Hospices Civils de Lyon

votre santé,
notre engagement

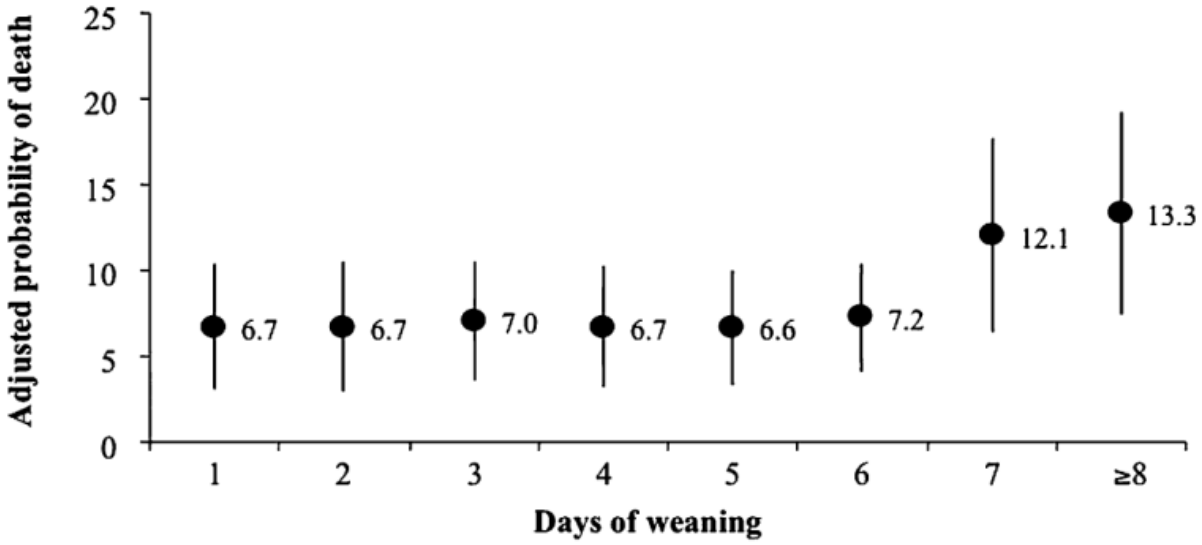
MA PROCÉDURE STANDARDISÉE DE SEVRAGE (HORS SEVRAGE PROLONGÉ)

JC Richard

Médecine intensive - Réanimation,

Hôpital de la Croix-Rousse, Lyon

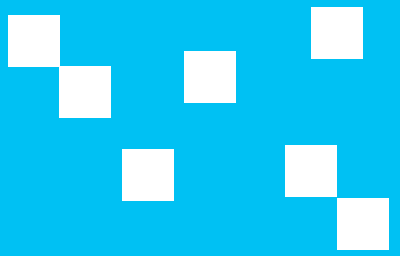
Introduction



~~Sedation protocol~~ → Early rehabilitation protocol → Fluid balance control → Weaning protocol → Spontaneous breathing trial → Extubation criteria → Non invasive respiratory support

Peñuelas O, Frutos-Vivar F, Fernández C, et al. Characteristics and outcomes of ventilated patients according to time to liberation from mechanical ventilation. Am J Respir Crit Care Med 2011;184(4):430–7.

RÉHABILITATION PRÉCOCE



Early rehabilitation protocol

Walking

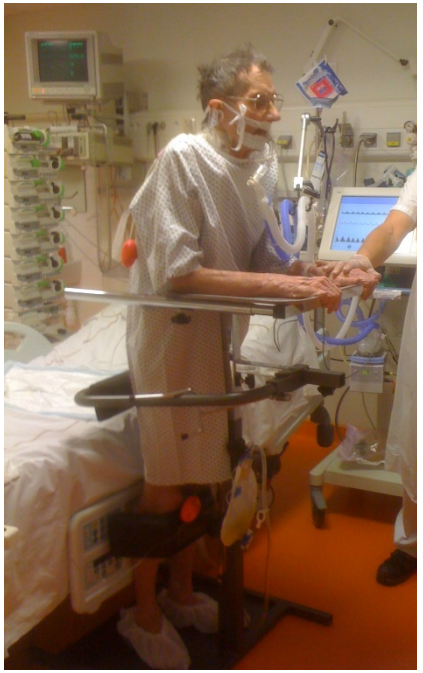
Pre-gait exercises

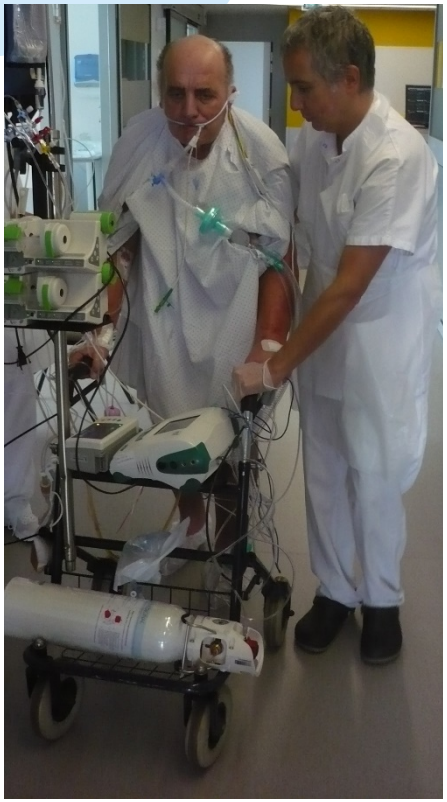
Transfer from bed to chair

Bedside upright sitting

Active motions exercise

Passive motions exercise





Early rehabilitation protocol

	n	Population
Burtin 2009	90	IMV Expected ICU stay ≥ 7 day on day 5
Chang 2011	34	IMV≥3days
Denehy 2013	150	ICU LOS ≥ 5 days IMV 55%
Schweickert 2009	104	IMV<3days

Early rehabilitation protocol

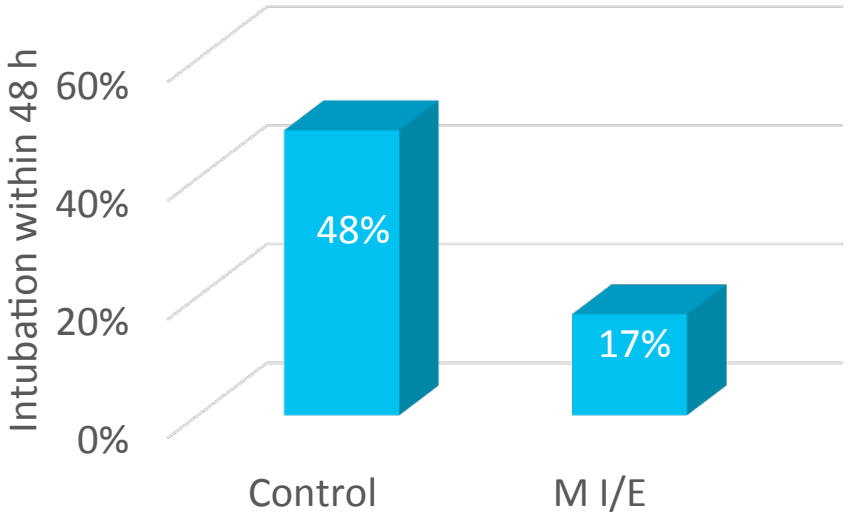
Quality Assessment							No. of Patients		Effect			
No. of studies	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Protocols for Early Mobilization	Usual Care	Relative [*RR* (95% *CI*)]	Absolute Increase (95% CI)	Quality	Importance
Mortality												
3	Randomized trials	Not serious*	Not serious	Not serious	Serious†	None	26/168 (15.5%)	27/176 (15.3%)	1.02 (0.62 to 1.67)	3 (−58 to 103) per 1,000	⊕⊕⊕◯ Moderate	Critical
ICU length of stay, d												
4	Randomized trials	Not serious	Serious‡	Not serious	Serious†	None§	172	183	—	MD, −0.56 (−2.76 to 1.63)	⊕⊕◯◯ Low	Critical
Ability to walk at ICU discharge (independent at ICU discharge)												
1	Randomized trials	Not serious	Not serious	Not serious	Very serious‖	None	3/31 (9.7%)	5/36 (13.9%)	0.70 (0.18 to 2.68)	−42 (−114 to 233) per 1,000	⊕⊕◯◯ Low	Critical
Ability to walk at hospital discharge (independent at hospital discharge)												
2	Randomized trials	Not serious	Not serious	Not serious	Serious¶	None	48/75 (64.0%)	36/87 (41.4%)	1.56 (1.15 to 2.10)	232 (62 to 455) per 1,000	⊕⊕⊕◯ Moderate	Critical
6-min-walk distance at discharge, m												
1	Randomized trials	Not serious	Not serious	Not serious	Very serious‖	None	31	36	—	MD, 53 (−16.96 to 122.96)	⊕⊕◯◯ Low	Critical
Duration of mechanical ventilation, d												
1	Randomized trials	Serious**	Not serious	Not serious	Serious¶	None	49	55	—	MD, −2.7 (−4.21 to −1.19)	⊕⊕◯◯ Low	Critical
Ventilator-free days												
1	Randomized trials	Not serious	Not serious	Not serious	Very serious‖	None	49	55	—	MD, 2.4 (−3.59 to 8.39)	⊕⊕◯◯ Low	Critical
Serious adverse events												
1	Case series	N/A	N/A	N/A	N/A	N/A	34/5,267 (0.6%)	N/A	Not estimable	6.5 events per 1,000 PT treatment sessions	⊕⊕◯◯ Low	Critical
Serious adverse events (arrhythmia)												
1	Case series	N/A	N/A	N/A	N/A	N/A	10/5,267 (0.2%)	N/A	Not estimable	1.9 events per 1,000 PT treatment sessions	⊕⊕◯◯ Low	Critical

ATS/CHEST recommendation. For acutely hospitalized adults who have been mechanically ventilated for more than 24 hours, we suggest protocolized rehabilitation directed toward early mobilization (conditional recommendation, low certainty in the evidence).

Girard TD, Alhazzani W, Kress JP, et al. An Official American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically Ill Adults. Rehabilitation Protocols, Ventilator Liberation Protocols, and Cuff Leak Tests. Am J Respir Crit Care Med 2017;195(1): 120–33.

Single-center RCT on 65 pts after IMV for ARF without prolonged weaning
Intervention: mechanical Insufflation-Exsufflation (M I/E) 3 times per day during 48 h

	Group A (n = 40)	Group B (MI-E) (n = 35)	P
Age (years)	62 ± 19.2	61.4 ± 15.1	NS
Sex (M/F)	21/19	28/7	NS
SAPS II	47.8 ± 17.7	45 ± 15	NS
Duration of MV (days)	9.4 ± 4.8	10.5 ± 4.1	NS
Patients with chronic pulmonary disorders (n, %)	9 (23%)	7 (20%)	NS
Patients with hypoxemic respiratory failure (n,%)	24 (60%)	18 (52%)	NS
Reasons for MV (n)			
COPD exacerbations	6	4	
Congestive heart failure	5	4	
Community-acquired pneumonia	11	6	
Hospital-acquired pneumonia	-	2	
Postoperative respiratory failure	5	8	
Acute lung injury	-	1	
Thoracic trauma	6	3	
Sepsis	7	4	
Cardiac arrest	-	3	

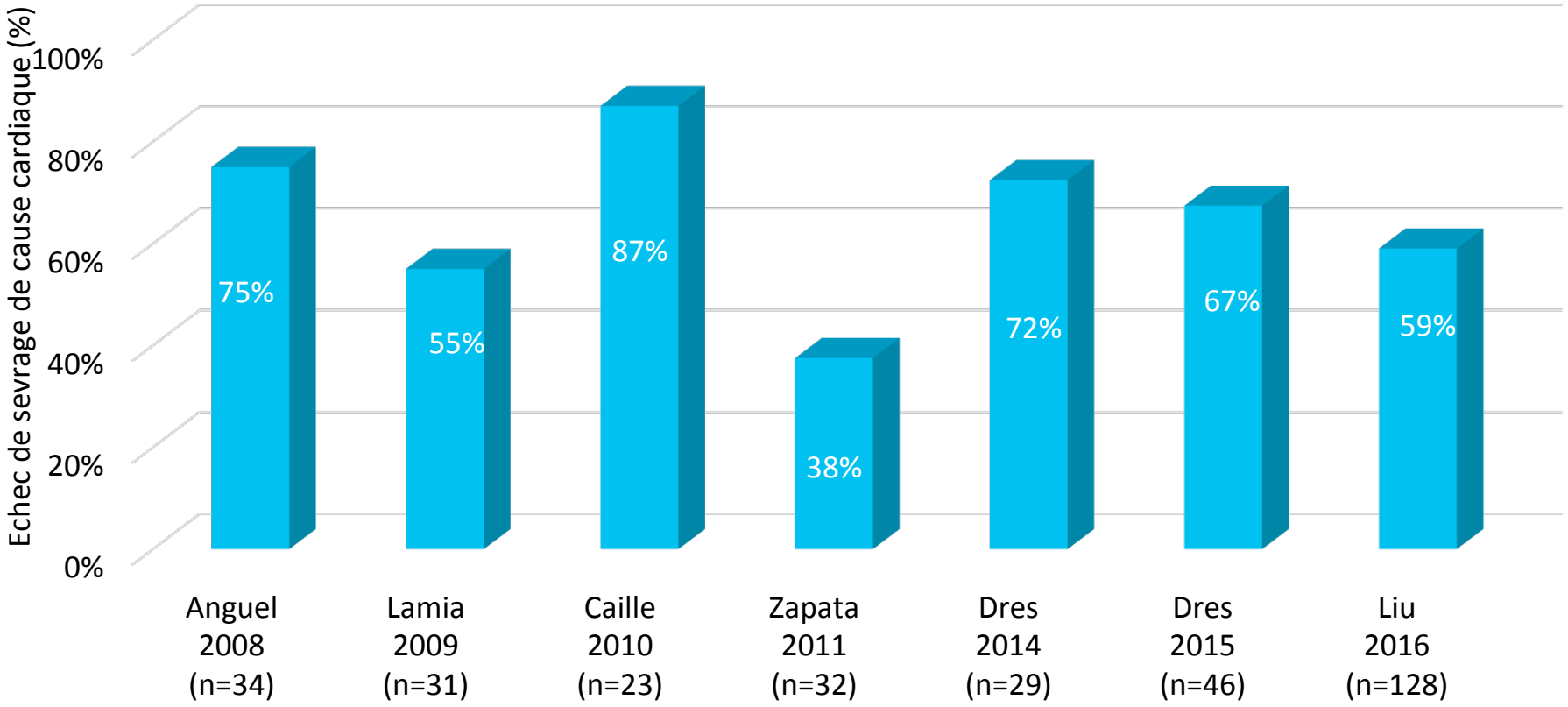


Limits:
- Single center study
- High failure rate in control group

Gonçalves MR, Honrado T, Winck JC, Paiva JA. Effects of mechanical insufflation-exsufflation in preventing respiratory failure after extubation: a randomized controlled trial. Crit Care 2012;16(2):R48.

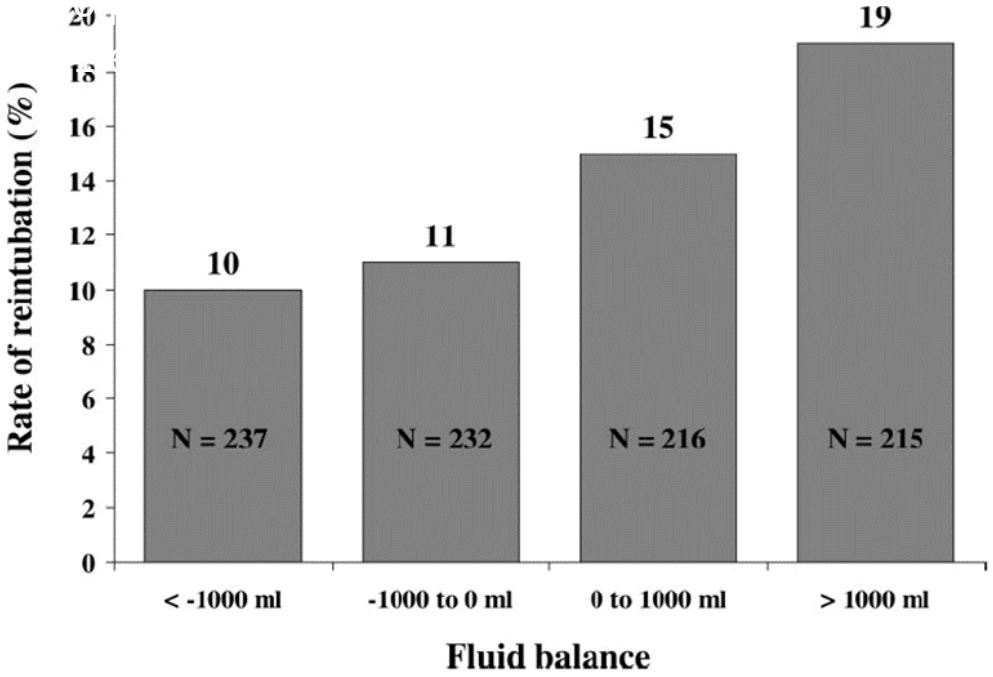
BALANCE HYDRIQUE LORS DU SEVRAGE

Incidence de l'OAP au cours du sevrage



- *Incidence très élevée*
- *Etude de faible effectifs*
- *Mais population sélectionnée (forte prévalence de la BPCO, patients en échec de sevrage)*

Risk Factors for Extubation Failure in Patients Following a Successful Spontaneous Breathing Trial*



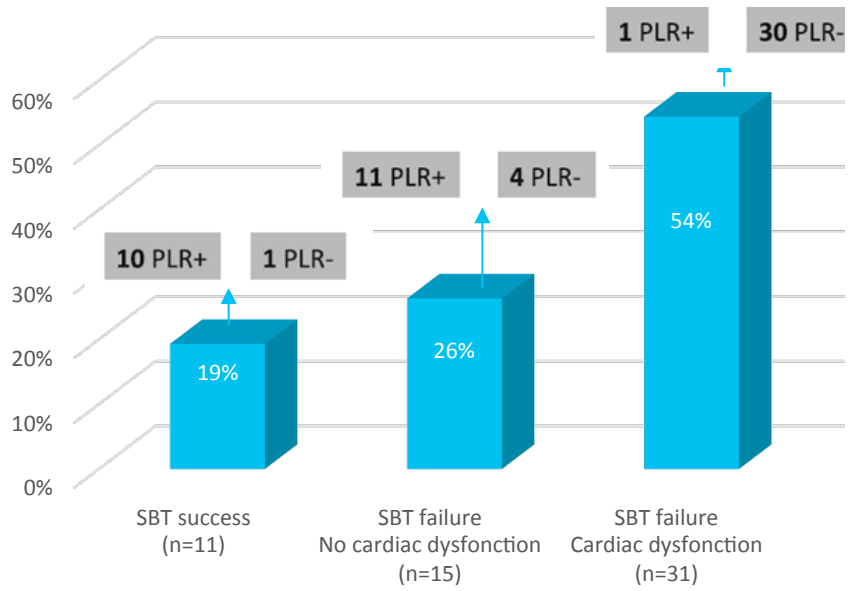
	OR	95% CI
RSBI (per unit)	1.01	1.003-1.015
Positive fluid balance	1.7	1.15-2.53
Pneumonia *	1.77	1.10-2.84

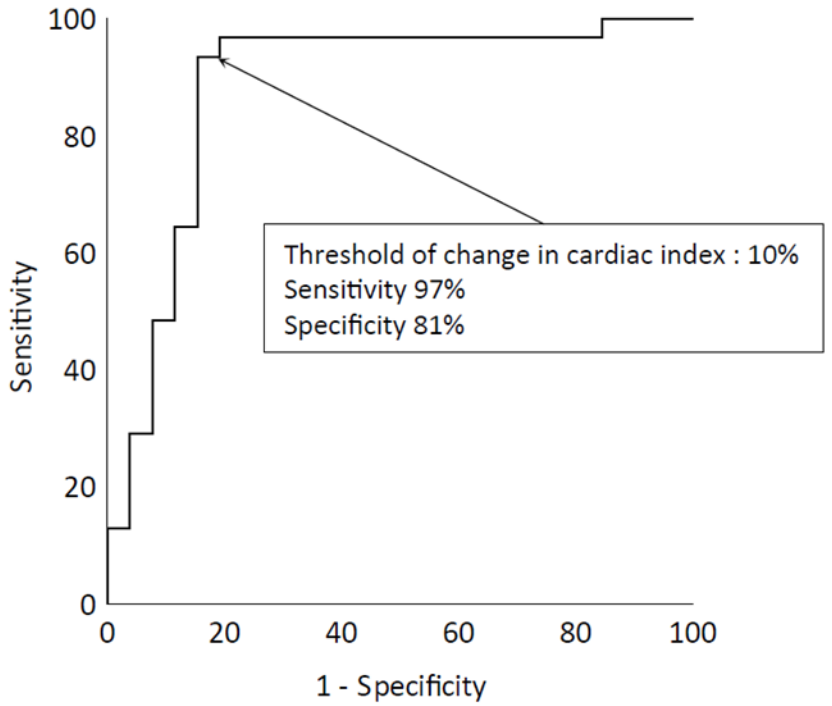
* As the reason for initiating MV

Frutos-Vivar F, Ferguson ND, Esteban A, et al. Risk factors for extubation failure in patients following a successful spontaneous breathing trial. Chest 2006;130(6):1664–71.

Passive leg raising performed before a spontaneous breathing trial predicts weaning-induced cardiac dysfunction

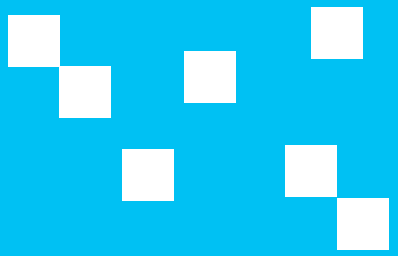
30 pts with SBT failure
57 SBT trials



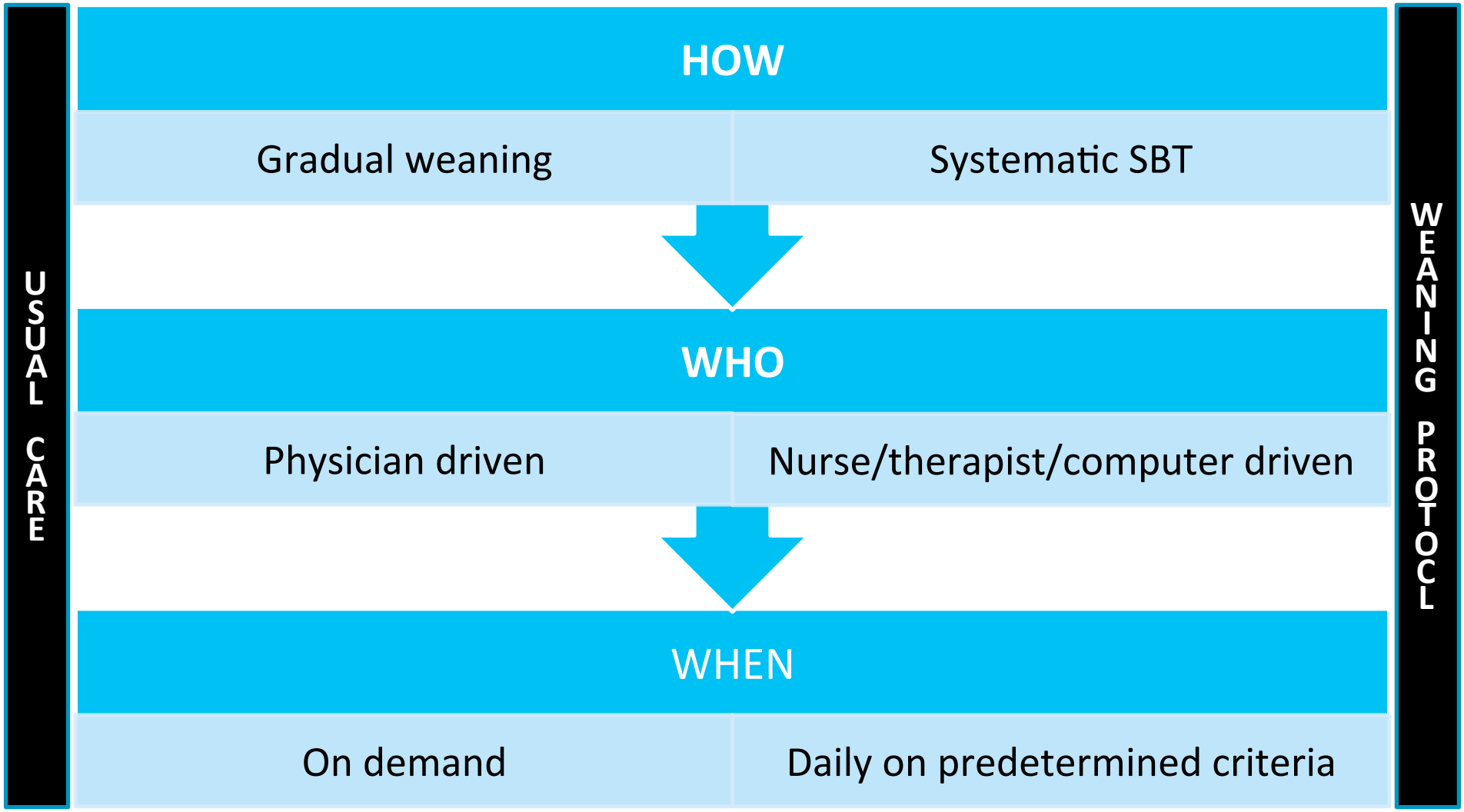


Dres M, Teboul J-L, Anguel N, Guerin L, Richard C, Monnet X. Passive leg raising performed before a spontaneous breathing trial predicts weaning-induced cardiac dysfunction. Intensive Care Med 2015;41(3):487–94.

PROTOCOLES DE SEVRAGE

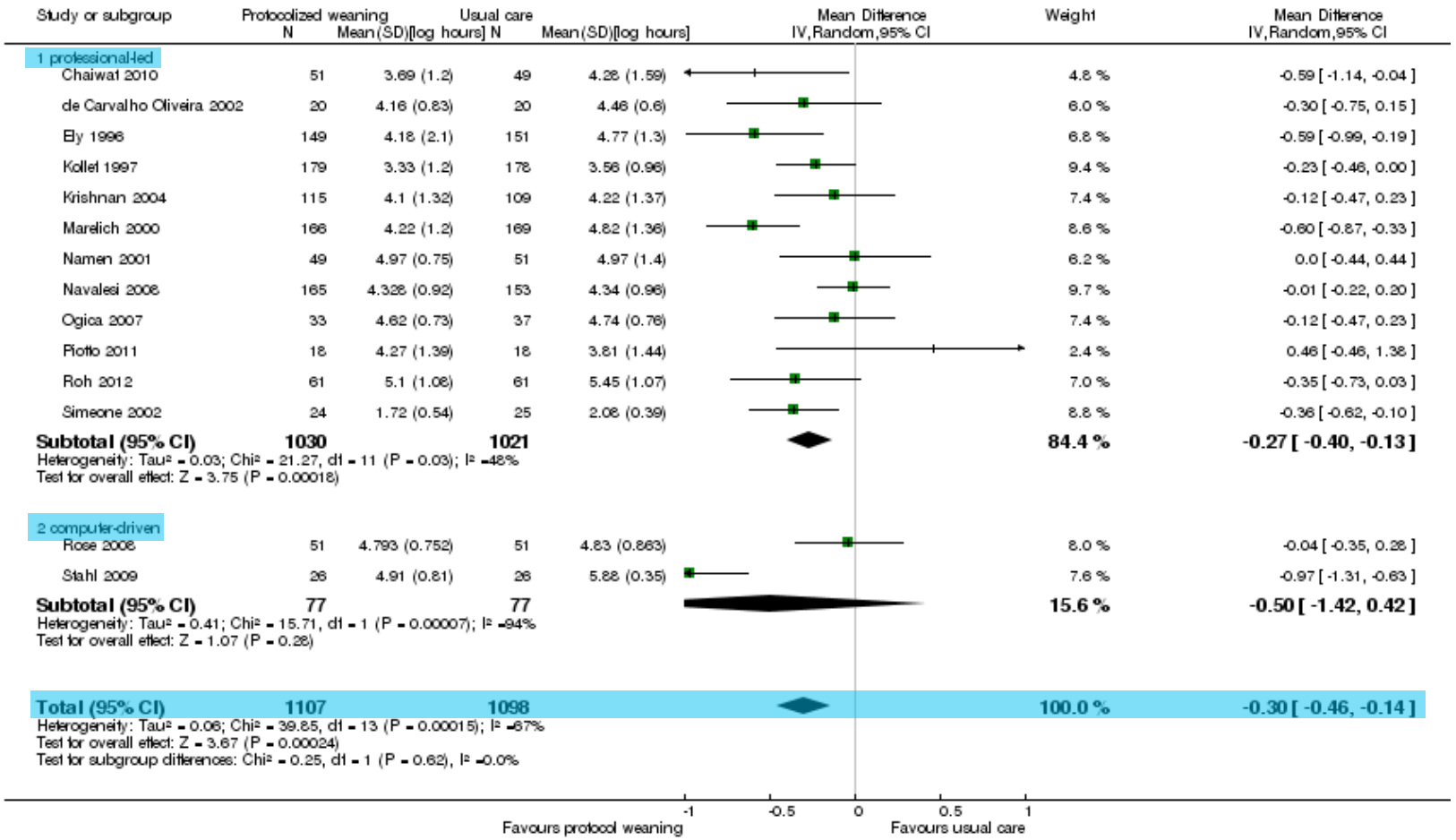


Weaning protocol



Weaning protocol

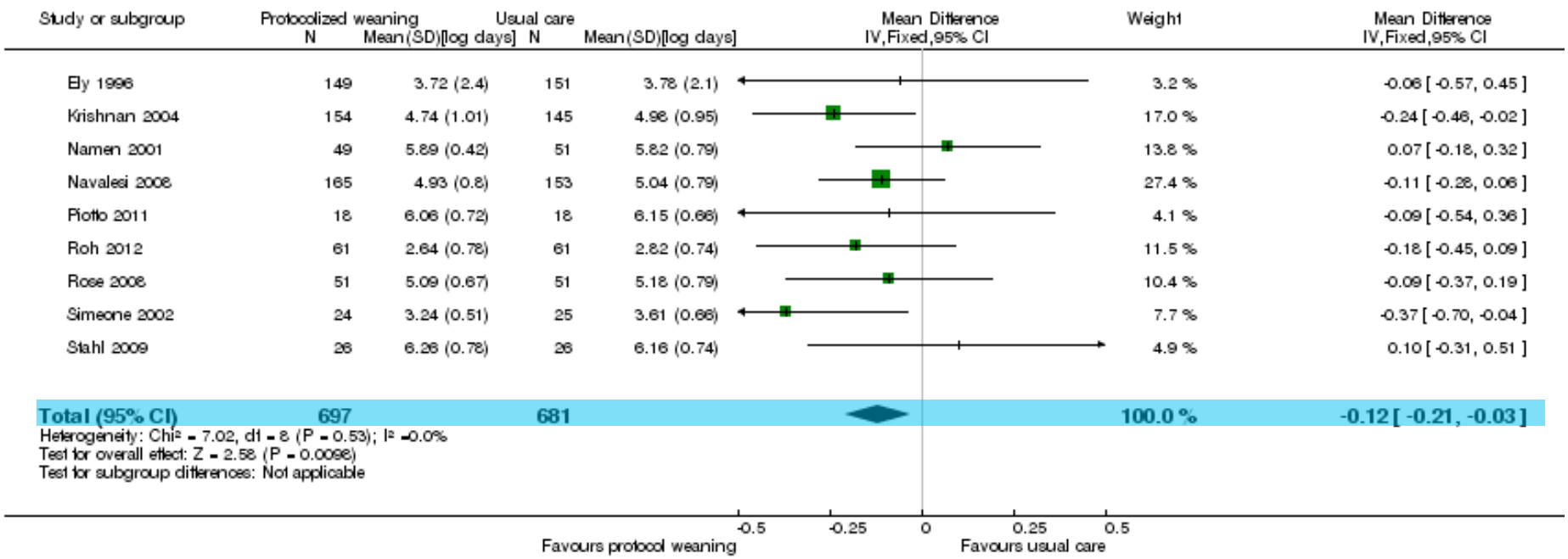
Total duration of MV



Blackwood B, Burns KEA, Cardwell CR, O'Halloran P. Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill adult patients. Cochrane Database Syst Rev 2014;(11):CD006904.

Weaning protocol

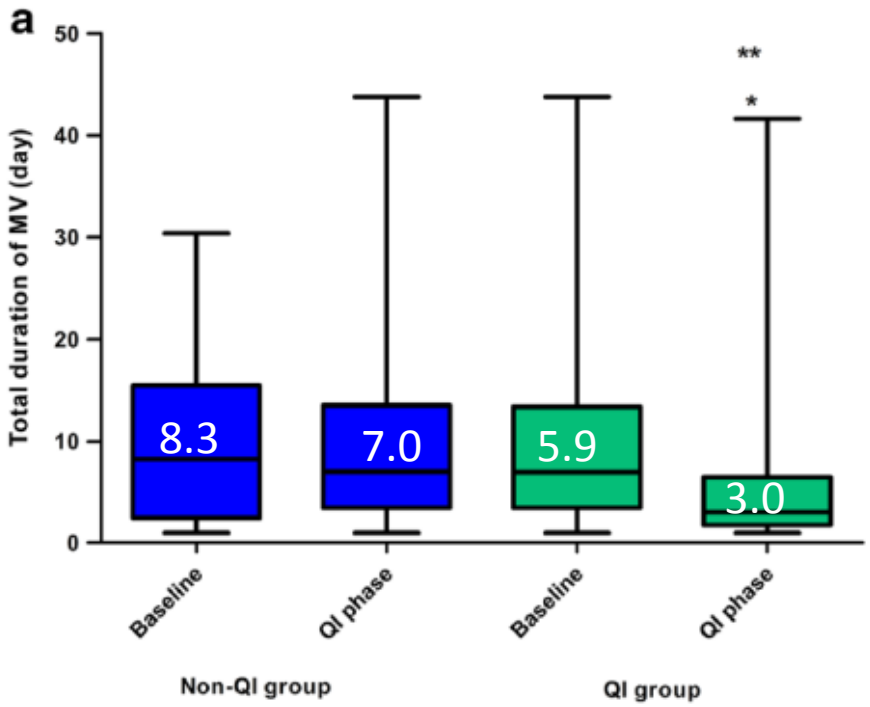
ICU LOS

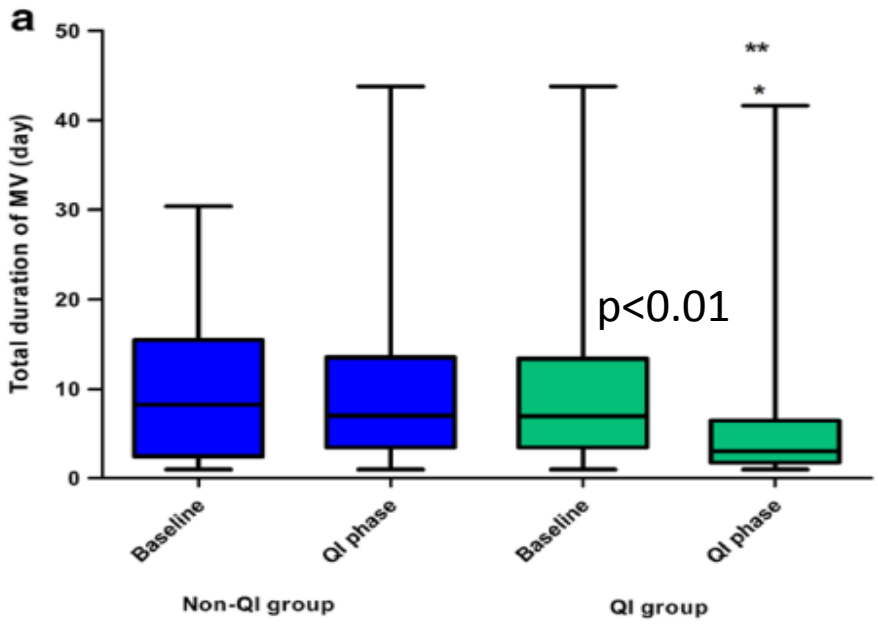


Blackwood B, Burns KEA, Cardwell CR, O'Halloran P. Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill adult patients. Cochrane Database Syst Rev 2014;(11):CD006904.

Quality improvement program

Cluster randomized controlled trial
14 ICUs – 884 pts
Baseline phase – Quality improvement (QI) phase





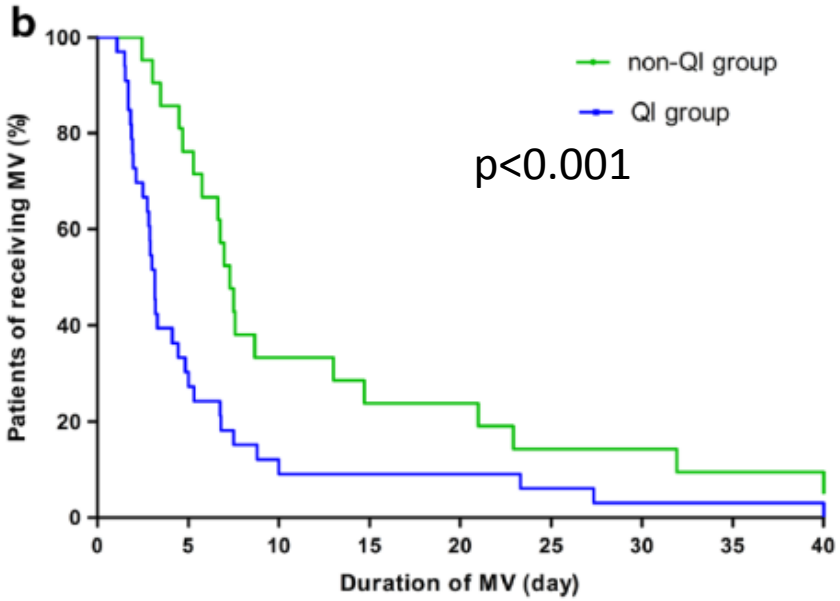
Zhu B, Li Z, Jiang L, et al. Effect of a quality improvement program on weaning from mechanical ventilation: a cluster randomized trial. Intensive Care Med 2015;41(10):1781–90.

Screening criteria

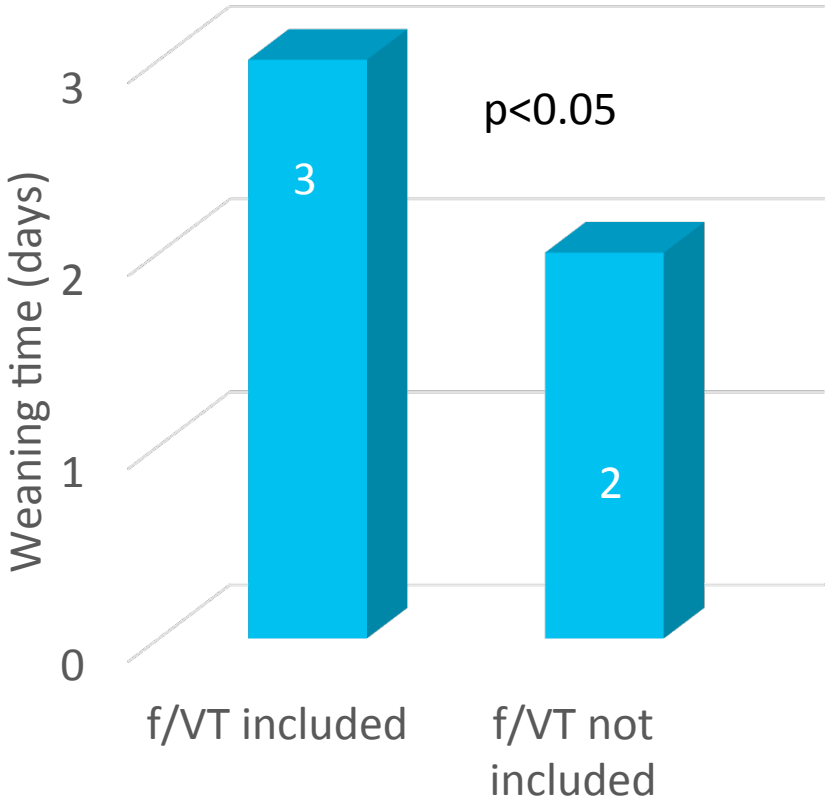
RCT 300 pts - Intervention: Daily screening by physiotherapist ± SBT 2 hours

Screening criteria

- *PaO_2/FiO_2 > 200 mm Hg and PEEP≤5 cm H_2O*
- *F/VT<105*
- *Cough adequate during suctioning*
- *No sedative or vasopressor (dopamine ≤5μg/kg/min)*



RCT 304 pts - Intervention: SBT using f/VT as screening criteria vs. without f/VT



Ely EW; N Engl J Med 1996;335(25):1864–9.
Tanios MA. Crit Care Med 2006;34(10):2530–5.

Screening criteria

Critères de screening proposés

- 1. Neurologique : ROS ± absence de sédation
- 2. Respiratoire : $SPO_2 \geq 90\%$ sous $FiO_2 \leq 40\text{-}50\%$ et PEP ≤ 5 cm H2O
- 3. Cardiovasculaire : faible dose de vasopresseur
- ~~résolution de la cause initiale de l'IRA~~
- ~~f/VT~~

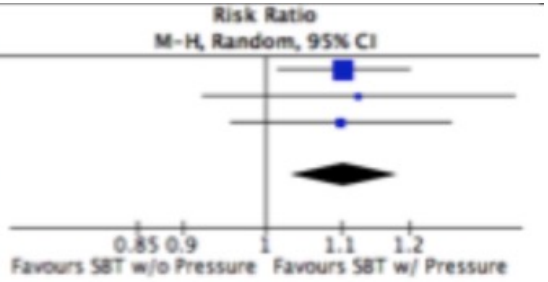
MODALITÉS DU WEANING TRIAL

PIÈCE EN T OU AI, NIVEAU DE PEP?

Successful SBT

Study or Subgroup	SBT with Pressure Events	Total	SBT without Pressure Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Esteban 1997	205	238	192	246	65.1%	1.10 [1.02, 1.20]
Haberthur 2002	54	60	24	30	11.6%	1.13 [0.92, 1.37]
Matic 2004	120	150	80	110	23.3%	1.10 [0.96, 1.26]
Total (95% CI)		**448**		**386**	**100.0%**	**1.11 [1.03, 1.18]**
Total events	379		296			

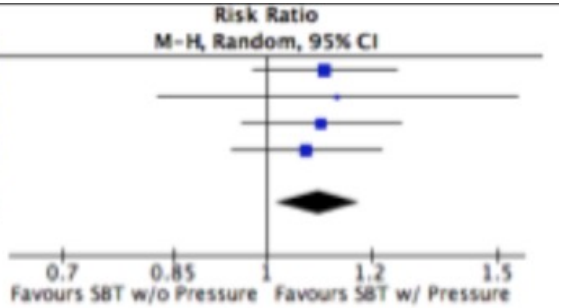
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.04$, df = 2 (P = 0.98); $I^2 = 0\%$
Test for overall effect: Z = 2.91 (P = 0.004)



Extubation success

Study or Subgroup	SBT with Pressure Events	Total	SBT without Pressure Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Esteban 1997	167	238	156	246	34.5%	1.11 [0.98, 1.26]
Haberthur 2002	43	60	19	30	5.5%	1.13 [0.83, 1.55]
Matic 2004	120	150	80	110	28.1%	1.10 [0.96, 1.26]
Zhang 2014	78	93	90	115	31.8%	1.07 [0.94, 1.22]
Total (95% CI)		**541**		**501**	**100.0%**	**1.09 [1.02, 1.18]**
Total events	408		345			

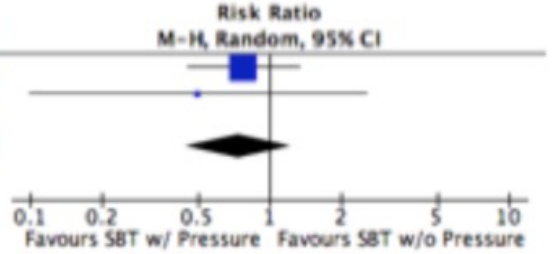
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.18$, df = 3 (P = 0.98); $I^2 = 0\%$
Test for overall effect: Z = 2.40 (P = 0.02)



Short term mortality

Study or Subgroup	SBT with Pressure Events	Total	SBT without Pressure Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Esteban 1997	21	238	28	246	90.1%	0.78 [0.45, 1.33]
Matic 2004	2	30	4	30	9.9%	0.50 [0.10, 2.53]
Total (95% CI)		**268**		**276**	**100.0%**	**0.74 [0.45, 1.24]**
Total events	23		32			

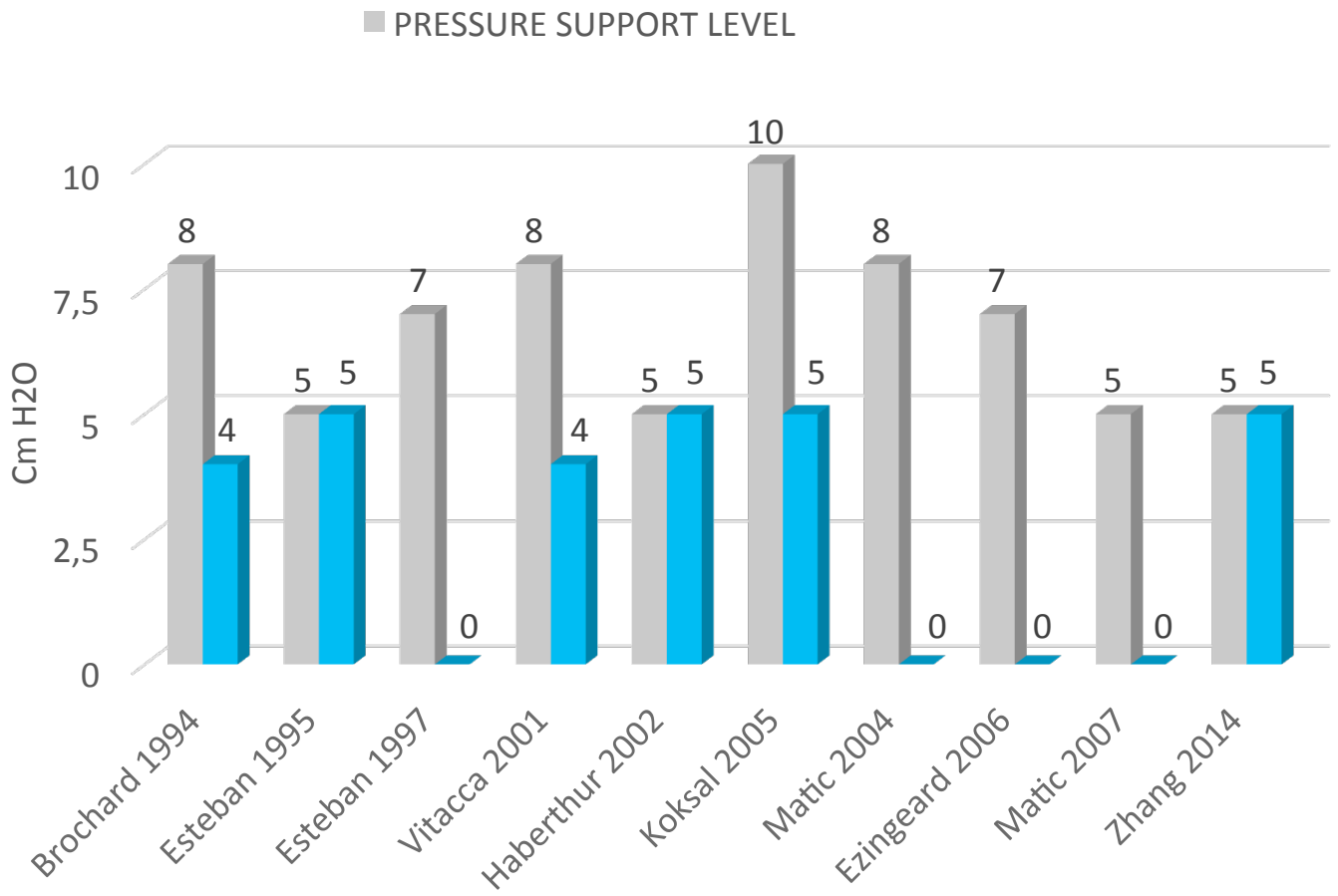
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.25$, df = 1 (P = 0.61); $I^2 = 0\%$
Test for overall effect: Z = 1.15 (P = 0.25)



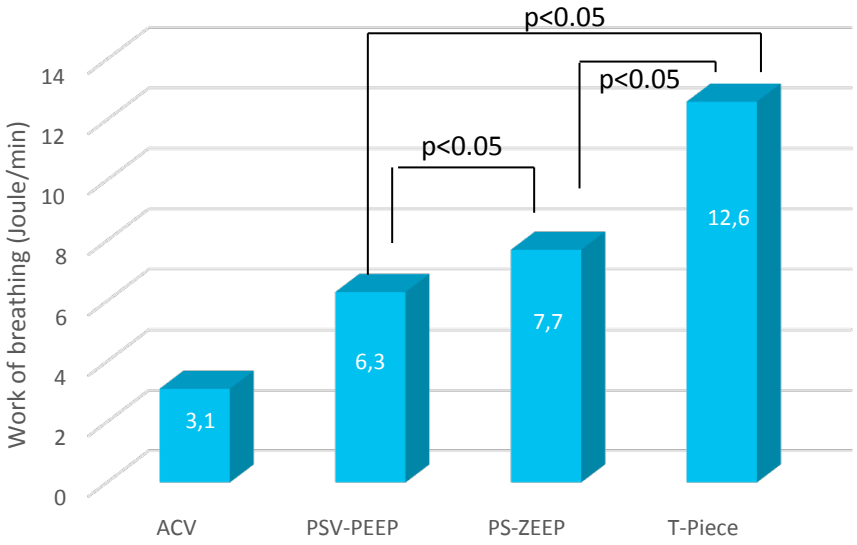
For acutely hospitalized patients ventilated more than 24 h, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5-8 cm H_2O) rather than without (T-piece or CPAP) (Conditional Recommendation, Moderate Quality Evidence).

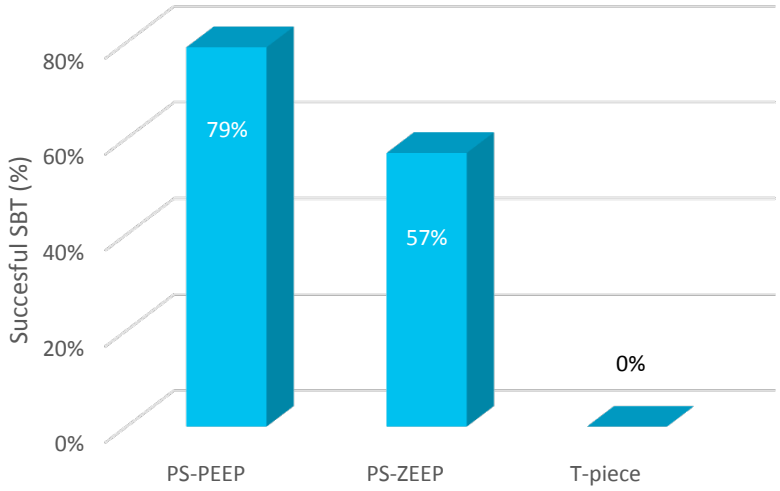
Ouellette DR, Patel S, Girard TD, et al. Liberation From Mechanical Ventilation in Critically Ill Adults: An Official American College of Chest Physicians/American Thoracic Society Clinical Practice Guideline: Inspiratory Pressure Augmentation During Spontaneous Breathing Trials, Protocols Minimizing Sedation, and Noninvasive Ventilation Immediately After Extubation. Chest 2017;151(1):166–80.

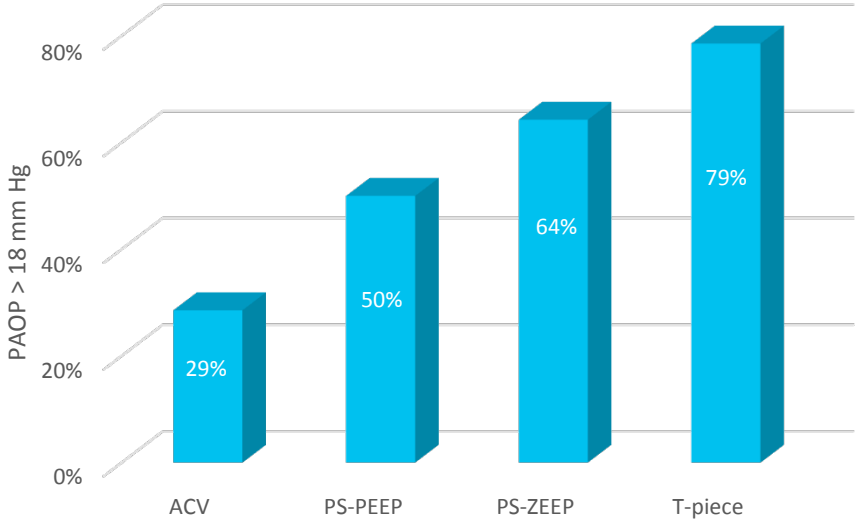
PEEP and PS levels in trials



14 pts with 1 SBT failure monitored with a Swan-Ganz catheter
PS7-PEEP5, PS-ZEEP, T-piece



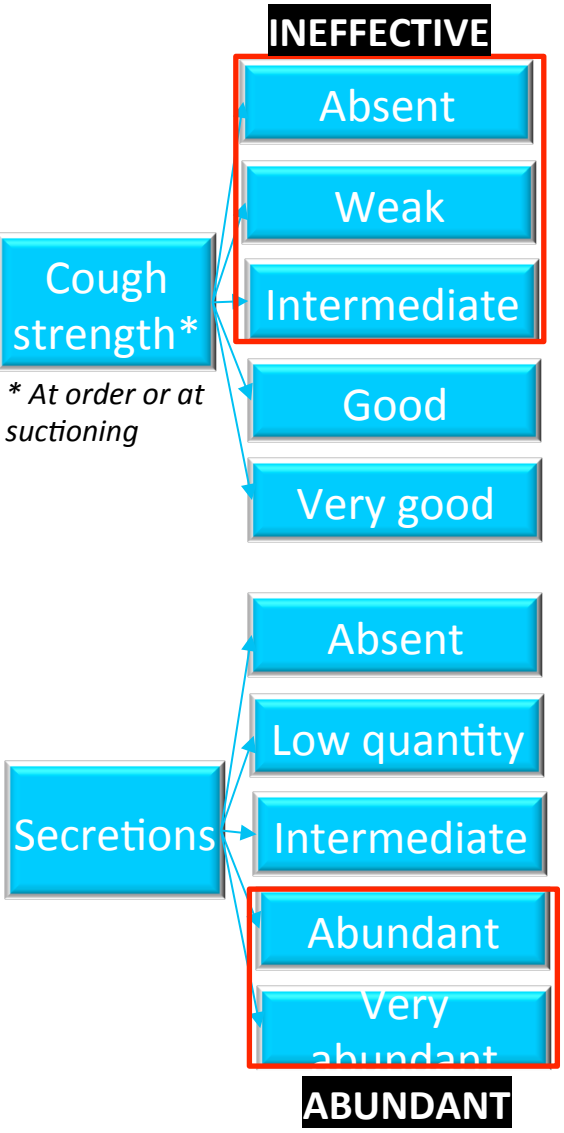




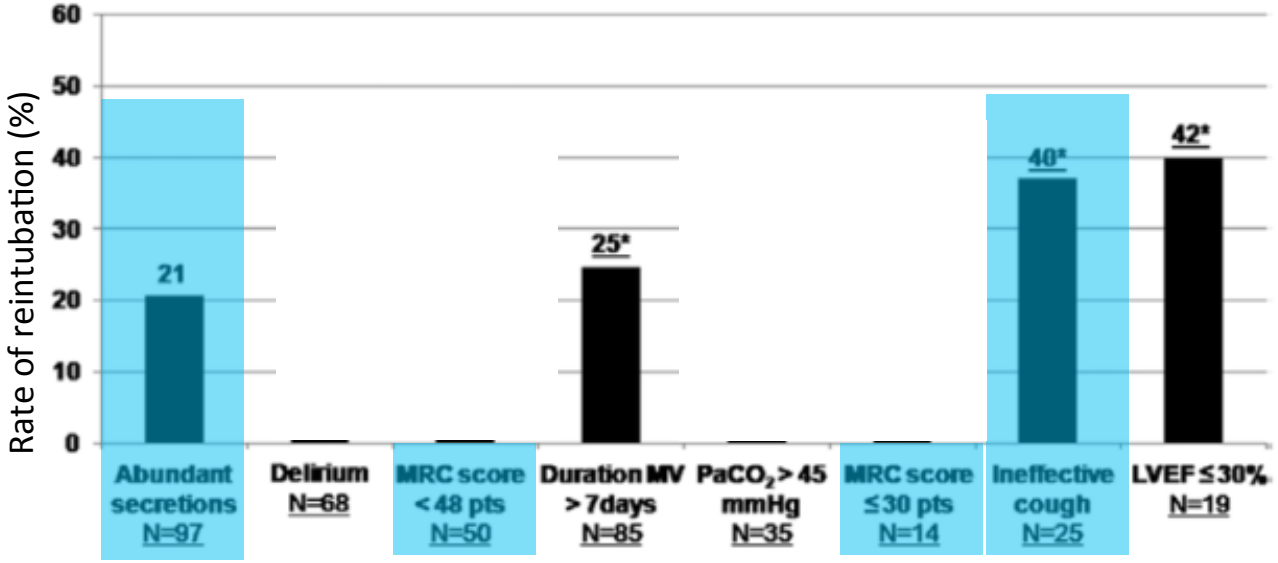
Cabello B, Thille AW, Roche-Campo F, Brochard L, Gomez FJ, Mancebo J. Physiological comparison of three spontaneous breathing trials in difficult-to-wean patients. Intensive Care Med 2010;36(7):1171–9.

CRITÈRES D’EXTUBABILITÉ

Encombrement-Qualité de la toux



Prospective observational study
224 pts under MV for > 24hrs – Extubation failure 14%



Variables Associated With Extubation Failure	Reintubation ≤ 72 Hr		Reintubation ≤ 7 D	
	Adjusted Odds Ratio[a] (95% CI)	*p*	Adjusted Odds Ratio[a] (95% CI)	*p*
Abundant secretions	3.32 (1.21–9.13)	0.020		NS
Ineffective cough	5.03 (1.80–14.1)	0.002	5.09 (1.88–13.8)	0.001
Duration of mechanical ventilation before extubation > 7 d	2.87 (1.11–7.41)	0.030	3.66 (1.54–8.69)	0.003
Severe systolic left ventricular dysfunction (left ventricular ejection fraction ≤ 30%)		NS	5.23 (1.65–16.6)	0.005

AUC = 0.79

AUC = 0.78

Thille AW, Boissier F, Ben Ghezala H, Razazi K, Mekontso-Dessap A, Brun-Buisson C. Risk factors for and prediction by caregivers of extubation failure in ICU patients: a prospective study. Crit Care Med 2015;43(3):613–20.

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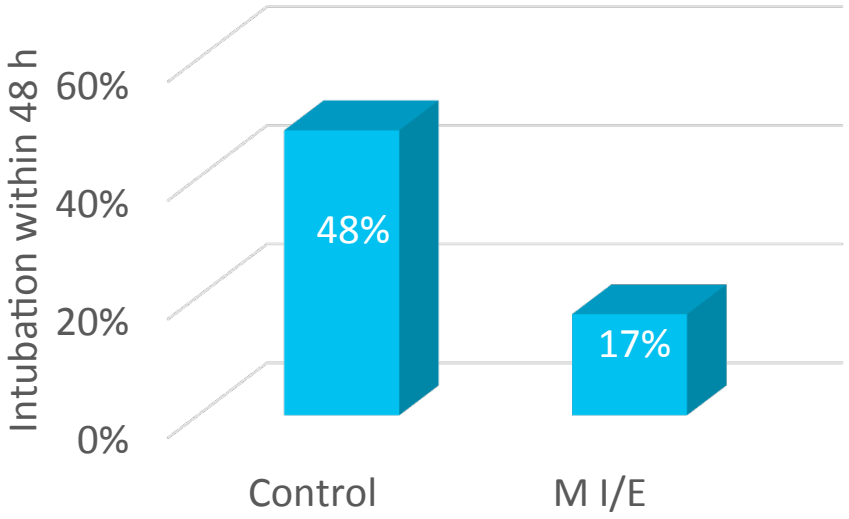

Limits:
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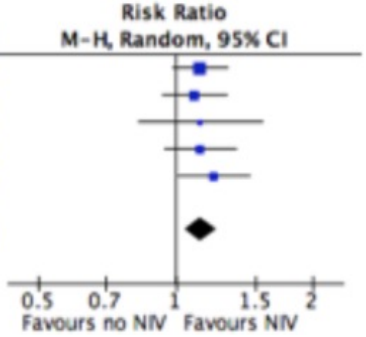
ASSISTANCE RESPIRATOIRE POST EXTUBATION

PROPHYLACTIC NIV POST-EXTUBATION

Extubation success

Study or Subgroup	Extubation to NIV Events	Total	Extubation w/o NIV Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Ferrer 2006	70	79	65	83	32.4%	1.13 [0.99, 1.30]
Ferrer 2009	48	54	42	52	23.4%	1.10 [0.94, 1.30]
Khilnani 2011	17	20	15	20	6.3%	1.13 [0.83, 1.55]
Mohamed 2013	51	60	45	60	19.0%	1.13 [0.95, 1.36]
Nava 2005	44	48	37	49	18.9%	1.21 [1.01, 1.45]
Total (95% CI)		**261**		**264**	**100.0%**	**1.14 [1.05, 1.23]**
Total events	230		204			

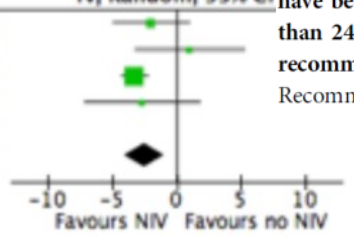
Heterogeneity: Tau² = 0.00; Chi² = 0.66, df = 4 (P = 0.96); I² = 0%
Test for overall effect: Z = 3.26 (P = 0.001)



ICU LOS

Study or Subgroup	Extubation to NIV Mean	SD	Total	Extubation w/o NIV Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Ferrer 2006	11	8	79	13	11	83	20.3%	-2.00 [-4.95, 0.95]
Ferrer 2009	11	13	54	10	9	52	11.4%	1.00 [-3.24, 5.24]
Mohamed 2013	8.3	3.1	60	11.6	2.6	60	57.9%	-3.30 [-4.32, -2.28]
Nava 2005	8.9	5.7	48	11.6	14.9	49	10.4%	-2.70 [-7.17, 1.77]
Total (95% CI)			**241**			**244**	**100.0%**	**-2.48 [-4.03, -0.93]**

Heterogeneity: Tau² = 0.81; Chi² = 4.19, df = 3 (P = 0.24); I² = 28%
Test for overall effect: Z = 3.14 (P = 0.002)

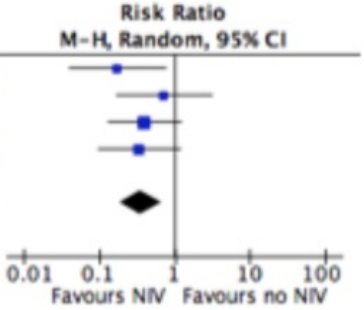


3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for more than 24 h, and who have passed an SBT, we recommend extubation to preventative NIV (Strong Recommendation, Moderate Grade of Evidence).

Short term mortality

Study or Subgroup	Extubation to NIV Events	Total	Extubation w/o NIV Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Ferrer 2006	2	79	12	83	19.3%	0.18 [0.04, 0.76]
Ferrer 2009	3	54	4	52	19.8%	0.72 [0.17, 3.07]
Mohamed 2013	4	60	10	60	34.1%	0.40 [0.13, 1.21]
Nava 2005	3	48	9	49	26.8%	0.34 [0.10, 1.18]
Total (95% CI)		**241**		**244**	**100.0%**	**0.37 [0.19, 0.70]**
Total events	12		35			

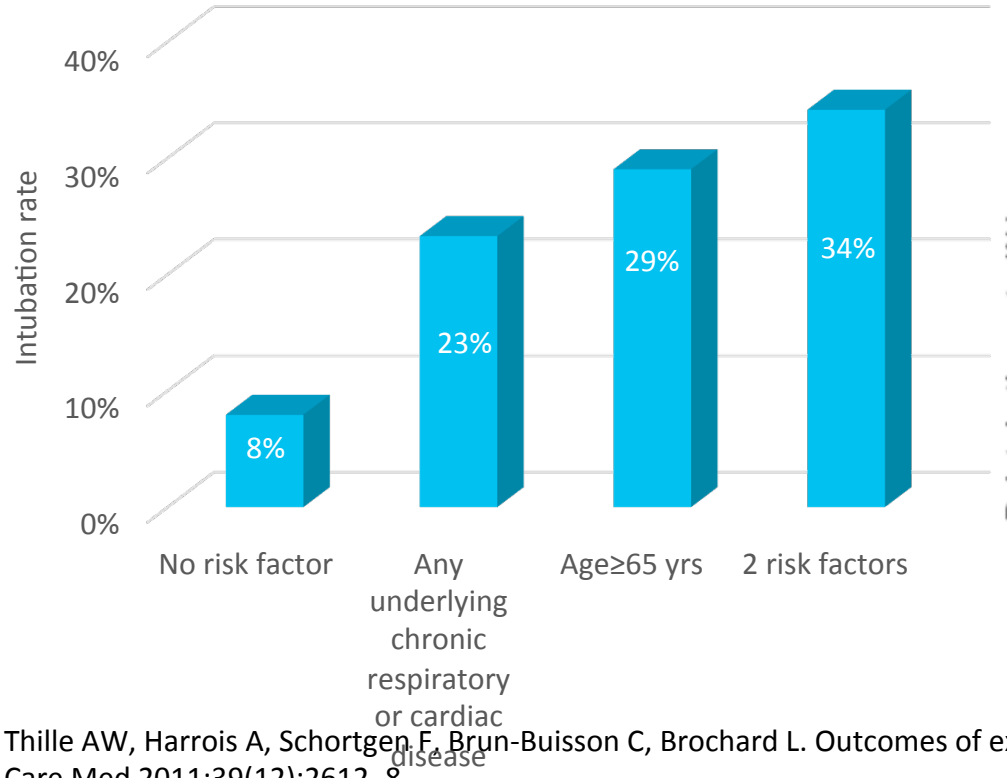
Heterogeneity: Tau² = 0.00; Chi² = 1.89, df = 3 (P = 0.60); I² = 0%
Test for overall effect: Z = 3.05 (P = 0.002)



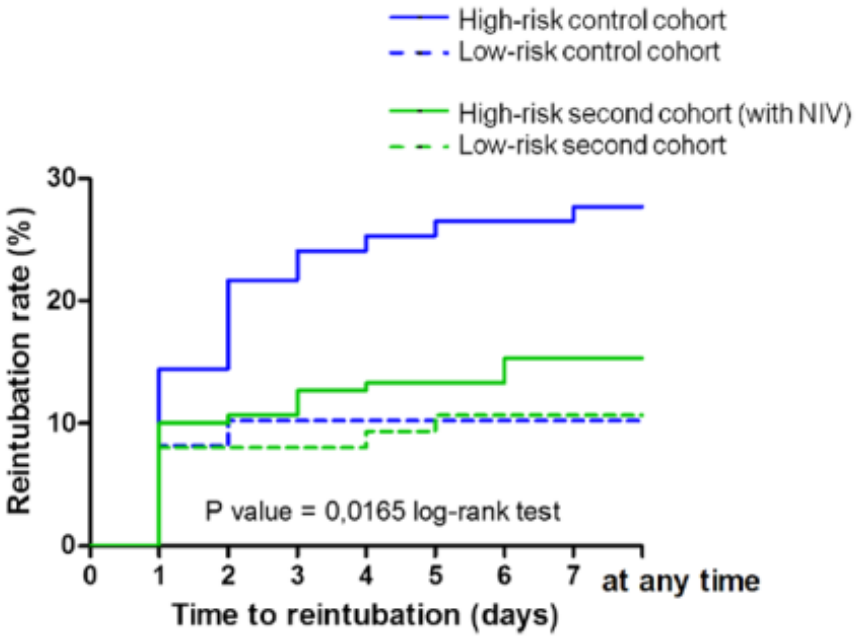
Ouellette DR, Patel S, Girard TD, et al. Liberation From Mechanical Ventilation in Critically Ill Adults: An Official American College of Chest Physicians/American Thoracic Society Clinical Practice Guideline: Inspiratory Pressure Augmentation During Spontaneous Breathing Trials, Protocols Minimizing Sedation, and Noninvasive Ventilation Immediately After Extubation. Chest 2017;151(1):166–80.

PROPHYLACTIC NIV POST-EXTUBATION
Target population – 1. High risk patients

132 extubations without prophylactic NIV



225 extubations
150 high risk patients (age ≥ 65 yrs or underlying chronic cardiac/respiratory disease with prophylactic NIV (> 8h/day)



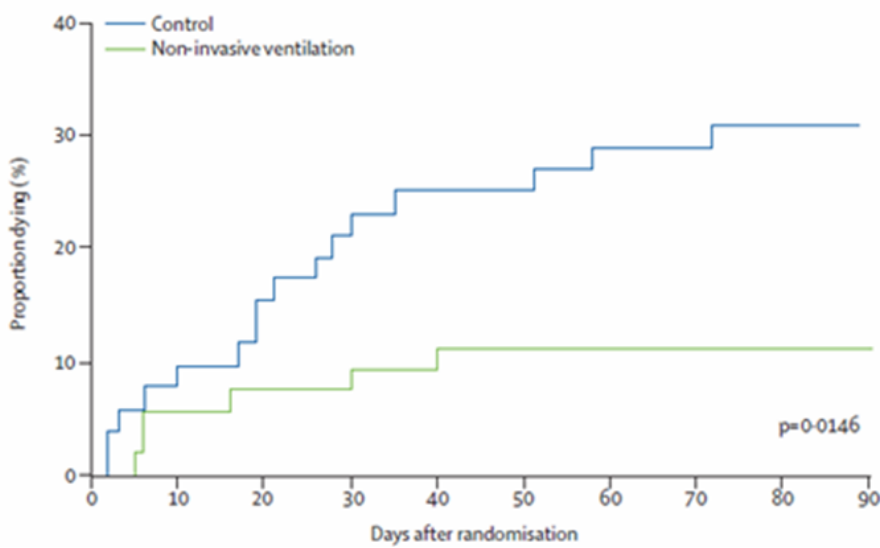
Thille AW, Harrois A, Schortgen F, Brun-Buisson C, Brochard L. Outcomes of extubation failure in medical intensive care unit patients. Crit Care Med 2011;39(12):2612–8.

Thille AW, Boissier F, Ben-Ghezala H, et al. Easily identified at-risk patients for extubation failure may benefit from noninvasive ventilation: a prospective before-after study. Crit Care 2016;20:48.

PROPHYLACTIC NIV POST-EXTUBATION
Target population – 2. Hypercapnic patients at end of SBT

RCT 106 patients with chronic respiratory disorders + $PaCO_2$ > 45 mm Hg (end of T piece SBT trial)
70% COPD
Primary judgment criterion: post-extubation ARF

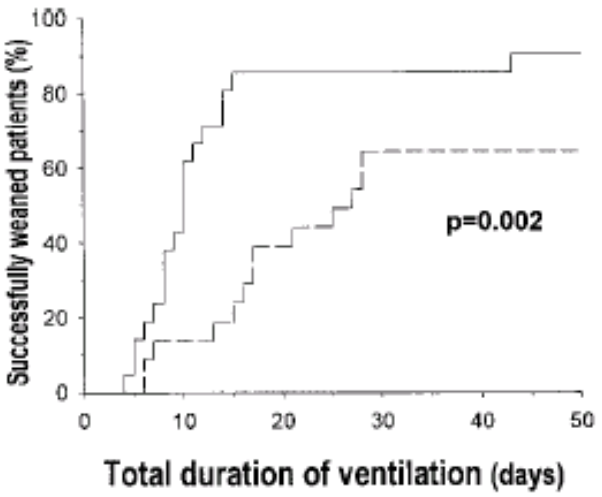
	Non-invasive ventilation (n=54)	Control (n=52)	Odds ratio (95% CI)	p
Outcome variables				
Respiratory failure after extubation	8 (15%)	25 (48%)	5·32 (2·11–13·46)	<0·0001
Main causes of respiratory failure after extubation			..	0·3451
Respiratory failure	3	18		
Aspiration or excess respiratory secretions	3	3		
Cardiac failure	1	2		
Upper-airway obstruction	0	1		
Encephalopathy	1	1		
Time from extubation to respiratory failure (h)	29 (13)	17 (18)	..	0·0982
Criteria met for reintubation	6 (11%)	10 (19%)	1·90 (0·64–5·68)	0·3741

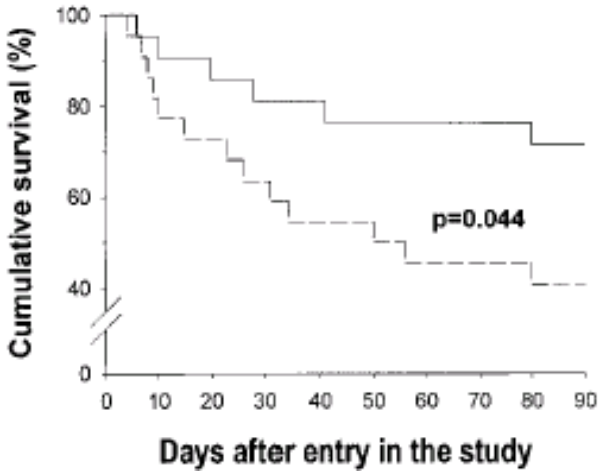


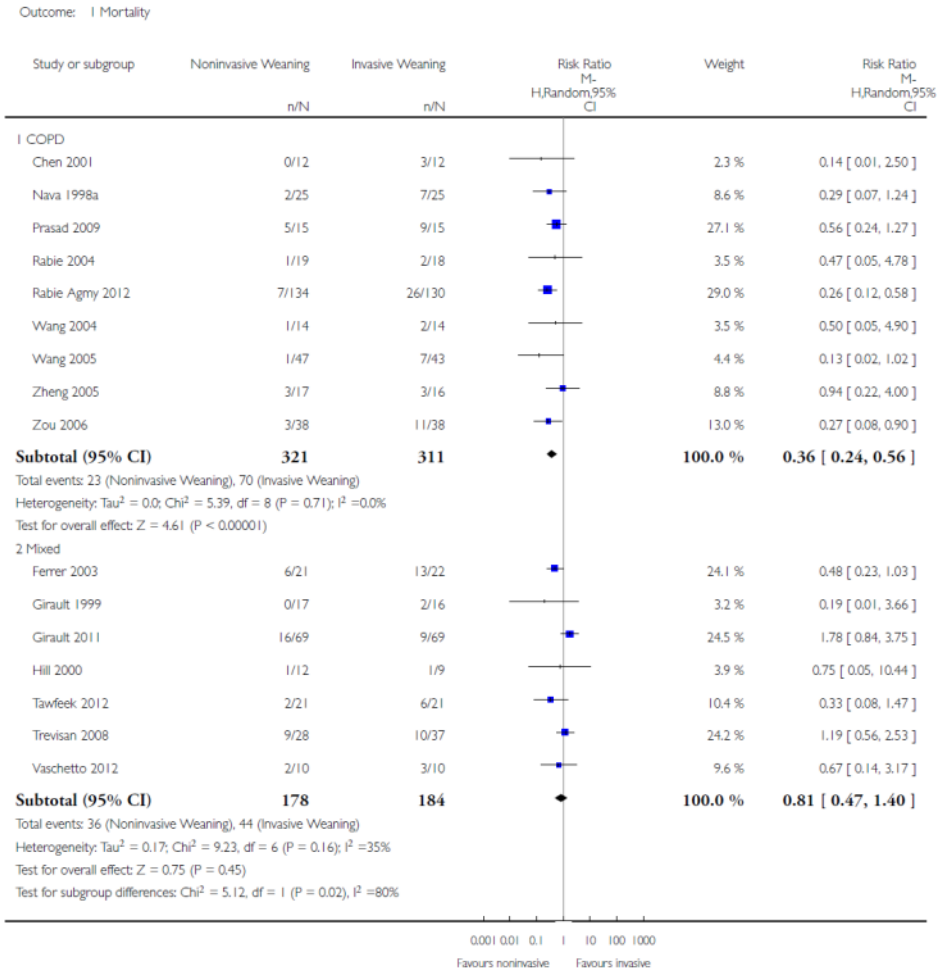
Ferrer M, Sellarés J, Valencia M, et al. Non-invasive ventilation after extubation in hypercapnic patients with chronic respiratory disorders: randomised controlled trial. Lancet 2009;374(9695):1082–8.

PROPHYLACTIC NIV POST-EXTUBATION

Target population – 3. Liberal strategy if SBT-PS+PEEP







Ferrer M, Esquinas A, Arancibia F, et al. Noninvasive ventilation during persistent weaning failure: a randomized controlled trial. Am J Respir Crit Care Med 2003;168(1):70–6.

VNI PROPHYLACTIQUE POST-EXTUBATION
Délai d'instauration – Dose de VNI

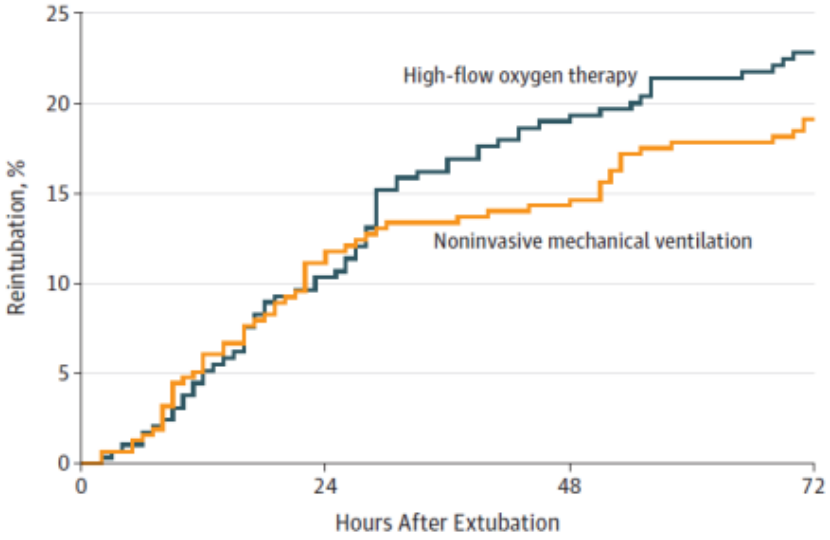
	Situation clinique	Délai	Dose prévue Dose effective
Nava 2005 CCM	VM>48h + ($PaCO_2$>45, encombr., toux ineff., card., comorbidités.,>1échec SBT)	1 h post-extubation	>8h/j ?
Ferrer 2006 AJRCCM	VM>48h + (>65 ans, IOT pour OAP, APACHE>12)	Post-extubation immédiate	Max 19 ± 8 h
Ferrer 2009 Lancet	VM>48h + PaCO2>45 en fin de SBT	Post-extubation immédiate	Max 18 ± 7 h
Khilnani 2011 AIC	VM>48h + IOT pour EABPCO	Post-extubation immédiate	>7h/j 8 ± 2 h
Su 2011 Respir Care	VM>48 h	Post-extubation immédiate	>12h ?
Ornico 2013 Crit Care	VM>72h+IOT pour IRA	Post-extubation immédiate	24 h ?

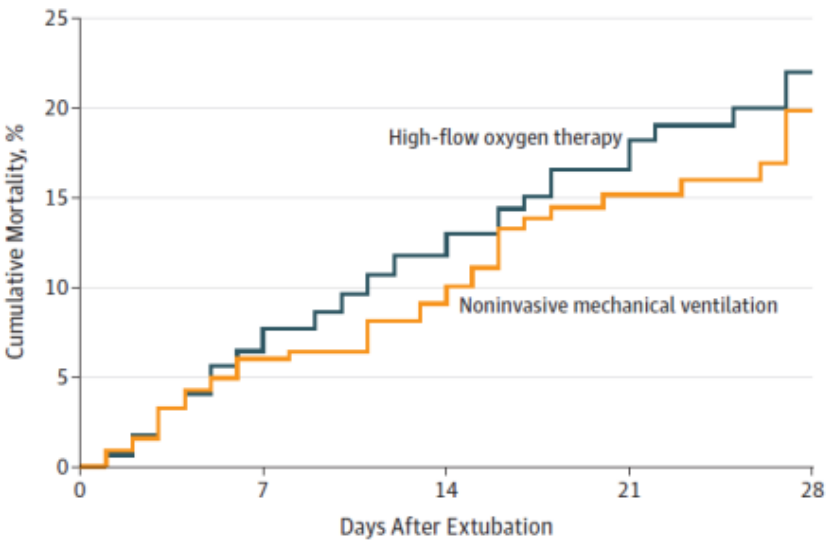
Oxygénothérapie à haut débit post-extubation – Patients à haut risque

Multicenter RCT

604 pts without hypercapnia during SBT with high risk of extubation failure:

Age>65yr, heart failure, moderate-to-severe pulmonary disease, APACHE2>12 (extubation day), airway patency problems, inability to deal with respiratory secretions, ≥1 failed SBT trial, mechanical ventilation for more than 7 days





Hernández G, Vaquero C, Colinas L, et al. Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients: A Randomized Clinical Trial. JAMA 2016;316(15):1565–74.

Conclusion

~~Sedation protocol~~	1ère étape du sevrage
Early rehabilitation protocol	Avec critères prédéterminés utilisés par les paramédicaux Montée en charge progressive (mais rapide)
Fluid balance control	A protocoliser avant le 1er test de sevrabilité
Weaning protocol	Avec critères de screening validés utilisés par les paramédicaux
Spontaneous breathing trial	En AI 5-7 cm H2O ± PEP – 30 à 120 min
Extubation criteria	Evaluation semi-quantitative de la force de toux ± stratégie de toux assistée
Non invasive respiratory support	Utilisation de VNI 1. chez les patients à haut risque (Age>65, pathologie cardio-respiratoire), 2. chez les patients hypercapniques en fin de SBT, 3. chez les patients sevrés avec une PEP