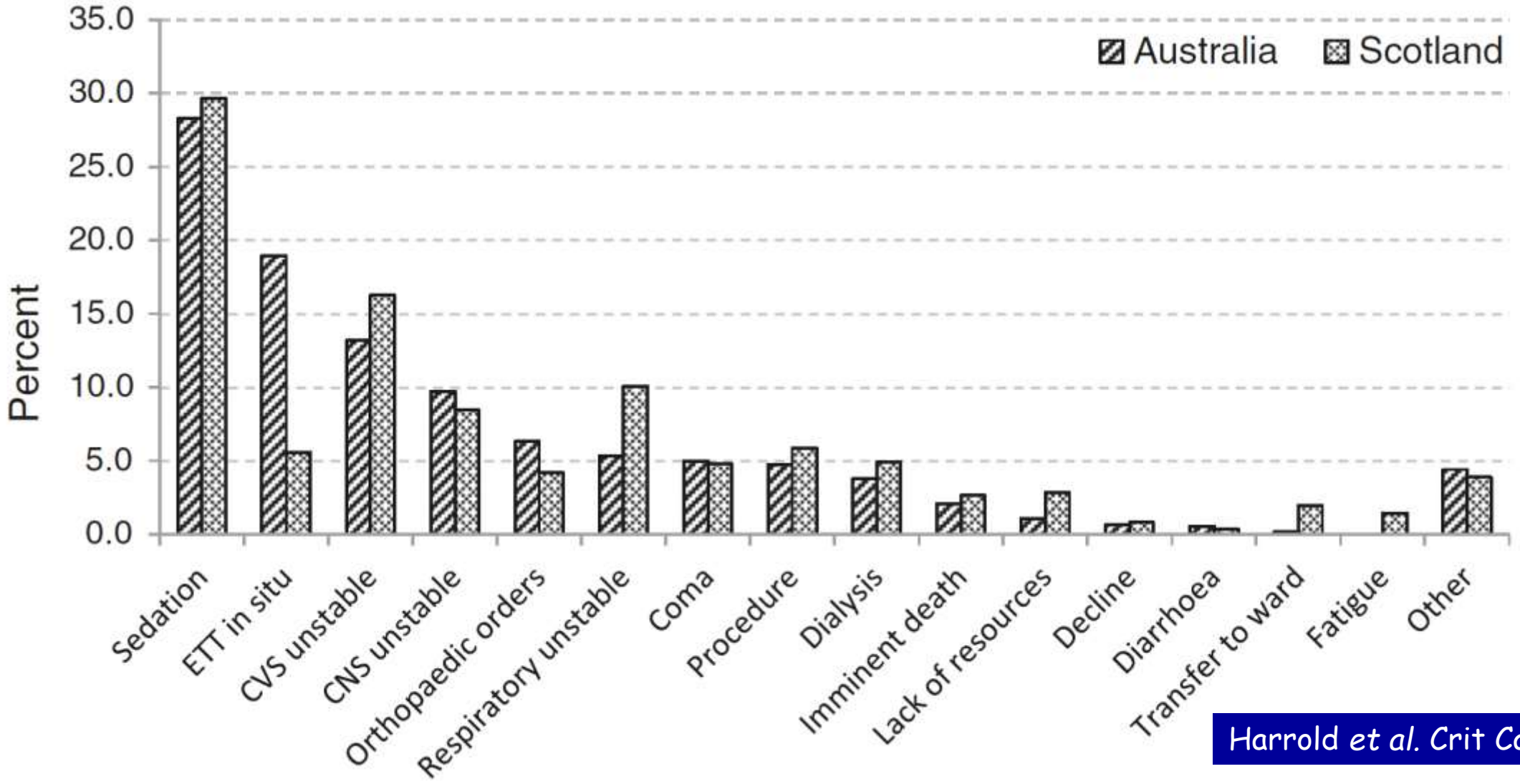
- Prospective cohort study
- 12 ICUs Australia/NZ
- 192 patients MV for >48 hrs

Level 7-10
Level 6
Level 5
Level 4
Level 3
Level 2
Level 1
Level 0

10 = walking independently
9 = walking with assistance of one person
8 = walking with assistance of two people
7 = marching on the spot
6 = transferring from bed to
5 = standing
4 = sitting on the edge of the bed
2 = passively moved to the chair
1 = exercises in bed
0 = no activity

TEAM study Crit Care 2015

Reported barriers to mobilization



Harrold *et al.* Crit Care 2015

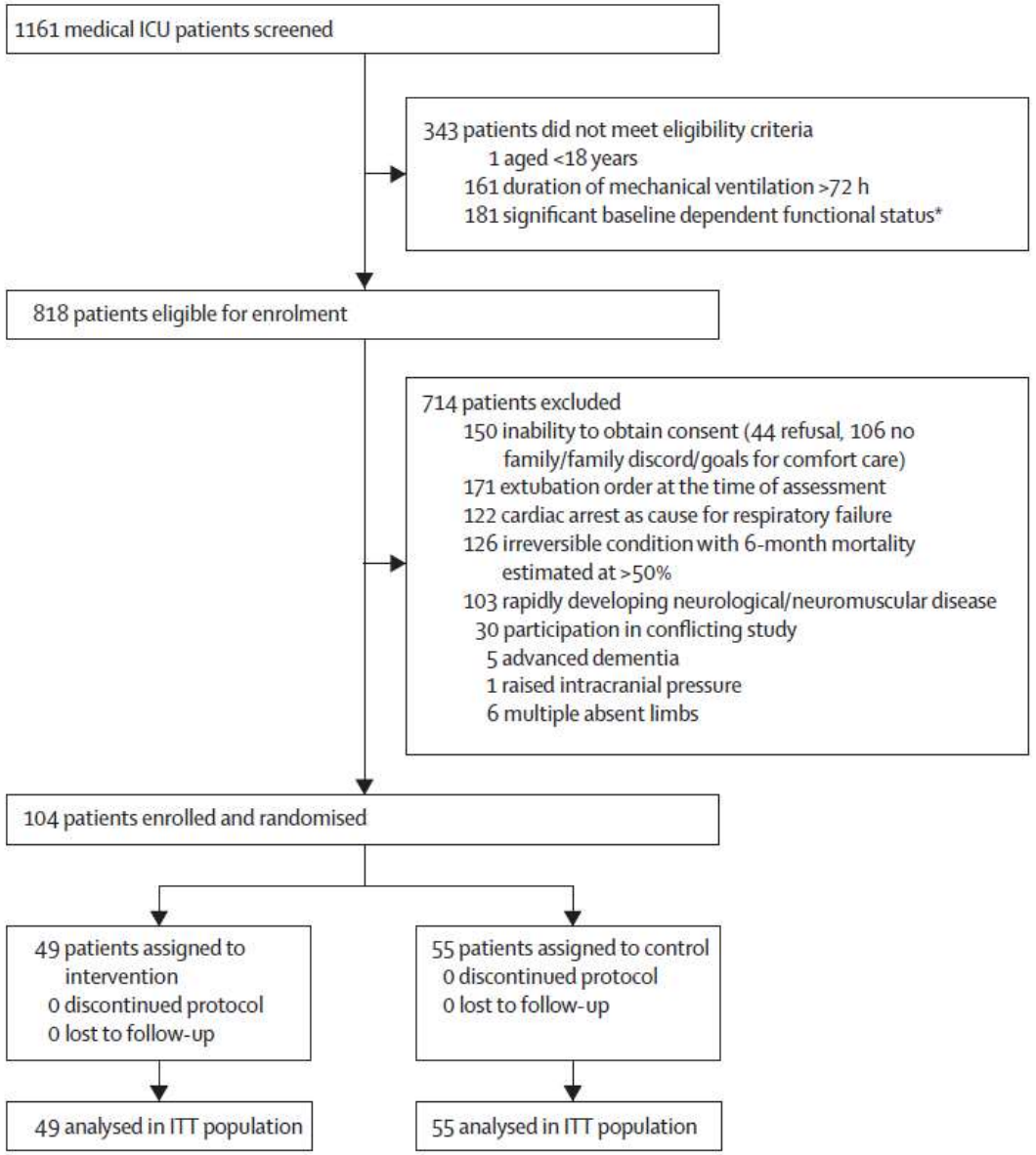
Safety of Patient Mobilization and Rehabilitation in the ICU

Type of safety event	N patients	% mobilization/rehabilitation sessions
Fall	5,972	11 (0.07%)
Endotracheal tube removal	6,303	2 (0.01%)
Intravascular catheter event	6,134	35 (0.2%)
Other catheter or tube removal	4,959	15 (0.09%)
Cardiac arrest	5,830	4 (0.03%)
Hemodynamic changes	6,593	126 (0.7%)
Desaturation	5,753	78 (0.5%)
Other	6,579	312 (1.8%)

Nydahl *et al.* Annals ATS 2017

EVALUATION

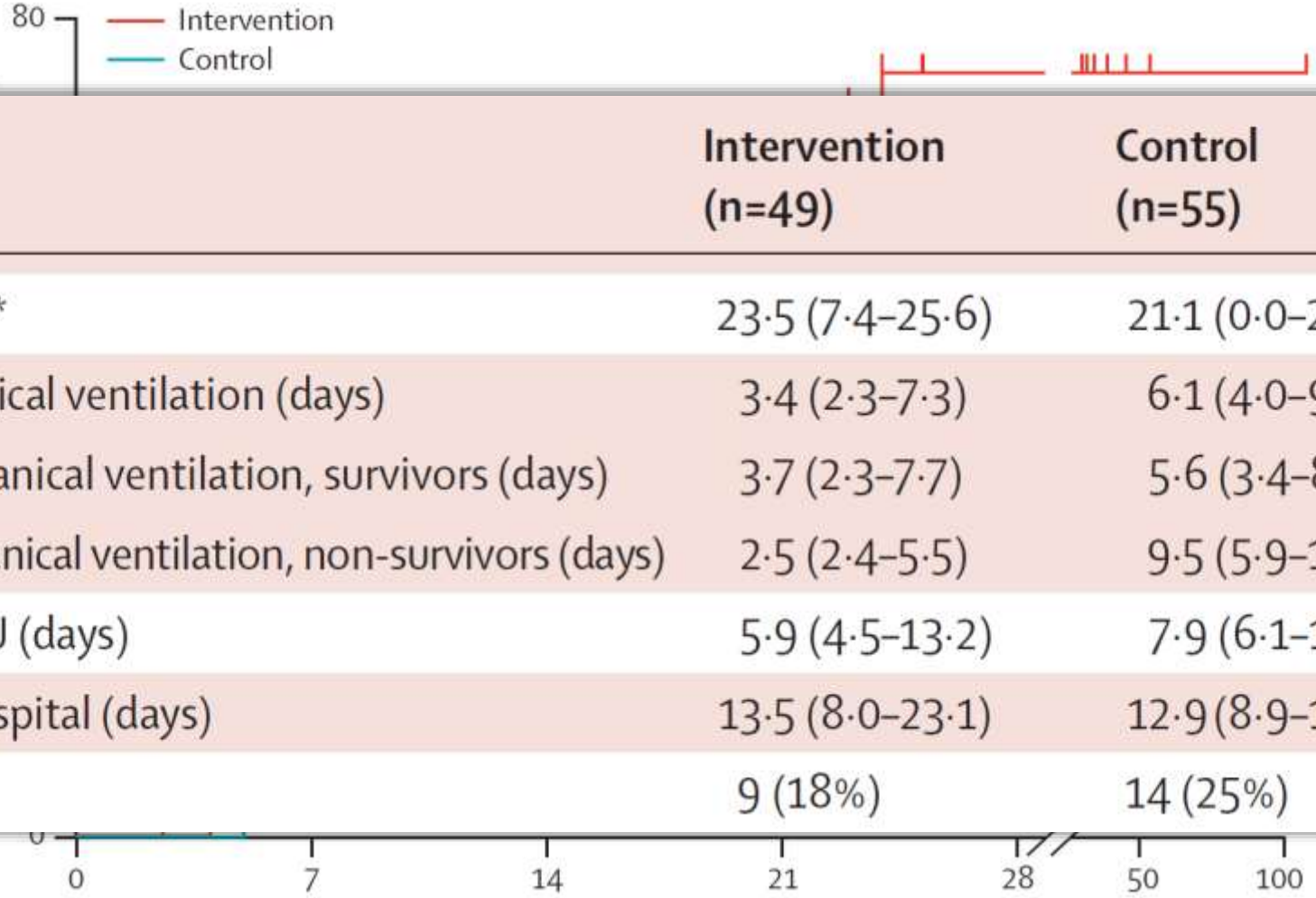
	Intervention (n=49)	Control (n=55)
Age (years)	57·7 (36·3–69·1)	54·4 (46·5–66·4)
Female	29 (59%)	23 (42%)
Black race	30 (61%)	31 (56%)
Barthel Index score	100 (85–100)	100 (90–100)
Body-mass index (kg/m²)	27·4 (25·1–32·4)	28·0 (23·5–34·1)
APACHE II score	20·0 (15·8–24·0)	19·0 (13·3–23·0)
Sepsis	42 (86%)	45 (82%)
Diabetes	18 (37%)	18 (33%)
Primary diagnosis on admission to intensive care		
Acute lung injury	27 (55%)	31 (56%)
COPD exacerbation	4 (8%)	6 (11%)
Acute exacerbation of asthma	5 (10%)	4 (7%)
Sepsis	7 (14%)	9 (16%)
Haemorrhage	1 (2%)	2 (4%)
Malignancy	2 (4%)	1 (2%)
Other	3 (6%)	2 (4%)



Schweickert *al.* Lancet 2009

Passive range of motion exercises for all limbs/Active assisted (with manual assistance) and active (independent) range of motion exercises in the supine position/Bed mobility activities, including transferring to upright sitting/Transfer training (ie, repetition of sit-to-stand transfers from bed to chair/Walking

Probability of return to independent functional status in intervention and control groups



	Intervention (n=49)	Control (n=55)	p value
Ventilator-free days*	23·5 (7·4–25·6)	21·1 (0·0–23·8)	0·05
Duration of mechanical ventilation (days)	3·4 (2·3–7·3)	6·1 (4·0–9·6)	0·02
Duration of mechanical ventilation, survivors (days)	3·7 (2·3–7·7)	5·6 (3·4–8·4)	0·19
Duration of mechanical ventilation, non-survivors (days)	2·5 (2·4–5·5)	9·5 (5·9–14·1)	0·04
Length of stay in ICU (days)	5·9 (4·5–13·2)	7·9 (6·1–12·9)	0·08
Length of stay in hospital (days)	13·5 (8·0–23·1)	12·9 (8·9–19·8)	0·93
Hospital mortality	9 (18%)	14 (25%)	0·53

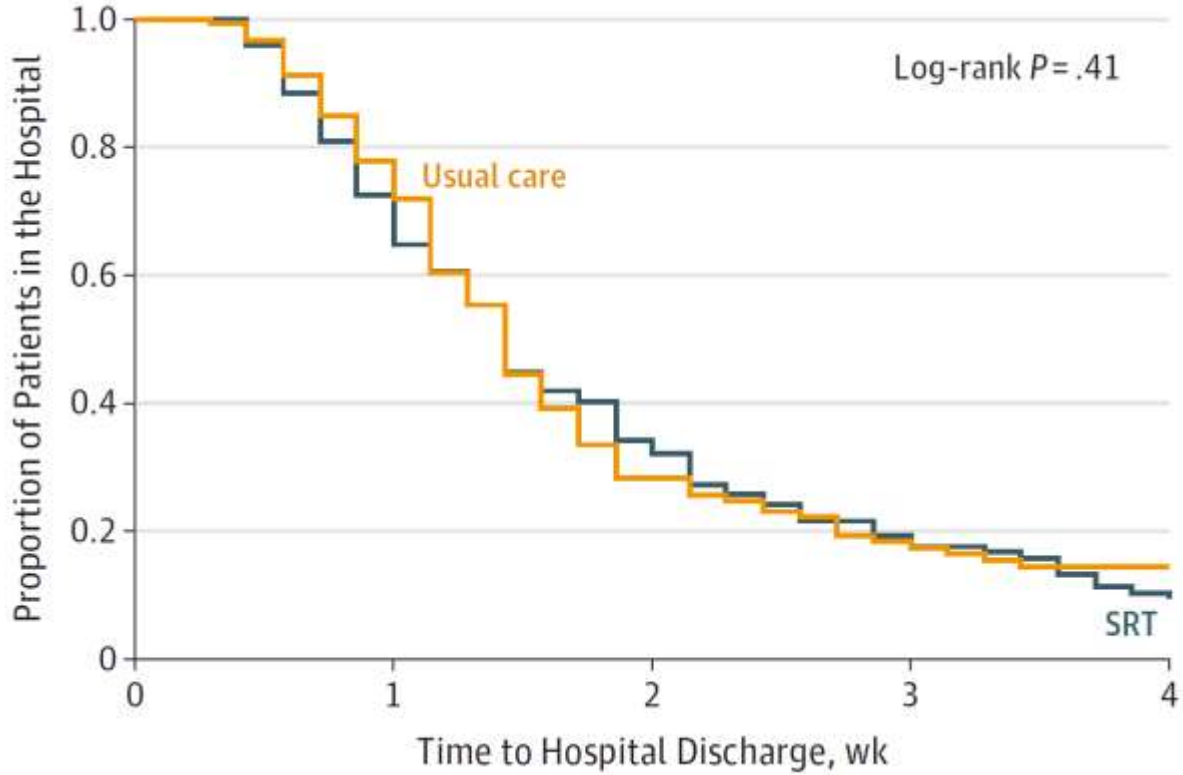
Independent functional status was defined as the ability to perform six ADLs (bathing, dressing, eating, grooming, transferring from bed to chair, using the toilet) and walking independently

Schweickert *al.* Lancet 2009

RCT

Morris *et al.* JAMA 2016

- Single-center study
- IMV or NIV with P/F < 300
- Intervention
  - 3 exercise types
    - passive range of motion, physical therapy, and progressive resistance exercises,
    - administered by a rehabilitation team for a total of 3 separate sessions every day of hospitalization for 7 days per week
- Usual care group received routine care as dictated by the patient's attending physician from Monday through Friday



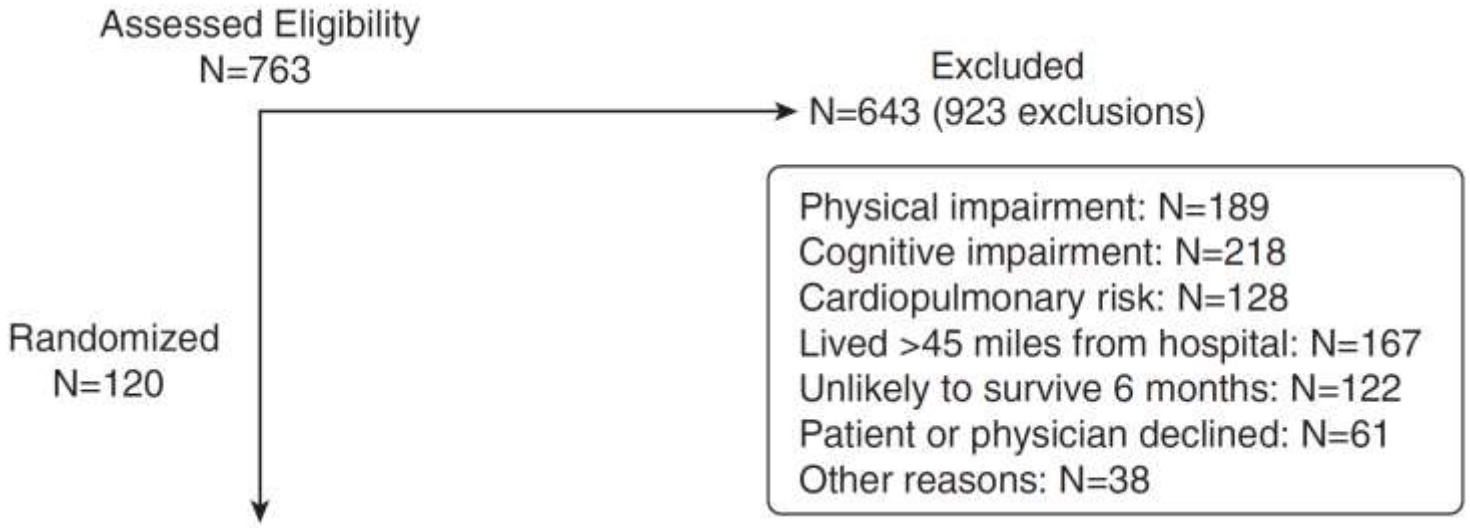
Morris *et al.* JAMA 2016

	Median (IQR)			
	SRT (n = 150)	Usual Care (n = 150)	Median Difference (95% CI)	*P* Value
Hospital days (primary outcome)	10.0 (6 to 17)	10.0 (7 to 16)	0 (−1.5 to 3)	.41[a]
Free days[b]				
Hospital	18 (7 to 22)	18 (9 to 21)	0 (−3 to 1.5)	.96[c]
Ventilator	24 (19 to 26)	24 (20 to 26)	0 (−2 to 1)	.59[c]
Intensive care unit				
Days	7.5 (4 to 14)	8.0 (4 to 13)	0 (−2.5 to 2)	.68[a]
Free days[b]	19 (8 to 23)	19 (12 to 24)	0 (−1.5 to 3)	.83[c]

RCT

Moss et al. AJRCCM 2016

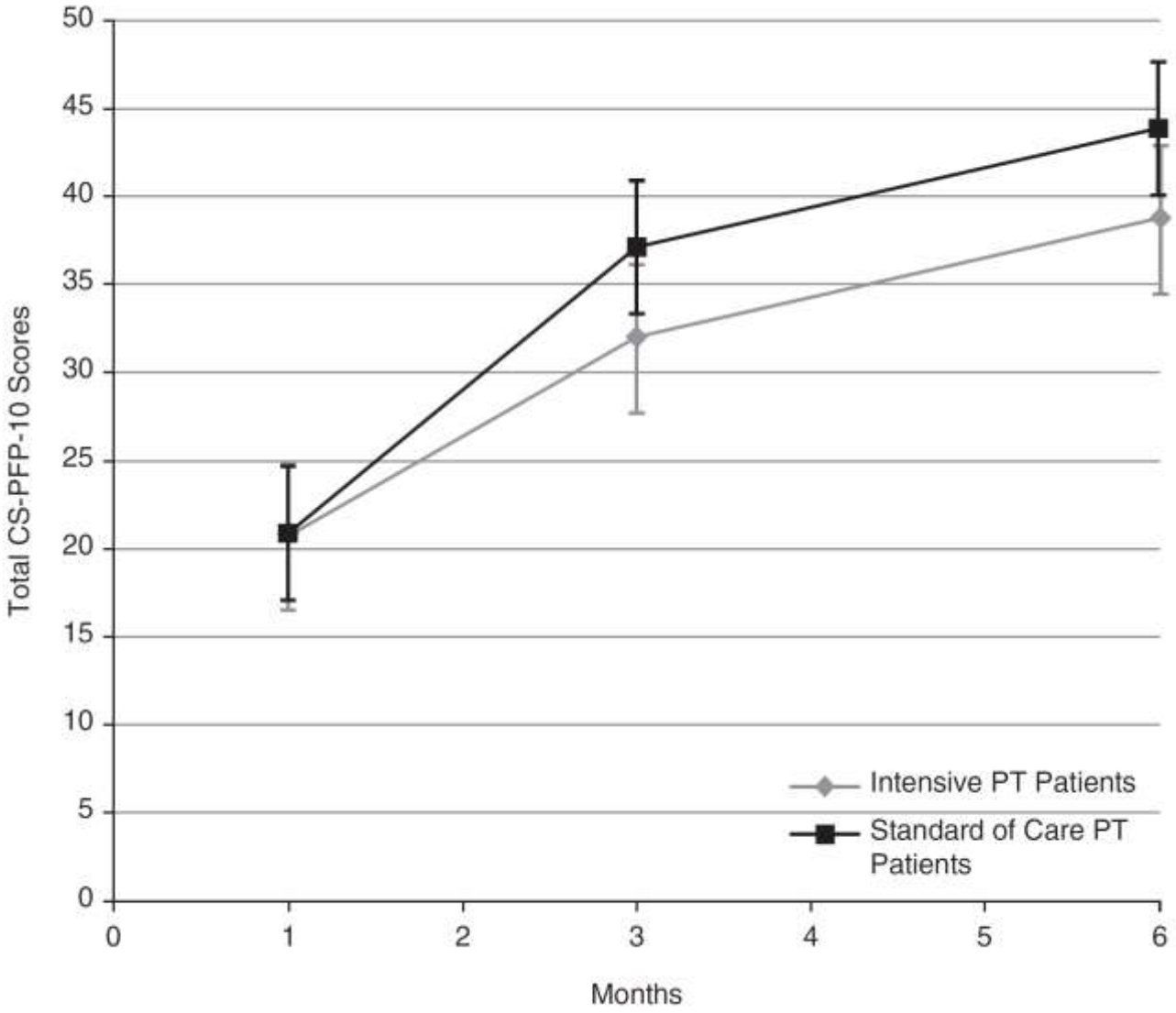
- 5 centers
- Patients who required mechanical ventilation for 4 or more days
- Intervention: 30 min/day 7/7 during 28 days
- Control: 3 days a week



Moss et al. AJRCCM 2016

	Intensive PT Patients (*n* = 59)	Standard-of-Care PT Patients (*n* = 61)	*P* Value
Total time in physical therapy, min	408 ± 261	86 ± 63	<0.001
Total number of sessions	12.4 ± 6.5	6.1 ± 3.8	<0.001
ICU sessions	6.4 ± 5.3	3.8 ± 2.4	0.002
Hospital ward sessions	6.2 ± 4.7	3.8 ± 3.0	0.003
Outpatient sessions	3.7 ± 2.8	0	
Average duration of individual sessions, min	39.4 ± 11.0	21.8 ± 3.5	<0.001
ICU sessions	31.3 ± 7.0	21.0 ± 3.2	<0.001
Non-ICU sessions	45.3 ± 13.4	22.0 ± 4.8	<0.001

Assessments of physical functioning

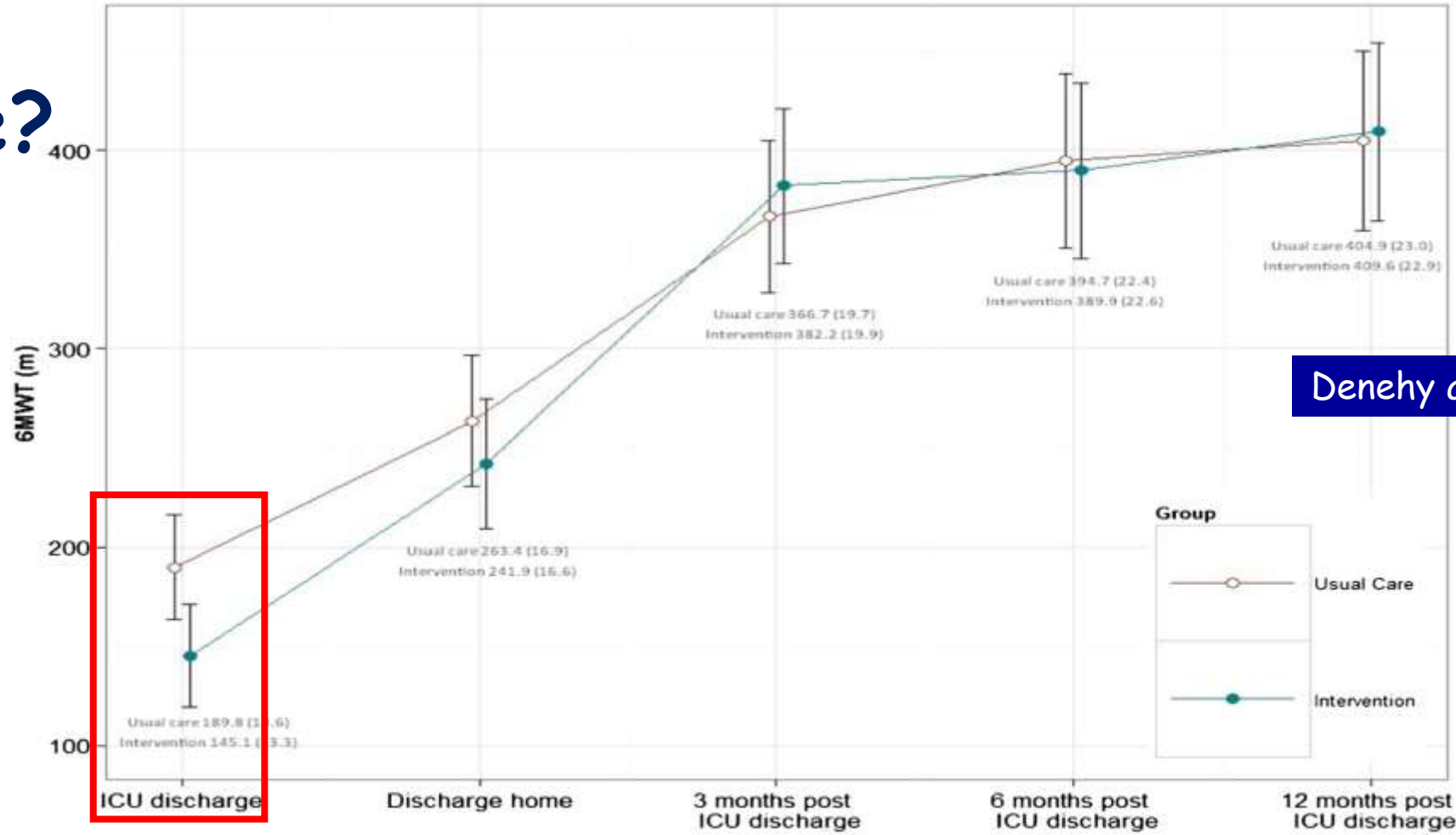


28-d ICU-free days	13 (3–18)	11 (4–18)	0.69
ICU length of stay, d	15 (10–25)	16 (10–24)	0.69
Mechanical ventilation duration, d	10 (7–18)	10 (7–19)	0.89
28-d hospital-free days	7 (0–12)	7 (0–14)	0.97
Hospital length of stay, d	21 (16–32)	21 (14–38)	0.97
Discharged to home	51% (25/49)	49% (27/55)	0.84
90-d institution-free days	61 (39–73)	56 (33–75)	0.87
180-d institution-free days	151 (129–163)	146 (123–165)	0.89

Moss et al. AJRCCM 2016

Where?

	ICU		Ward	Outpatients
Frequency of exercise sessions	Mechanically ventilated	Weaned		
	15 min/day	2 × 15 min/day	2 × 30 min/day progressed to 1 × 60 min/day	60 min twice weekly for 8 wk
Type of exercise	Marching in place Moving from sitting to standing Arm and leg active and active resistance movements		Cardiovascular, progressive resistance strength training and functional exercise	Cardiovascular, progressive resistance strength training and functional exercise



Denehy *al.* Crit Care 2013

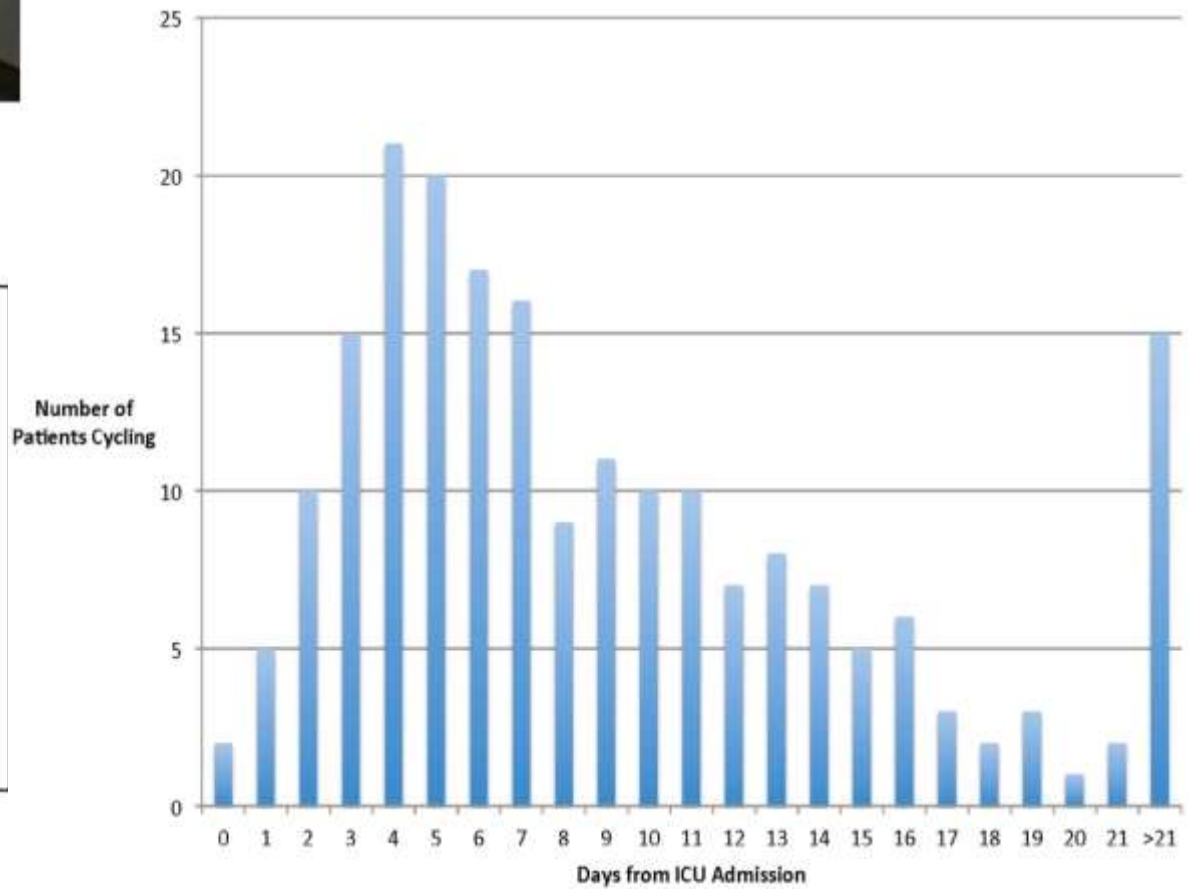
Cycling

Kho *et al.* PLOSone 2016

179 Patients Potentially Eligible

145 Patients Excluded (Reasons, n=175)
- Study Exclusion Criteria (n=144)
  - 68 Exemptions precluding cycling during 1st 4 days of mechanical ventilation
  - 18 Specific surgical exclusion as stipulated by surgical or ICU team
  - 15 Equipment unable to fit patient's body dimensions
  - 11 Acute proven or suspected central or peripheral neuromuscular weakness
  - 10 Acute conditions impairing ability to cycle
  - 7 Pre-hospital inability to follow simple commands in English
  - 6 Palliative goals of care
  - 5 Physician declines
  - 2 Temporary pacemaker
  - 2 Expected hospital mortality >90%
- **Eligible Not Enrolled** (n=31)
  - 22 Workload
  - 5 Research coordinator not available
  - 3 Patient or SDM declines consent
  - 1 Research coordinator error/missed

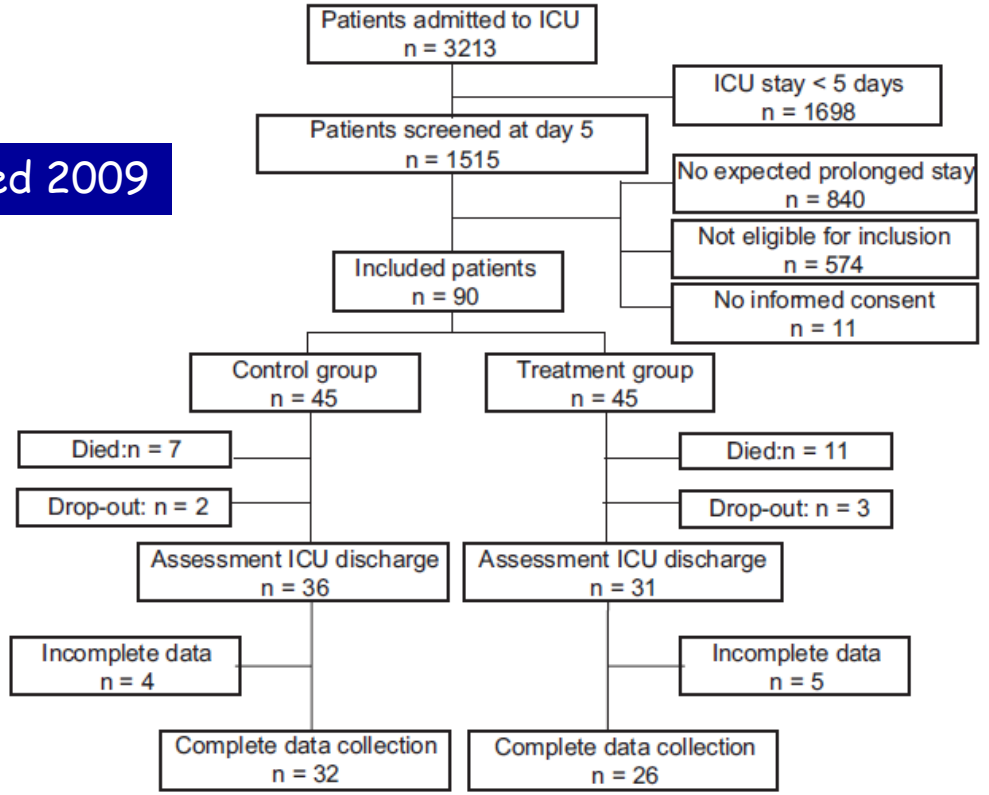
34 Patients Enrolled



Cycling: RCT

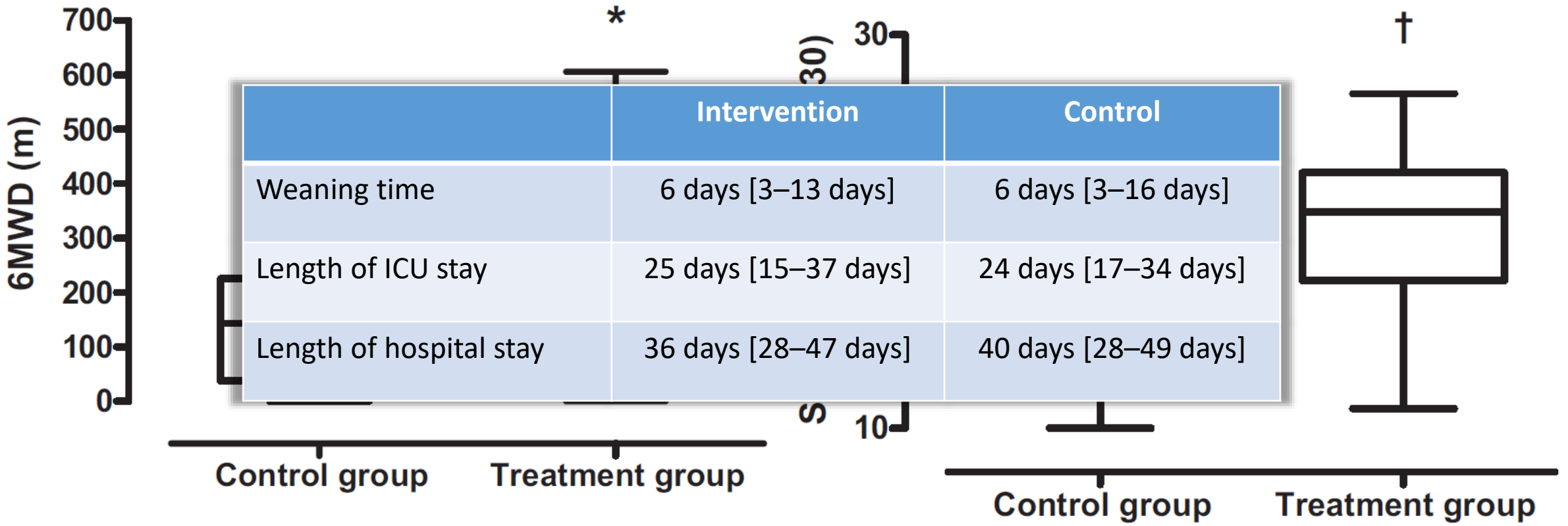
Burtin *al.* Crit Care Med 2009

- Single-center
- Each session: cycling for 20 mins at an individually adjusted intensity level
- Sedated patients: passive manner for 20 consecutive minutes at a fixed pedaling rate of 20 cycles/min
- Able to cycle actively
  - Cycling divided into two bouts of 10 mins or into more intervals when needed



	Control Group (n = 36)	Treatment Group (n = 31)
Pao_2 on oxygen, torr [kPa]	110 ± 29 [14.7 ± 3.9]	100 ± 27 [13.3 ± 3.6]
$Paco_2$ on oxygen, torr [kPa]	40 ± 6 [5.3 ± 0.8]	39 ± 9 [5.2 ± 1.2]
Surgical patients, n (%)	29 (81)	28 (90)
ICU stay before inclusion, days	10 ± 8	14 ± 10[a]

6-min walking distance and SF-36 PF score at hospital discharge



	Intervention	Control
Weaning time	6 days [3–13 days]	6 days [3–16 days]
Length of ICU stay	25 days [15–37 days]	24 days [17–34 days]
Length of hospital stay	36 days [28–47 days]	40 days [28–49 days]

Burtin *al.* Crit Care Med 2009

Official Executive Summary of an American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically Ill Adults

Gregory A. Schmidt, Timothy D. Girard, John P. Kress, Peter E. Morris, Daniel R. Ouellette, Waleed Alhazzani, Suzanne M. Burns, Scott K. Epstein, Andres Esteban, Eddy Fan, Miguel Ferrer, Gilles L. Fraser, Michelle Gong, Catherine Hough, Sangeeta Mehta, Rahul Nanchal, Sheena Patel, Amy J. Pawlik, Curtis N. Sessler, Thomas Strøm, William Schweickert, Kevin C. Wilson, and Jonathon D. Truwit

- ***Should Acutely Hospitalized Adults Who Have Been Mechanically Ventilated for >24 Hours Be Subjected to Protocolized Rehabilitation Directed toward Early Mobilization or no Protocolized Attempts at Early Mobilization?***
- The evidence synthesis demonstrated that patients who received an intervention directed toward early mobilization had a shorter duration of mechanical ventilation and were more likely to be able to walk at hospital discharge. There were no differences in mortality, ICU length of stay, ability to walk at ICU discharge, six minute walk distance, or ventilator-free days. Low rates of serious adverse events, including arrhythmias, have been reported.
- **ATS/ACCP recommendation**
- For acutely hospitalized adults who have been mechanically ventilated for >24 hours, we suggest protocolized rehabilitation directed toward early mobilization (Conditional recommendation, low certainty in the evidence).

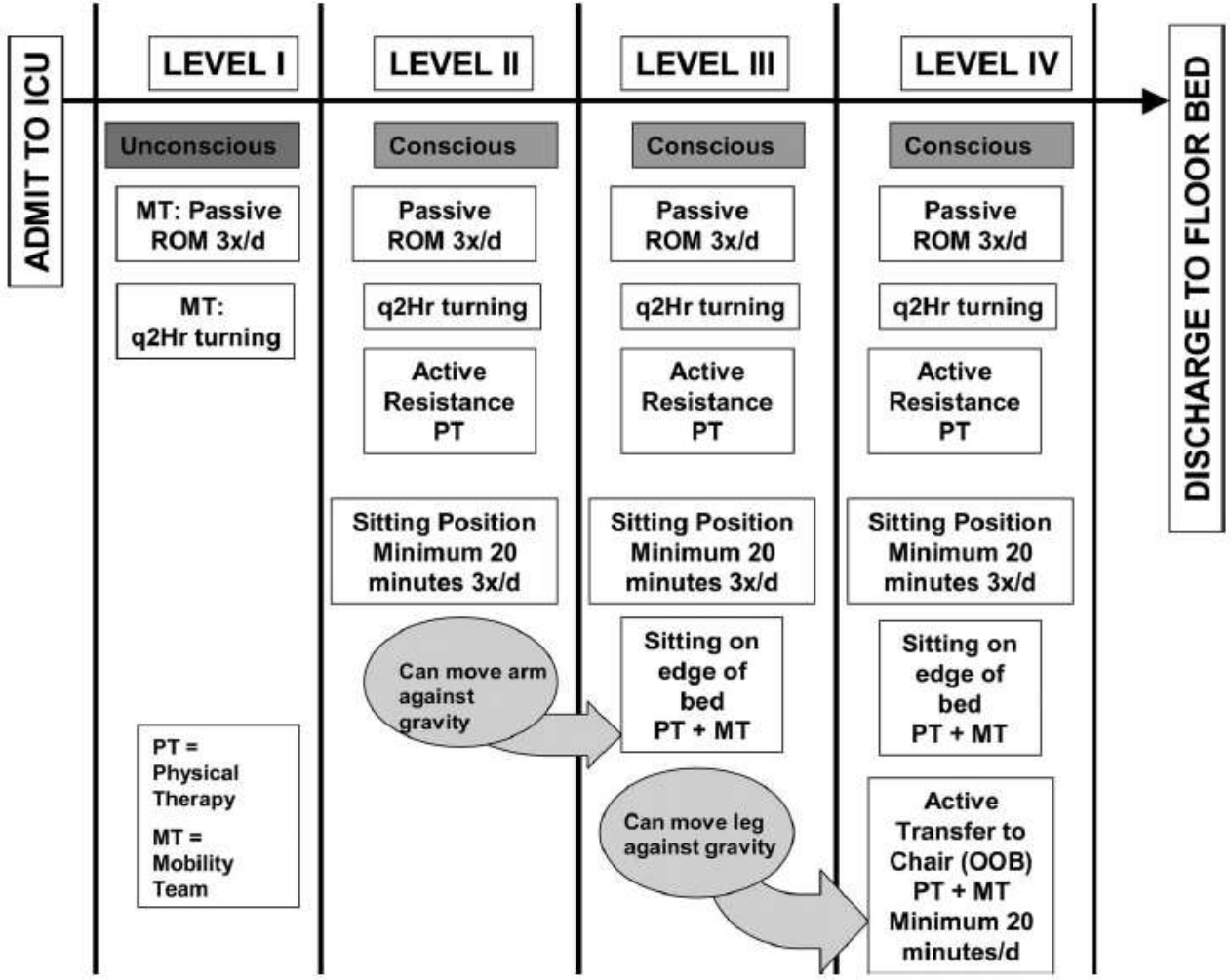
Mobility team implementation

- 7 days per week exclusively by the Mobility Team
  - critical care nurse
  - nursing assistant
  - physical therapist

	Usual Care (n = 135)	Protocol (n = 145)	*p*
Days to first out of bed	13.7 (11.7–15.7)	8.5 (6.6–10.5)	<.001
Days to first out of bed (adjusted[a])	11.3 (9.6–13.4)	5.0 (4.3–5.9)	<.001
Ventilator days	9.0 (7.5–10.4)	7.9 (6.4–9.3)	.298
Ventilator days (adjusted[a])	10.2 (8.7–11.7)	8.8 (7.4–10.3)	.163
ICU LOS days	8.1 (7.0–9.3)	7.6 (6.3–8.8)	.084
ICU LOS days (adjusted[a])	6.9 (5.9–8.0)	5.5 (4.7–6.3)	.025
Hospital LOS days	17.2 (14.2–20.2)	14.9 (12.6–17.1)	.048
Hospital LOS days (adjusted[a])	14.5 (12.7–16.7)	11.2 (9.7–12.8)	.006

Data are presented as means (confidence intervals).

Adjusted[a], adjusted for body mass index, Acute Physiology and Chronic Health Evaluation II, and vasopressors.



Morris *al.* Crit Care Med 2008