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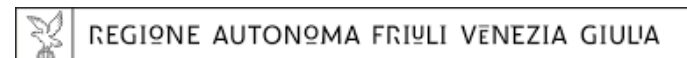


## *Weaning dalla ventilazione non invasiva in un setting acuto*

Dott. Alessandro Amaddeo  
SOC Pronto Soccorso e Pediatria d'urgenza  
IRCCS Burlo Garofolo  
Trieste



**UNIVERSITÀ  
DEGLI STUDI  
DI TRIESTE**

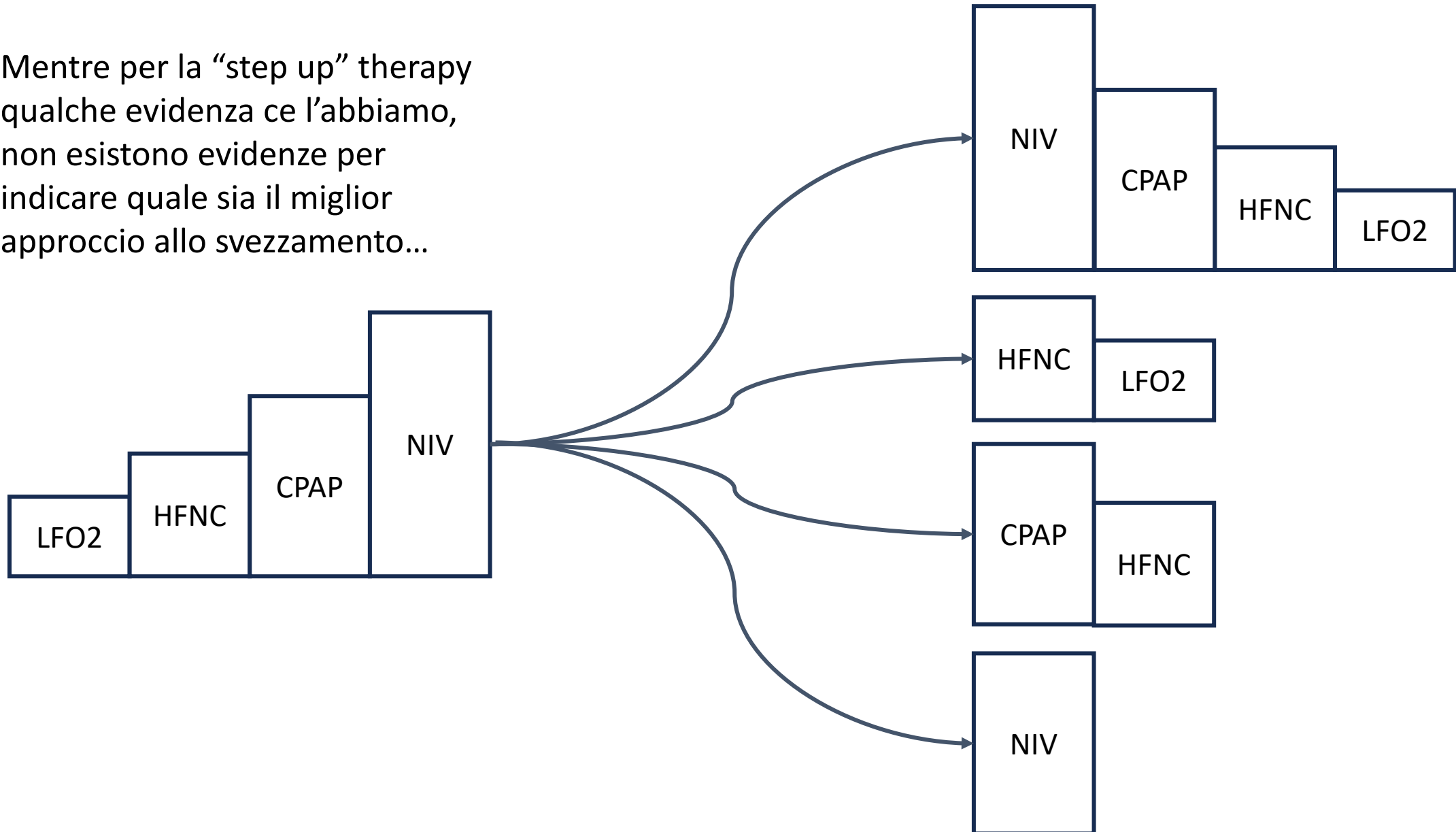


ISTITUTO DI RICOVERO e CURA  
a CARATTERE SCIENTIFICO  
Burlo Garofolo di Trieste



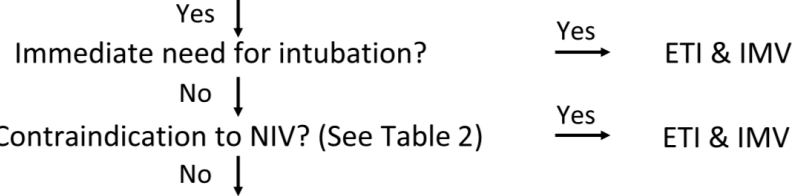
# Weaning...come?

Mentre per la “step up” therapy qualche evidenza ce l’abbiamo, non esistono evidenze per indicare quale sia il miglior approccio allo svezzamento...



# Weaning...come?

Signs & symptoms of acute respiratory distress/failure? (See Table 1)



Choose Best Modality & Interface Based on Clinical Situation:

Type I Respiratory Failure	Type II Respiratory Failure
Mild Hypoxia (FiO <sub>2</sub> 22%–70%)	Mod/Severe Hypoxia (FiO <sub>2</sub> >70%)
Mild to Moderate ↑ WOB	Moderate to Severe ↑ WOB
No Hypercapnea Pco <sub>2</sub> 40_45)	Hypercapnea Pco <sub>2</sub> >50)

NIV Modality:	HFNCOT	CPAP	BIPAP
<b>Interface:</b>	High Flow Nasal Cannula	Nasal Mask / Helmet	Oronasal / Full Face mask
<b>Initial Settings:</b>	2 L/kg/min (1st 10kg) 0.5 L/kg/min (each kg>10 kg)	3–5 cm H <sub>2</sub> O	6–8 cm H <sub>2</sub> O / 3–5 cm H <sub>2</sub> O
<b>Max Settings:</b>	As indicated on device equipment packaging	8–10 cm H <sub>2</sub> O	10–15 cm H <sub>2</sub> O / 6–10 cm H <sub>2</sub> O
<b>FiO<sub>2</sub>:</b>	Sufficient oxygen delivery to maintain SpO <sub>2</sub> = 92%–98%		

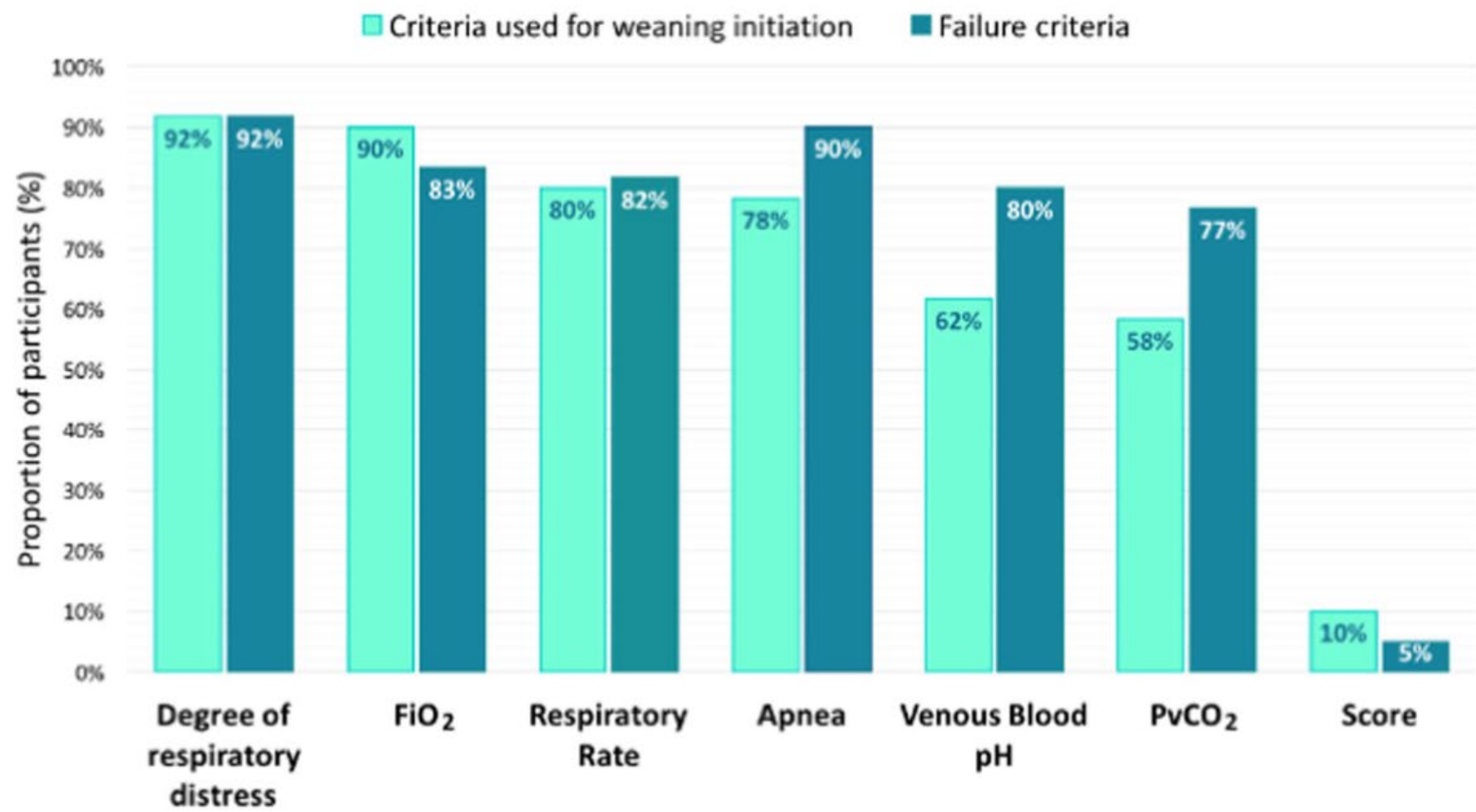
In parte la modalità di svezzamento dipende anche dall'indicazione al supporto respiratorio

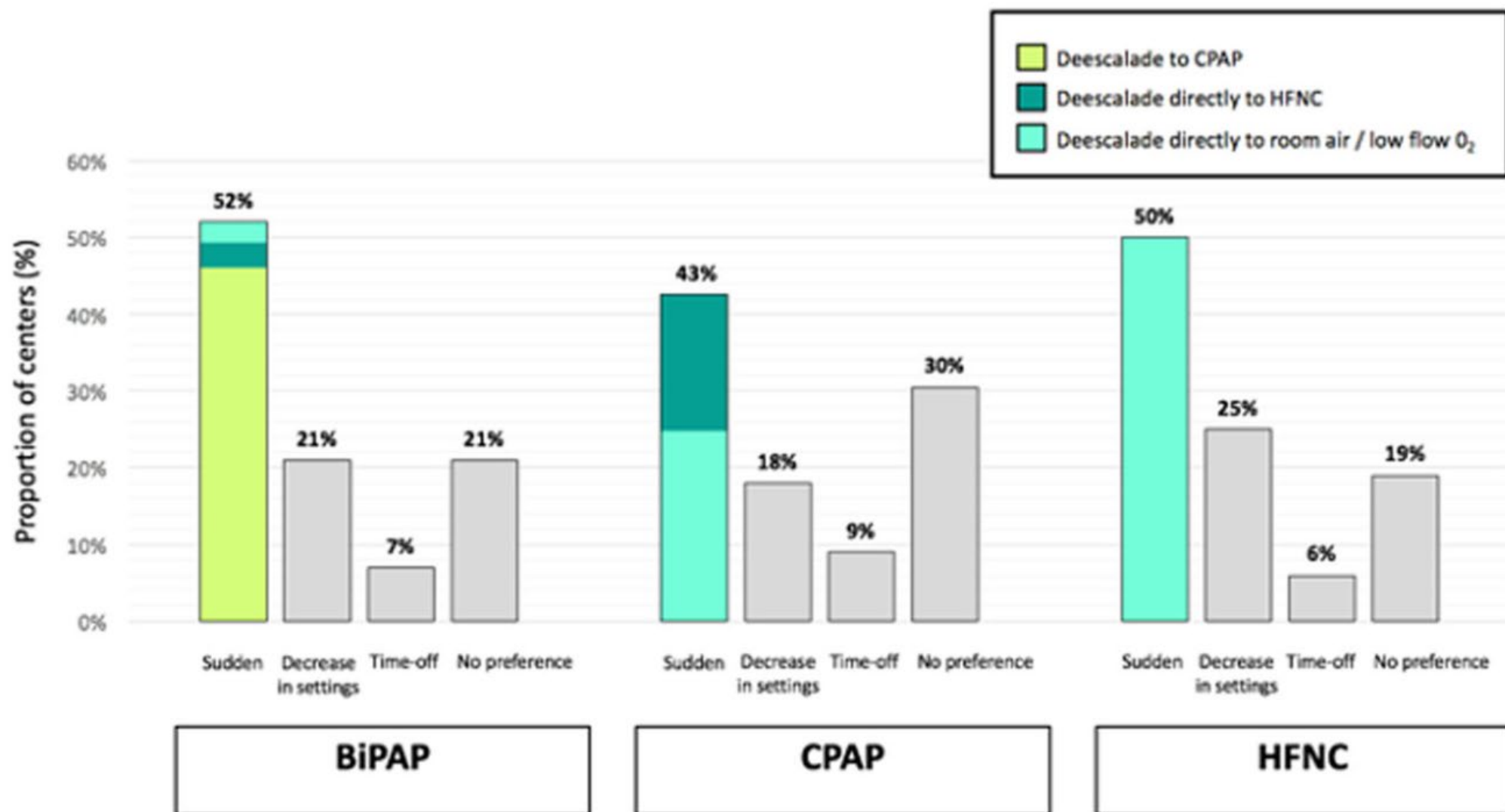
Continu

IMV

Marie Suzanne MD<sup>1</sup> | Alessandro Amaddeo MD, PhD<sup>2</sup> | Isabelle Pin MD<sup>1</sup> |  
Christophe Milési MD<sup>3</sup> | Guillaume Mortamet MD, PhD<sup>4</sup>

Risposte a un questionario da parte di 29 PICU francesi





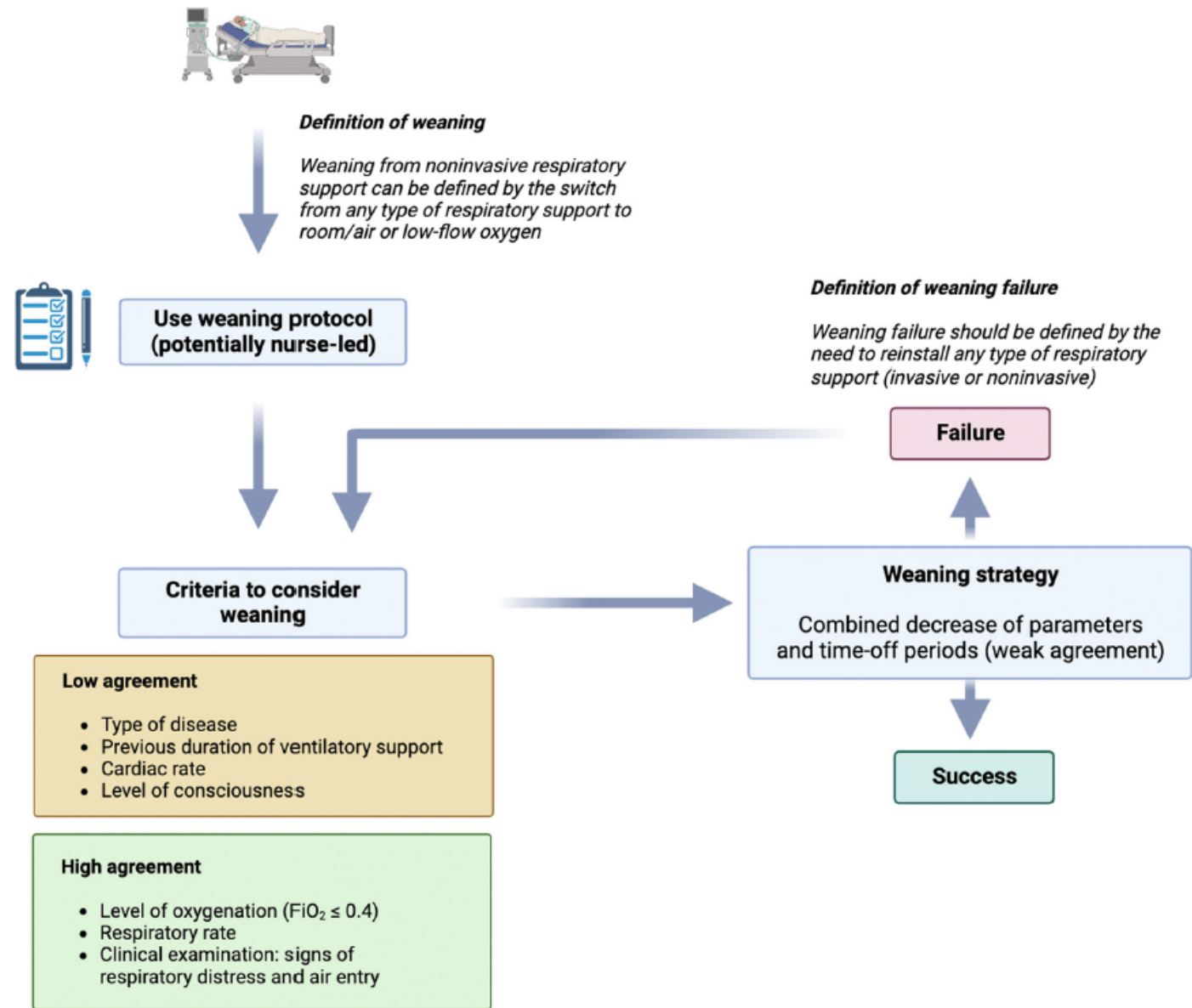
BiPAP: Bi-level Positive Airway Pressure; CPAP: Continuous Positive Airway Pressure; HFNC: High Flow Nasal Cannula

# Weaning from noninvasive respiratory support in children in acute settings: Expert consensus statement using modified Delphi methodology

Più in generale...

Guillaume Mortamet MD<sup>1</sup>  | Christophe Milési MD<sup>2</sup>  |  
Florent Baudin MD, PhD<sup>3</sup>  | Nilufer Yalindag MD<sup>4</sup> | Martin Kneyber MD, PhD<sup>5,6</sup> |  
Marti Pons-Odena MD, PhD<sup>7,8</sup>

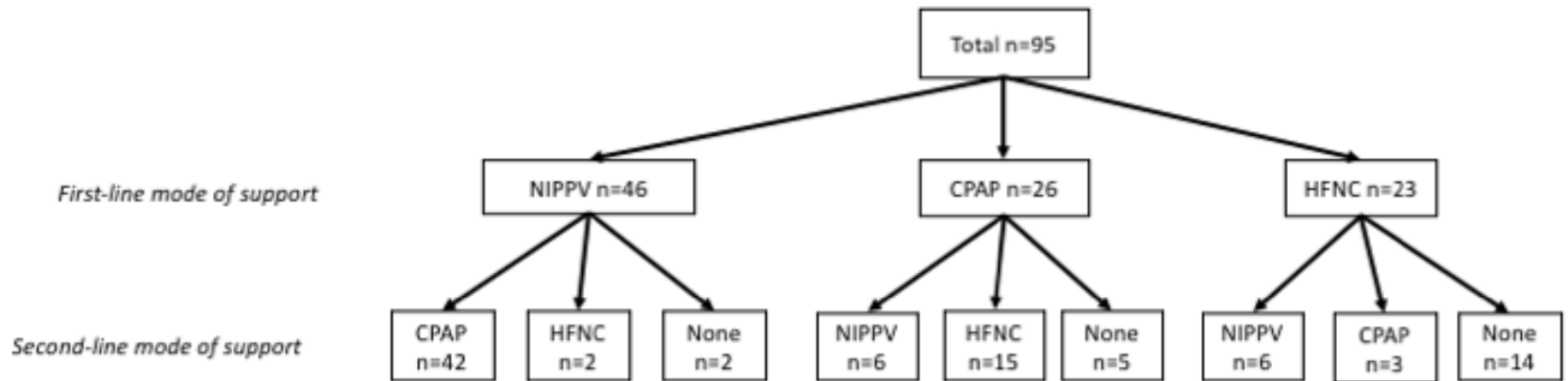
25 international experts from 10 countries (Spain n = 6, United Kingdom n = 5, France n = 3, United States n = 2, Canada n = 2, Italy n = 1, India n = 1, Argentina n = 1, Indonesia n = 1, Qatar n = 1, Australia n = 1, and Turkey n = 1)



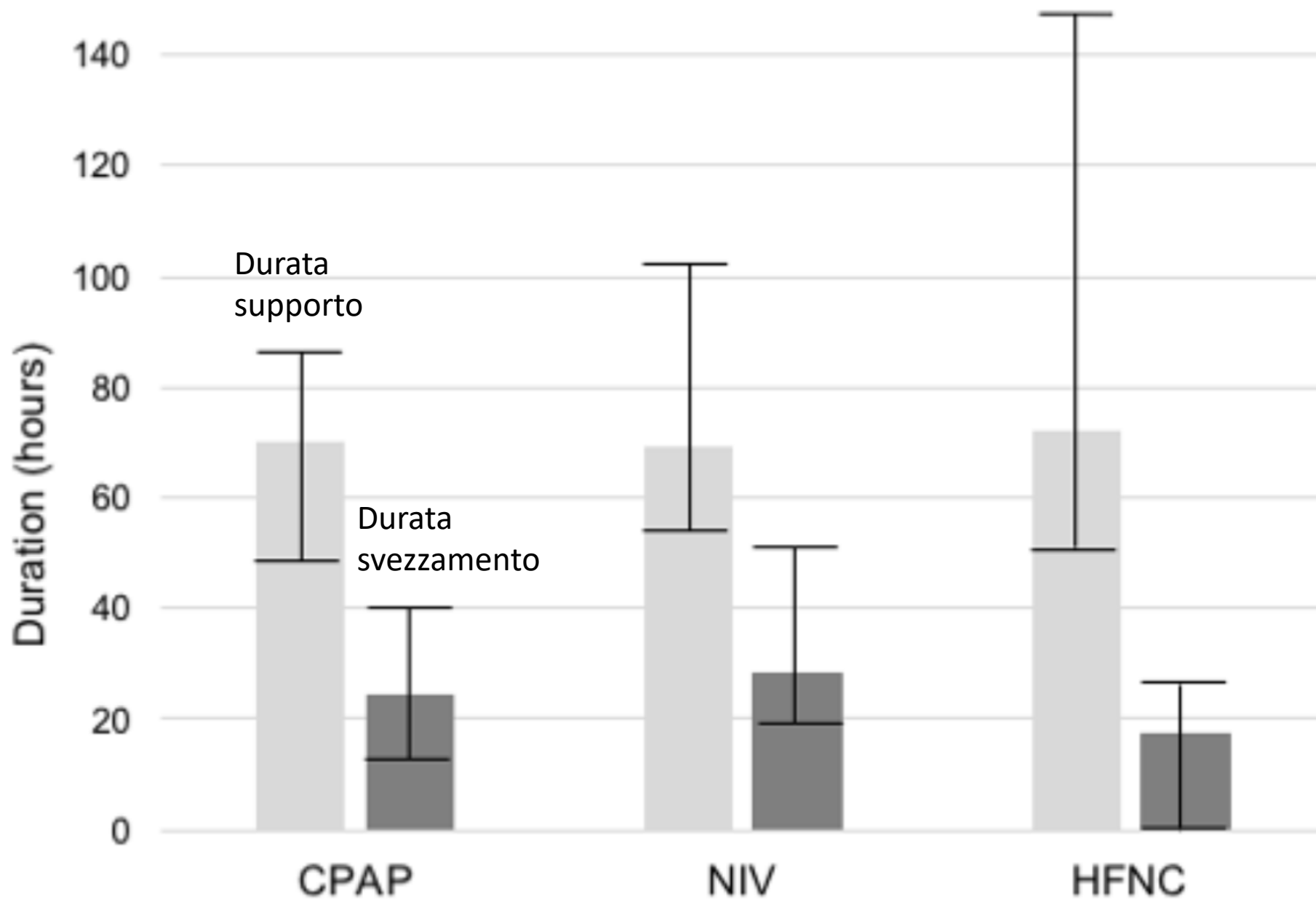
**FIGURE 1** Clinical statements about the weaning from noninvasive respiratory support.

# Weaning From Noninvasive Ventilatory Support in Infants With Severe Bronchiolitis: An Observational Study

## HFNC e bronchiolite...2



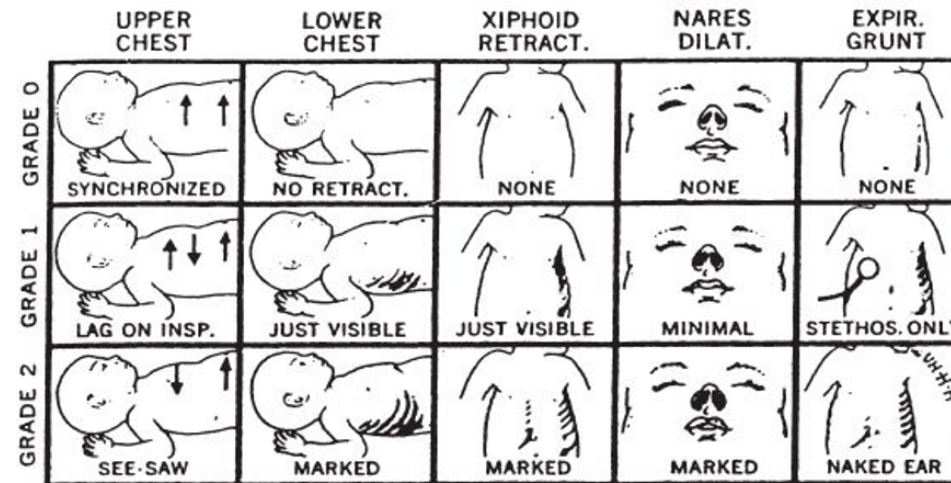
\*CPAP: Continuous Positive Airway Pressure; HFNC: High Flow Nasal Cannula; NIPPV: Non Invasive positive Airway Pressure



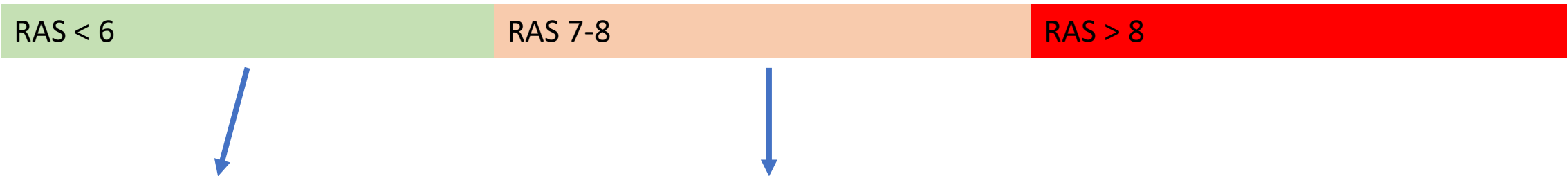
## Appendix I. Respiratory Assessment Score

Age Variable	Respiratory Rate		
	0	1 pt	2 pts
< 2 mos	</= 60	61 - 69	>/= 70
2 mos – 1 yr	</= 50	51 - 59	>/= 60
1 – 2 yr	</= 40	41 - 44	>/= 45
2 – 3 yr	</= 34	35 - 39	>/= 40
4 – 5 yr	</= 30	31 - 35	>/= 36
6 – 12 yr	</= 26	27 - 30	>/= 31
>12 yr	</= 23	24 - 27	>/= 28

Feature	0 pts	1 pt	2 pts
Chest Movement	equal	respiratory lag	seesaw respiration
Intercostal Retraction	none	minimal	marked
Xiphoid Retraction	none	minimal	marked
Nasal Flaring	none	minimal	marked
Expiratory Grunt	none	audible with stethoscope	audible



Screening per HFNC holiday X2/die, se RAS < 6 allora tentativo di weaning...

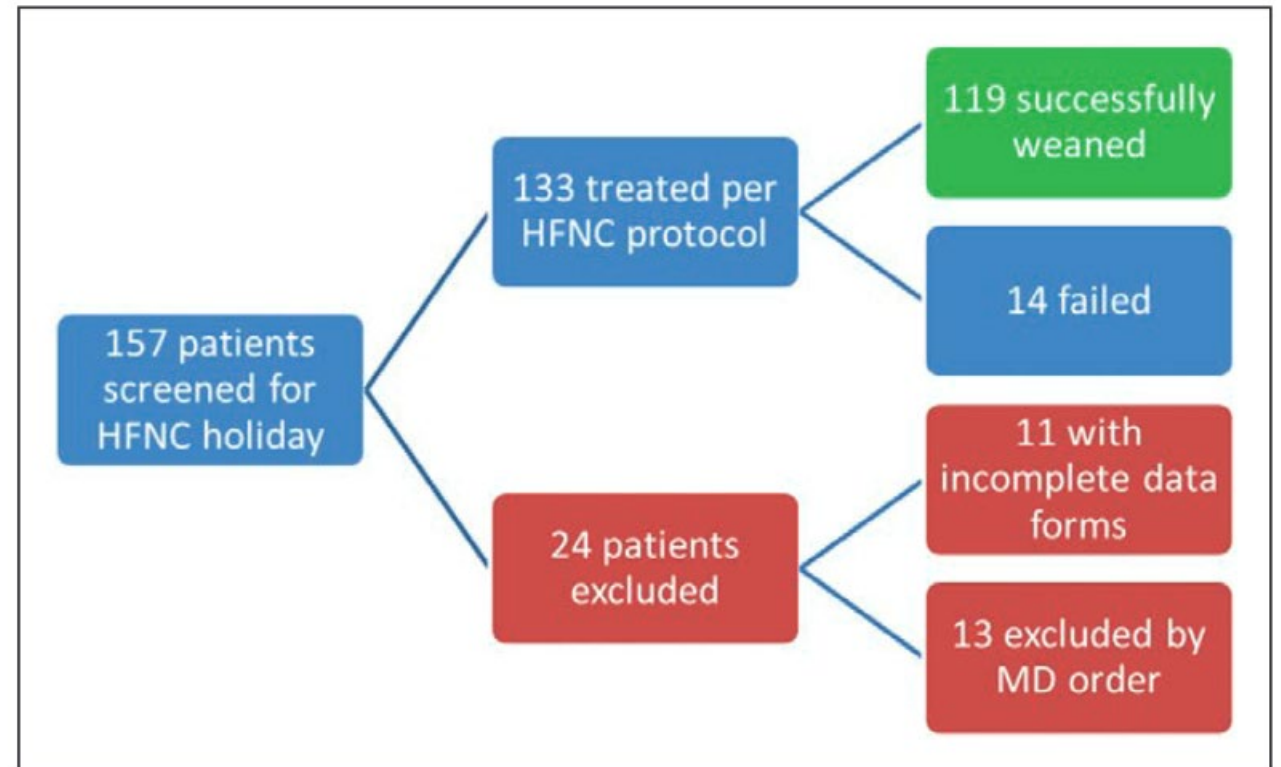


Appendix II. Age based low flow nasal cannula guidelines

Age	Flow Rate (liters per minute)
> 2 months	0.5
2 months – 2 years	1-1.5
3 – 4 years	No more than 2-3
> 4 years	No more than 4

**TABLE 1. Characteristics of Patients Treated on High-Flow Nasal Cannula Protocol**

Characteristics	<i>n</i> = 133
Gender (male), <i>n</i> (%)	73 (54.9)
Age at PICU admission (mo), median (25–75th)	14.4 (6.1–38.6)
Weight (kg), median (25–75th)	9.5 (6.5–14.2)
Primary reason for HFNC, <i>n</i> (%)	
Asthma	7 (5.3)
Bronchiolitis	57 (42.9)
Bacterial pneumonia	15 (11.3)
Viral pneumonia/pneumonitis	14 (10.5)
Postoperative	11 (8.3)
Trauma	2 (1.5)
Sepsis	1 (0.8)
Other	26 (19.6)
Secondary diagnosis (yes), <i>n</i> (%)	79 (59.4)
Location of HFNC initiation, <i>n</i> (%)	
ED	46 (34.6)
Non-ED	87 (65.4)



**Figure 1.** Patient screening, inclusion, and exclusion for high-flow nasal cannula (HFNC) weaning protocol. MD = medical doctor.

Age (mo)	Weight (kg)	Primary Diagnosis	Secondary Diagnosis	Outcome	PICU Length of Stay (d)
17	10.5	Postextubation	Pulmonary hemorrhage	Slowly weaned	35
5	6.7	Postextubation	Status post liver transplant	Slowly weaned	21
9	9	Postextubation	VACTERL <sup>a</sup> , complex heart disease	Intubated	28
7	6.6	Postextubation	Status post liver transplant	Intubated	19
6	4.9	Postextubation	Laryngomalacia	Tracheostomy	24
60	15	RSV	Dandy-Walker	Tracheostomy	47
24	10.4	Pleural effusion	Long-chain 3-hydroxyacyl-CoA dehydrogenase	Intubated	24
13	8.1	RSV	Pulmonary atresia	Slowly weaned	10
15	9.5	Human metapneumovirus	None	Slowly weaned	5
15	12.2	Bone marrow transplant	None	Do not intubate order-progressed to death	53
4	4.2	Rhinovirus	None	Intubated	8
0.5	3.7	RSV	None	Intubated	8
3	5.1	RSV	Chronic lung disease	Intubated	13
2	5.3	RSV	None	Slowly weaned	10

RSV = respiratory syncytial virus.

<sup>a</sup>VACTERL association: vertebral defects, anal atresia, cardiac defects, tracheoesophageal fistula, renal anomalies, and limb abnormalities.

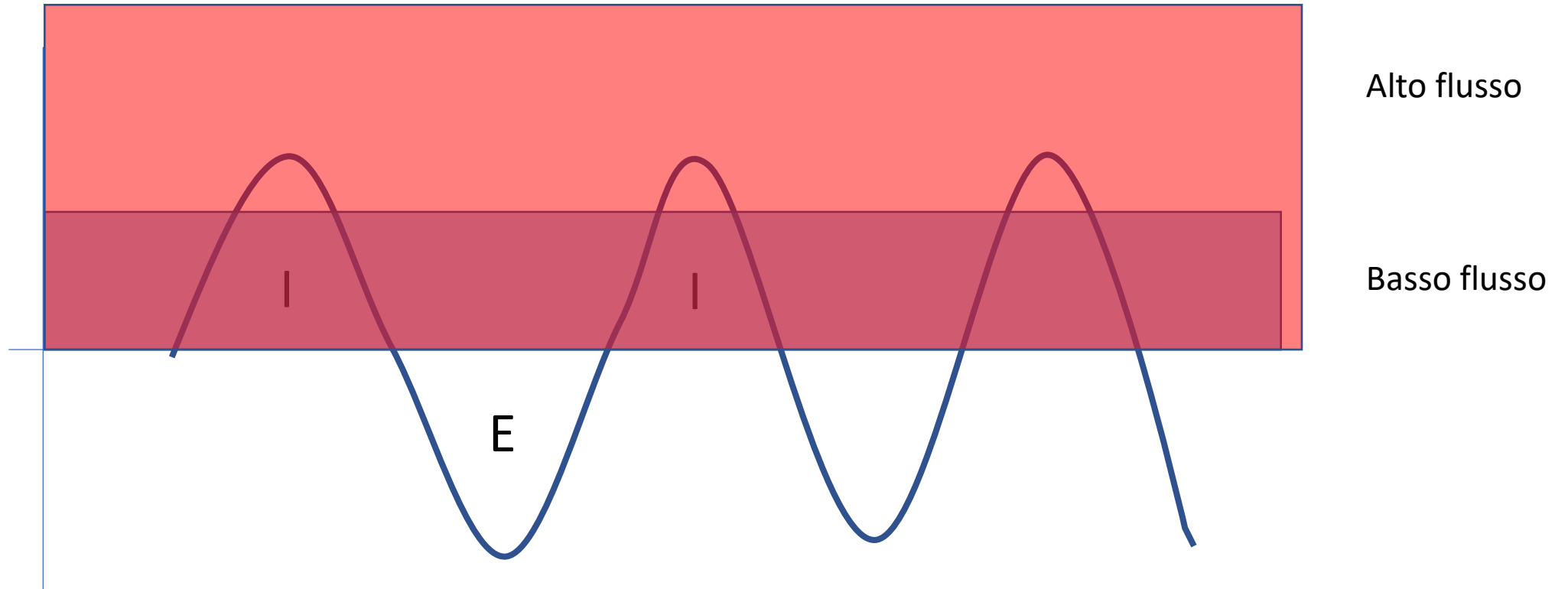
# Perché dimezzare il flusso non ha senso?

THE JOURNAL OF PEDIATRICS • www.jpeds.com

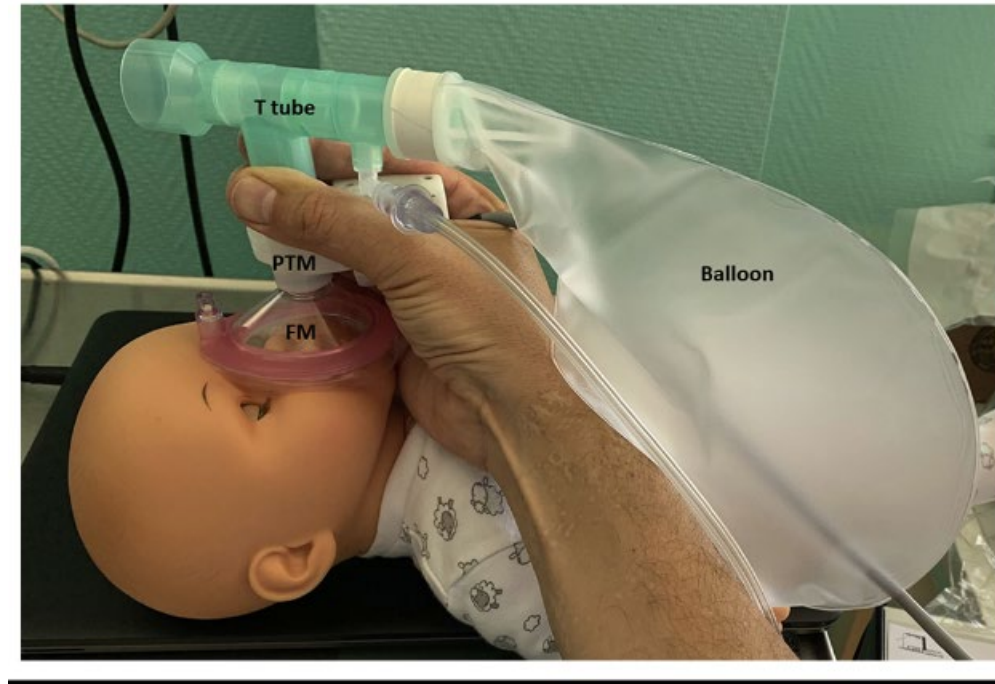
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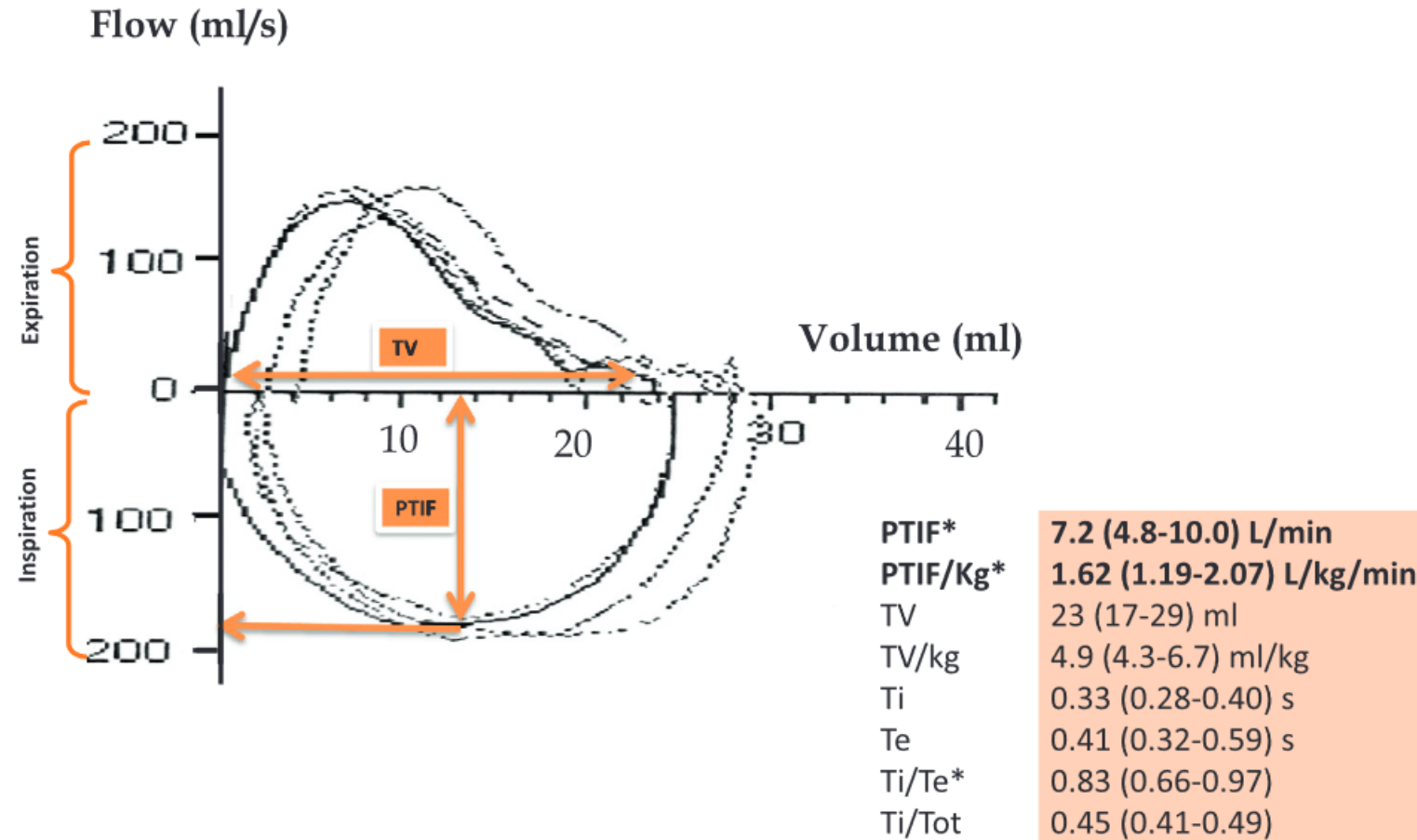


## Assessment of Peak Inspiratory Flow in Young Infants with Acute Viral Bronchiolitis: Physiological Basis for Initial Flow Setting in Patients Supported with High-Flow Nasal Cannula



# Misura del peak tidal inspiratory flow (PTIF)



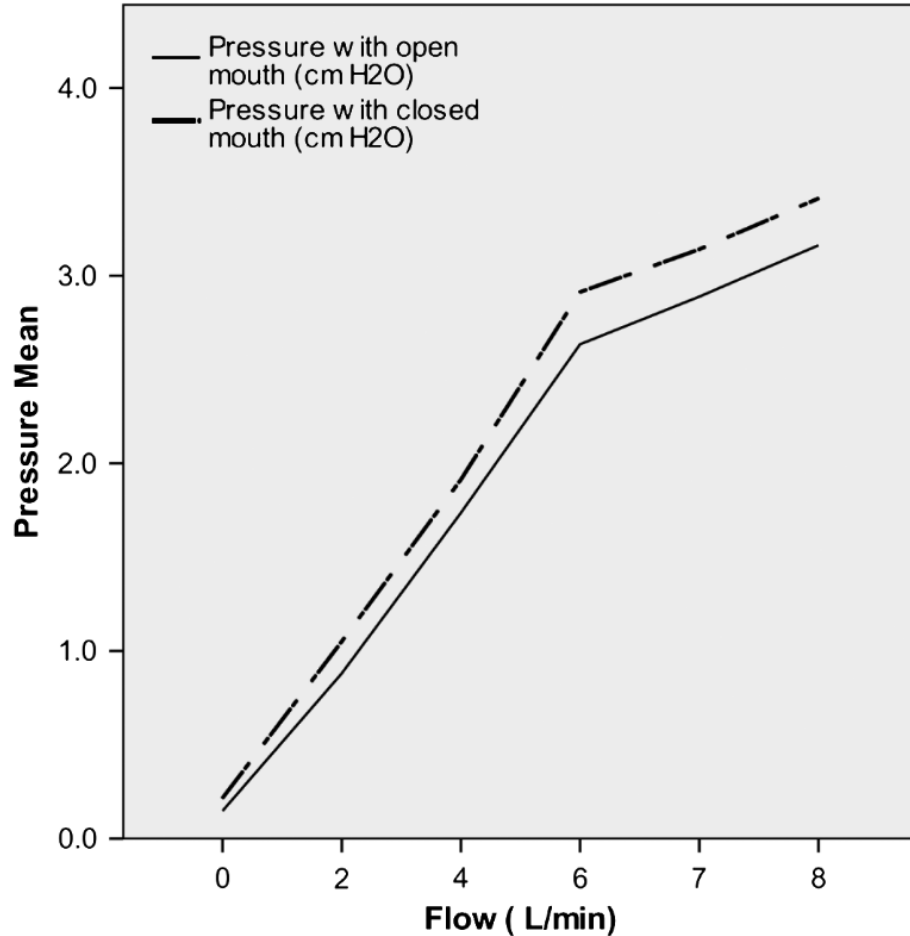


Per valori di 2-2.5 l/kg/min si tratta sempre di un alto flusso

# Nasopharyngeal Airway Pressures in Bronchiolitis Patients Treated With High-Flow Nasal Cannula Oxygen Therapy

Che pressione genera l'alto flusso

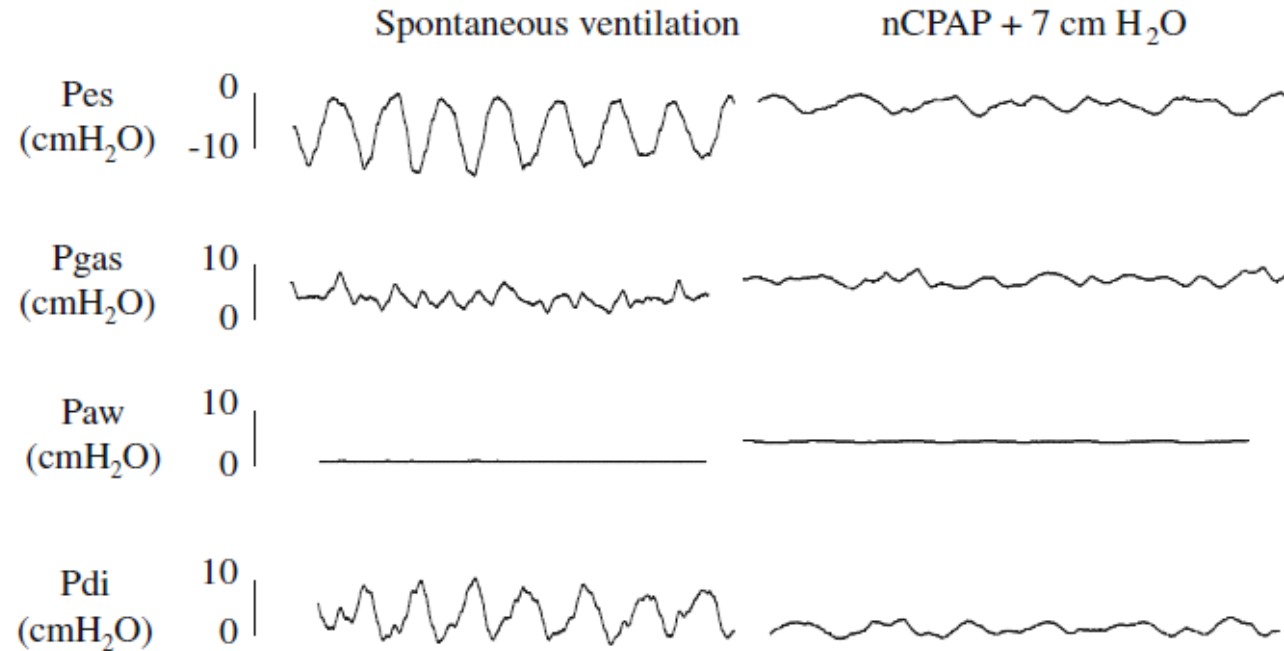
*Bhawana Arora, MD,\* Prashant Mahajan, MD, MPH, MBA,\*† Marwan A. Zidan, PhD,‡ and Usha Sethuraman, MD†*



# Optimal level of nasal continuous positive airway pressure in severe viral bronchiolitis

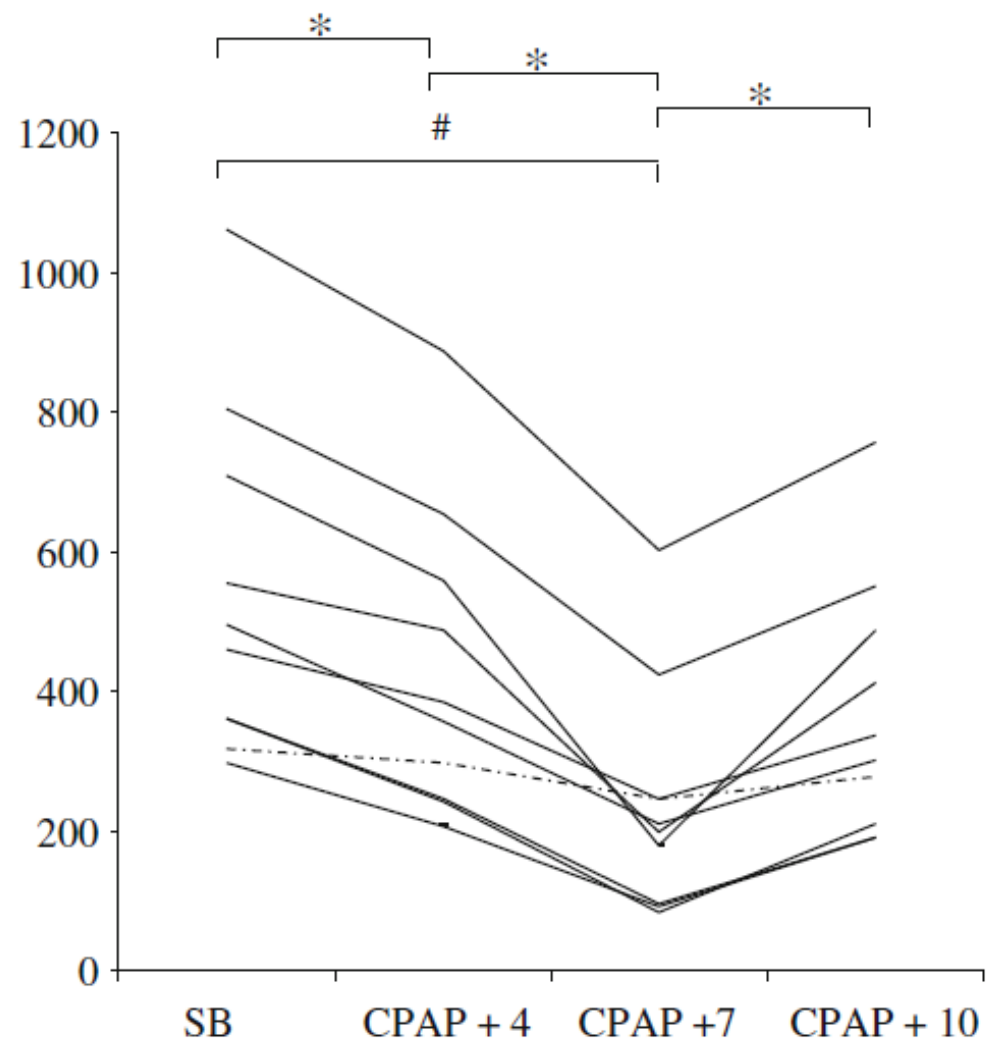
Che pressione serve...

Intensive Care Med (2011) 37:2002–2007  
DOI 10.1007/s00134-011-2372-4

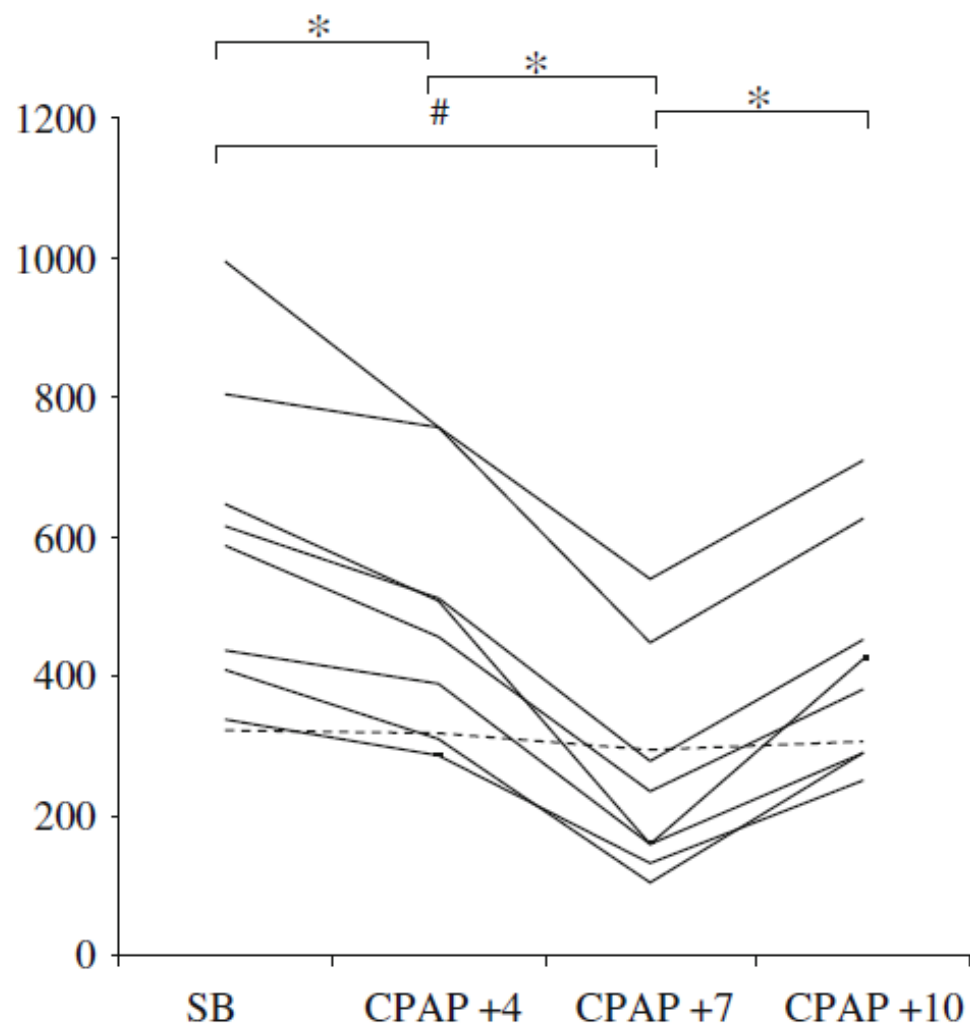


**Fig. 1** Inspiratory pressure effort during spontaneous breathing and with nCPAP support. Traces from an infant during spontaneous breathing (SB) (*left panel*) and with nasal continuous pressure support (nCPAP) with a pressure level of 7 cmH<sub>2</sub>O (*right panel*). Parameters of respiratory muscle load measured are shown:  $P_{es}$ , oesophageal pressure;  $P_{gas}$ , gastric pressure;  $P_{di}$ , transdiaphragmatic pressure;  $P_{aw}$ , airway pressure

PTPes/mn ( $\text{cmH}_2\text{O.s. min}^{-1}$ )



PTPdi/mn ( $\text{cmH}_2\text{O.s. min}^{-1}$ )



# Quindi...

Se per ottenere un alto flusso servono almeno 2.5 l/kg/min

Se la pressione massima nelle vie aeree non supera i 4 cmH<sub>2</sub>O

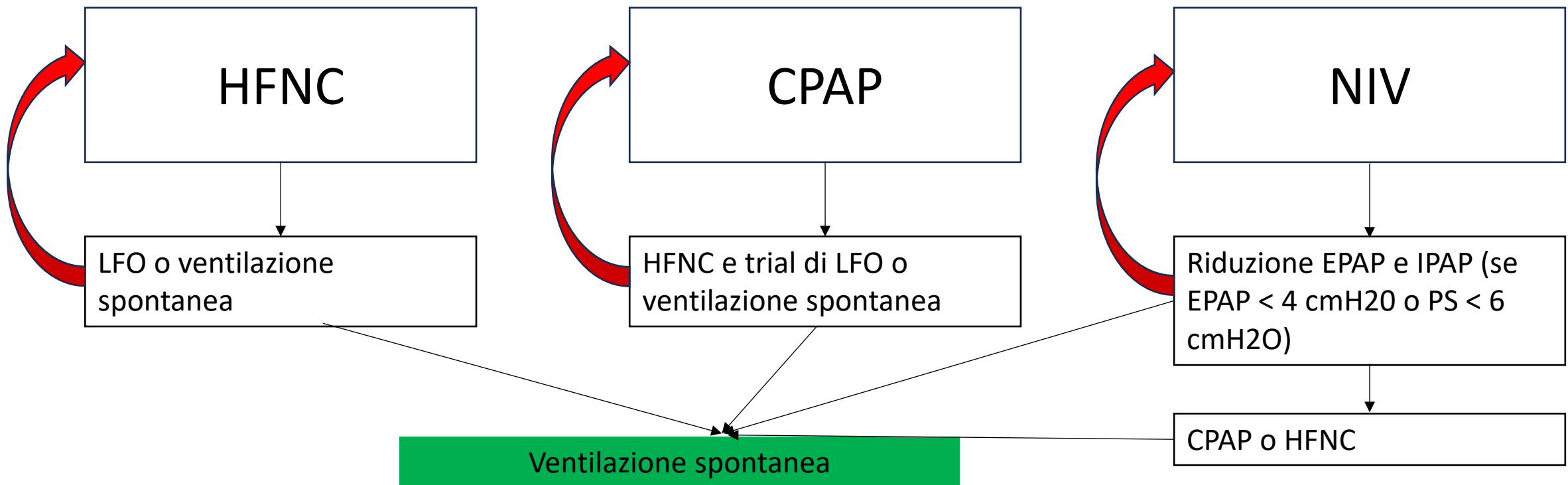
Se la pressione richiesta è di almeno 7 cmH<sub>2</sub>O...

Dimezzare o ridurre il flusso non ha senso, meglio passare subito a un basso flusso (anche con le cannule dell'AIRVO).

# In conclusione

Una volta che il paziente è stabile dal almeno 6 ore, con FiO<sub>2</sub> in riduzione (e < 40%), con RR stabile o in riduzione è ragionevole fare un trial di svezzamento...

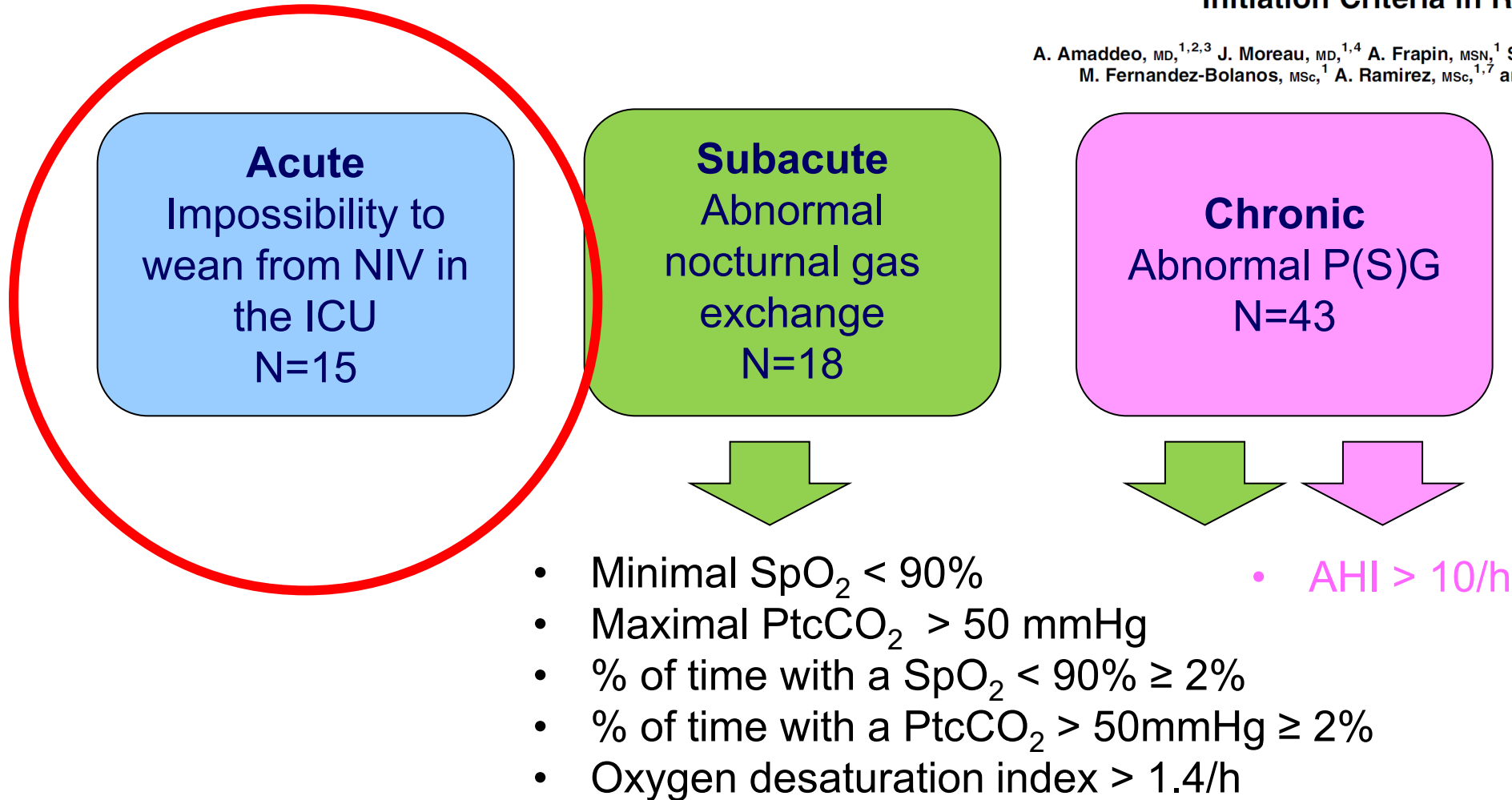
Il come dipende dal tipo di paziente e dalla causa dell'IRA, in generale:



# Non tutti i pazienti sono svezzabili...

## Long Term Continuous Positive Airway Pressure (CPAP) and Noninvasive Ventilation (NIV) in Children: Initiation Criteria in Real Life

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# Long Term Continuous Positive Airway Pressure (CPAP) and Noninvasive Ventilation (NIV) in Children: Initiation Criteria in Real Life

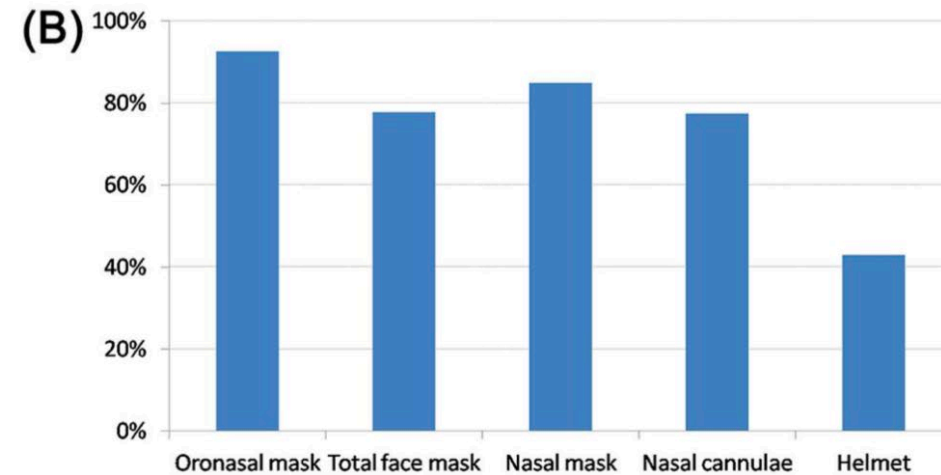
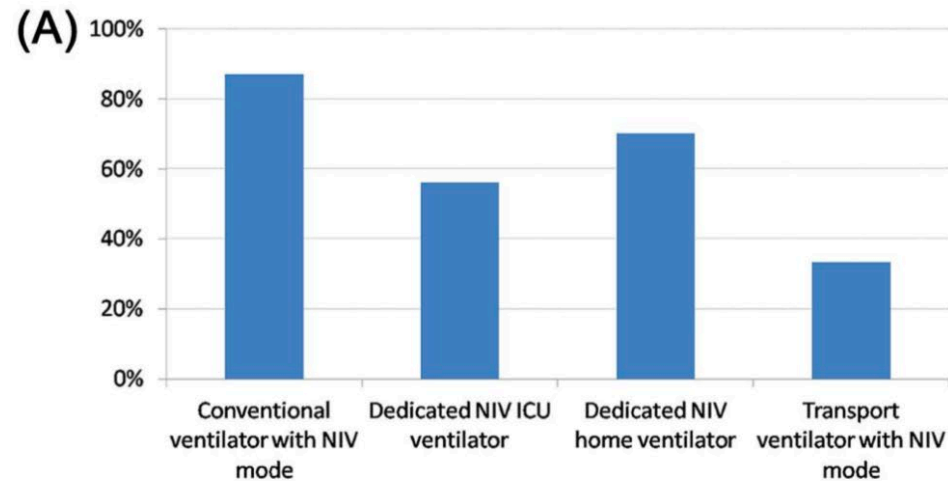
A. Amaddeo, MD,<sup>1,2,3</sup> J. Moreau, MD,<sup>1,4</sup> A. Frapin, MSN,<sup>1</sup> S. Khirani, PhD,<sup>1,5</sup> O. Felix, MD,<sup>1,6</sup>  
M. Fernandez-Bolanos, MSc,<sup>1</sup> A. Ramirez, MSc,<sup>1,7</sup> and B. Fauroux, MD, PhD<sup>1,2,3\*</sup>

	Acute group <i>n</i> = 15	Subacute group <i>n</i> = 18	Chronic group <i>n</i> = 43
Median age, years (interquartile range)	0.3 (0.1–13.5)	0.6 (0.2–18.2)	1.6 (0.1–19.5)
Female to male ratio (F/M)	7/8	8/10	22/21
Diagnosis	Pierre Robin syndrome 6 Laryngomalacia 3 Polymalformative syndrome 2 Kabuki syndrome 1 Cystic fibrosis 1 Bronchopulmonary dysplasia 1 Neuromuscular disorder 1	Laryngomalacia 4 Prader Willi syndrome 1 Pierre Robin syndrome 1 Bronchopulmonary dysplasia 1 Crouzon syndrome 1 Treacher Collins syndrome 1 Vocal cord palsy 1 Down syndrome 1 Mucopolysaccharidosis type 2 1 Duchenne muscular dystrophy 1 Immunodeficiency with lymphoid tissue hyperplasia 1 Craniofacial malformation 1 Generalised dystonia 1 Achondroplasia 1 Tracheomalacia 1	Pierre Robin syndrome 5 Down syndrome 5 Mucopolysaccharidosis type 1 3 Charge syndrome 3 Laryngomalacia 3 Polymalformative syndrome 3 Treacher Collins syndrome 2 Achondroplasia 2 Prader Willi syndrome 2 Bronchopulmonary dysplasia 2 Congenital myasthenia 1 Nemaline myopathy 1 Mucopolysaccharidosis type 2 1 Myhre syndrome 1 Spinal muscular atrophy 1 Rett syndrome 1 Goldenhar syndrome 1 Hanhart syndrome 1 Beckwith Wiedemann syndrome 1 Loeys Dietz syndrome 1 Ossificant fibrodysplasia 1 Idiopathic OSAS 1

# Non-invasive ventilation practices in children across Europe

Pediatr Pulmonol. 2018  
Aug;53(8):1107-1114.

Juan Mayordomo-Colunga MD,PhD<sup>1</sup> | Martí Pons-Òdena MD,PhD<sup>2</sup> |  
Alberto Medina MD,PhD<sup>1</sup> | Corsino Rey MD,PhD<sup>1</sup> | Christophe Milesi MD,PhD<sup>3</sup> |  
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Demet Demirkol MD<sup>7</sup> | Milagros García-López MD<sup>8</sup> | Peter Rimensberger MD,PhD<sup>9</sup>



Non importa cosa si usa  
ma conoscere il materiale

# Ventilatori per CPAP/NIV



## Standard CPAP/NIV

### Advantages:

- Small size
- Integrated humidifier\*

### Disadvantages:

- \* No internal battery
- \* Flow detection > 30 Kg
- \* Inaccurate data < 30 Kg
- \* Autoset CPAP > 30Kg
- \* No alarms (for CPAP devices)

## Life support

### Advantages:

- \* Battery: about 8 h
- \* Flow detection > 5 Kg
- \* Alarms

### Disadvantages:

- \* Heavy/cumbersome
- \* External humidifier



## Intermediate devices

### Advantages:

- \* Medium size
- \* Integrated humidifier
- \* Battery: about 2-6 h (+external)
- \* Alarms
- \* Options (ex. Smart Start)

### Disadvantages:

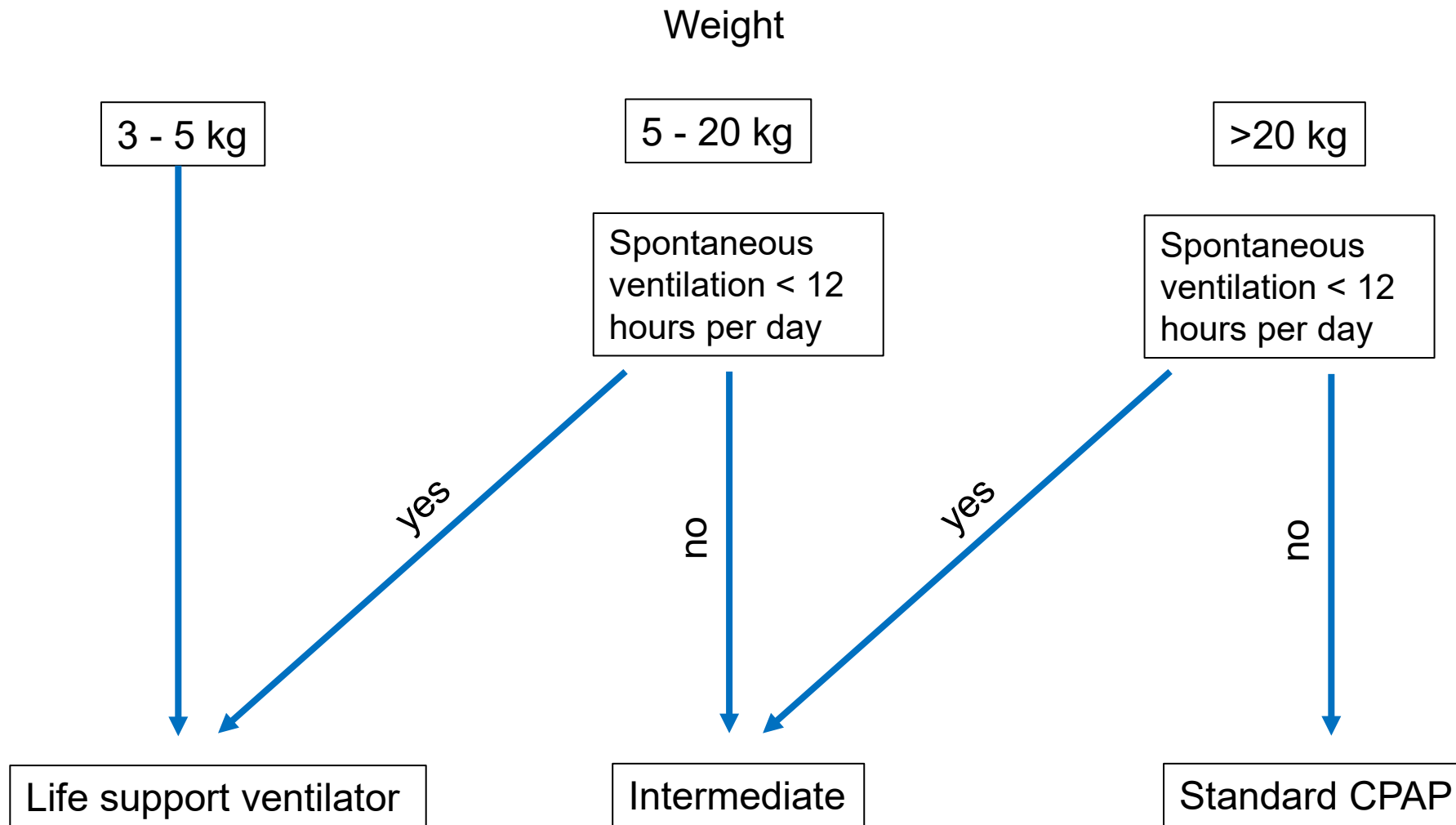
- \* Flow detection > 10-13 Kg
- \* Inaccurate data < 10-13 Kg



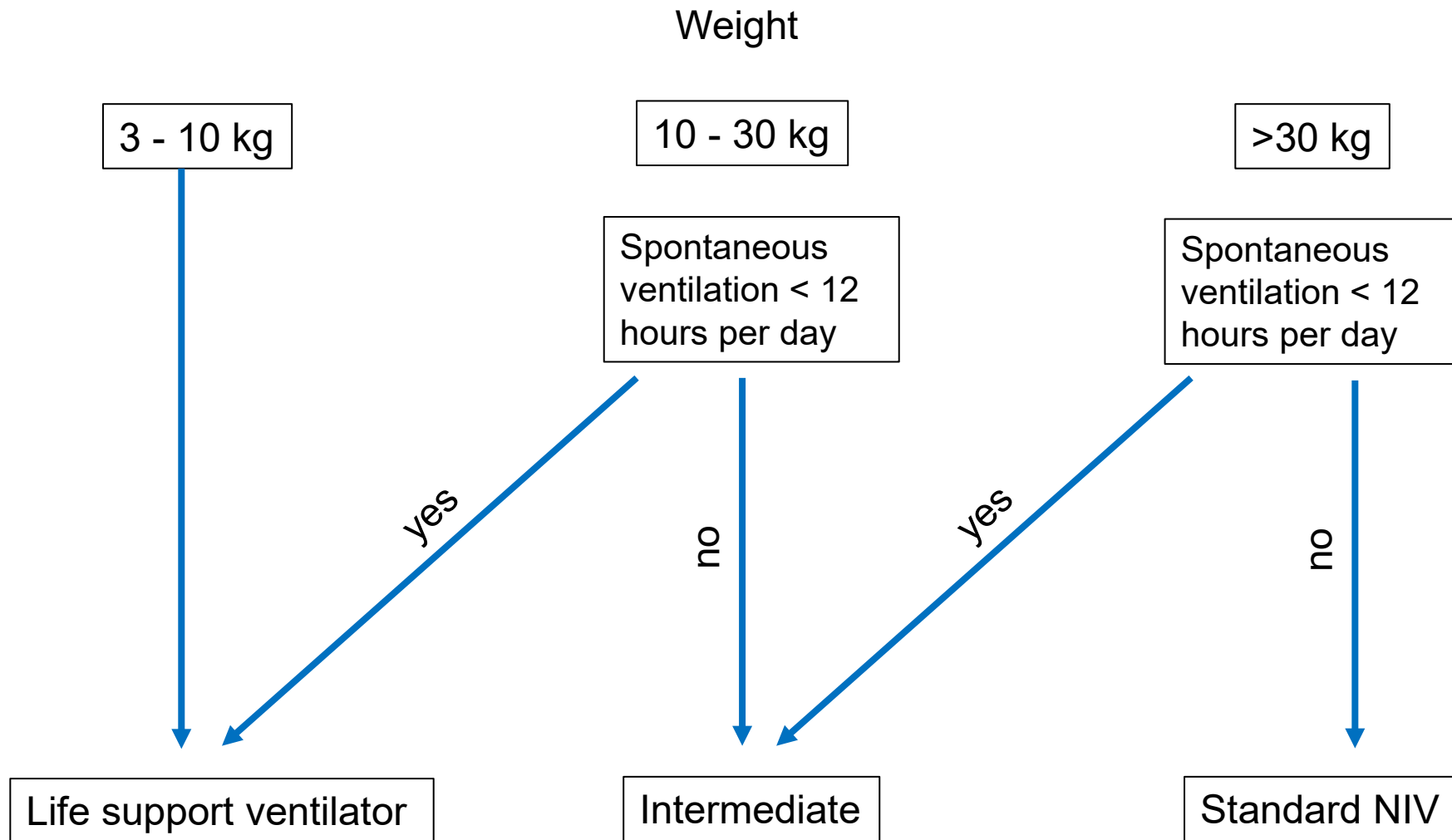
# Scelta del ventilatore

Ventilatore	CPAP/AutoCPAP	BIPAP	Peso minimo
<b>ResMed</b>			
Airsense 10 (std)	sì	no	30kg
Lumis (std)	Constant CPAP	sì	13kg / 30kg (iVAPS)
Stellar (interm)	Constant CPAP	sì	13kg / 13kg (iVAPS)
Astral (LS)	Constant CPAP	sì	5kg
<b>Philips Respironics</b>			
DreamStation (std)	sì	no	30kg
BIPAP AVAPS (std)	Constant CPAP	sì	10kg / 20kg (AVAPS)
BIPAP A40 (interm)	Constant CPAP	sì	10kg / 20kg (AVAPS)
Trilogy EVO (LS)	Constant CPAP	sì	2.5kg
<b>F &amp; P</b>			
Icon (std)	sì	no	30kg
<b>Lowenstein</b>			
Prisma 20 (std)	sì	no	30kg
PrismaVent 40 (interm)	Constant CPAP	sì	10kg

# Choice of the device - CPAP



# Choice of the device - NIV



# Choice of the device

Other factors to consider:

- **Underlying disease** (progressive respiratory insufficiency)
- **Need for multiple programs** (within the same device): day/night, MPV, chest physiotherapy
- **Ergonomy** of the ventilator, humidifier, battery
- **Patient's and parents' preferences**
- **Economical** considerations
- In-built software
- *Integrated SpO<sub>2</sub>, PtcCO<sub>2</sub>, telemonitoring*

# Come iniziare una NIV long term in PICU

1. Scegliere ventilatore e interfaccia secondo la propria esperienza
2. Se possibile alternare già le maschere
3. Iniziare con gli stessi parametri del ventilatore della rianimazione, avendo però pazienza di cambiare in corsa d'opera Tgl e Tempi
4. Ottimizzare tutti i fattori “confondenti” prima del trasferimento (infezioni, RGE, dolore, sedazione, fisioterapia respiratoria)
5. A seconda del reparto di destinazione iniziare già in PICU con un trial di ventilazione spontanea
6. Iniziare in PICU per almeno 24 ore prima del trasferimento

## INSUFFICIENZA RESPIRATORIA, OSSIGENOTERAPIA E UTILIZZO DELLA CPAP IN ETA' PEDIATRICA

**CORSO TEORICO PRATICO**



**FIRENZE**  
**29-30 NOVEMBRE 2024**

# Respiratory effort during noninvasive positive pressure ventilation and continuous positive airway pressure in severe acute viral bronchiolitis

# Bronchiolite....

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 Lucie Griffon MD<sup>1,2</sup> | Charlotte Collignon MD<sup>3</sup> | Sylvain Renolleau MD, PhD<sup>2,3</sup> |  
 Brigitte Fauroux MD, PhD<sup>1,2</sup>

