



***Corso di formazione***  
***“VENTILAZIONE NON INVASIVA***  
***FUORI DALLA TERAPIA INTENSIVA”***



# **TIMING DELLA VENTILAZIONE NON INVASIVA**

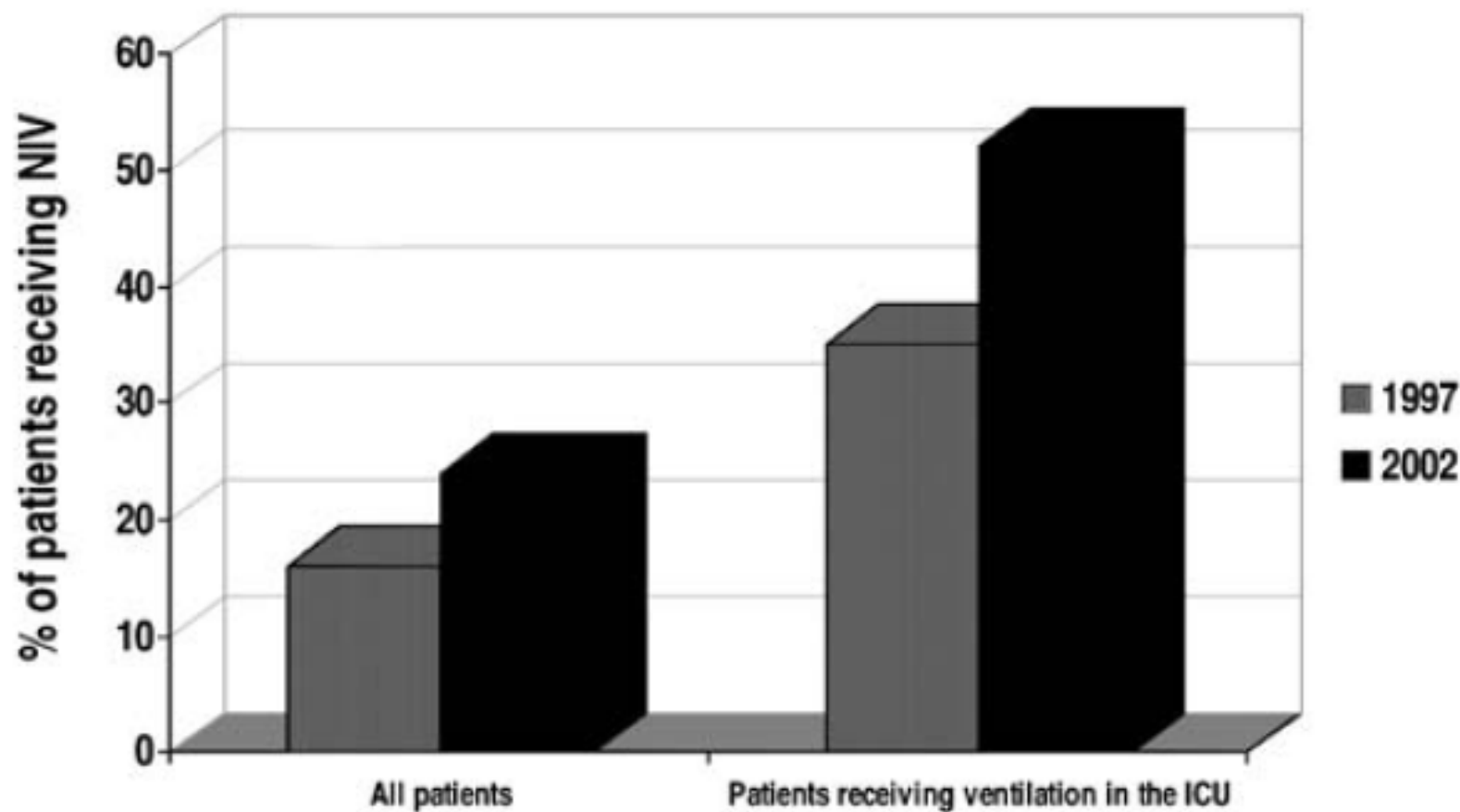
***SCDU Anestesia, Rianimazione e Terapia Intensiva***

***Università del Piemonte Orientale “Amedeo Avogadro”***

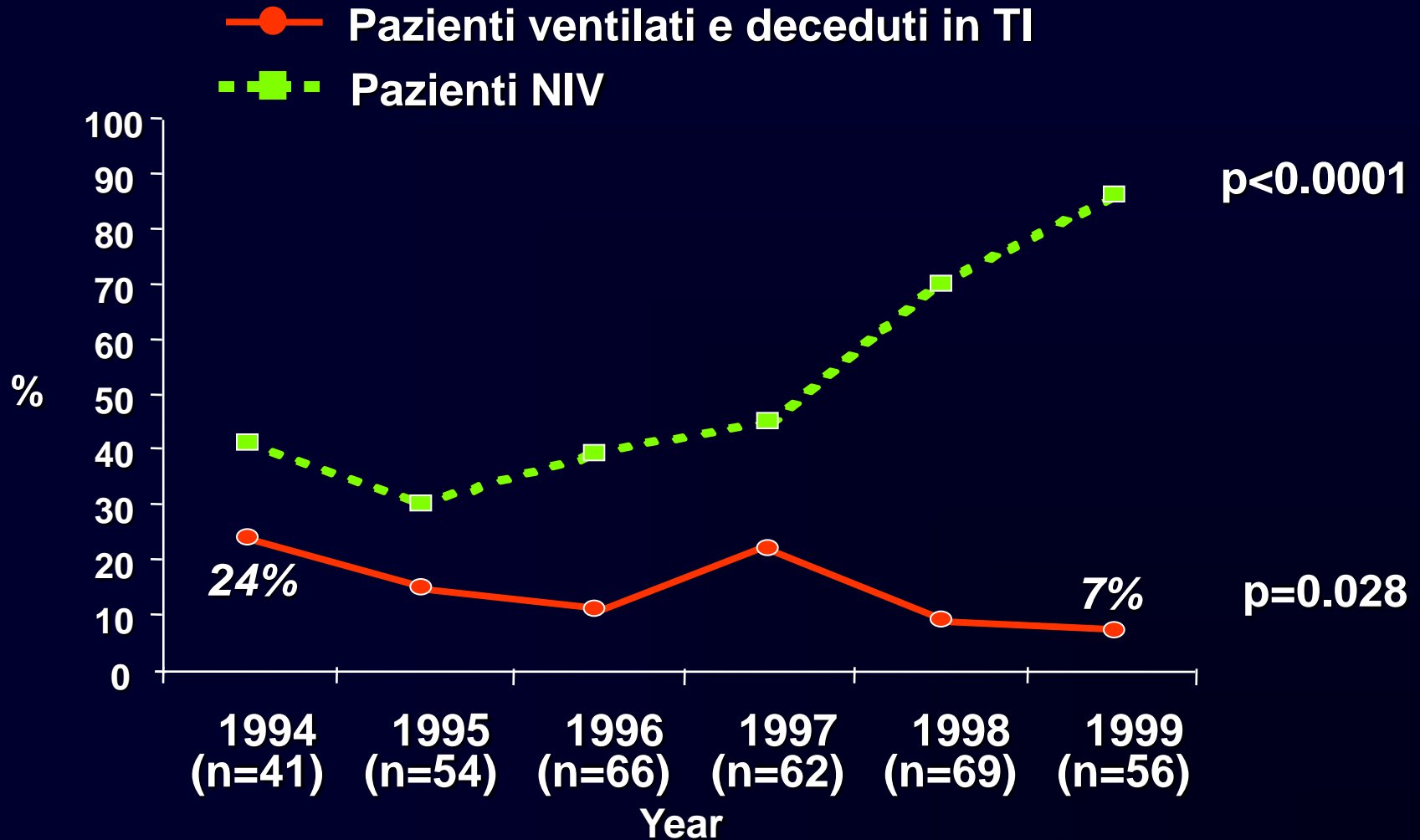
***Azienda Ospedaliera Universitaria “Maggiore della Carità” – Novara***

Alexandre Demoule  
Emmanuelle Girou  
Jean-Christophe Richard  
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Laurent Brochard

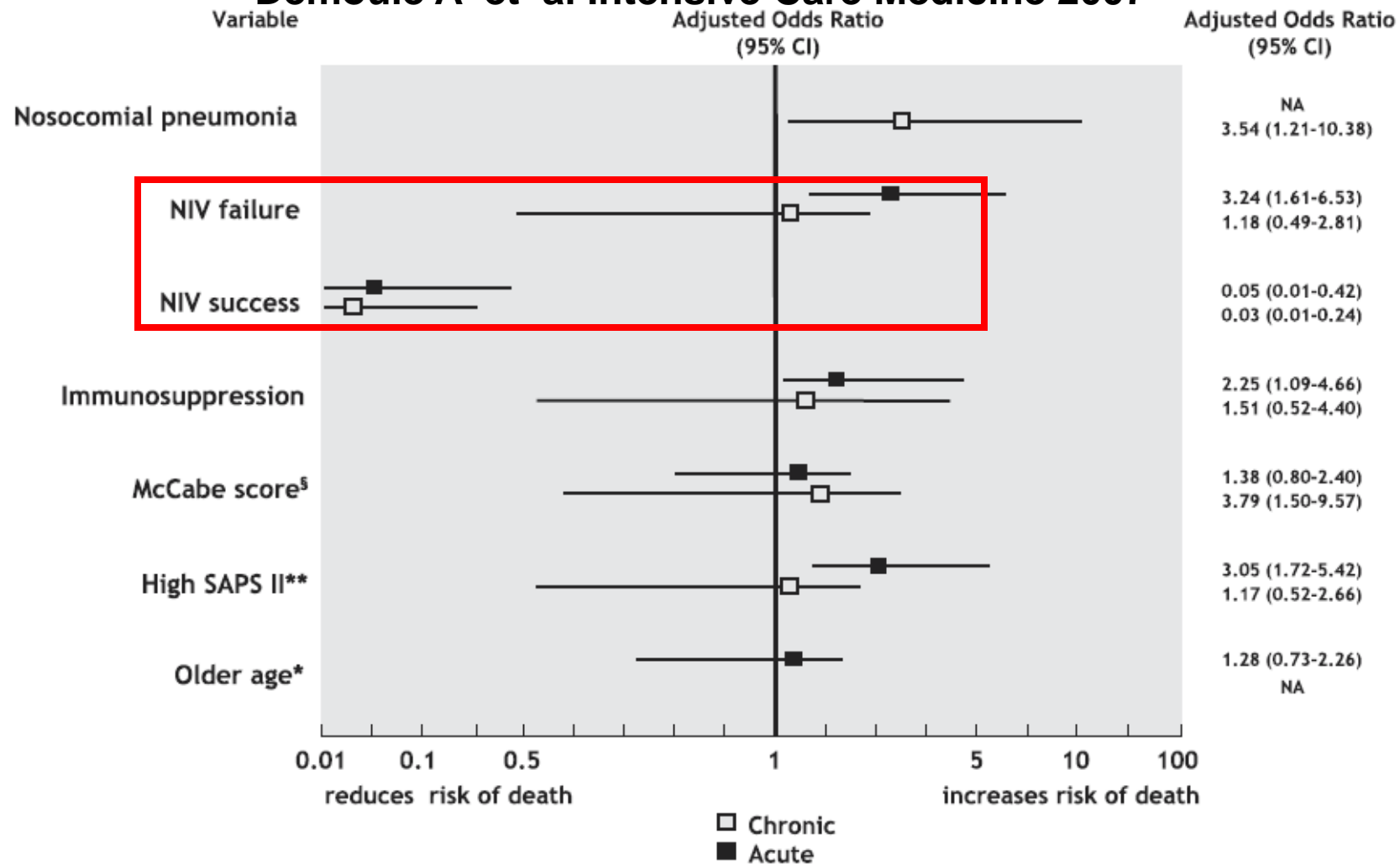
## Increased use of noninvasive ventilation in French intensive care units



# Trend di mortalità in terapia intensiva per BPCO ed EPA



Girou et al. JAMA 2002



**Fig.1** Independent risk factors for death in patients with acute *de novo* respiratory failure (*de novo*, black squares) and in those with cardiogenic pulmonary edema or acute-on-chronic respiratory failure (*CPE-AOC*, white squares). In all multivariate analyses presented in the figures ventilatory support was entered as a single variable with three distinct categories: invasive mechanical ventilation was the reference category with an OR at 1.00 and was compared to NIV success and NIV failure. NA Not available

(variable not entered in the logistic regression model); NIV non-invasive ventilation; SAPS Simplified Acute Physiology Score; \*age above 64 years in patients with acute *de novo* respiratory failure and 72 years in those with cardiogenic pulmonary edema or acute-on-chronic respiratory failure; \*\*SAPS II above 47 points in patients with acute *de novo* respiratory failure and 38 points in those with cardiogenic pulmonary edema or acute-on-chronic respiratory failure; § presence of an ultimately or rapidly fatal disease

## ADVANCES IN MECHANICAL VENTILATION

MARTIN J. TOBIN, M.D.

N Engl J Med, Vol. 344, No. 26 • June 28, 2001

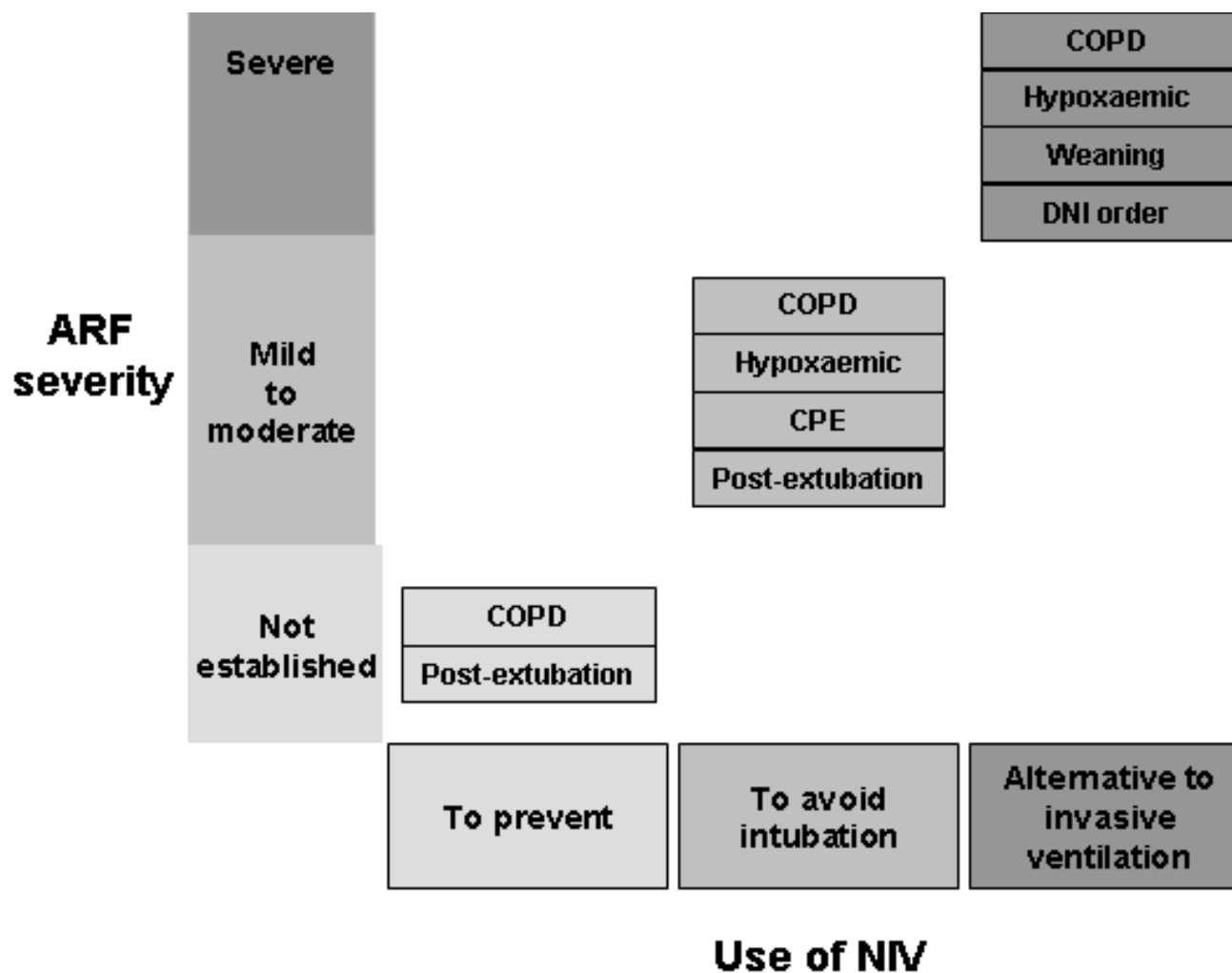
The objectives of mechanical ventilation are primarily to decrease the work of breathing and reverse life-threatening hypoxemia or acute progressive respiratory acidosis.

# **Perchè usare la NIV?**

- 1. Per prevenire l'intubazione**
- 2. Per evitare l'intubazione**
- 3. Come alternativa all'intubazione**

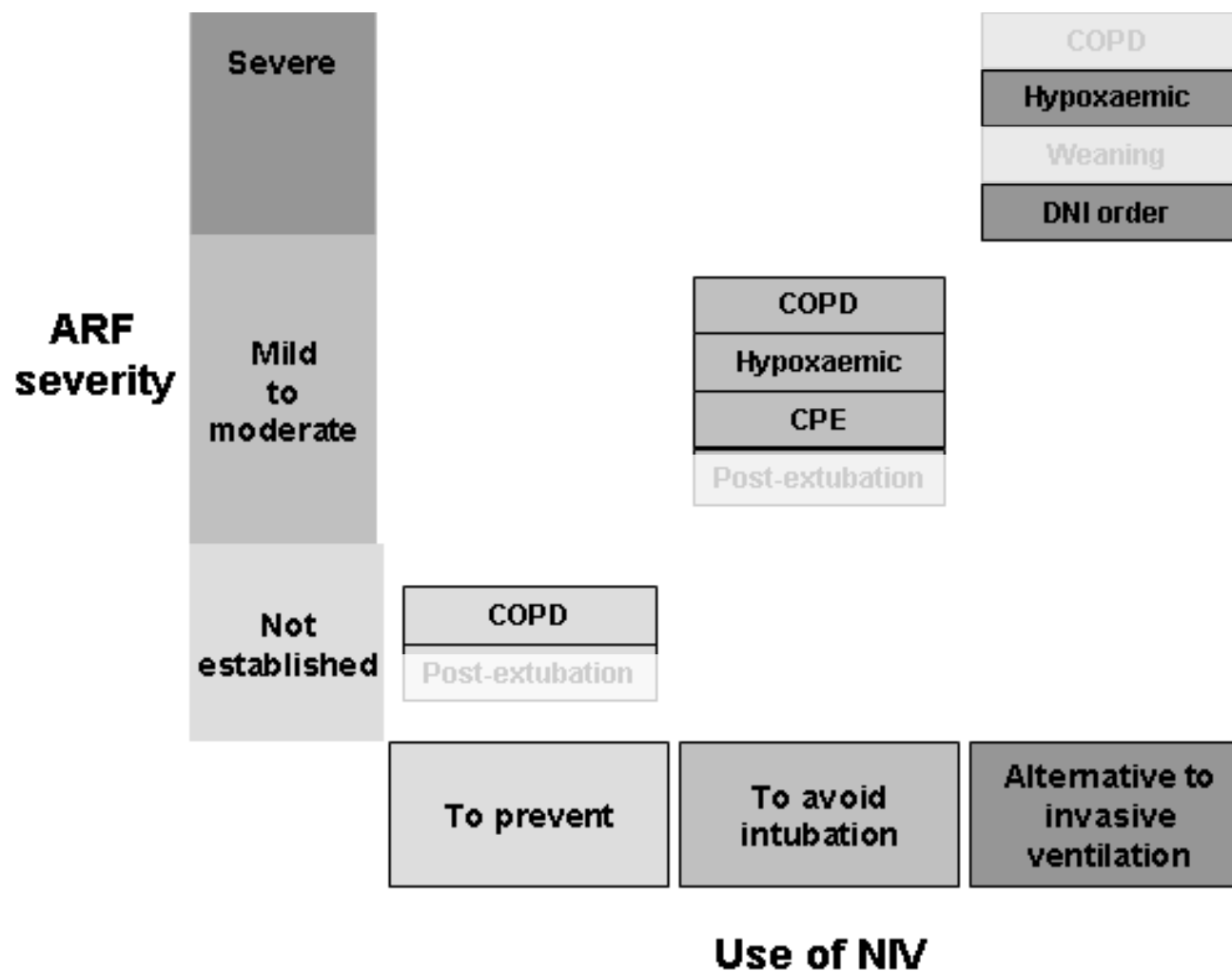
Stefano Nava  
Paolo Navalesi  
Giorgio Conti

## Time of non-invasive ventilation



Stefano Nava  
Paolo Navalesi  
Giorgio Conti

## Time of non-invasive ventilation





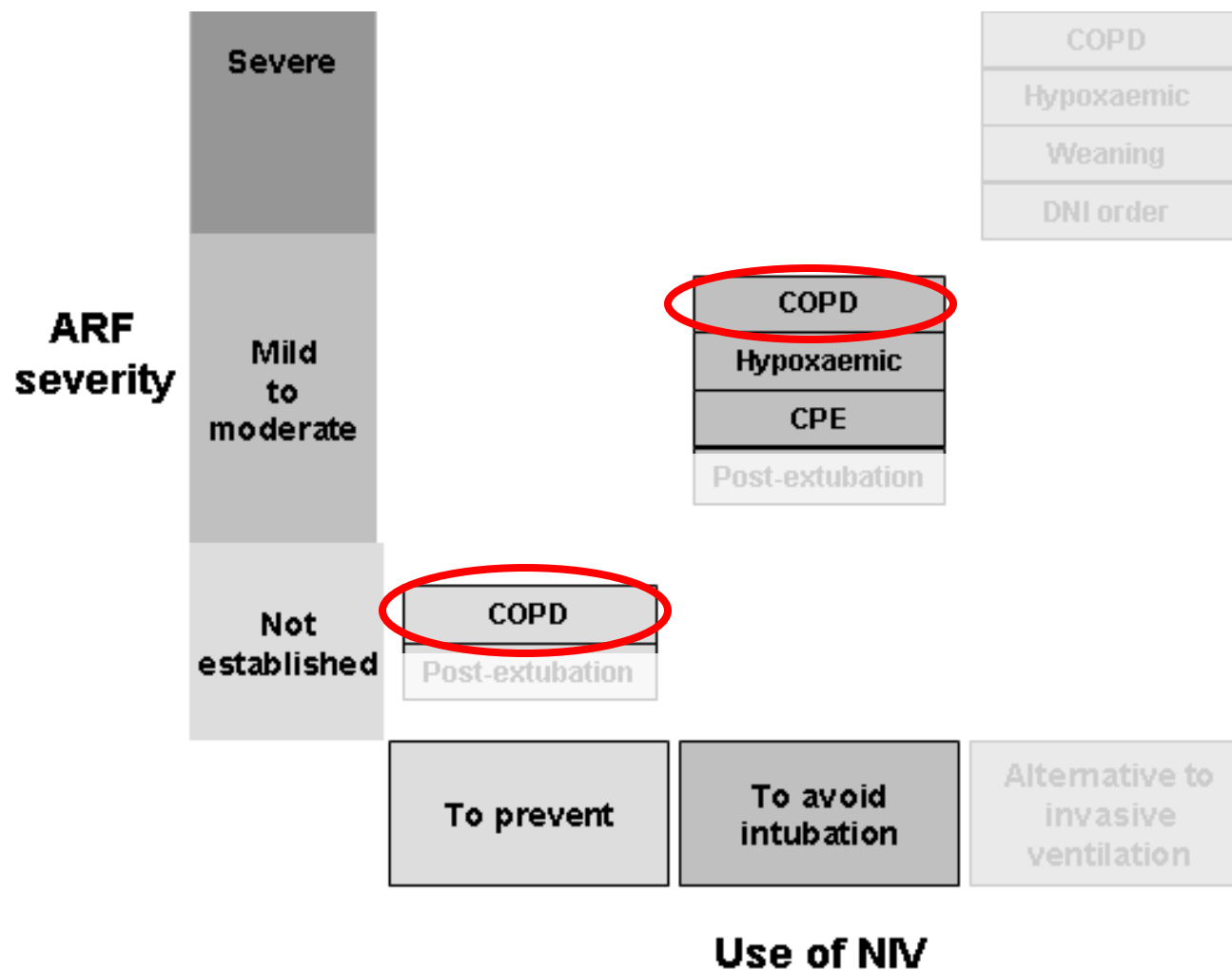
# Candidati alla NIV

- BPCO
- Ipossiemicici
- EPA
- DNI (do not intubate)

**BPCO**

Stefano Nava  
Paolo Navalesi  
Giorgio Conti

## Time of non-invasive ventilation



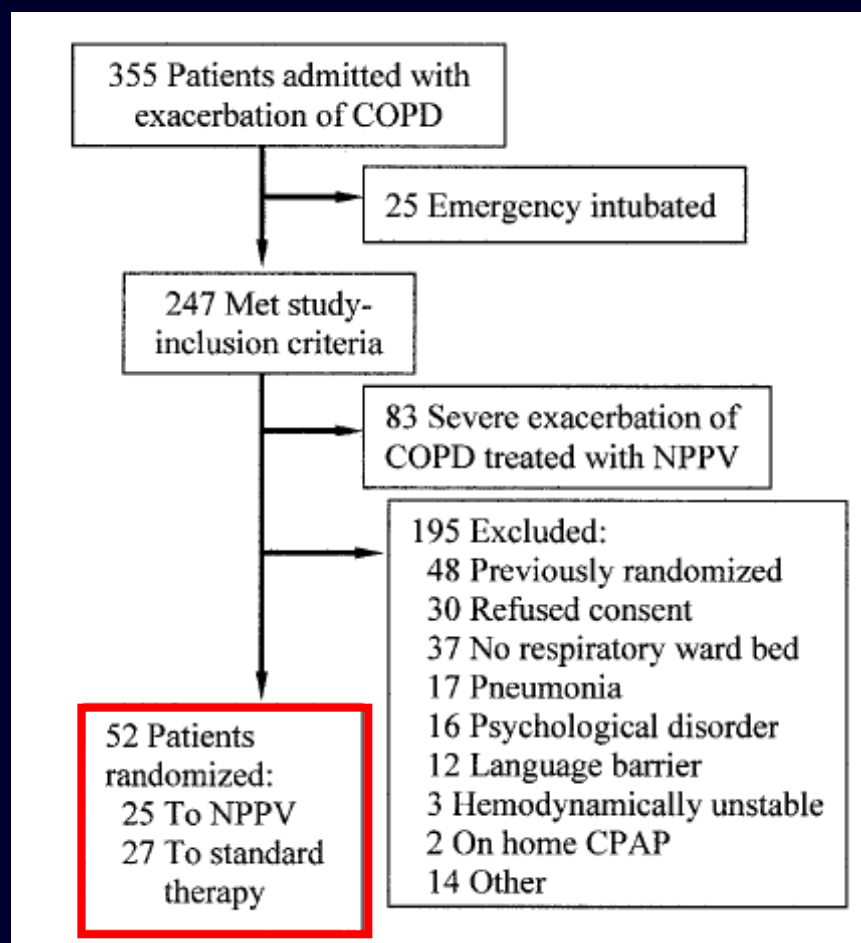
# **NIV in BPCO**

**Molto precocemente  
per prevenire l'acidosi respiratoria ....**

# Noninvasive Positive-Pressure Ventilation in Patients With Milder Chronic Obstructive Pulmonary Disease Exacerbations: A Randomized Controlled Trial

Sean P Keenan MD MSc, Caroline E Powers RRT, and David G McCormack MD

[Respir Care 2005;50(5):610–616. © 2005]



# Noninvasive Positive-Pressure Ventilation in Patients With Milder Chronic Obstructive Pulmonary Disease Exacerbations: A Randomized Controlled Trial

Sean P Keenan MD MSc, Caroline E Powers RRT, and David G McCormack MD

[Respir Care 2005;50(5):610–616. © 2005]

Table 1. Baseline Characteristics and Co-interventions

Characteristic	NPPV (n = 25)	Control (n = 27)	p
Age (mean ± SD)	69 ± 9	71 ± 8	0.447
Sex (male/female)	10/15	14/13	0.392
FEV <sub>1</sub> (% of predicted)*	36 ± 12	31 ± 15	0.187
BMI (kg/m <sup>2</sup> )	24 ± 7	23 ± 6	0.611
APACHE II	17 ± 4	19 ± 5	0.125
P <sub>a</sub> CO <sub>2</sub> (mm Hg)	50 ± 15	51 ± 17	0.924
pH	7.40 ± 0.04	7.40 ± 0.05	0.961
Borg score	5.7 ± 2.4	6.1 ± 2.5	0.566
History of prior endotracheal intubation	2/25	3/27	0.704

# Noninvasive Positive-Pressure Ventilation in Patients With Milder Chronic Obstructive Pulmonary Disease Exacerbations: A Randomized Controlled Trial

Sean P Keenan MD MSc, Caroline E Powers RRT, and David G McCormack MD

[Respir Care 2005;50(5):610–616. © 2005]

Seventeen patients were compliant with NPPV for 2 days and 12 patients for the full 3 days prescribed.

## **CONCLUSIONI:**

**L'efficacia della NIV in aggiunta alla terapia standard nei BPCO di media gravità rimane ancora poco chiara.**

# **NIV in BPCO**

**Precocemente  
per evitare l'intubazione....**



# CONSENSUS CONFERENCE

## **International Consensus Conferences in Intensive Care Medicine: Noninvasive Positive Pressure Ventilation in Acute Respiratory Failure**

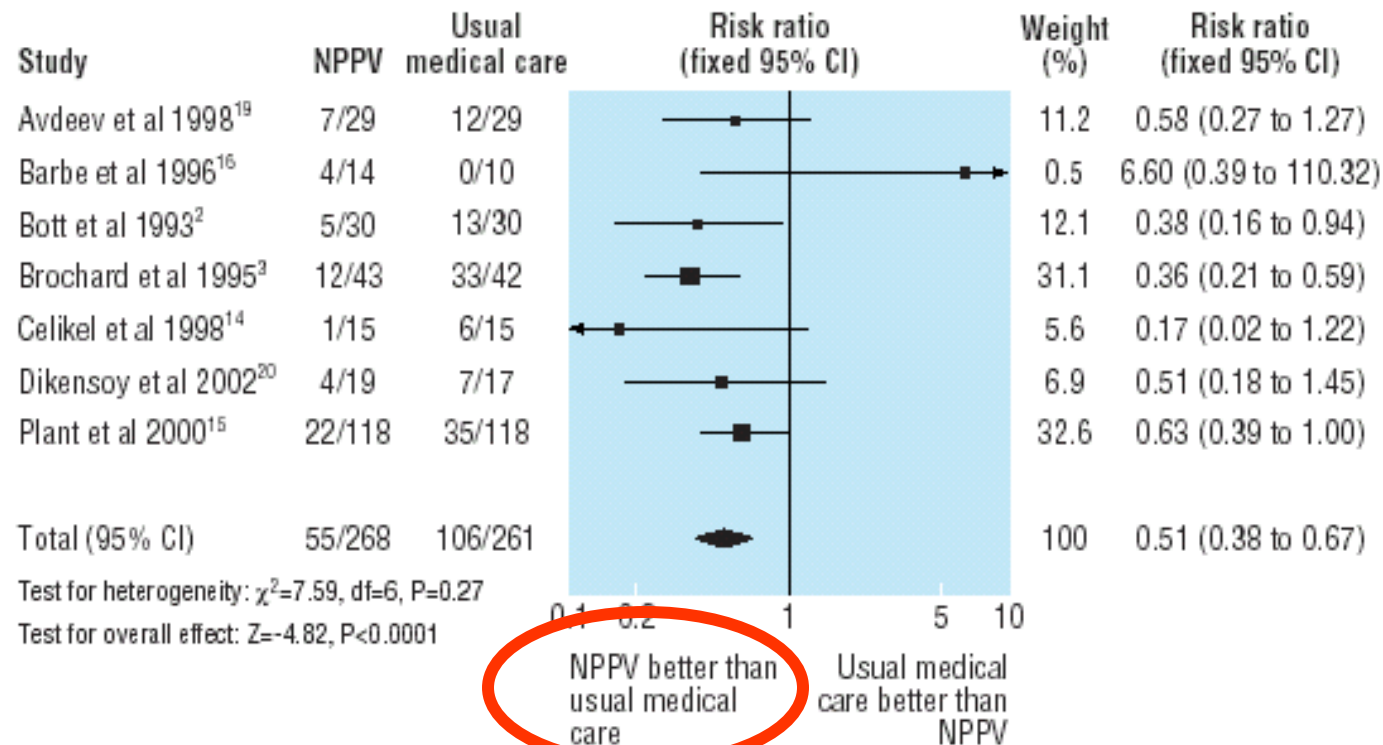
Am J Respir Crit Care Med Vol 163. pp 283–291, 2001

### **Raccomandazioni :**

**Nei pazienti ospedalizzati per riacutizzazione di BPCO, con rapido deterioramento clinico, l'utilizzo della NIV va considerato per prevenire l'ulteriore deterioramento degli scambi gassosi, l'aumento del lavoro respiratorio e la necessità di intubazione.**

# Non-invasive positive pressure ventilation to treat respiratory failure resulting from exacerbations of chronic obstructive pulmonary disease: Cochrane systematic review and meta-analysis

Josephine V Lightowler, Jadwiga A Wedzicha, Mark W Elliott, Felix S F Ram



**Fig 2** Risk of treatment failure (mortality, need for intubation, and intolerance) in seven studies of non-invasive positive pressure ventilation (NPPV) as an adjunct to usual medical care

# Non-invasive ventilation in acute respiratory failure

British Thoracic Society Standards of Care Committee

Non-invasive ventilation in acute respiratory failure

*Thorax* 2002;57:192-211

## Key points

- Non-invasive ventilation (NIV) works – an evidence-based verdict
- NIV can be used in any hospital given the following minimum facilities:
  - A consultant committed to developing an NIV service
  - Nurses on a respiratory ward, high dependency unit, or intensive care unit who are keen to be involved in NIV
  - An intensive care unit to provide back up for patients who do not improve on NIV
  - A non-invasive ventilator and a selection of masks
- NIV is particularly indicated in:
  - COPD with a respiratory acidosis pH 7.25–7.35 ( $H^+$  45–56 nmol/l)
  - Hypercapnic respiratory failure secondary to chest wall deformity (scoliosis, thoracoplasty) or neuromuscular diseases
  - Cardiogenic pulmonary oedema unresponsive to CPAP
  - Weaning from tracheal intubation
- NIV is *not* indicated in:
  - Impaired consciousness
  - Severe hypoxaemia
  - Patients with copious respiratory secretions

# **NIV in BPCO**

**Come alternativa all'intubazione...**

# Domanda n°1

**Può la NIV essere un'alternativa alla ventilazione invasiva nei BPCO con grave insuff. respiratoria tale da richiedere ventilazione meccanica ma non necessariamente l'intubazione (pz capaci di espettorare, collaboranti ed emodinamicamente stabili)?**



# Risultati

	Noninvasive ventilation group (n=23)		Conventional ventilation group (n=26)		<i>p</i>
	<i>n</i>	%	<i>n</i>	%	
<b>Patients with complications</b>	<b>6</b>	<b>26</b>	<b>11</b>	<b>42</b>	<b>0.37</b>
Patients with complications causing death	5	22	4	15	0.41
<b>Death after discharge from ICU</b>	<b>1</b>	<b>4.3</b>	<b>1</b>	<b>3.8</b>	<b>0.72</b>
Ventilator-associated pneumonia	3	13	9	34	0.07
Septic shock	5	22	4	15	0.41
Sepsis or severe sepsis	1	4	9	34	0.009
Acute renal failure	1	4	0	0	0.46
Pneumothorax	1	4	0	0	0.46
Urinary tract infection	0	0	2	8	0.27
Gastrointestinal bleeding	0	0	1	4	0.58
Other	1	4	2	8	0.54
Tracheostomy	3	13	6	23	0.29
Home ventilation	0	0	1	4	0.53

# Domanda n° 2

**Può il ritardo nella ventilazione e nell'intubazione essere un danno nei pz in cui fallisce la NIV?**



	Noninvasive ventilation group (n=23)		<i>p</i>
	Intubation not required (n=11)	Intubation required (n=12)	
Age (years)	74.4±4	72.5±8	0.47
Simplified Acute Physiology Score II	35±2.3	39±6	0.04
Kelly score	1.7±0.4	3±0.5	0.0001
Number of invasive devices	3±0.5	4.6±0.7	0.0001
Patients improved at 1 h	4 (36%)	4 (33%)	0.61
Duration of mechanical ventilation (days)	3±1.4	16±19	0.03
Length of ICU stay (days)	7±2.4	22±19	0.02
ICU survivors	11 (100%)	7 (58%)	0.02
Hospital survivors	10 (91%)	7 (58%)	0.02
Septic complications <sup>a</sup>	0 (0%)	6 (50%)	0.009

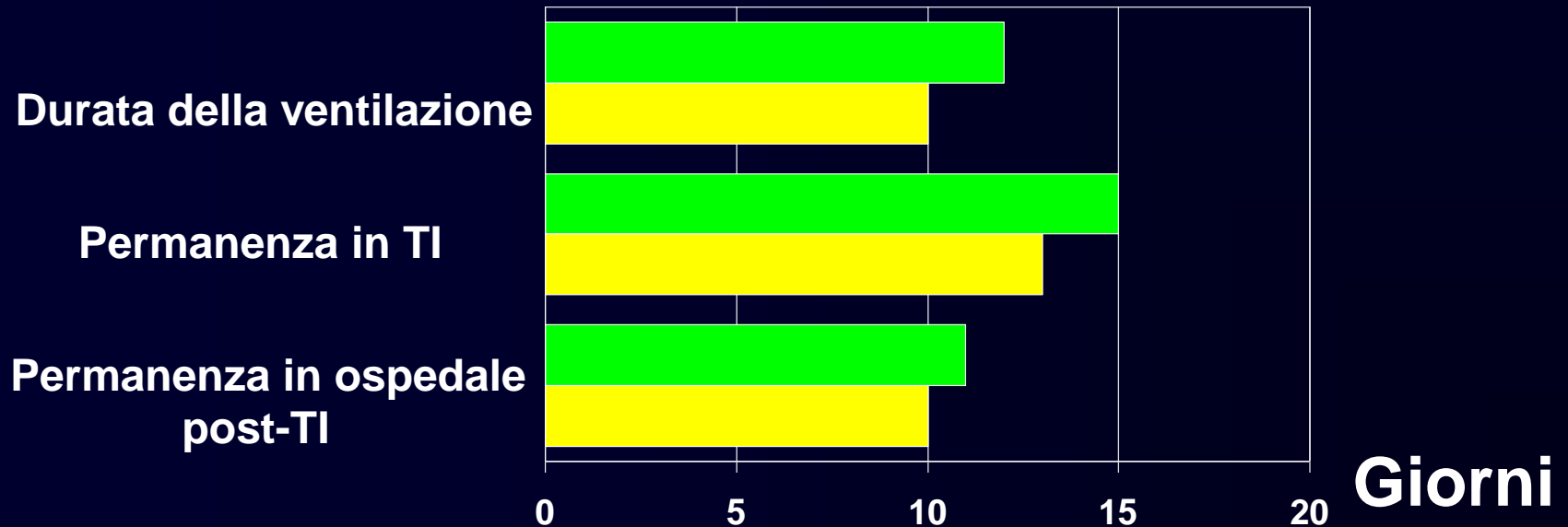
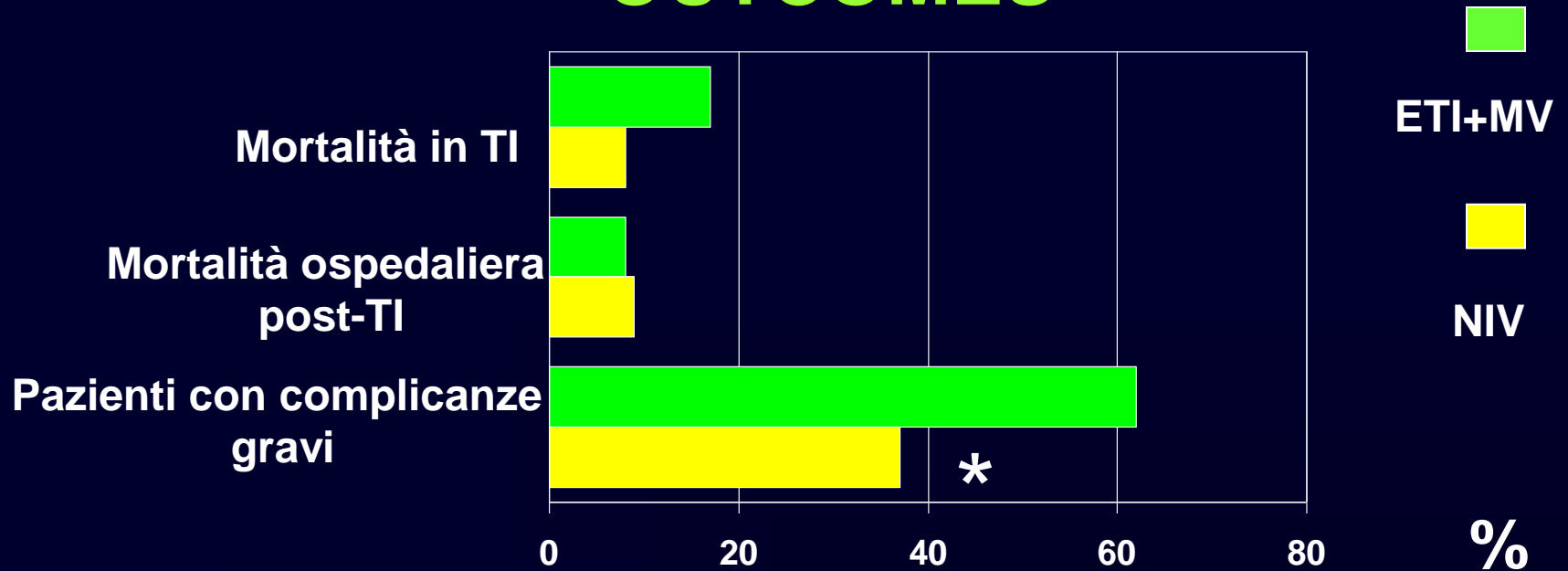
**Conti G. et al. Intensive Care Medicine 2002**



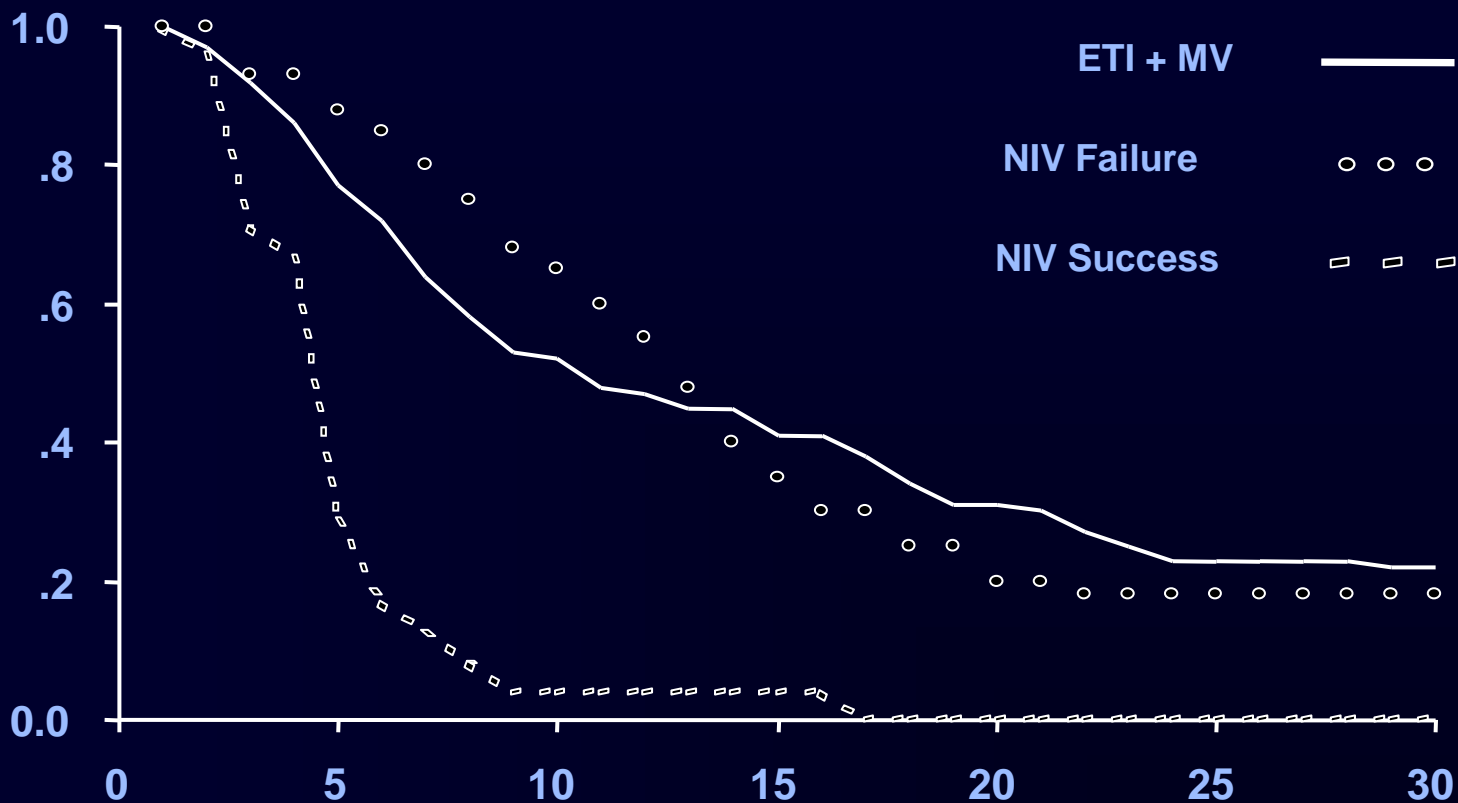
Enzo Squadrone  
Pamela Frigerio  
Claudio Fogliati  
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Massimo Antonelli  
Roberta Costa  
Paola Baiardi  
Paolo Navalesi

**Noninvasive vs invasive ventilation  
in COPD patients with severe acute  
respiratory failure deemed  
to require ventilatory assistance**

# OUTCOMES

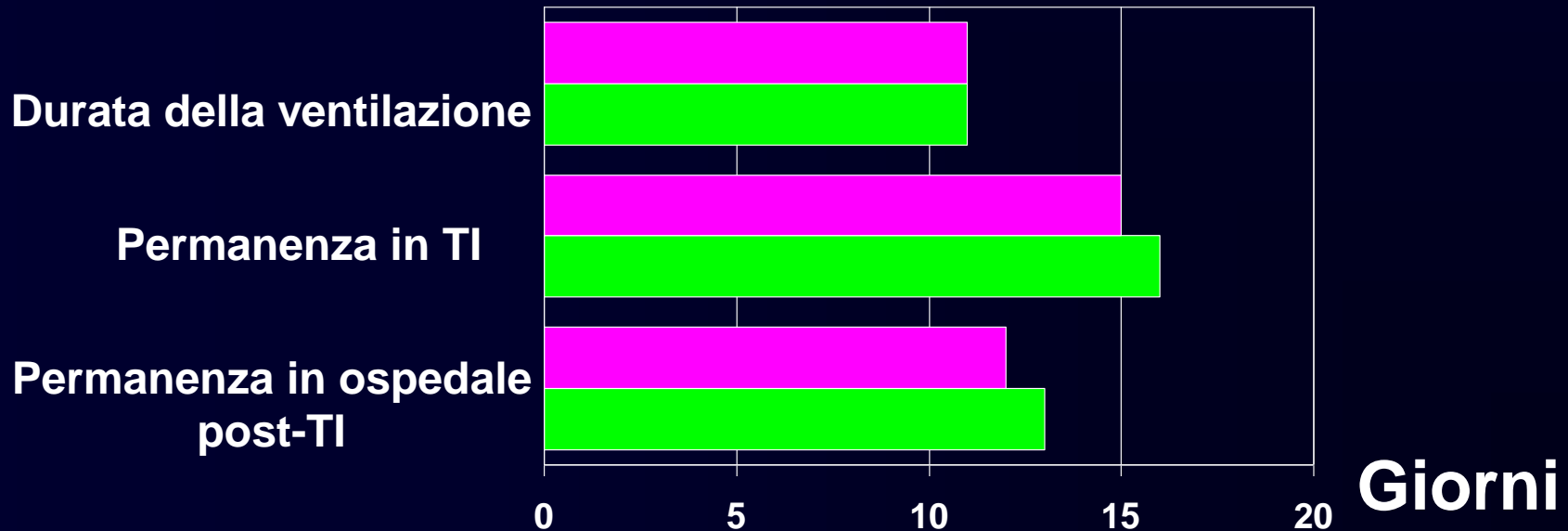
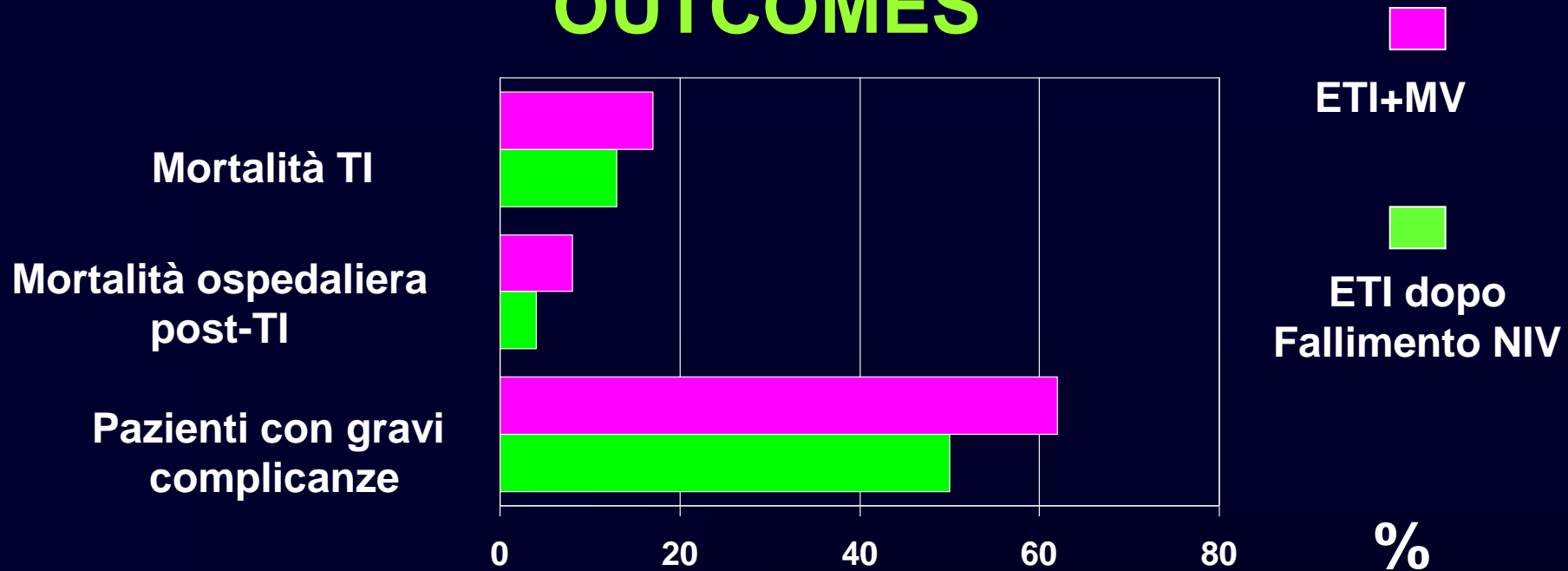


Patients remaining on  
mechanical ventilation (%)



Days

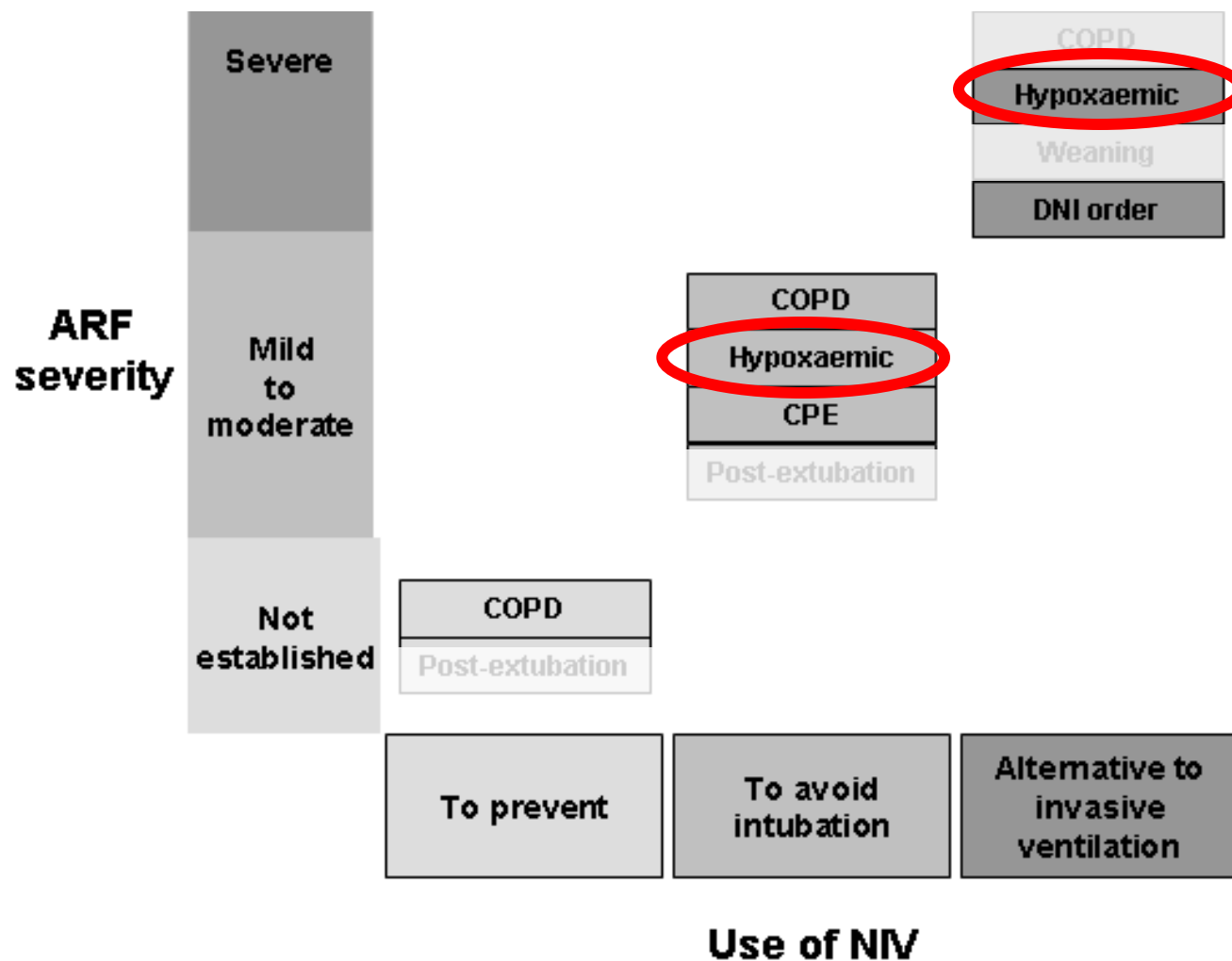
# OUTCOMES



**Insuff. Resp. Acuta  
Ipossiémica**

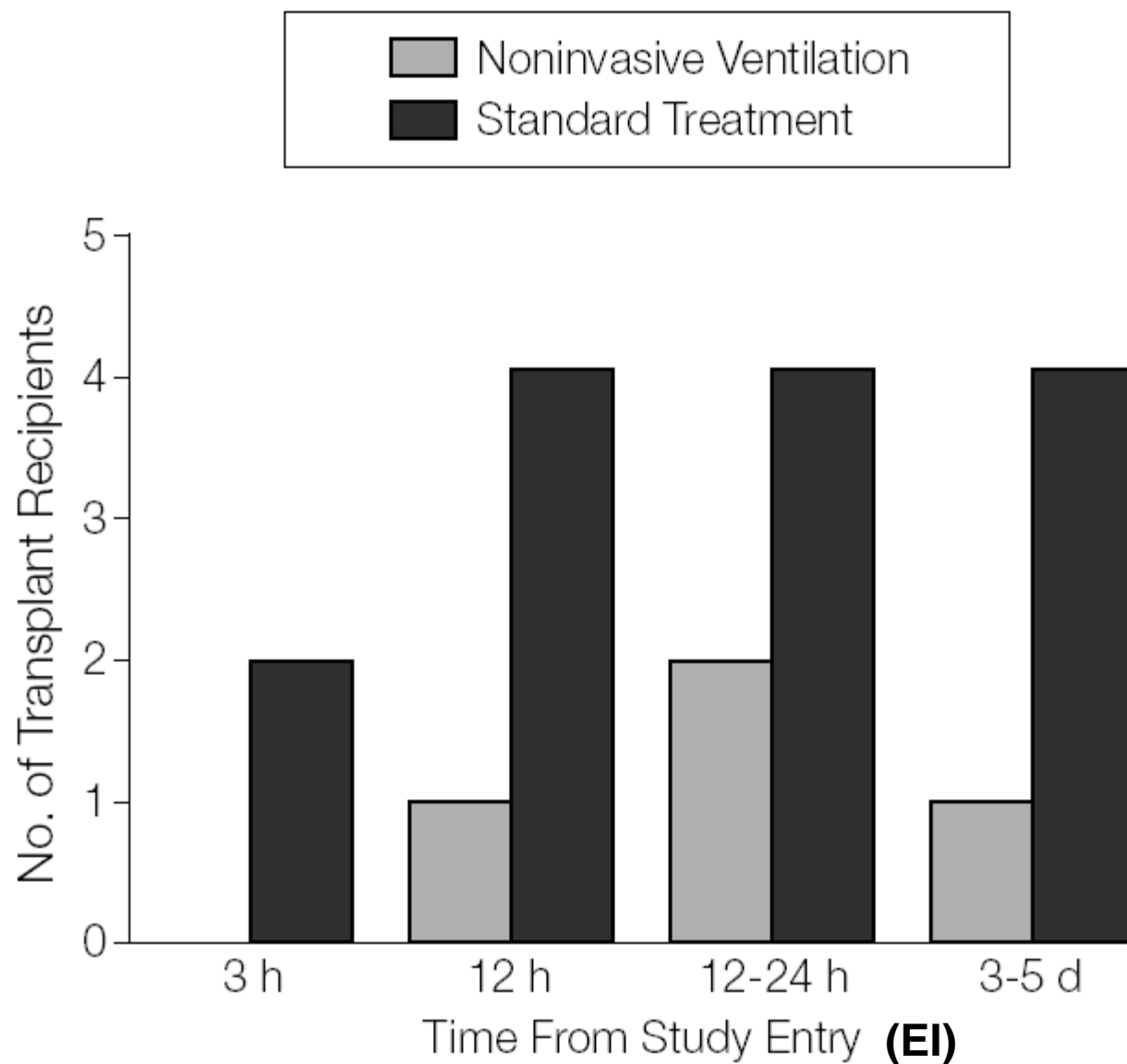
Stefano Nava  
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Giorgio Conti

## Time of non-invasive ventilation



# **NIV in Ipossiémico**

**Precocemente,  
per evitare l'intubazione.**



from Antonelli et al.

*JAMA. 2000;283:235-241*



TABLE 2. OUTCOMES OF TREATMENT.\*

OUTCOME	NONINVASIVE- VENTILATION GROUP (N=26)	STANDARD- TREATMENT GROUP (N=26)	P VALUE	RELATIVE RISK (95% CI)
Intubation — no./total no. (%)	12/26 (46)	20/26 (77)	0.03	0.60 (0.38–0.96)
Immunosuppression from hematologic cancer and neutropenia	8/15 (53)	14/15 (93)	0.02	0.57 (0.35–0.93)
Drug-induced immunosuppression	3/9 (33)	5/9 (56)	0.32	0.60 (0.20–1.79)
Immunosuppression from the acquired immunodeficiency syndrome	1/2 (50)	1/2 (50)	0.83	1.00 (0.14–7.10)
Initial improvement in PaO <sub>2</sub> :FiO <sub>2</sub> — no. (%)	12 (46)	4 (15)	0.02	
Sustained improvement in PaO <sub>2</sub> :FiO <sub>2</sub> without intubation — no. (%)	13 (50)	5 (19)	0.02	
Death in the ICU — no./total no. (%)†	10/26 (38)	18/26 (69)	0.03	0.56 (0.32–0.96)
Immunosuppression from hematologic cancer and neutropenia	7/15 (47)	13/15 (87)	0.02	0.54 (0.30–0.96)

**Conclusioni : nell'immunodepresso l'inizio precoce della NIV è associato a riduzione della frequenza di intubazione e gravi complicanze e migliora la probabilità di sopravvivenza alla dimissione.**

# **International Consensus Conferences in Intensive Care Medicine: Noninvasive Positive Pressure Ventilation in Acute Respiratory Failure**

ORGANIZED JOINTLY BY THE AMERICAN THORACIC SOCIETY, THE EUROPEAN RESPIRATORY SOCIETY, THE EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE, AND THE SOCIÉTÉ DE RÉANIMATION DE LANGUE FRANÇAISE, AND APPROVED BY THE ATS BOARD OF DIRECTORS, DECEMBER 2000

Larger, controlled studies are required to determine the potential benefit of adding NPPV to standard medical treatment in the avoidance of ETI in hypoxemic ARF.

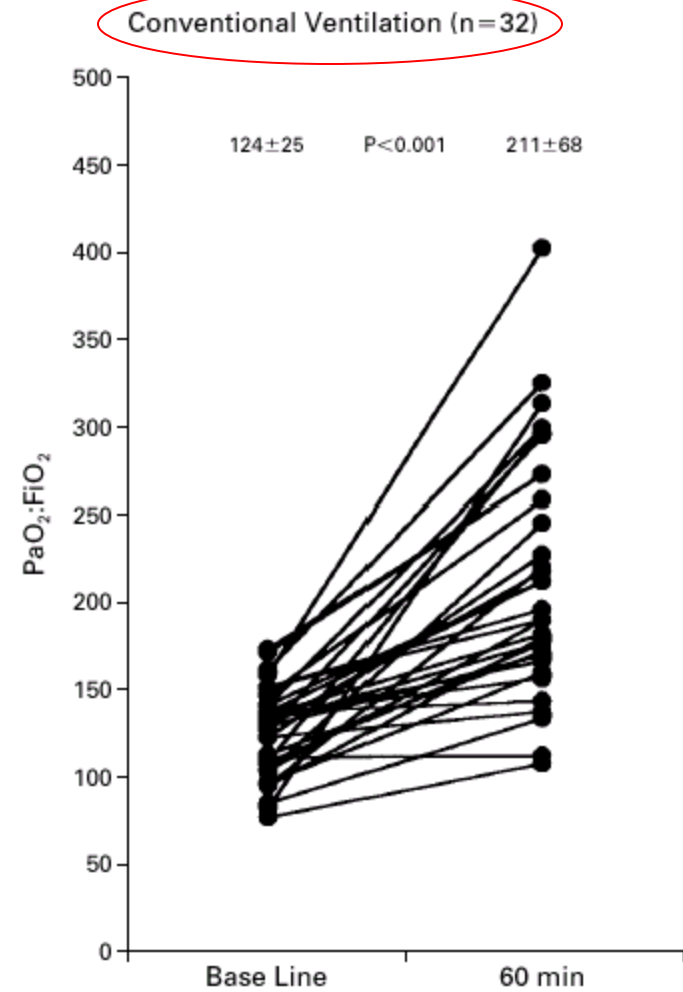
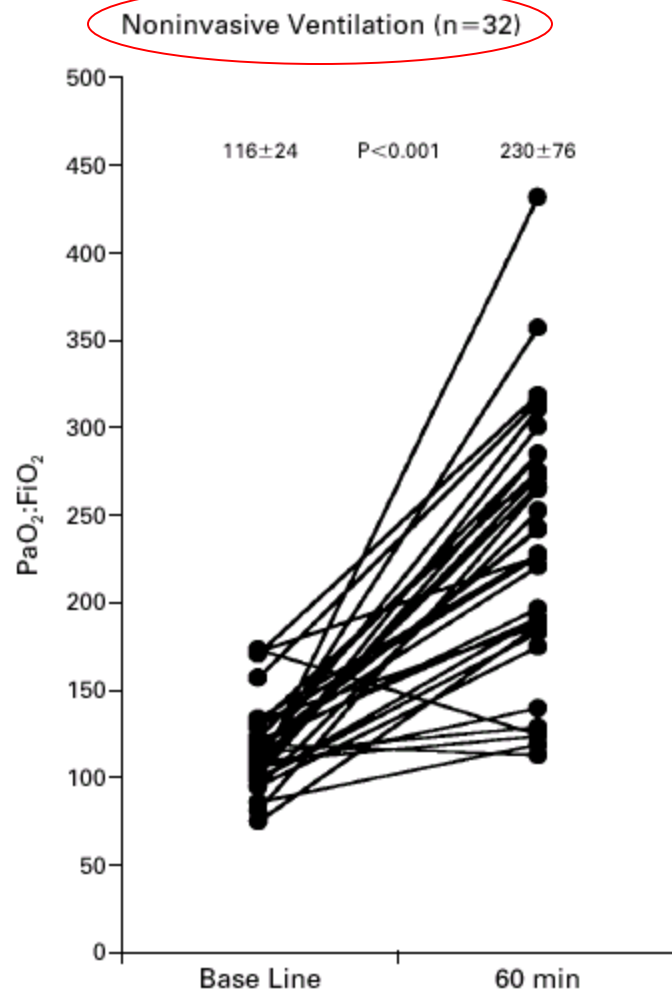
# **International Consensus Conferences in Intensive Care Medicine: Noninvasive Positive Pressure Ventilation in Acute Respiratory Failure**

ORGANIZED JOINTLY BY THE AMERICAN THORACIC SOCIETY, THE EUROPEAN RESPIRATORY SOCIETY, THE EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE, AND THE SOCIÉTÉ DE RÉANIMATION DE LANGUE FRANÇAISE, AND APPROVED BY THE ATS BOARD OF DIRECTORS, DECEMBER 2000

The addition of NPPV to standard medical treatment of patients with ARF may prevent ETI, and reduce the rate of complications and mortality in patients with hypercapnic ARF.

# **NIV in Ipossiémico**

**In alternativa all'intubazione.**



**TABLE 2. SERIOUS COMPLICATIONS AND COMPLICATIONS RESULTING IN DEATH.**



VARIABLE*	NONINVASIVE- VENTILATION GROUP (N= 32)	CONVENTIONAL- VENTILATION GROUP (N= 32)
Patients with complications — no. (%)†	12 (38)	21 (66)
Patients with complications causing death in ICU — no.	9	15
No. of complications per patient‡	1.3	1.7
Death after discharge from ICU — no.	1	1
Complications — total no./no. causing death in ICU (% of group)§		
Myocardial infarction or cardiogenic shock	2/2 (6)	4/4 (12)
Sepsis¶	6/5 (19)	11/6 (34)
Renal failure	3/0 (9)	5/0 (16)
Pancreatitis	1/0 (3)	1/1 (3)
Polyneuropathy of the critically ill	0/0	1/0 (3)
Pneumonia	1/0 (3)	8/2 (25)§
Sinusitis	0/0	2/0 (6)
Pulmonary embolism	0/0	1/1 (3)
Massive blood loss	0/0	1/1 (3)
Infection at study entry**	2/2 (6)	0/0

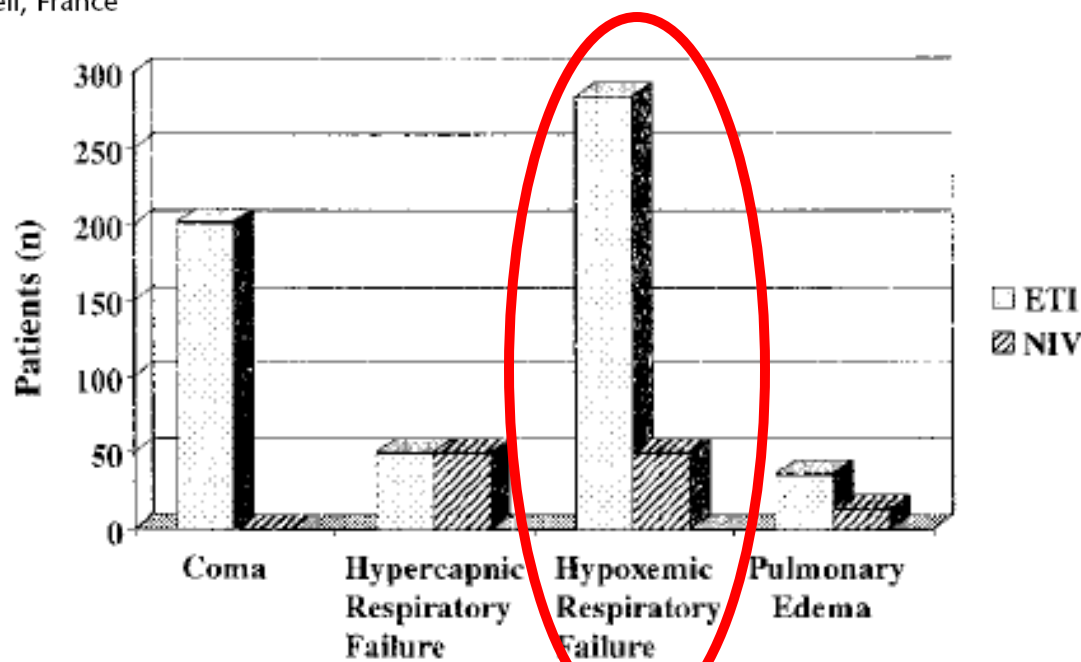
# Noninvasive Versus Conventional Mechanical Ventilation

## An Epidemiologic Survey

Am J Respir Crit Care Med Vol 163. pp 874–880, 2001

ANNALISA CARLUCCI, JEAN-CHRISTOPHE RICHARD, MARC WYSOCKI, ERIC LEPAGE, LAURENT BROCHARD  
and the SRLF Collaborative Group on Mechanical Ventilation

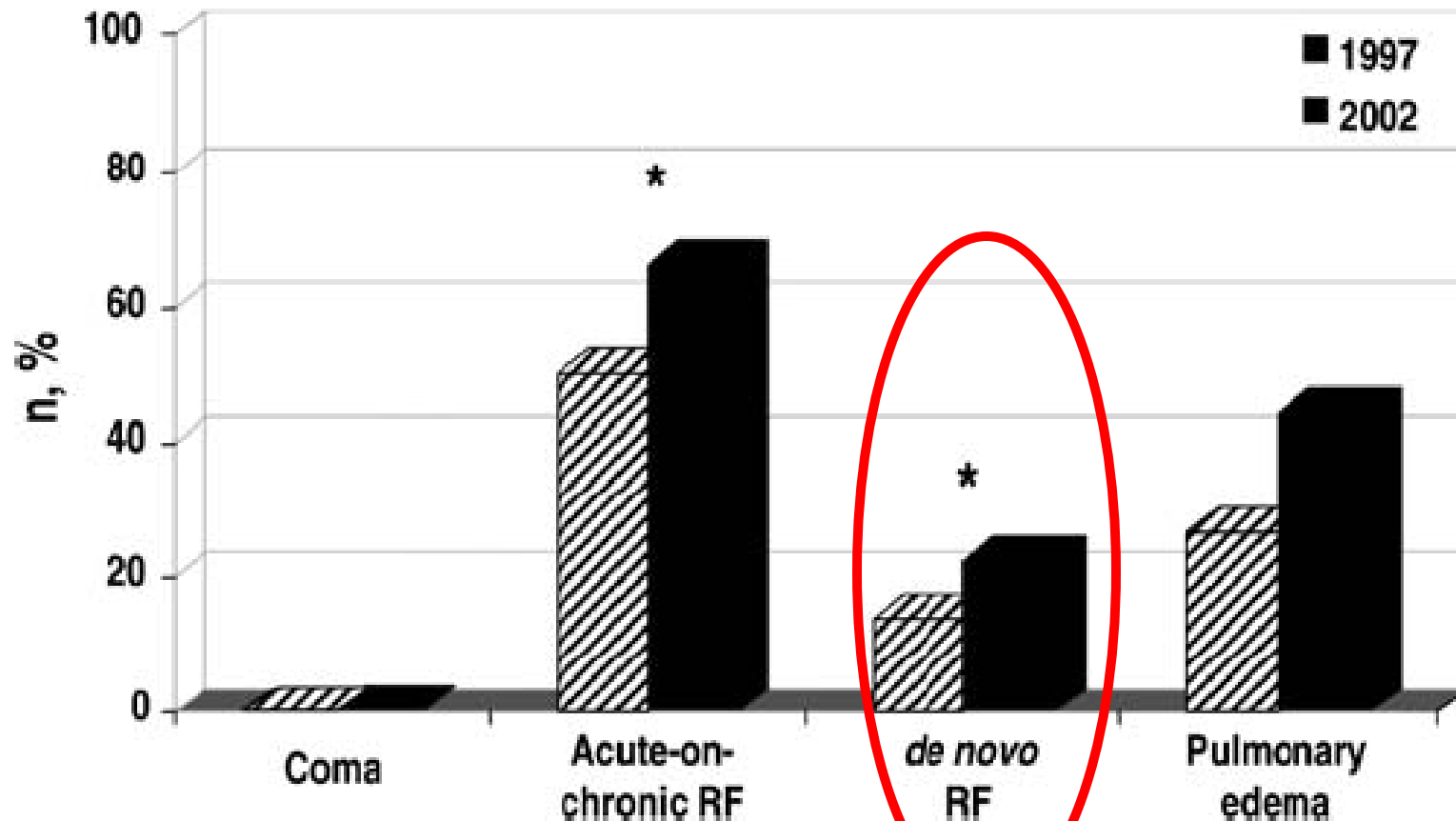
Paris XII Université, Department of Biostatistics, Medical Intensive Care Unit, Institut National de la Recherche et de la Santé Médicale U 492,  
Henri Mondor Hospital, Créteil, France



*Figure 1.* Distribution of the number of patients mechanically ventilated with ETI or NIV in the groups of patients with coma, hypercapnic respiratory failure, hypoxemic respiratory failure, and pulmonary edema.

Alexandre Demoule  
Emmanuelle Girou  
Jean-Christophe Richard  
Solenne Taillé  
Laurent Brochard

## Increased use of noninvasive ventilation in French intensive care units



**Fig. 4** Changes in relative use of noninvasive ventilation between 1997 and 2002, according to the reason for respiratory failure (RF).  
\*  $p < 0.05$  between the two studies



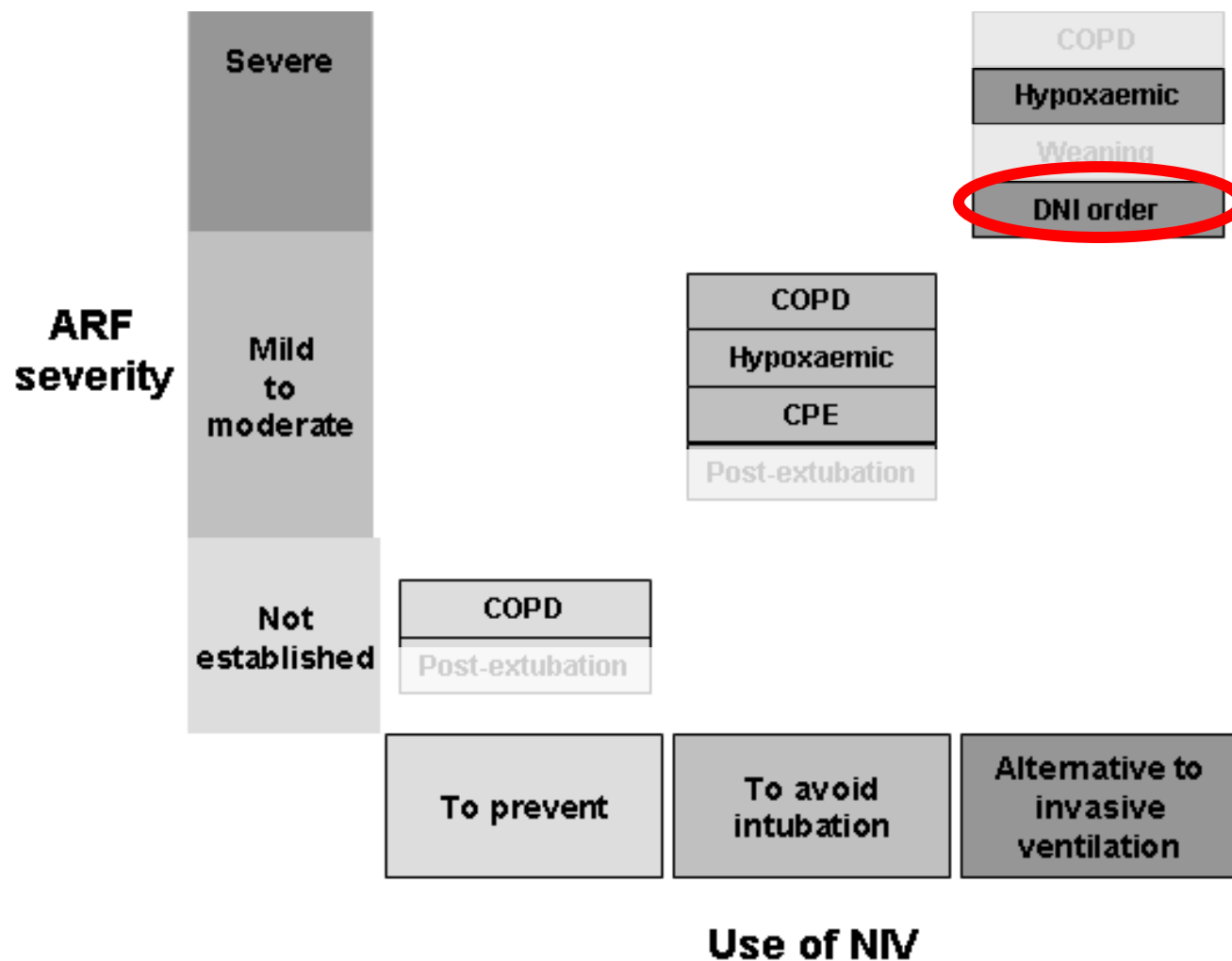
**NIV nell'insuff.respiratoria ipossiémica.....possibile,  
ma occorre attenzione!!!**



**D.N.I.**

Stefano Nava  
Paolo Navalesi  
Giorgio Conti

## Time of non-invasive ventilation



# NIV

## NELLE MALATTIE IN FASE TERMINALE

### Malattie croniche in fase terminale

- BPCO
- Fibrosi polmonare
- Fibrosi cistica
- Malattie neuromuscolari (es.: SLA)

### Tumori

- ematici
- solidi

# Trattamento della dispnea

- **Trattamento farmacologico**
- **Ossigeno**
- **Ventilazione non invasiva (?)**

# **NIV NELLE MALATTIE IN FASE TERMINALE**

- **NIV per trattare acuzie intercorrenti**
- **NIV come terapia palliativa**

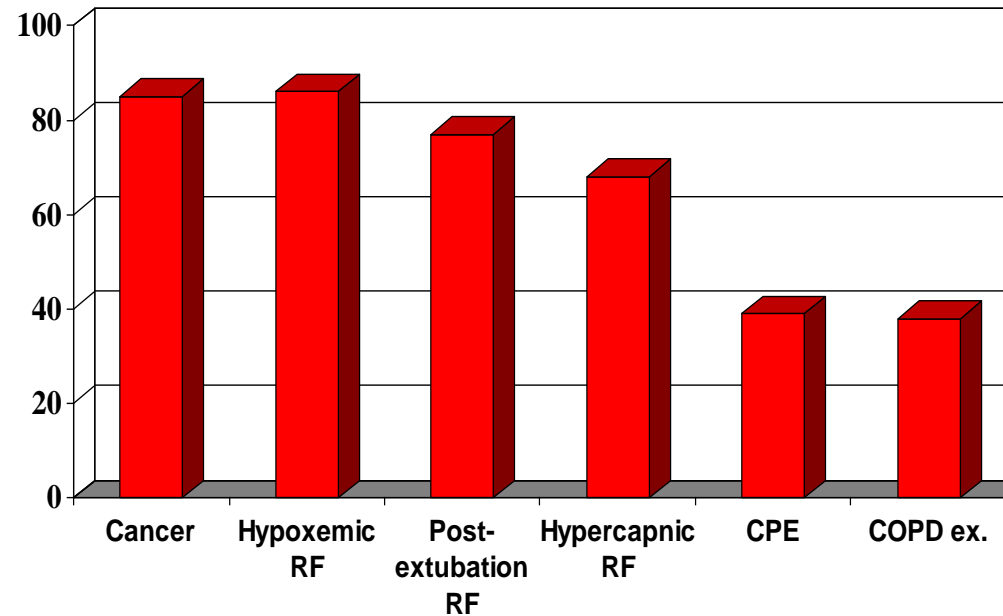
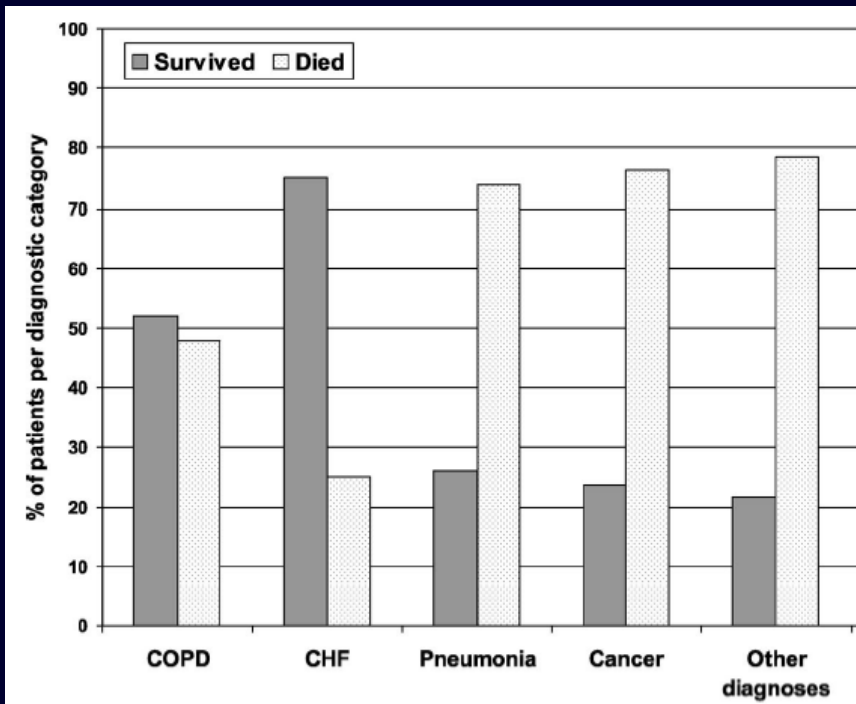
## Outcomes of patients with do-not-intubate orders treated with noninvasive ventilation\*

(Crit Care Med 2004; 32:2002–2007)

Mitchell Levy, MD; Maged A. Tanios, MD, MPH; David Nelson, RRT; Kathy Short, RN, RRT; Anthony Senechia, RRT; John Vespia, CRT; Nicholas S. Hill, MD

## Noninvasive positive pressure ventilation reverses acute respiratory failure in select “do-not-intubate” patients

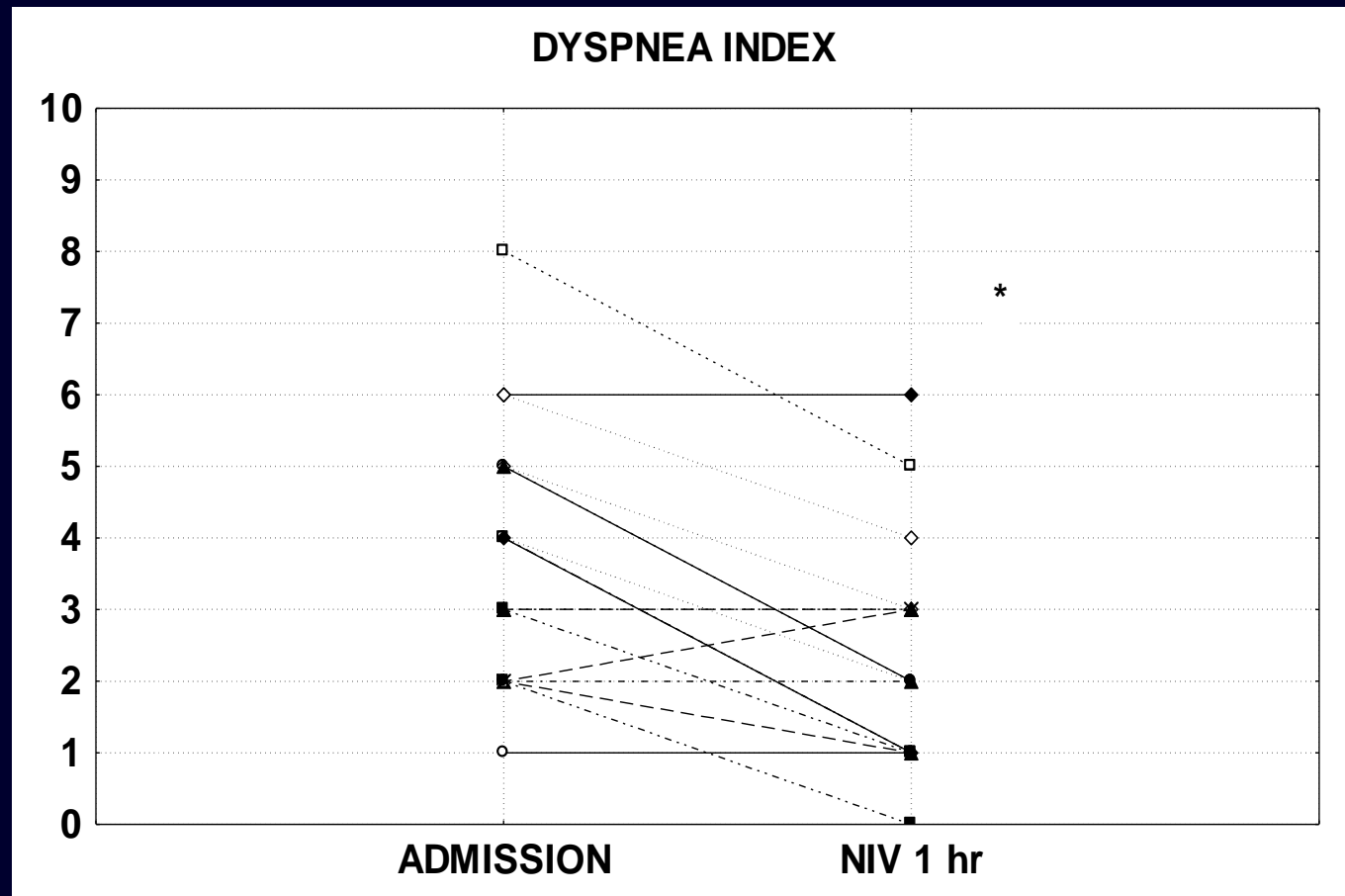
Guilherme Schettino, MD, PhD; Neila Altobelli, RRT; Robert M. Kacmarek, PhD, RRT



## Noninvasive mechanical ventilation as a palliative treatment of acute respiratory failure in patients with end-stage solid cancer

**Annamaria Cuomo** Palliative Care Unit, Fondazione S. Maugeri, IRCCS, Istituto Scientifico di Pavia, Pavia,  
**Monica Delmastro, Piero Ceriana** and **Stefano Nava** Respiratory Unit, Fondazione S. Maugeri, IRCCS, Istituto  
Scientifico di Pavia, Pavia and **Giorgio Conti, Massimo Antonelli** and **Emanuele Iacobone** Intensive Care  
Unit, Università Cattolica, Roma, Italy

### Observational study on 23 patients with solid malignancies





# VENTILAZIONE MECCANICA NONINVASIVA NELLE MALATTIE IN FASE TERMINALE

## NIV COME TERAPIA PALLIATIVA

**↓ dispnea e miglioramento QoL**

**ridurre l'impiego di farmaci**

guadagnare tempo per comunicare e prendere  
decisioni per sé e per i propri cari

**↑ sofferenza**

**prolunga il processo della morte**

**↑ aumenta inutilmente i costi**

# Palliative Care's Place in the Course of Illness



## Definition of Palliative Care

The goal of palliative care is to prevent and relieve suffering and to support the best possible quality of life for patients and their families, regardless of the stage of the disease or the need for other therapies.

(World Health Organization 2002)

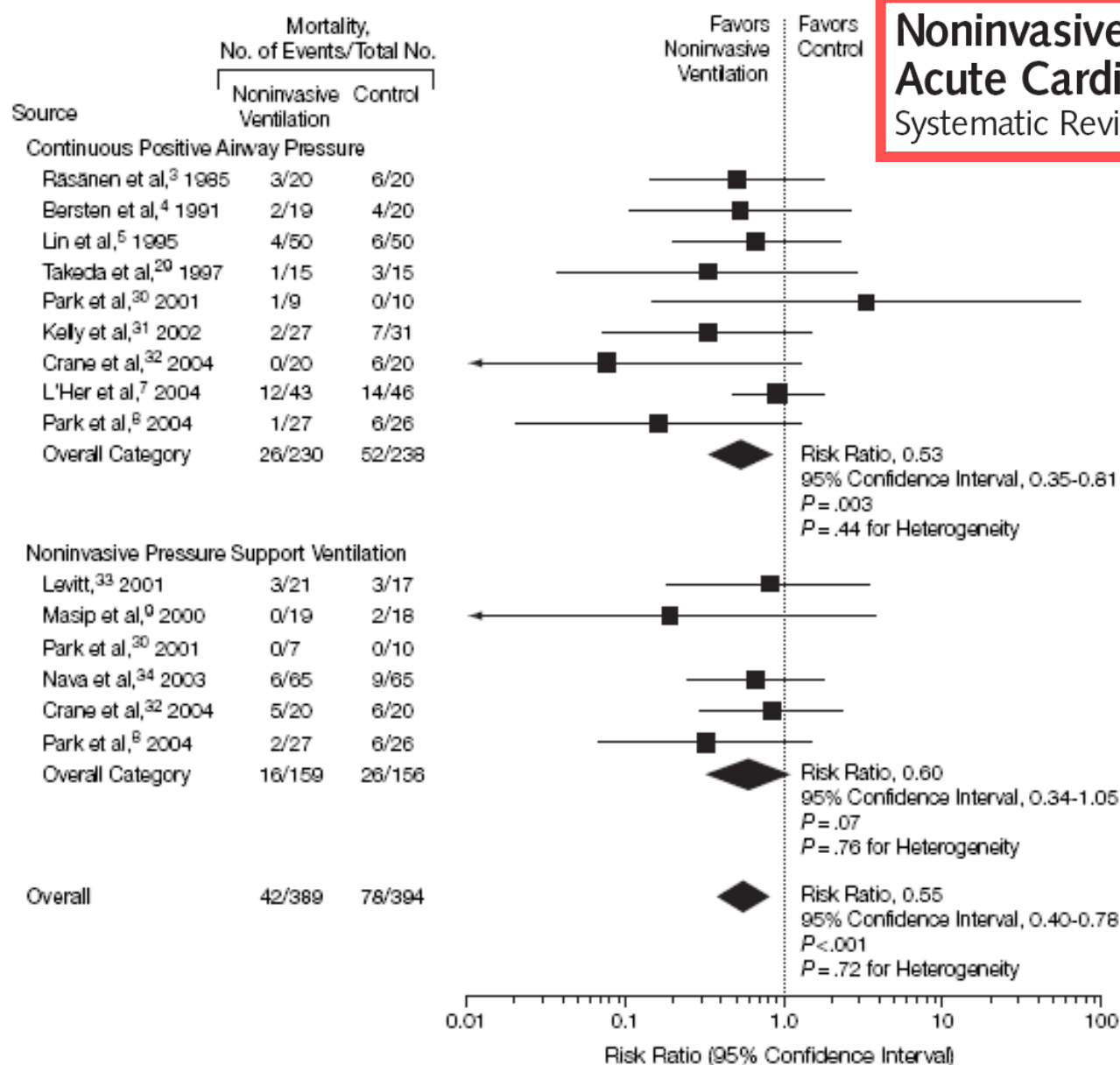
**E.P.A.**

**CPAP**



**Riconosciuto ruolo di  
“First line therapy” nell’EPA**

**Figure 2.** Effects of Noninvasive Ventilation on Death



Data markers are proportional to the amount of data contributed by each trial.

## Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Systematic Review and Meta-analysis

Josep Masip, MD

Marta Roque, BSc

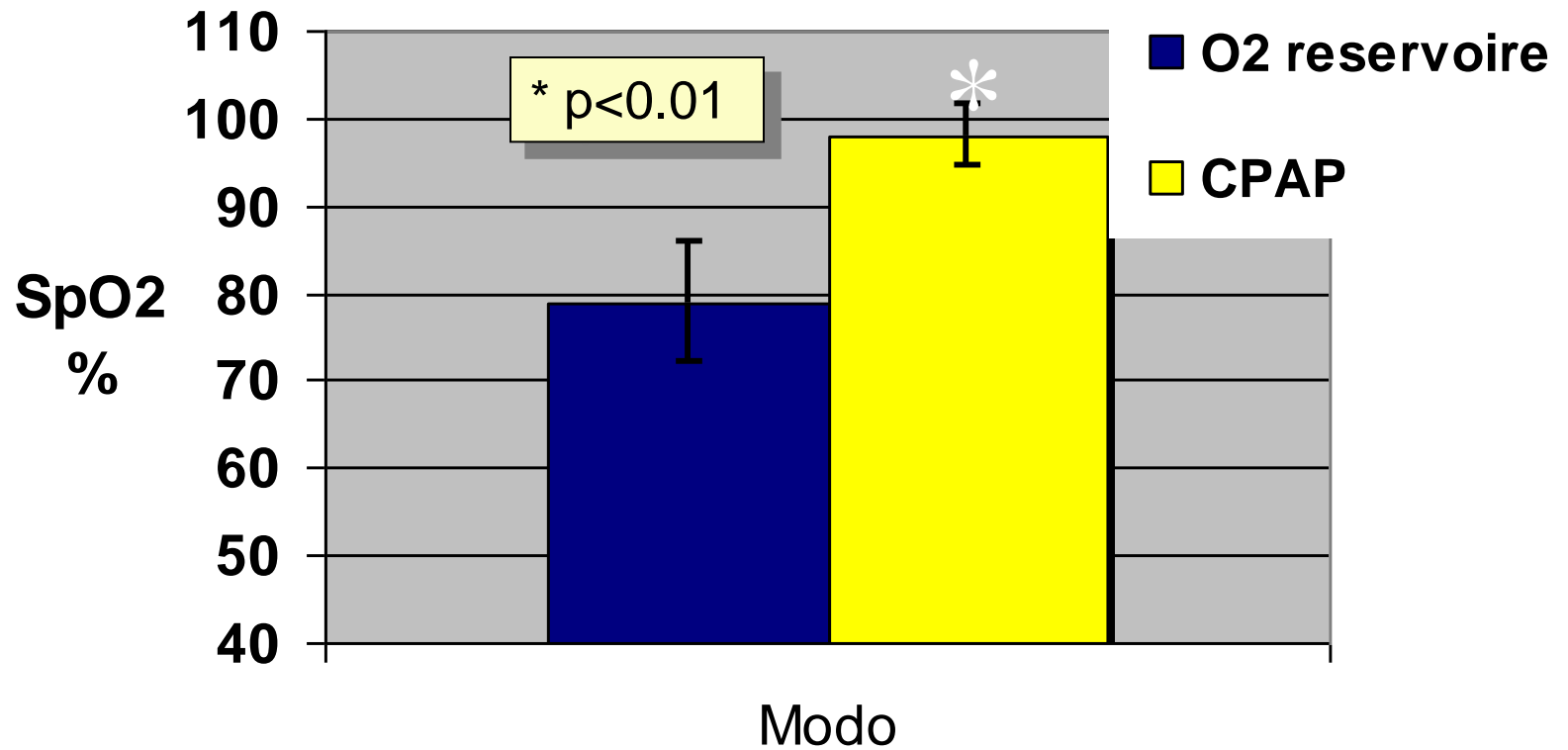
Bernat Sánchez, MD

Rafael Fernández, MD

Mireia Subirana, RN

José Angel Expósito, BSc

*JAMA.* 2005;294:3124-3130



Erwan L'Her  
Françoise Duquesne  
Emmanuelle Girou  
Xavier Donin de Rosiere  
Philippe Le Conte  
Serge Renault  
Jean-Paul Allamy  
Jean-Michel Boles

## Noninvasive continuous positive airway pressure in elderly cardiogenic pulmonary edema patients

Outcome	Oxygen ( <i>n</i> =46)	CPAP ( <i>n</i> =43)	<i>p</i> value
Initial improvement in PaO <sub>2</sub> /F <sub>I</sub> O <sub>2</sub>	24 (52)	34 (79)	0.008
PaO <sub>2</sub> /F <sub>I</sub> O <sub>2</sub> >300 at 1 h	7 (15)	20 (47)	0.001
Clinical improvement (dyspnea score)	24 (52)	36 (84)	0.002
Serious complications	17 (37)	4 (9)	0.002
Ventilatory assistance	14 (30)	4 (9)	0.01
48-h mortality	11 (24)	3 (7)	0.017
In-hospital mortality	14 (30)	12 (28)	0.8
Death within the emergency department	10 (22)	3 (7)	0.05
Death within the general ward	4 (9)	9 (21)	0.19
In-hospital length of stay (mean±SD, days)			
Among all patients	9±7	12±11	0.07
Among survivors	10±4	13±8	0.20
Among non-survivors	6±10	12±17	0.30

Data are number of patients (numbers in parentheses are percentages)

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Death within the emergency department	10 (22)	3 (7)	0.05
Death within the general ward	4 (9)	9 (21)	0.19
In-hospital length of stay (mean±SD, days)			
Among all patients	9±7	12±11	0.07
Among survivors	10±4	13±8	0.20
Among non-survivors	6±10	12±17	0.30

Data are number of patients (numbers in parentheses are percentages)



# RICORDA

La CPAP è una misura terapeutica temporanea per l'EPA che non deve interferire con l'appropriata terapia farmacologica del problema di base.

La risoluzione dell' EPA è completa quando la capacità contrattile del ventricolo sx è ristabilita.

CPAP 10 cmH<sub>2</sub>O

Associare Pressure Support se COPD

Associare terapia medica

**Grazie**