AER
ACTUALITÉS EN RÉANIMATION

27ème Congrès francophone
ACTUALITÉS EN RÉANIMATION
Cité Centre de Congrès de LYON
7&8 Décembre 2023

Sevrage de la Ventilation Mécanique

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CHU Poitiers

Université de Poitiers

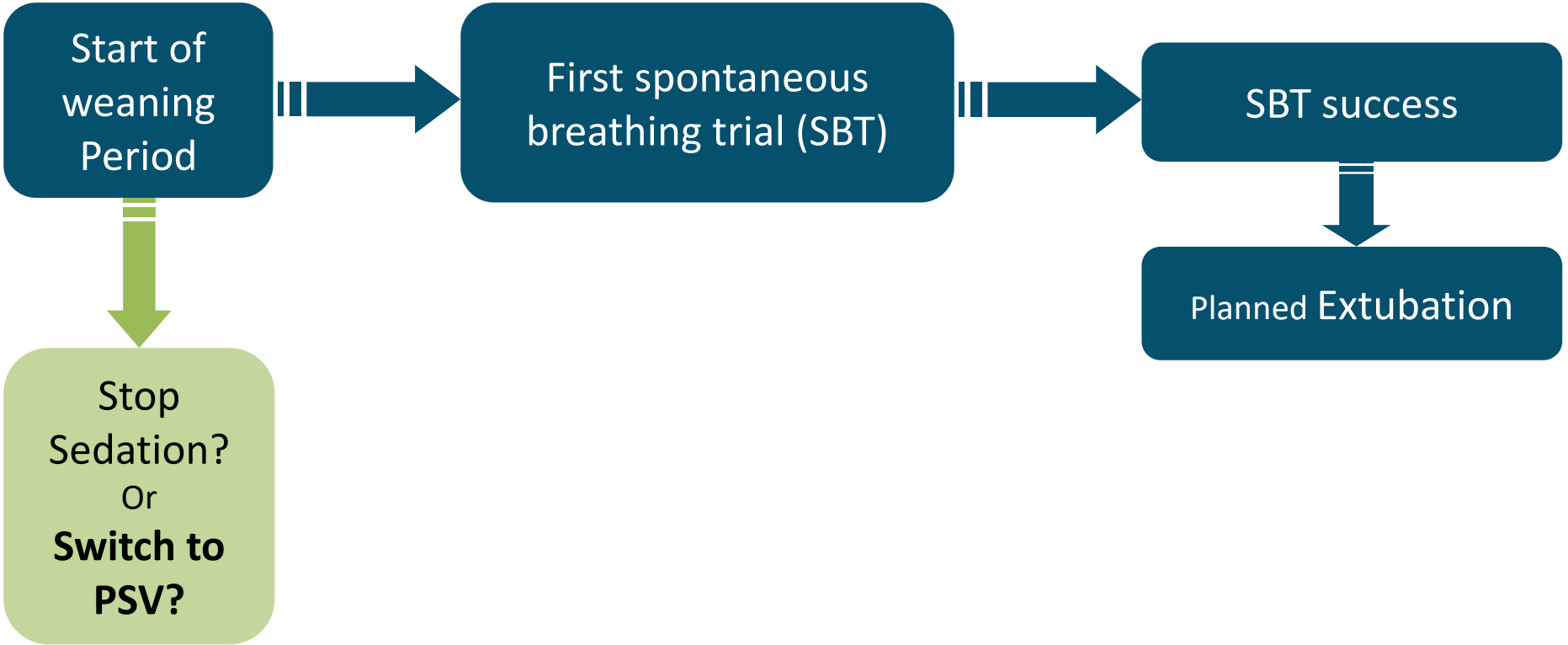
Conflicts of Interest

Fisher & Paykel provided the high-flow nasal oxygen equipment and masks for non-invasive ventilation in several randomized clinical trials coordinated by our center but had no other involvement in these studies.

My COI

Personal fees from **Fisher & Paykel and GE Healthcare**: travel & accommodation expense coverage to attend scientific meetings and payment for lectures

Process of Weaning



Start of weaning period: switch to PSV?

Wean Earlier and Automatically with New Technology (the WEAN Study)

A Multicenter, Pilot Randomized Controlled Trial

Karen E. A. Burns[1,2], Maureen O. Meade[3], Martin R. Lessard[4,5], Lori Hand[6], Qi Zhou[3], Sean P. Keenan[7], and Francois Lellouche[4,8]

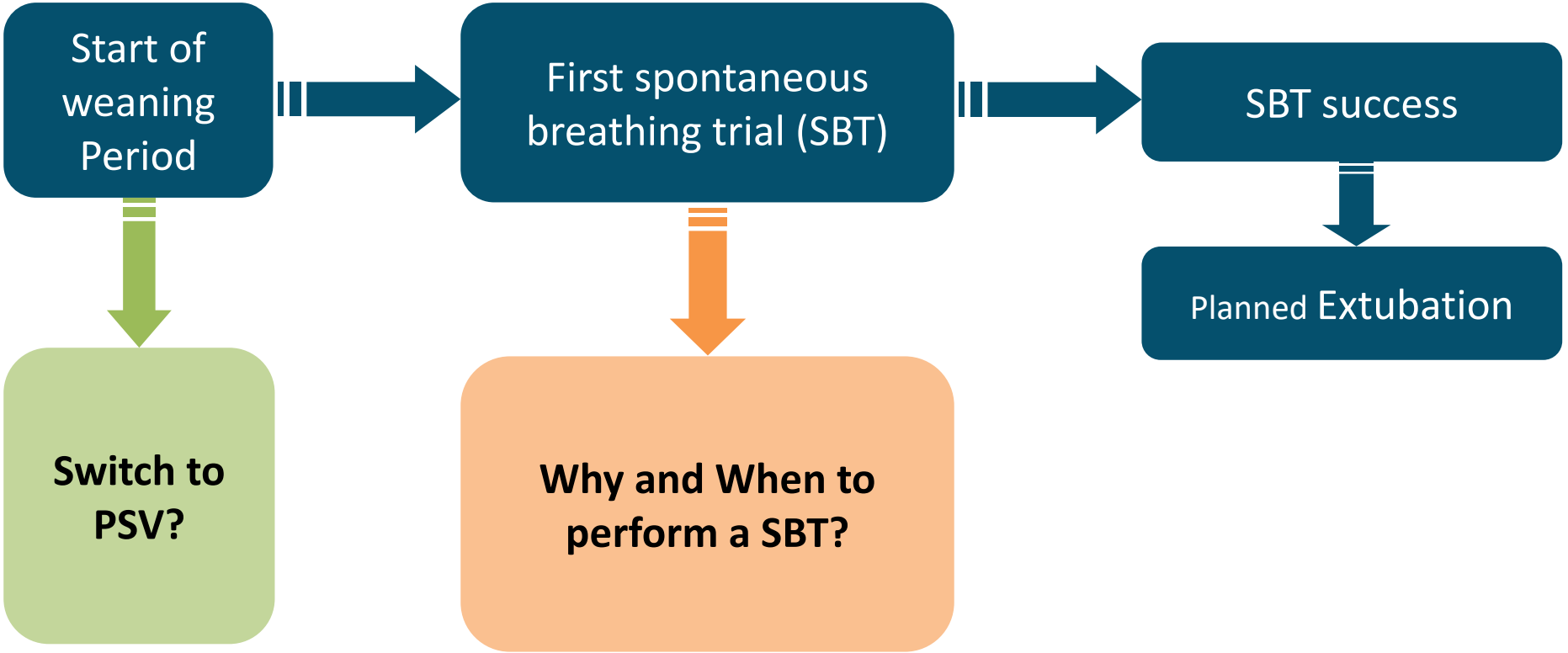
SmartCare vs. PSV (n=97)

- SpO_2 > 90% with **FiO_2 ≤ 70%**
- **PEEP ≤ 12** cm H_2O

→ 70 % with sedation

Burns KEA et al., Am Journal of Respiratory Critical Care Medicine 2013; 187:1203-1211.

Process of Weaning



Why to perform a SBT?

To mimic the physiological condition after extubation:

with a T-piece or with low levels of PSV (5-8 cm H_2O) for 30 min to 2 hours

Is the patient able to breathe without the ventilator?

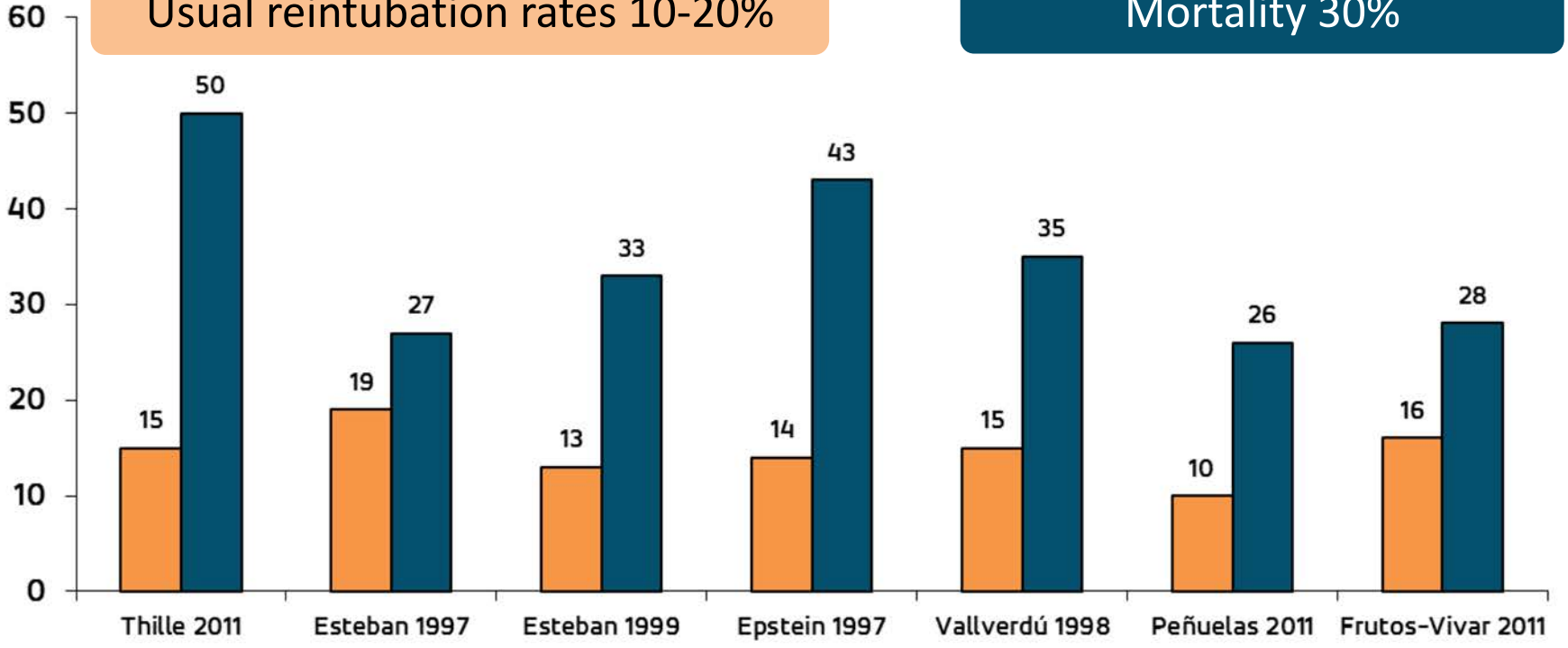
With the final objective of decreasing the risk of reintubation:

the main patient-centered outcome after extubation

Extubation failure in ICUs

Usual reintubation rates 10-20%

Mortality 30%



Thille AW et al., Current Opinion Crit Care 2013; 19:57-64.

Limitations of the SBT

Difficulties in assessment of

the risk of obstruction, cough strength, secretions, swallowing disorders ?

Is the patient able to breathe without the endotracheal tube?

Reintubation rates up to 30-40% in patients with weak cough

regardless of the method to assess cough strength

When to perform a SBT?

1. **Patient awake** with a RASS between +1 and -2 (regardless of sedation)

2. **Cardiovascular stability:** no need for vasopressors or minimal dosis (<0.3γ/kg/min)

3. **Respiratory rate ≤ 35** breaths per minute

4. **Adequate oxygenation** defined as $PaO_2/FiO_2 \geq 150$ mm Hg with PEEP ≤ 8 cmH_2O and $FiO_2 \leq 0.4$

5. **Adequate cough:** *More to decide on extubation than to decide on a SBT?*

Criteria adapted from international consensus conference on weaning from mechanical ventilation, ERJ 2007; 29:1033-1056.
Used in Spontaneous-Breathing Trials with PSV or a T-Piece: Thille AW et al., New England Journal of Medicine 2022; 387:1843-1854.

Usefulness of weaning predictors?

F/V_T - PI max. - PE max. - $P_{0.1}$ – VC

Annals of Intensive Care

Sex difference in the risk of extubation failure in ICUs

--Manuscript Draft--

Table 1: Comparison of patient characteristics between males and females.

	Male N=425	Female N=216	P value*
Respiratory rate, breaths/min	22 ± 6	23 ± 7	**0.007**
Tidal volumes in ml or ml/kg?	505 ml **7.5 ml/kg**	413 ml **8.1 ml/kg**	**<0.001** **0.005**
F/V_T in ml^{-1}	48 ± 26	60 ± 26	**<0.001**

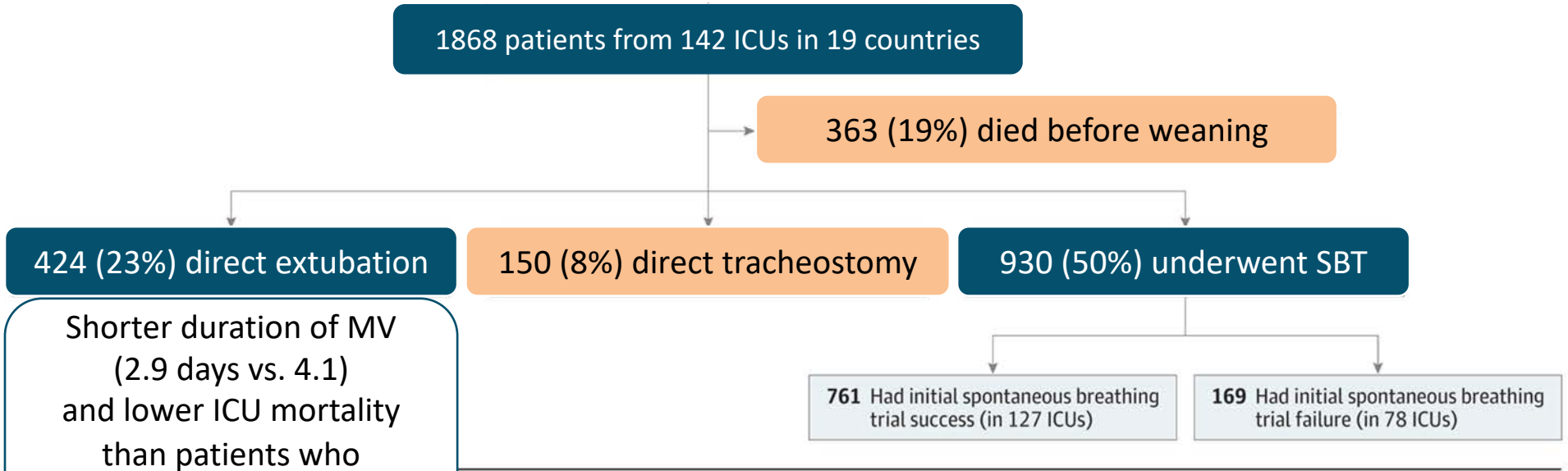
Decreased risk of reintubation in females!

Should we perform a SBT?

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Ventilator Weaning and Discontinuation Practices for Critically Ill Patients

Karen E. A. Burns, MD, MSc; Leena Rizvi, BSc; Deborah J. Cook, MD, MSc; Gerald Lebovic, PhD; Peter Dodek, MD, MHSc; Jesús Villar, MD, PhD; Arthur S. Slutsky, MD, MASc; Andrew Jones, MD; Farhad N. Kapadia, MD; David J. Gattas, MB, BS, MMed; Scott K. Epstein, MD; Paolo Pelosi, MD; Kallirroi Kefala, MD; Maureen O. Meade, MD, MSc; for the Canadian Critical Care Trials Group



Shorter duration of MV (2.9 days vs. 4.1) and lower ICU mortality than patients who underwent SBT

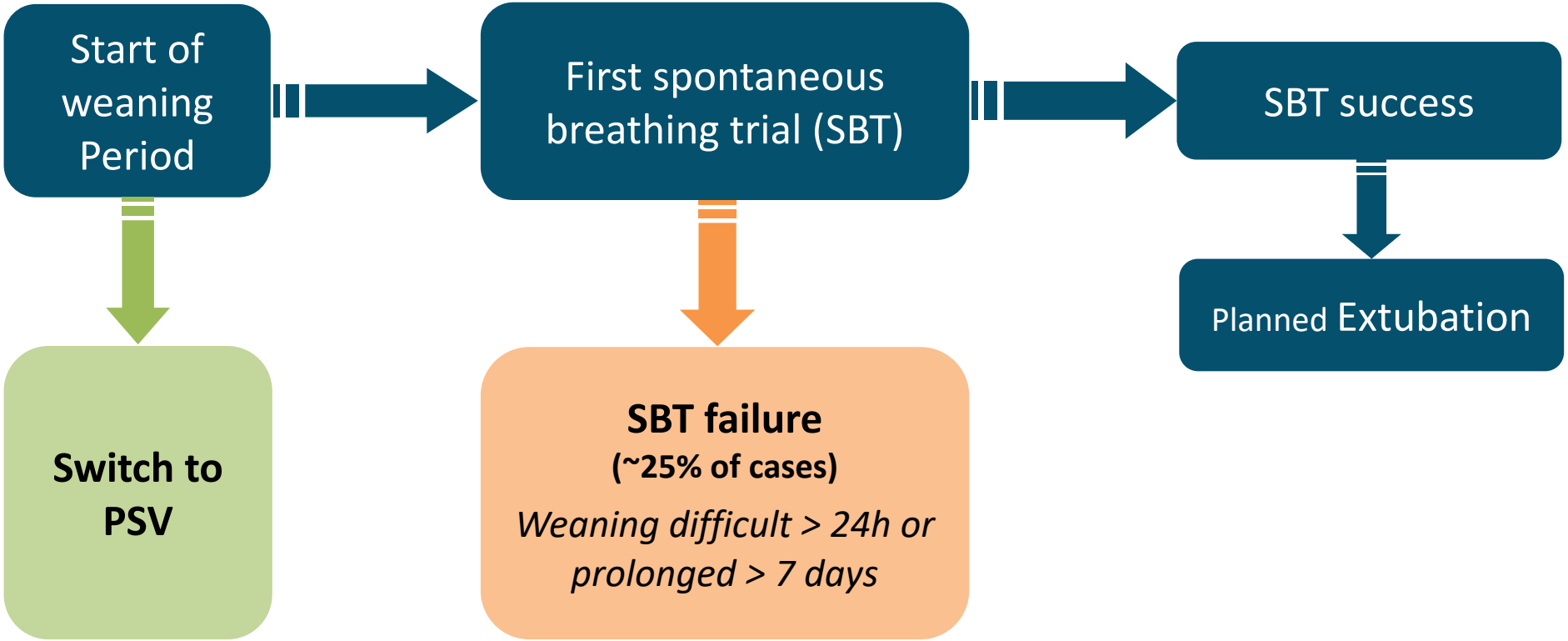
Burns KEA et al., JAMA 2021; 325:1173-1184.

Table 1. Patient Characteristics in a Study of Ventilator Weaning and Discontinuation Practices in Critically Ill Patients

Characteristic	No. (%)				
	Total (n = 1867 in 142 ICUs)[a, b]	Death before discontinuation attempt (n = 363 in 112 ICUs)[a]	Direct extubation	Direct tracheostomy (n = 150 in 78 ICUs)	Initial SBT
Sex					
Men	1173 (62.8)	220 (60.6)	272 (64.2)	102 (68.0)	579 (62.3)
Women	694 (37.2)	143 (39.4)	152 (35.8)	48 (32.0)	351 (37.7)
Younger	61.8 (48.9-73.1)	64.8 (53.1-75.1)	59 [46-71]	57.5 (42.8-68.4)	63 [49-73]
median (IQR)[c]	5 (3-7)	6 (3-8)		4 (2-7)	
Type of admission					
Medical	1299 (69.6)	297 (81.8)	261 (61.6)	103 (68.7)	638 (68.6)
More postoperative	367 (19.7)	51 (14.0)	39%	37 (24.7)	31%
	201 (10.8)	15 (4.1)		10 (6.7)	

Reason for intubation[d]					
Decreased level of consciousness	455 (24.4)	100 (27.5)	105 (24.8)	44 (29.3)	206 (22.2)
Operative	415 (22.2)	39 (10.7)	125 (29.5)	22 (14.7)	229 (24.6)
Hypoxemia alone	320 (17.1)	64 (17.6)	61 (14.4)	31 (20.7)	164 (17.6)
Hypercarbia and hypoxemia	183 (9.8)	36 (9.9)	29 (6.8)	16 (10.7)	102 (11.0)
Cardiac arrest	167 (8.9)	88 (24.2)	25 (5.9)	9 (6.0)	45 (4.8)
Airway patency	162 (8.7)	12 (3.3)	50 (11.8)	20 (13.3)	80 (8.6)
Other	89 (4.8)	17 (4.7)[e]	19 (4.5)[f]	2 (1.3)[g]	51 (5.5)[h]
Hypercarbia alone	55 (2.9)	5 (1.4)	10 (2.4)	2 (1.3)	38 (4.1)
Secretions	21 (1.1)	2 (0.6)	0	4 (2.7)	15 (1.6)
Primary diagnosis for receiving					
Less ARF	852 (45.6)	209 (57.6)	38%	65 (43.3)	45%
Neurologic/coma (nonsurgical)	407 (21.8)	87 (24.0)	94 (22.2)	45 (30.0)	181 (19.5)
Postoperative (elective or emergent) admission	387 (20.7)	34 (9.4)	121 (28.5)	26 (17.3)	206 (22.2)
Acute on chronic respiratory failure	112 (6.0)	18 (5.0)	21 (5.0)	8 (5.3)	65 (7.0)
Other	92 (4.9)	14 (3.9)	28 (6.6)	3 (2.0)	47 (5.1)
Neuromuscular disorder	17 (0.9)	1 (0.3)	1 (0.2)	3 (2.0)	12 (1.3)
Ventilator support at ICU admission					
Less NIV failure	1093 (58.5)	199 (54.8)	25%	72 (48.0)	38%
	670 (35.9)	146 (40.2)		65 (43.3)	

Process of Weaning



Reasons for SBT failure? WIPO+++

Echocardiographic diagnosis of pulmonary artery occlusion pressure elevation during weaning from mechanical ventilation*

17/39

Bouchra Lamia, MD, MPH, PhD; Julien Maizel, MD; Ana Ochagavia, MD; Denis Chemla, MD, PhD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Intensive Care Med (2008) 34:1231–1238
DOI 10.1007/s00134-008-1038-3

ORIGINAL

Nadia Anguel
Xavier Monnet
David Osman
Vincent Castelain
Christian Richard
Jean-Louis Teboul

Increase in plasma protein concentration for diagnosing weaning-induced pulmonary oedema

24/46

Extravascular Lung Water, B-Type Natriuretic Peptide, and Blood Volume Contraction Enable Diagnosis of Weaning-Induced Pulmonary Edema*

10/21

Martin Dres, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]; Nadia Anguel, MD[1]; Laurent Guerin, MD[1,2]; Christian Richard, MD[1,2]; Xavier Monnet, MD, PhD[1,2]

Incidence **48%!!**

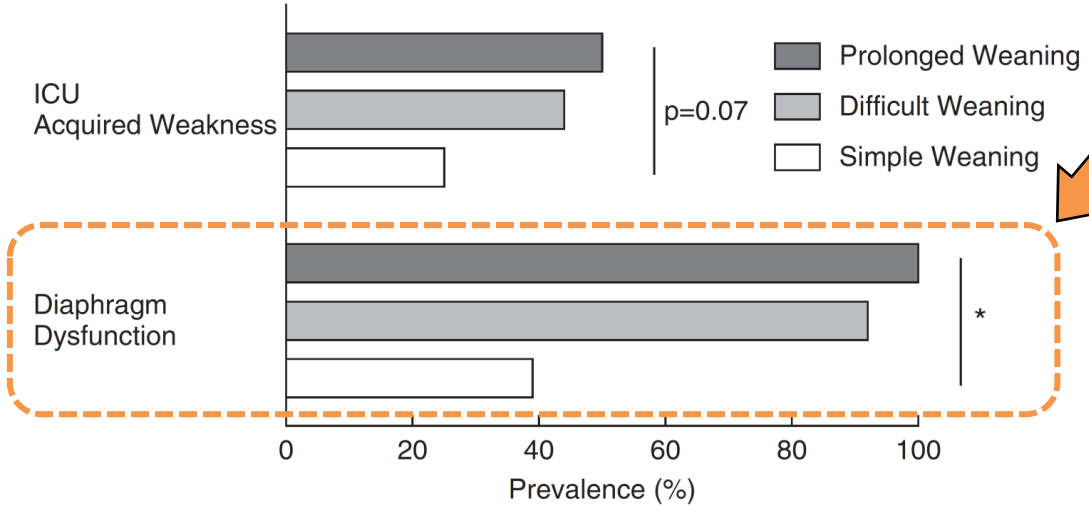
Diaphragm dysfunction

ORIGINAL ARTICLE

Coexistence and Impact of Limb Muscle and Diaphragm Weakness at Time of Liberation from Mechanical Ventilation in Medical Intensive Care Unit Patients

Martin Dres[1,2*], Bruno-Pierre Dubé[1,3*], Julien Mayaux[2], Julie Delemazure[2], Danielle Reuter[2], Laurent Brochard[4,5], Thomas Similowski[1,2], and Alexandre Demoule[1,2]

[1]Sorbonne Universités, UPMC University Paris 06, INSERM, UMRS1158 Neurophysiologie Respiratoire Expérimentale et Clinique, Paris, France; [2]AP-HP, Groupe Hospitalier Pitié-Salpêtrière Charles Foix, Service de Pneumologie et Réanimation Médicale (Département "R3S"), Paris, France; [3]Département de Médecine, Service de Pneumologie, Hôpital Hôtel-Dieu du Centre Hospitalier de l'Université de Montréal, Montréal, Québec, Canada; [4]Keenan Research Centre for Biomedical Science of St. Michael's Hospital, Toronto, Ontario,



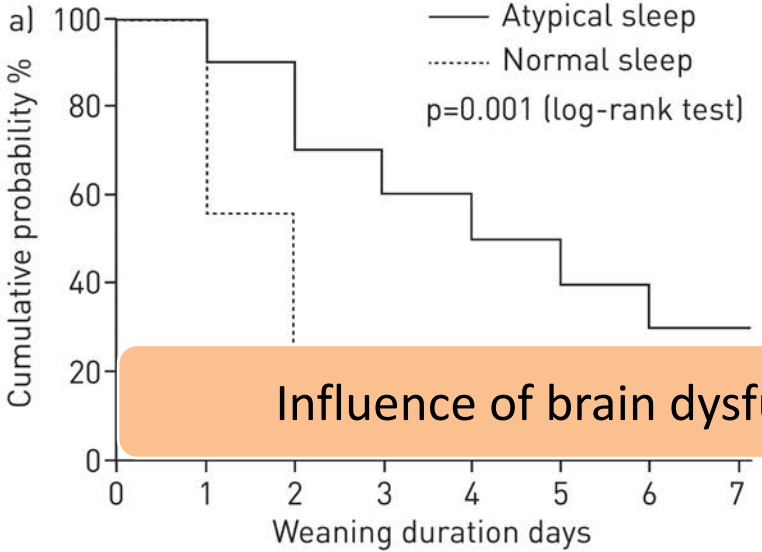
Almost all patients with difficult or prolonged weaning **had diaphragm dysfunction**

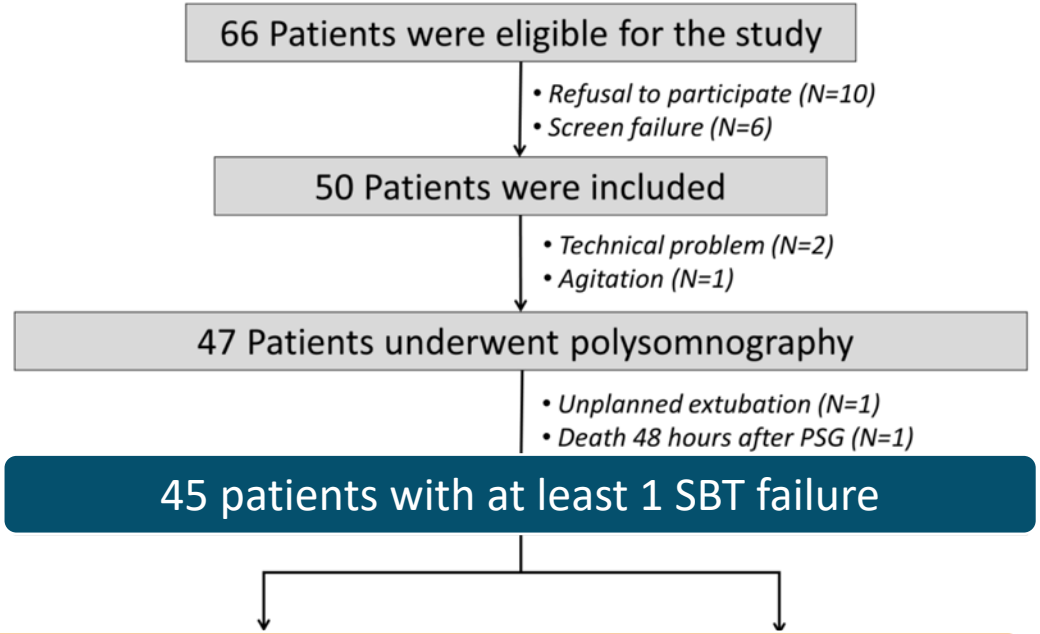
Dres M et al., Am J Respir Crit Care Med 2017; 195:57-66.

Abnormal sleep

Impact of sleep alterations on weaning duration in mechanically ventilated patients: a prospective study

Arnaud W. Thille[1,2], Faustine Reynaud[1,2], Damien Marie[1,2], Stéphanie Barrau[1,2], Ludivine Rousseau[1,2], Christophe Rault[1,3], Véronique Diaz[1,3], Jean-Claude Meurice[1,4], Rémi Coudroy[1,2], Jean-Pierre Frat[1,2], René Robert[1,2] and Xavier Drouot[1,3]





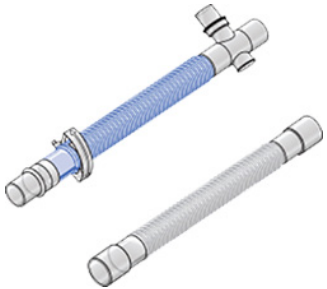
Influence of brain dysfunction on ability to breathe spontaneously?

Thille AW et al., European Respiratory Journal 2018; 51:1702465.

Role of SBT

Which spontaneous breathing trial (SBT)?

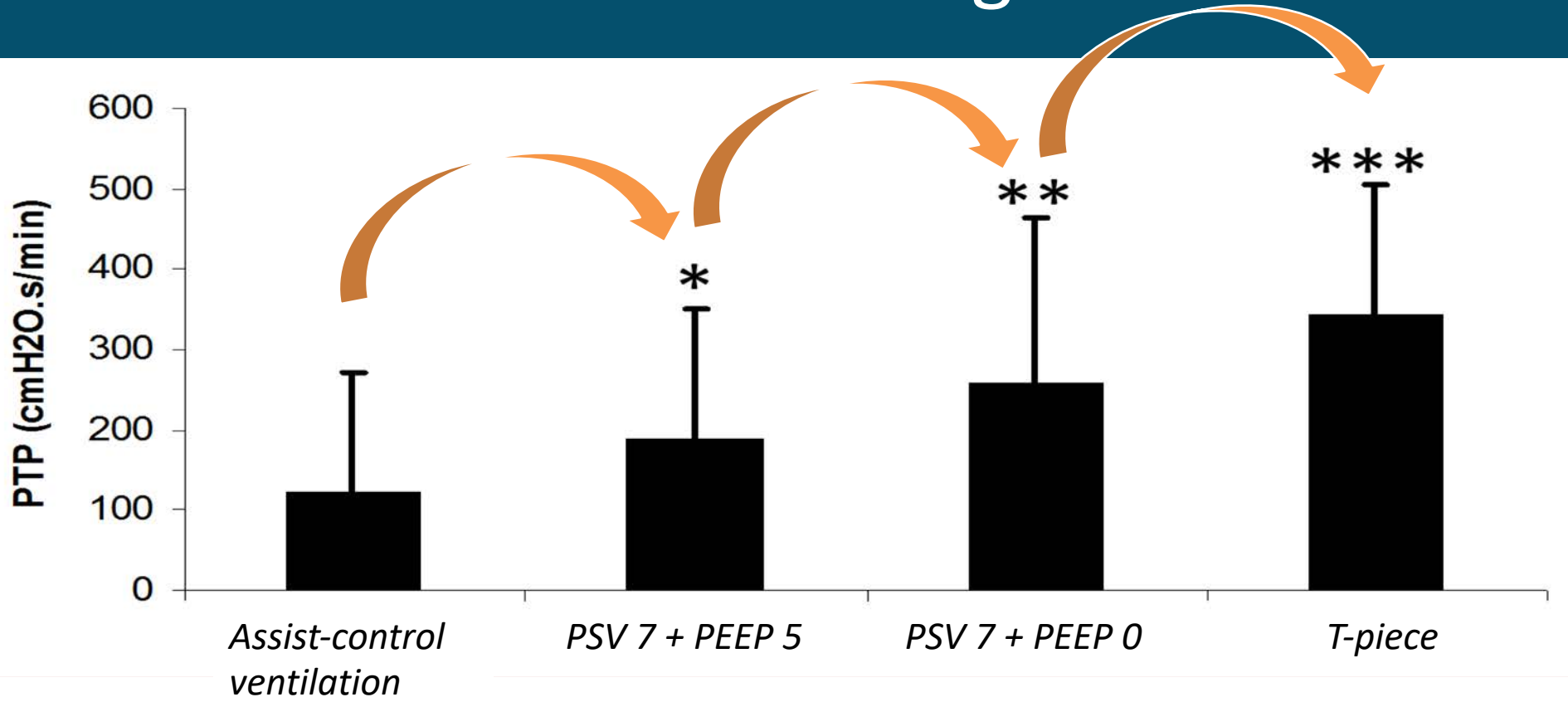
T-piece trial



PSV trial

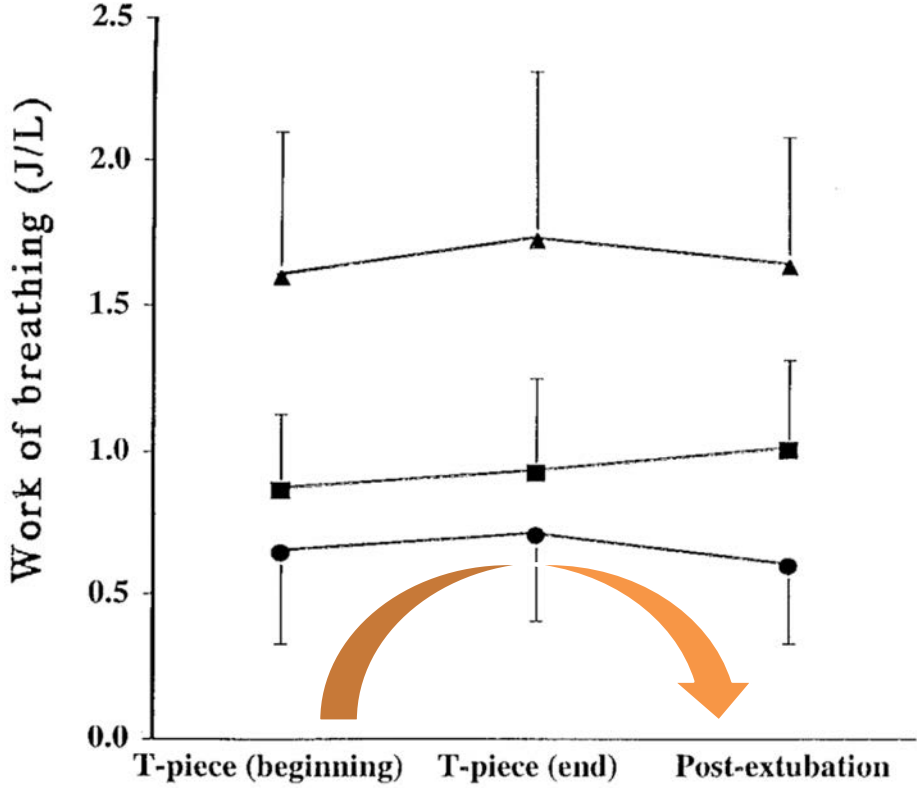
PS 5-8 cm H_2O with or without PEEP

Patient effort according to the SBT



Cabello B et al., Intensive Care Med 2010; 36:1171-79.

T-piece trial versus post-extubation



Work of breathing does not decrease after extubation!!!

Patient effort during T-Piece = Post-extubation

Strauss C et al., Am J Respir Crit Care Med 1998; 157:23-30.

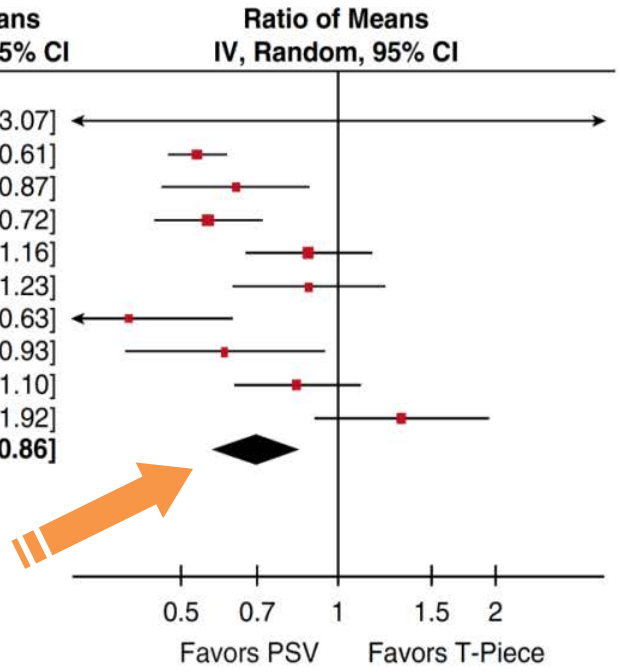
Effort to Breathe with Various Spontaneous Breathing Trial Techniques

A Physiologic Meta-analysis

Michael C. Sklar[1,2], Karen Burns[2,3], Nuttapol Rittayamai[4], Ashley Lanys[2], Michela Rauseo[2,5], Lu Chen[2], Martin Dres[2,6], Guang-Qiang Chen[2,7], Ewan C. Goligher[3,8], Neill K. J. Adhikari[3,9], Laurent Brochard[2,3], and Jan O. Friedrich[2,3]

Study or Subgroup	Favors PSV Total	Favors T-Piece Total	Weight	Ratio of Means IV, Random, 95% CI
WOB				
*R-Cabello 2010	14	14	0.1%	0.50 [0.00, 323.07]
*R-Koh 2000	22	22	14.3%	0.54 [0.48, 0.61]
*R-Kuhlen 2003	12	12	11.1%	0.64 [0.47, 0.87]
*R-Mahul 2016	17	17	12.5%	0.57 [0.45, 0.72]
*R-Mehta 2000	20	20	11.8%	0.88 [0.67, 1.16]
NR-Brochard 1991	11	11	10.7%	0.88 [0.63, 1.23]
NR-Ishaaya 1995	8	8	8.7%	0.40 [0.25, 0.63]
NR-Nathan 1993	7	7	9.0%	0.61 [0.39, 0.93]
NR-Patel 1996	23	23	11.8%	0.84 [0.63, 1.10]
NR-Petros 1993	8	8	10.0%	1.32 [0.91, 1.92]
Subtotal (95% CI)	**142**	**142**	**100.0%**	**0.70 [0.57, 0.86]**

Heterogeneity. $Tau^2 = 0.07$; $Chi^2 = 40.59$, df = 9 ($P < 0.00001$); $I^2 = 78\%$
Test for overall effect: $Z = 3.42$ ($P = 0.0006$)



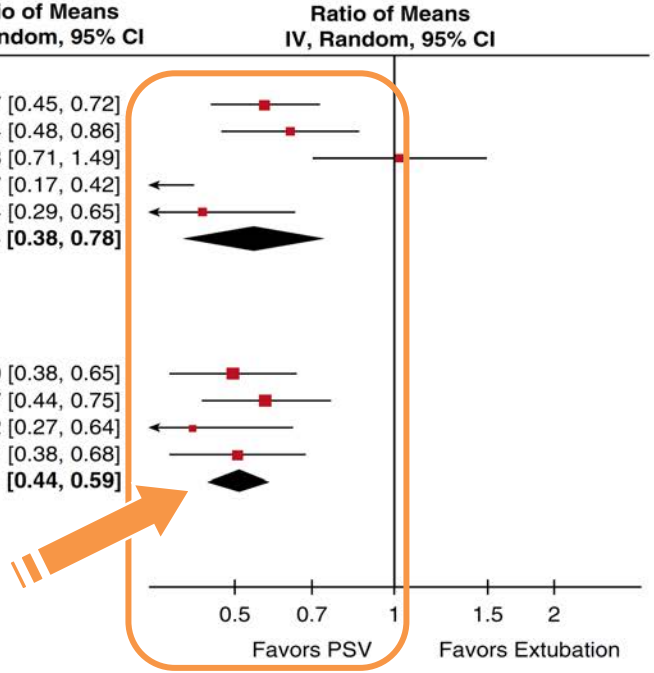
Sklar MC et al., Am J Respir Crit Care Med 2017; 195:1477-1485.

Effort to Breathe with Various Spontaneous Breathing Trial Techniques

A Physiologic Meta-analysis

Michael C. Sklar[1,2], Karen Burns[2,3], Nuttapol Rittayamai[4], Ashley Lanys[2], Michela Rauseo[2,5], Lu Chen[2], Martin Dres[2,6], Guang-Qiang Chen[2,7], Ewan C. Goligher[3,8], Neill K. J. Adhikari[3,9], Laurent Brochard[2,3], and Jan O. Friedrich[2,3]

Study or Subgroup	PSV Total	Extubation Total	Weight	Ratio of Means IV, Random, 95% CI
WOB				
*R-Mahul 2016	17	17	22.4%	0.57 [0.45, 0.72]
*R-Mehta 2000	20	20	21.2%	0.64 [0.48, 0.86]
NR-Brochard 1991	11	11	19.5%	1.03 [0.71, 1.49]
NR-Ishaaya 1995	8	8	17.8%	0.27 [0.17, 0.42]
NR-Nathan 1993	7	7	19.1%	0.44 [0.29, 0.65]
Subtotal (95% CI)	**63**	**63**	**100.0%**	**0.54 [0.38, 0.78]**
Heterogeneity. $Tau^2 = 0.13$; $Chi^2 = 22.80$, df = 4 (P = 0.0001); $I^2 = 82\%$				
Test for overall effect: Z = 3.33 (P = 0.0009)				
PTP				
*R-Mahul 2016	17	17	30.5%	0.50 [0.38, 0.65]
*R-Mehta 2000	20	20	30.5%	0.57 [0.44, 0.75]
NR-Ishaaya 1995	8	8	12.4%	0.42 [0.27, 0.64]
NR-Nathan 1993	7	7	26.6%	0.51 [0.38, 0.68]
Subtotal (95% CI)	**52**	**52**	**100.0%**	**0.51 [0.44, 0.59]**
Heterogeneity. $Tau^2 = 0.00$; $Chi^2 = 1.58$, df = 3 (P = 0.66); $I^2 = 0\%$				
Test for overall effect: Z = 8.69 (P < 0.00001)				



Sklar MC et al., Am J Respir Crit Care Med 2017; 195:1477-1485.

Is PSV trial a risky test?

PSV trial is an easier test than T-piece trial that may **underestimate the work of breathing** needed after extubation

PSV trial may ***hasten extubation***
but may ***increase the risk of extubation failure***

Research

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Pressure Support vs T-Piece Ventilation Strategies During Spontaneous Breathing Trials on Successful Extubation Among Patients Receiving Mechanical Ventilation

A Randomized Clinical Trial

Carles Subirà, MD; Gonzalo Hernández, MD, PhD; Antònia Vázquez, MD, PhD; Raquel Rodríguez-García, MD; Alejandro González-Castro, MD; Carolina García, MD; Olga Rubio, MD, PhD; Lara Ventura, MD; Alexandra López, MD; Maria-Carmen de la Torre, MD, PhD; Elena Keough, MD; Vanesa Arauzo, MD; Cecilia Hermosa, MD; Carmen Sánchez, MD; Ana Tizón, MD; Eva Tenza, MD, PhD; César Laborda, MD; Sara Cabañes, MD; Victoria Lacueva, MD; Maria del Mar Fernández, MD, PhD; Anna Arnau, MSc, PhD; Rafael Fernández, RMD, PhD

Inclusion criteria:

All patients intubated more than 24 hours in the ICU

A majority of patients at low risk of extubation failure

1153 patients in 18 centers

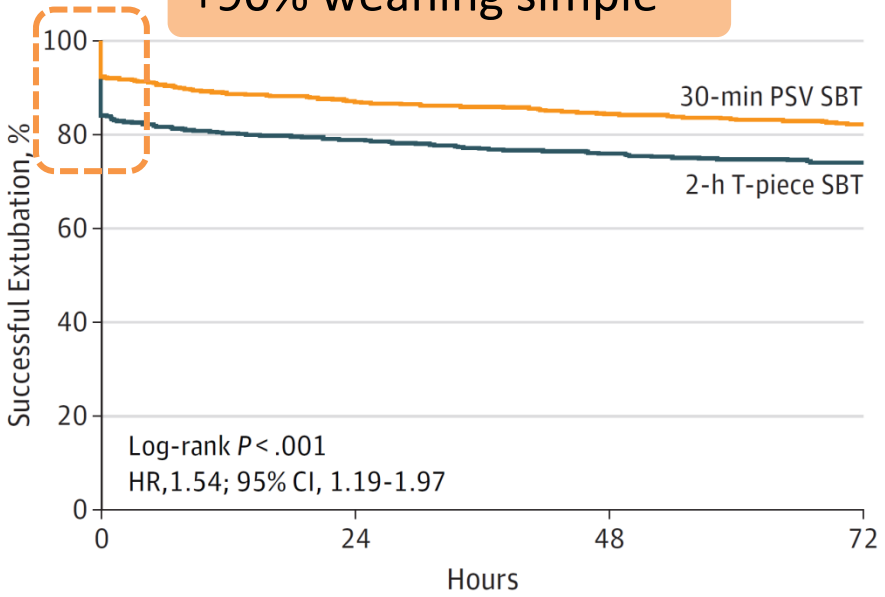
T-Piece
for 2 hours

PSV 8 cm H_20 – PEEP 0
for 30 min

Subirà C et al., JAMA 2019; 321:2175-2182.

Figure 2. Probability of Successful Extubation After First SBT in Each Group

+90% weaning simple



No. at risk				
30-min PSV SBT	575	501	484	472
2-h T-piece SBT	578	456	438	426

PSV indicates pressure support ventilation; SBT, spontaneous breathing trial. Successful extubation was defined as remaining free of mechanical ventilation for 72 hours after first SBT.

Reintubation 11% in both groups

Is it true in patients at high risk of extubation failure ???

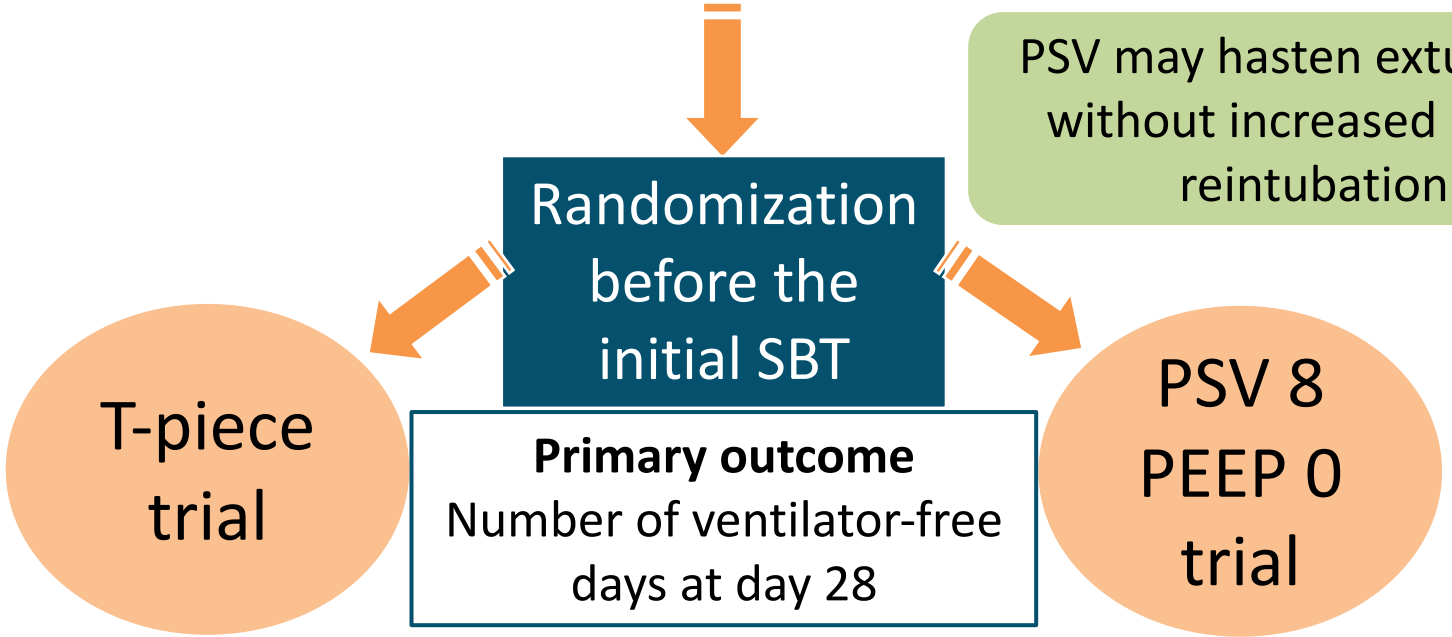
Subirà C et al., JAMA 2019; 321:2175-2182.

TiP-Ex study: 31 ICUs in France

1000 patients intubated >24h & at high risk of extubation failure

age ≥ 65y or underlying cardiac/respiratory disease

PSV may hasten extubation without increased risk of reintubation



ORIGINAL ARTICLE

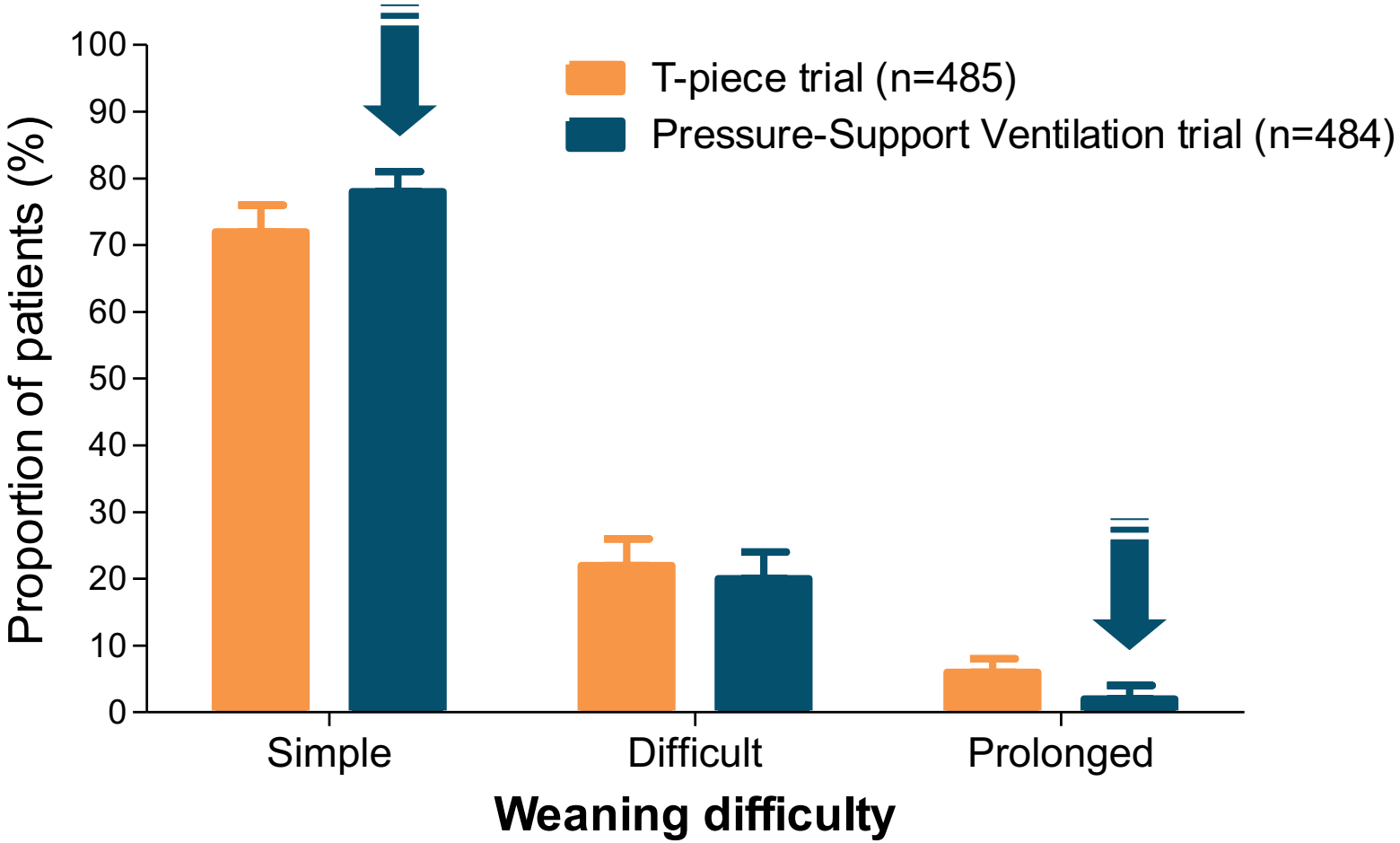
Spontaneous-Breathing Trials with Pressure-Support Ventilation or a T-Piece

A.W. Thille, A. Gacouin, R. Coudroy, S. Ehrmann, J.-P. Quenot, M.-A. Nay, C. Guitton, D. Contou, G. Labro, J. Reignier, G. Pradel, G. Beduneau, L. Dangers, C. Saccheri, G. Prat, G. Lacave, N. Sedillot, N. Terzi, B. La Combe, J.-P. Mira, A. Romen, M.-A. Azais, A. Rouzé, J. Devaquet, A. Delbove, M. Dres, J. Bourenne, A. Lautrette, J. de Keizer, S. Ragot, and J.-P. Frat, for the REVA Research Network*

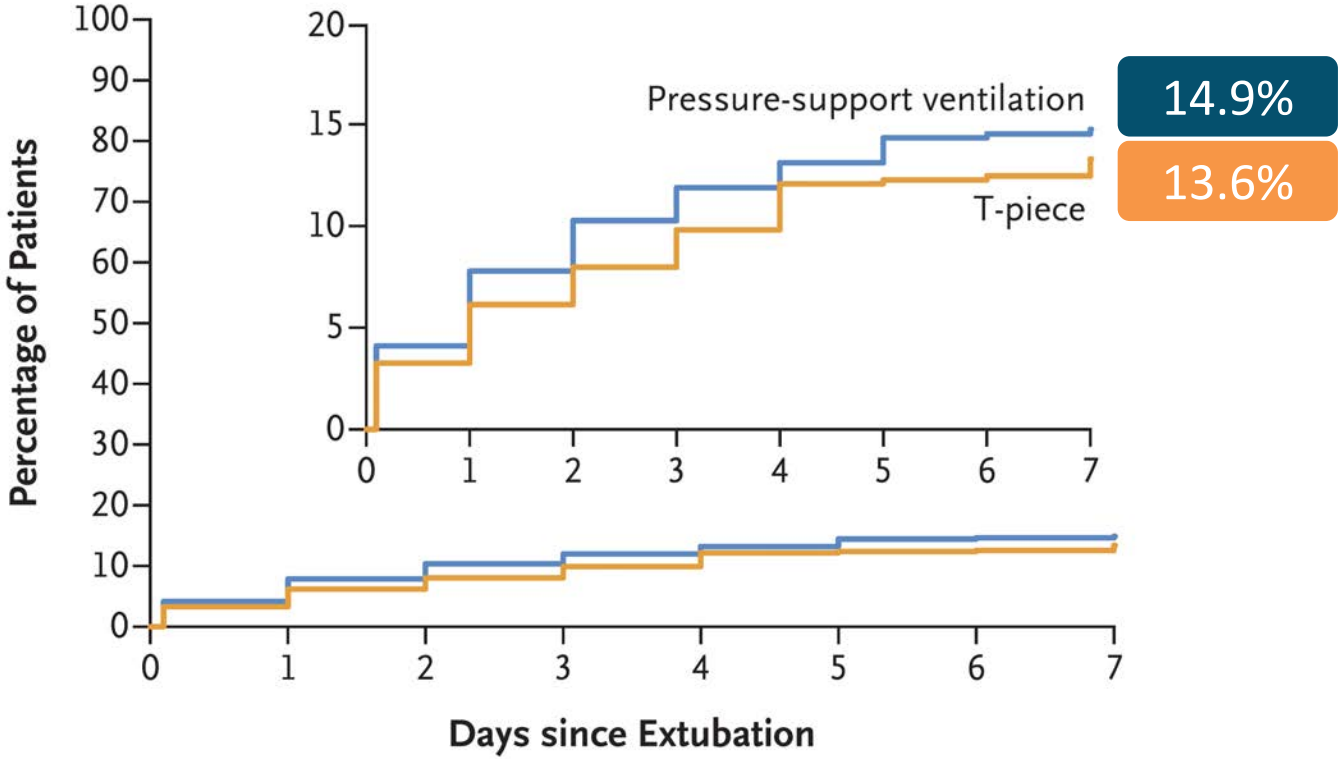
Table 2. Primary and Secondary Outcomes.

Outcome	Pressure-Support Ventilation (N = 484)	T-Piece (N = 485)	Absolute Difference (95% CI)*	P Value
Primary outcome				
Median total time alive and without exposure to invasive ventilation at day 28 (IQR) — days	27 (24-27)	27 (23-27)	0 (–0.5 to 1)	0.31

Thille AW et al., New England Journal of Medicine 2022; 387:1843-1854.


Proportion of patients (%)
100
90
80
70
60
50
40
30
20
10
0
T-piece trial (n=485)
Pressure-Support Ventilation trial (n=484)
Simple
Difficult
Prolonged
Weaning difficulty

B **Patients Who Had Undergone Reintubation**



No. at Risk

T-piece	485	468	454	445	436	425	424	423
Pressure-support ventilation	484	463	445	433	425	419	413	420

What to do in case of SBT failure?

Treat a weaning-induced pulmonary edema (wipo)

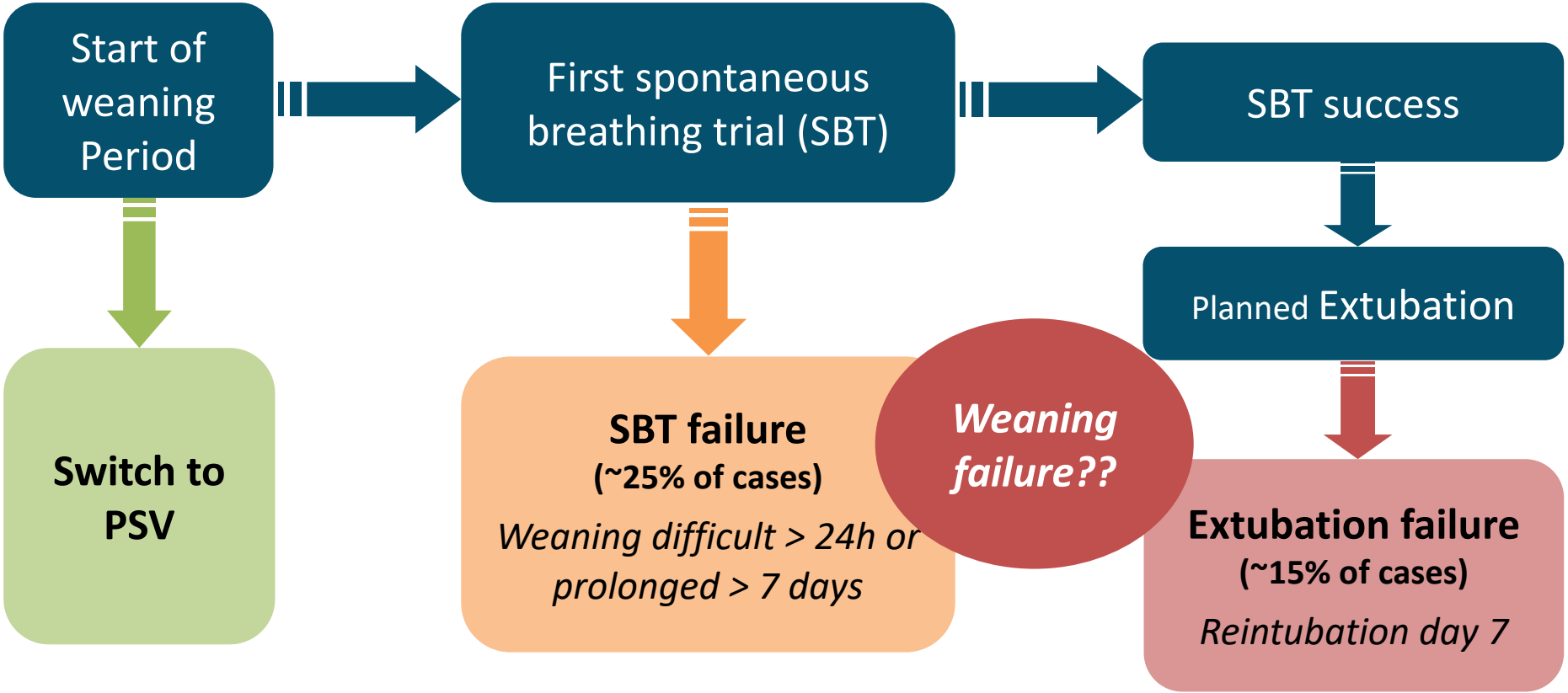
Rule out a new pneumonia or respiratory complication

Performing an easy SBT using PSV?

Early mobilization & partial ventilation for diaphragm rehabilitation

Maybe wait and sleep?

What is Weaning Failure?



Reasons for reintubation

ORIGINAL ARTICLE

Spontaneous-Breathing Trials with Pressure-Support Ventilation or a T-Piece

A.W. Thille, A. Gacouin, R. Coudroy, S. Ehrmann, J.-P. Quenot, M.-A. Nay, C. Guitton, D. Contou, G. Labro, J. Reignier, G. Pradel, G. Beduneau, L. Dangers, C. Saccheri, G. Prat, G. Lacave, N. Sedillot, N. Terzi, B. La Combe, J.-P. Mira, A. Romen, M.-A. Azais, A. Rouzé, J. Devaquet, A. Delbove, M. Dres, J. Bourenne, A. Lautrette, J. de Keizer, S. Ragot, and J.-P. Frat, for the REVA Research Network*

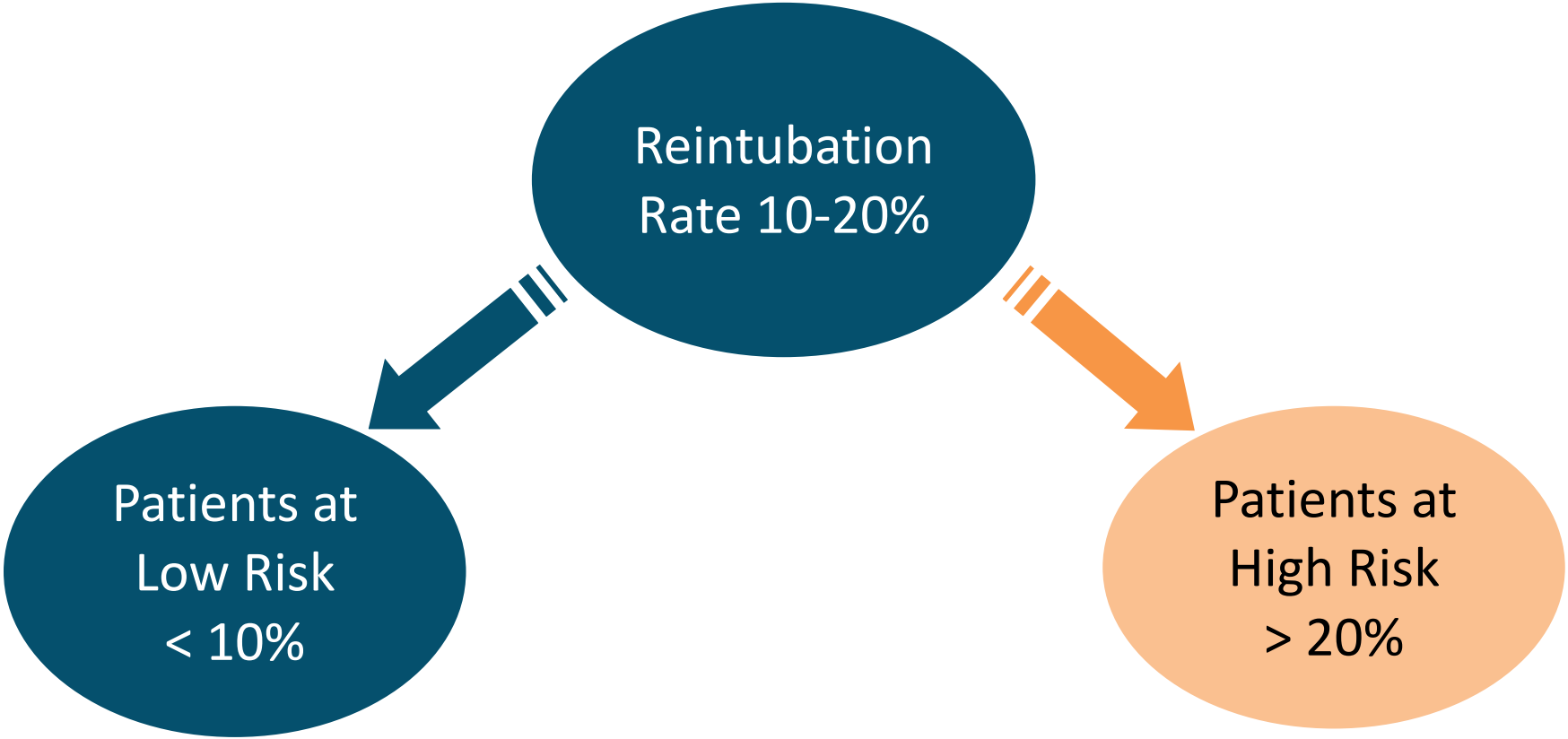
969 patients at high-risk of extubation failure in 31 French ICUs

Thille AW et al., New England Journal of Medicine 2022; 387:1843-1854.

Table 3. Adverse Events and Reasons for Reintubation.

Event or Reason	Pressure-Support Ventilation (N=484)	T-Piece (N=485)	P Value
Reason for reintubation — no. of patients/total no. (%)*			
Upper-airway obstruction	13/78 (16.7)	11/71 (15.5)	0.82
Cardiogenic pulmonary edema	10%	8%	0.69
Aspiration	5/78 (6.4)	8/71 (11.3)	0.31
Pneumonia	8/78 (10.3)	12/71 (16.9)	0.25
Atelectasis	10/78 (12.8)	4/71 (5.6)	0.13
Pleural effusion	3/78 (3.8)	1/71 (1.4)	0.62
Copious secretions	36%	31%	0.49
Ineffective cough	27%	18%	0.19
Weakness of respiratory muscles	22%	20%	0.72
Alveolar hypoventilation	6/78 (7.7)	5/71 (7.0)	0.86
Hypercapnic coma	7/78 (9.0)	0	0.01
Septic shock	5/78 (6.4)	4/71 (5.6)	0.99
Cardiogenic shock	1/78 (1.3)	1/71 (1.4)	0.99
Hemorrhagic shock	1/78 (1.3)	2/71 (2.8)	0.61
Indication for surgery	6/78 (7.7)	8/71 (11.3)	0.47
Cardiac or respiratory arrest	3/78 (3.8)	6/71 (8.5)	0.31

Patients at high risk of extubation failure



Outcomes of extubation failure in medical intensive care unit patients*

Arnaud W. Thille, MD, PhD; Anatole Harrois, MD; Frédérique Schortgen, MD; Christian Brun-Buisson, MD; Laurent Brochard, MD

Age ≥ 65y or underlying cardiac or respiratory disease

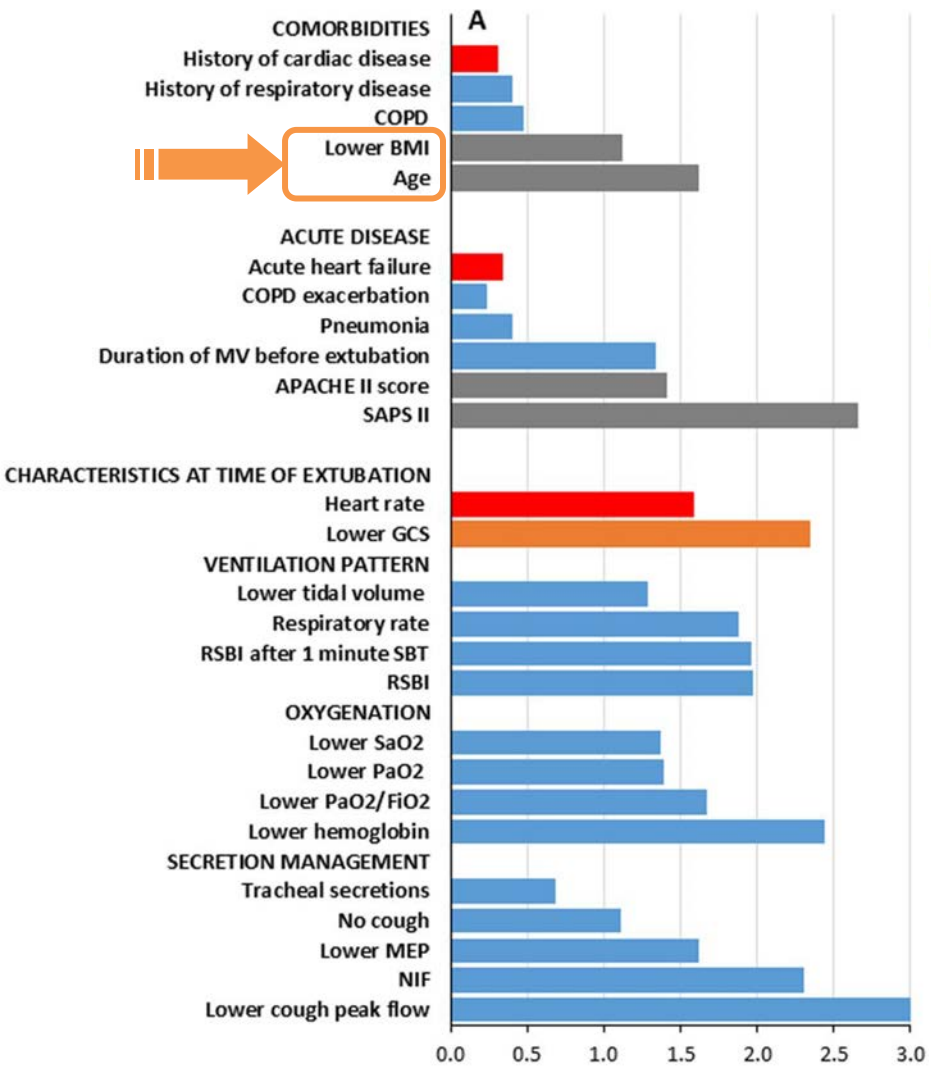
Thille AW et al., Crit Care Med 2011; 39: 2612-2618.

Reintubation rates > 20% with standard O_2

Patients at high risk of extubation failure

More than 65 years	
Underlying COPD or cardiac insufficiency	
BMI ≥ 30 kg/m^2	???
At least 2 comorbidities	
APACHE score > 12 the day on extubation	
Patients intubated for more than 7 days	
Difficult weaning	???
Risk of upper airway obstruction	
Difficulty to manage secretions	

Hernandez G et al., JAMA 2016; 315:1354-



Comorbidities

We found a higher risk of extubation failure in older patients. Chronic obstructive respiratory disease, history of chronic cardiac or respiratory disease were associated with a higher risk of extubation failure as well. In contrast, a higher body mass index was associated with successful extubation.

Torrini F et al., Crit Care 2021; 25:391.

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Ventilator Weaning and Discontinuation Practices for Critically Ill Patients

Karen E. A. Burns, MD, MSc; Leena Rizvi, BSc; Deborah J. Cook, MD, MSc; Gerald Lebovic, PhD; Peter Dodek, MD, MHSc; Jesús Villar, MD, PhD; Arthur S. Slutsky, MD, MASc; Andrew Jones, MD; Farhad N. Kapadia, MD; David J. Gattas, MB, BS, MMed; Scott K. Epstein, MD; Paolo Pelosi, MD; Kallirroi Kefala, MD; Maureen O. Meade, MD, MSc; for the Canadian Critical Care Trials Group

Table 4. Outcome Based on Success or Failure and Timing of Initial Spontaneous Breathing Trials Among Critically Ill Patients

Outcome	No. (%) SBT success	SBT failure	Absolute difference (95% CI)[a]
Based on success or failure of initial spontaneous breathing trials	n = 761 in 127 ICUs	n = 169 in 78 ICUS	
Total duration of mechanical ventilation, median (IQR), d[b]	3.5 (1.9 to 6.8)	6.1 (3.5 to 10.6)	2.6 (1.6 to 3.6)
Mortality ICU	9%	17%	8.4 (2.0 to 14.7)
Hospital mortality (deaths after ICU discharge)	45 (5.9)	10 (5.9)	0.0 (−3.9 to 3.9)
Mechanical vent. day 28	4%	12%	7.5 (2.0 to 13.0)
In the ICU at day 28[c]	60/751 (8.0)	26/166 (15.7)	7.7 (1.4 to 13.9)
ICU length of stay, median (IQR), d	7.7 (4.8 to 13.6)	10.6 (6.4 to 18.6)	2.8 (1.1 to 5.2)
Hospital length of stay, median (IQR), d	17.9 (10.5 to 31.2)	18.9 (10.9 to 34.9)[d]	1.0 (−3.5 to 5.6,)
Readmitted to ICU before hospital discharge	42 (5.5)	6 (3.6)	−2.0 (−5.6 to 1.6)
Reintubation	11%	9%	−1.9 (−7.1 to 3.3)

Burns KEA et al., JAMA 2021; 325:1173-1184.

Patients at high risk of extubation failure

More than 65 years	
Underlying COPD or cardiac insufficiency	
BMI ≥ 30 kg/m^2	
At least 2 comorbidities	
APACHE score > 12 the day on extubation	
Patients intubated for more than 7 days	
Difficult weaning	
Risk of upper airway obstruction	
Difficulty to manage secretions	+++

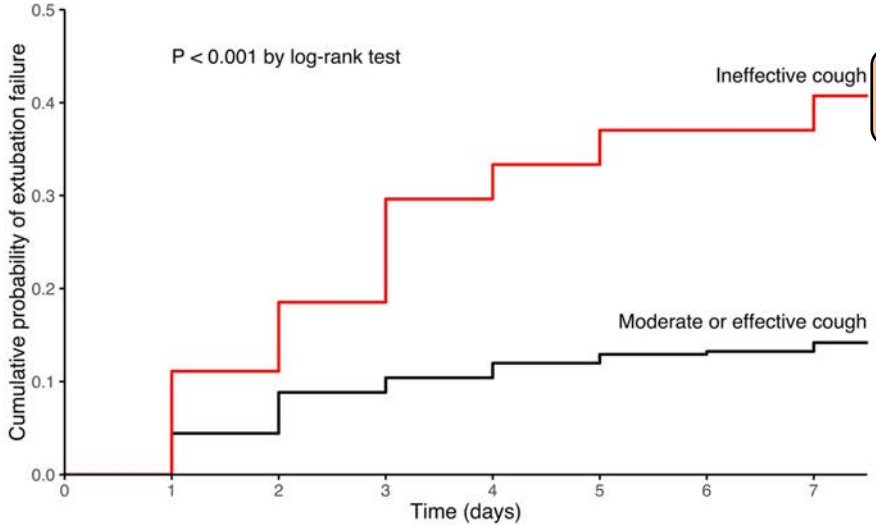
Hernandez G et al., JAMA 2016; 315:1354-

RESEARCH Open Access

Role of ICU-acquired weakness on extubation outcome among patients at high risk of reintubation

Arnaud W. Thille[1,2,3*], Florence Boissier[1,2], Michel Muller[4], Albrice Levrat[4], Gaël Bourdin[5], Sylvène Rosselli[5], Jean-Pierre Frat[1,2], Rémi Coudroy[1,2] and Emmanuel Vivier[5]

344 patients at high risk of reintubation



40%

Fig. 2 Kaplan-Meier curves of the cumulative probability of extubation failure defined as reintubation or death from extubation to day 7 in patients with ineffective cough (red line) and in those with moderate or effective cough (black line)

Semiquantitative 5-Likert scale:
0 = absent
1 = weak and ineffective
2 = moderate
3 = good and effective
4 = strong and very effective

Thille AW et al., Crit Care 2020; 24:86.

RESEARCH Open Access

Predictive power of extubation failure diagnosed by cough strength: a systematic review and meta-analysis

Jun Duan[1*†], Xiaofang Zhang[2†] and Jianping Song[3*]

> 7000 patients

Extubation failure rates according to cough strength assessed using **cough peak flow (CPF) or semi-quantitative cough strength score (SCSS)**

Weak cough using CPF → 36% vs. 6%*

Weak cough using SCSS → 37% vs. 11%*

Lower sensitivity but higher specificity using SCSS than using CPF

Duan J et al., Critical Care 2021; 25:357.

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Oxygen With Noninvasive Ventilation vs High-Flow Nasal Oxygen Alone on Reintubation Among Patients at High Risk of Extubation Failure

A Randomized Clinical Trial

Arnaud W. Thille, MD, PhD; Grégoire Muller, MD; Arnaud Gacouin, MD; Rémi Coudroy, MD; Maxens Decavèle, MD; Romain Sonneville, MD, PhD; François Beloncle, MD; Christophe Girault, MD; Laurence Dangers, MD; Alexandre Lautrette, MD, PhD; Séverin Cabasson, MD; Anahita Rouzé, MD; Emmanuel Vivier, MD; Anthony Le Meur, MD; Jean-Damien Ricard, MD, PhD; Keyvan Razazi, MD; Guillaume Barberet, MD; Christine Lebert, MD; Stephan Ehrmann, MD, PhD; Caroline Sabatier, MD; Jeremy Bourenne, MD; Gael Pradel, MD; Pierre Bailly, MD; Nicolas Terzi, MD, PhD; Jean Dellamonica, MD, PhD; Guillaume Lacave, MD; Pierre-Éric Danin, MD; Hodanou Nanadoumgar, MD; Aude Gibelin, MD; Lassane Zanre, MD; Nicolas Deye, MD, PhD; Alexandre Demoule, MD, PhD; Adel Maamar, MD; Mai-Anh Nay, MD; René Robert, MD, PhD; Stéphanie Ragot, PharmD, PhD; Jean-Pierre Frat, MD; for the HIGH-WEAN Study Group and the REVA Research Network

High-Wean study
30 ICUs in France

641 Patients at high-risk of extubation failure
Age > 65y or with any underlying cardiac or respiratory disease

Weak cough 25%

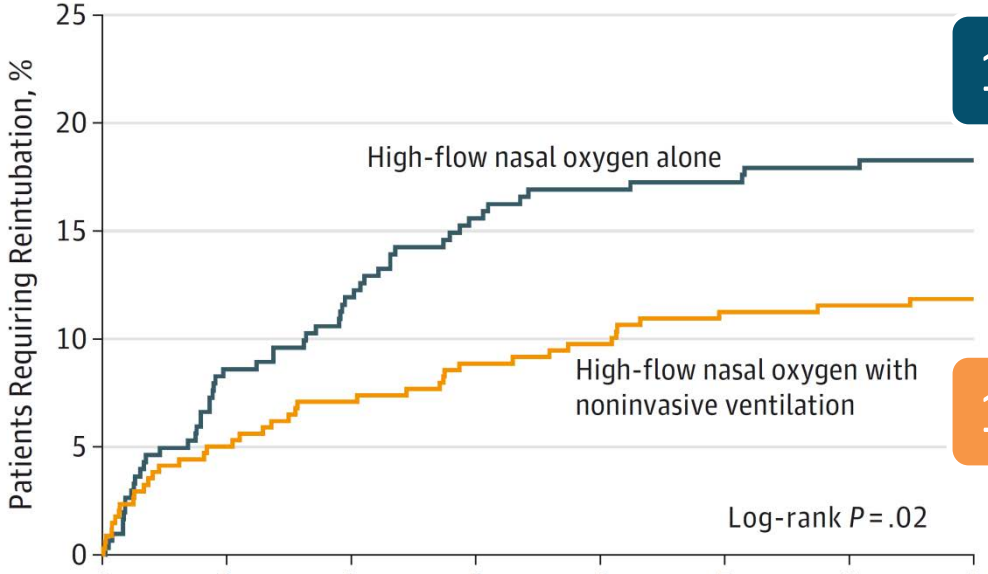
Randomization stratified on $PaCO_2$ > 45 mm Hg

High-flow nasal oxygen **alone**

High-flow nasal oxygen **with NIV**

Thille AW et al., JAMA 2019; 322: 1465-1475.

Figure 2. Kaplan-Meier Analysis of Time From Extubation to Reintubation for the Overall Study Population



No. at risk

High-flow nasal oxygen								
Alone	302	276	265	253	248	246	244	243
Noninvasive ventilation	339	321	314	308	305	294	292	291

18.2%

11.7%

NIV

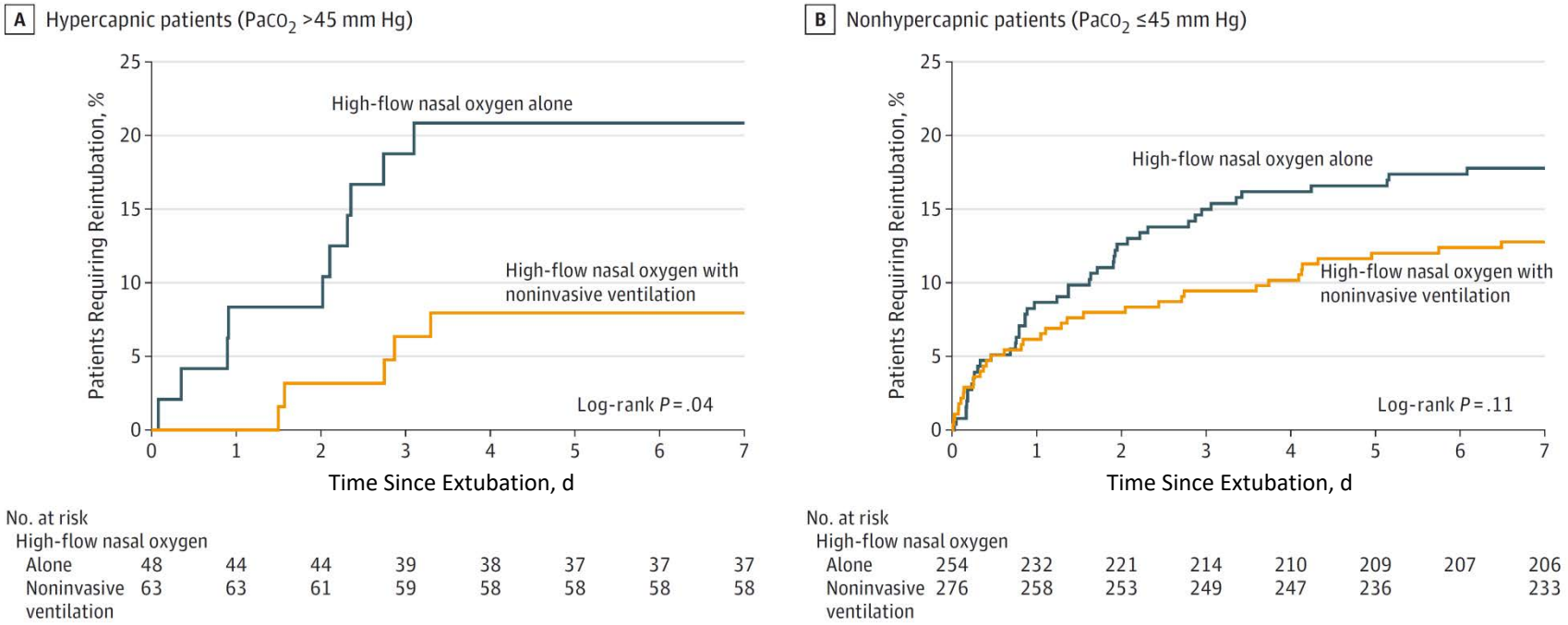
- PS 8 ± 2 cm H_2O
- PEEP 5 ± 1 cm H_2O

13 hours in mean within the first 24h

Thille AW et al., JAMA 2019; 322: 1465-1475.

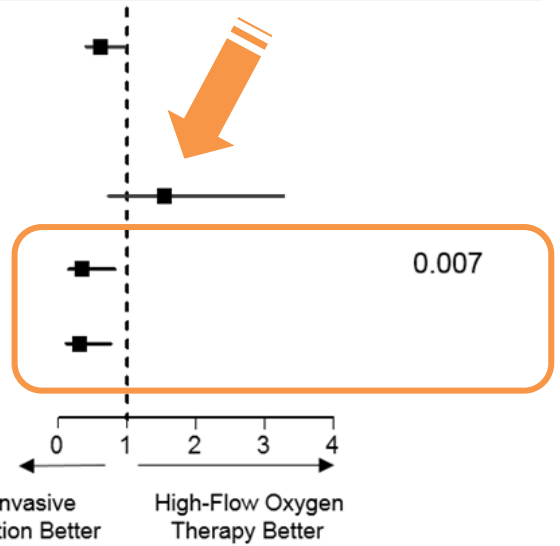
Sub-group analysis: $PaCO_2$ > 45 mm Hg

Figure 3. Kaplan-Meier Analysis of Time From Extubation to Reintubation According to Predefined Strata



Normal or underweight BMI < 25 N = 213	Overweight 25 ≤ BMI < 30 N = 204	Obesity BMI ≥ 30 N = 206

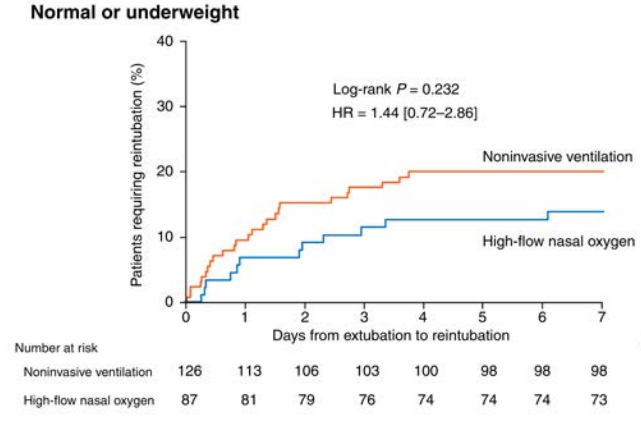
Subgroup	Intubation at day 7 / total number of patients Noninvasive ventilation group	High-Flow Oxygen Therapy group	Odds Ratio (95% CI)	Interaction P Value
All patients	40/330 (12%)	53/293 (18%)	0.62 (0.40-0.97)	
Body mass index				
< 25 kg/m^2	25/126 (20%)	12/87 (14%)	1.55 [0.73- 3.28]	
25 to 29 kg/m2	8/92 (9%)	24/112 (21%)	0.35 [0.15-0.82]	0.007
≥ 30 kg/m2	7/112 (6%)	17/94 (18%)	0.30 [0.12 - 0.76]	



Thille AW et al., Am J Respir Crit Care Med 2022; 205:440-449.

Reintubation rates according to the BMI

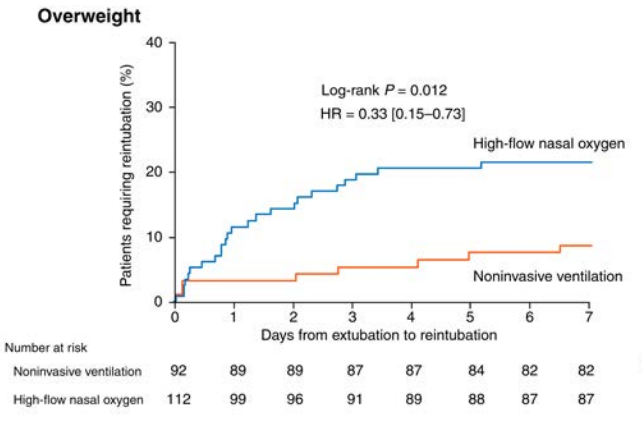
BMI < 25 kg/m^2



20%

14%

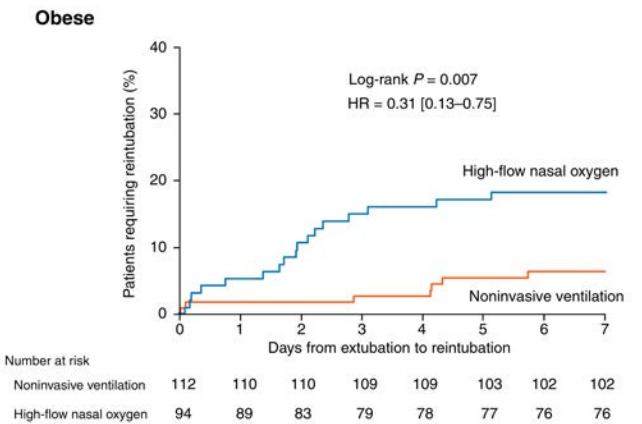
25 ≤ BMI < 30 kg/m^2



21%

9%

BMI ≥ 30 kg/m^2



18%

6%

Thille AW et al., Am J Respir Crit Care Med 2022; 205:440-449.

Conclusions