Con il patrocinio di

Associazione Italiana Pneumologi Ospedalieri

Ospedale San Giuseppe
MultiMedica S.p.A.

PNEUMOLOGIA 2016

Milano, 16 – 18 giugno 2016 · Centro Congressi Palazzo delle Stelline

PNEUMOLOGIA 2016

Milano, 16 – 18 giugno 2016 · Centro Congressi Palazzo delle Stelline

MINICORSO | Venerdì, 17 giugno 2016

LA VENTILAZIONE MECCANICA NON INVASIVA: INDICAZIONI E LIMITI OGGI

Coordinatore: *Stefano Nava (Bologna)*
Moderatori: *Stefano Nava (Bologna), Raffaele Scala (Lucca)*

14.30 - 15.00	NIV per lo svezzamento del paziente cronico tracheotomizzato *Piero Ceriana (Pavia)*
15.00 - 15.30	Indicazioni non tradizionali *Raffaele Scala (Lucca)*
15.30 - 16.00	Perché e quando la NIV fallisce *Rodolfo Ferrari (Bologna)*
16.00 - 16.30	Le interfacce: sappiamo già tutto? *Lara Pisani (Bologna)*
16.30 - 17.00	Ossigeno ad alto flusso umidificato: alternativa alla NIV? *Stefano Nava (Bologna)*
17.00 - 17.30	Discussione

15.30 - 16.00 Perché e quando la NIV fallisce
Rodolfo Ferrari (Bologna)

Rodolfo Ferrari

Medicina d'Urgenza e Pronto Soccorso

Policlinico Sant'Orsola – Malpighi

Bologna

NIV failure

Definition

Rate

Causes and timing

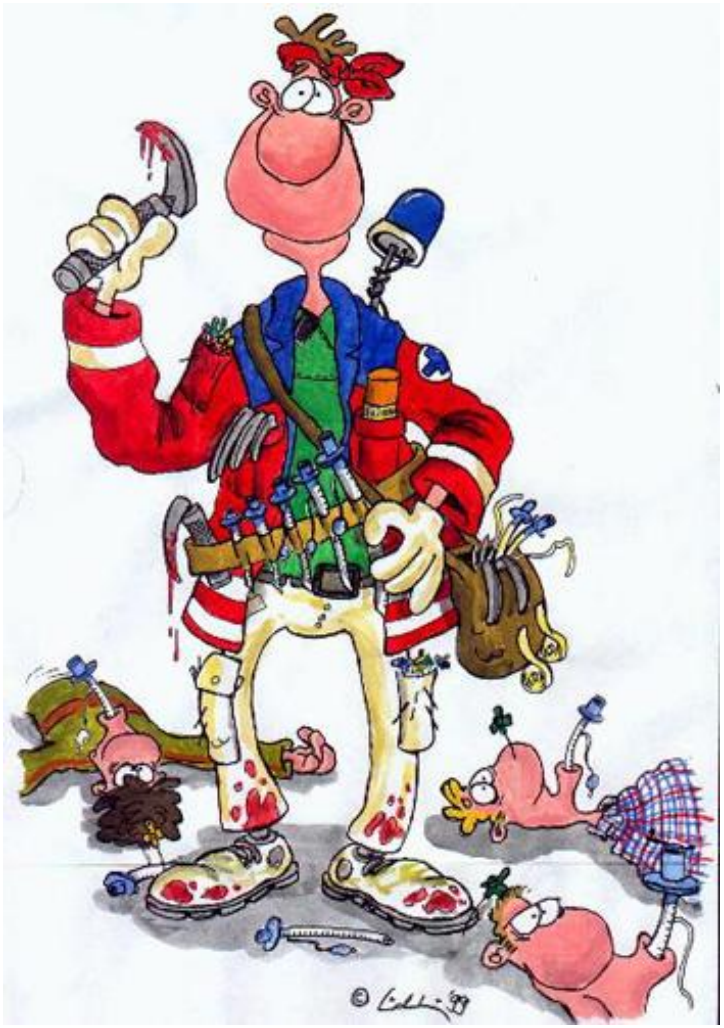
"… there is a "window of opportunity" when initiating NPPV. The window opens when patients become distressed enough to warrant ventilatory assistance but closes if they progress too far and become severely acidemic. …"

Liesching T, et al. Chest 2003

"A decision about tracheal intubation should be made before commencing NIV in every patient."

BTS GUIDELINE.

Thorax 2002;57:192-211



Outcomes of Noninvasive Ventilation for Acute Exacerbations of Chronic Obstructive Pulmonary Disease in the United States, 1998–2008

Divay Chandra[1*], Jason A. Stamm[1*], Brian Taylor[2], Rose Mary Ramos[1], Lewis Satterwhite[2], Jerry A. Krishnan[3], David Mannino[4], Frank C. Sciurba[1], and Fernando Holguín[1]

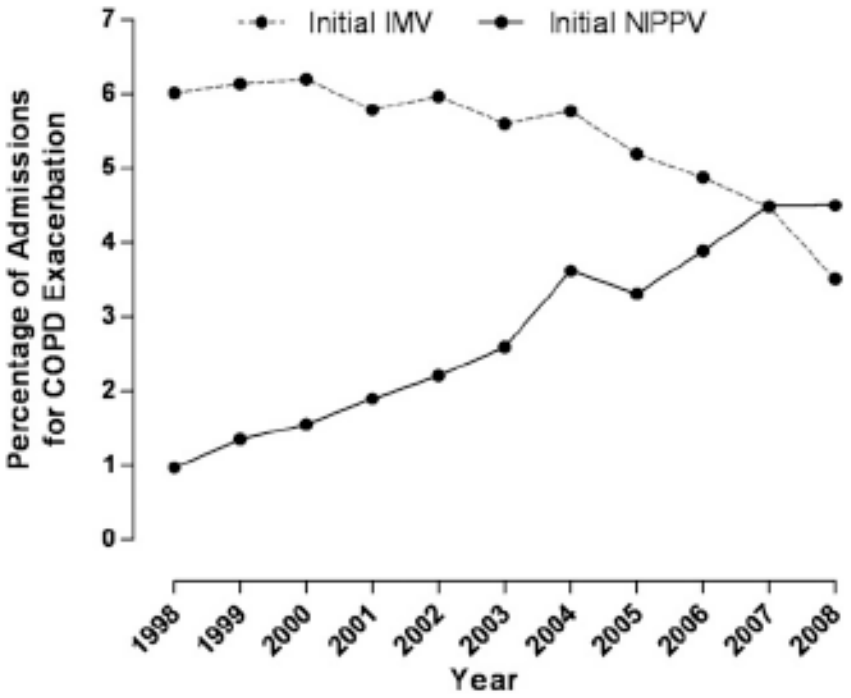


Figure 1. Temporal trends in the use of noninvasive positive pressure ventilation (NIPPV) and invasive mechanical ventilation (IMV) as the initial form of respiratory support in patients hospitalized with acute exacerbations of chronic obstructive pulmonary disease (COPD) in the United States, 1998–2008.

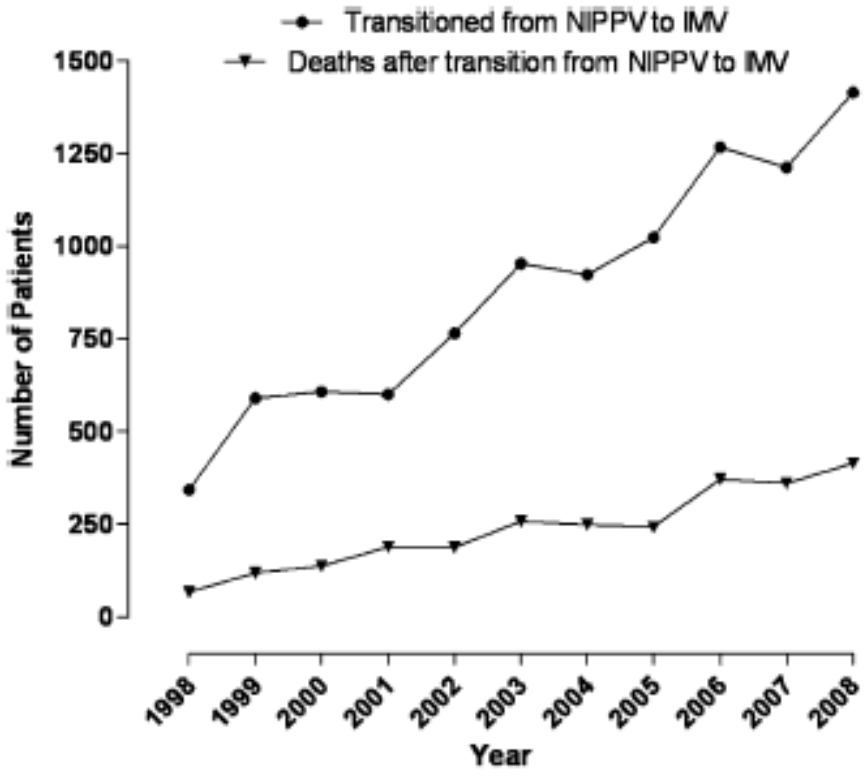


Figure 4. The number of patients and the number of in-hospital deaths among patients requiring transition from noninvasive positive pressure ventilation (NIPPV) to invasive mechanical ventilation (IMV) after admission for acute exacerbation of chronic obstructive pulmonary disease, 1998–2008.

NIV failure

Selection and risk stratification

Close monitoring

No delay

NIV failure

Immediate (< 1-2 h)

Early (1-2 to 48 h)

Late (> 48 h)

Ozyilmaz et al. BMC Pulmonary Medicine 2014, 14:19
http://www.biomedcentral.com/1471-2466/14/19

BMC Pulmonary Medicine

REVIEW Open Access

Timing of noninvasive ventilation failure: causes, risk factors, and potential remedies

Ezgi Ozyilmaz[1], Aylin Ozsancak Ugurlu[2] and Stefano Nava[3*]

Abstract

Background: Identifying the predictors of noninvasive ventilation (NIV) failure has attracted significant interest because of the strong link between failure and poor outcomes. However, very little attention has been paid to the timing of the failure. This narrative review focuses on the causes of NIV failure and risk factors and potential remedies for NIV failure, based on the timing factor.

Results: The possible causes of immediate failure (within minutes to <1 h) are a weak cough reflex, excessive secretions, hypercapnic encephalopathy, intolerance, agitation, and patient-ventilator asynchrony. The major potential interventions include chest physiotherapeutic techniques, early fiberoptic bronchoscopy, changing ventilator settings, and judicious sedation. The risk factors for early failure (within 1 to 48 h) may differ for hypercapnic and hypoxemic respiratory failure. However, most cases of early failure are due to poor arterial blood gas (ABGs) and an inability to promptly correct them, increased severity of illness, and the persistence of a high respiratory rate. Despite a satisfactory initial response, late failure (48 h after NIV) can occur and may be related to sleep disturbance.

Conclusions: Every clinician dealing with NIV should be aware of these risk factors and the predicted parameters of NIV failure that may change during the application of NIV. Close monitoring is required to detect early and late signs of deterioration, thereby preventing unavoidable delays in intubation.

Keywords: Noninvasive ventilation, Treatment failure, Respiratory insufficiency

Review

The utilization of noninvasive mechanical ventilation (NIV) has become one of the most important developments in the field of mechanical ventilation over the past two decades. The use of NIV during acute respiratory failure (ARF) has increased since the late 1990s for all diagnoses, including patients with and without chronic obstructive pulmonary disease (COPD), regardless of the supporting evidence for the later [1].

NIV failure has been defined as the need for endotracheal intubation (ETI) or death [2]. Its rate greatly varies between 5 and 60%, depending on numerous factors, including the cause of ARF [3,4]. Unsuccessful NIV was found to be independently associated with death, especially in patients with de novo ARF [5]. This may indicate the need for caution with regard to the application of NIV and for close monitoring to switch promptly to ETI when necessary.

Several investigators have tried to assess the best predictors of NIV failure [6-12]. However, to the best of our knowledge, despite the rather extensive literature in the NIV field, there is only one paper, published 10 years ago, summarizing the evidence for the risk factors for NIV failure, and no studies of the timing of the failure [13]. Based on data from randomized controlled trials (RCTs), three temporal moments were identified: 1) immediate failure (within minutes to <1 h), 2) early failure (1 to 48 h), and 3) late failure (after 48 h) (Figure 1) [6-12]. The purpose of this narrative review is to illustrate the main patient-related predictors or risks factors of immediate, early, and late failure. We also discuss possible remedies to avoid ETI and nonpatient-related risk factors.

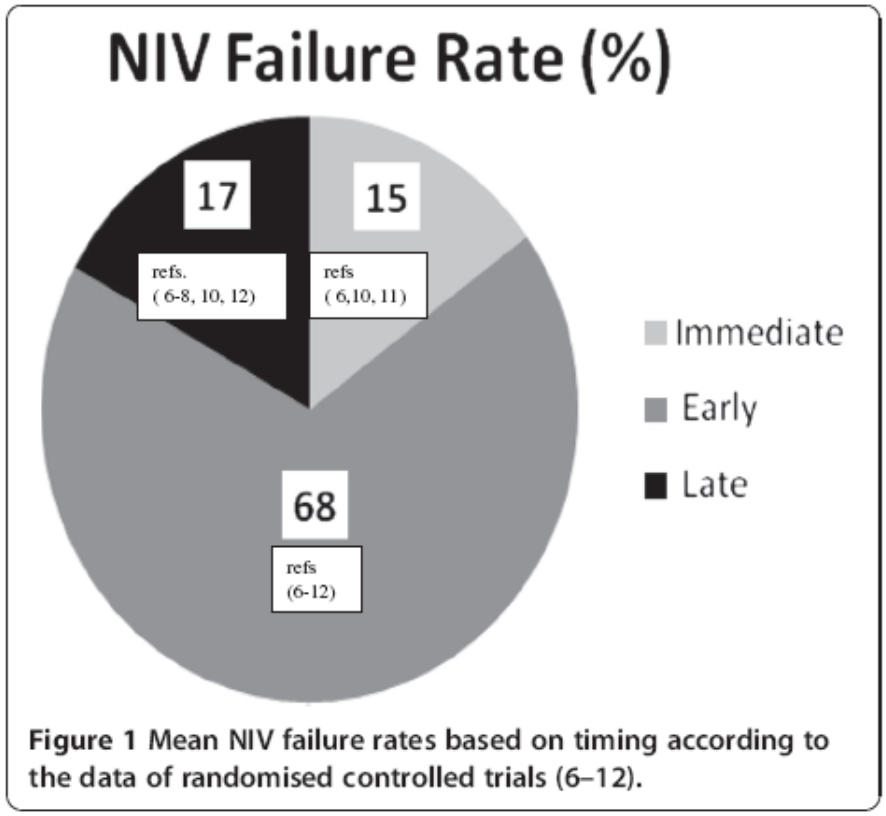


Figure 1 Mean NIV failure rates based on timing according to the data of randomised controlled trials (6–12).

* Correspondence: stefanava@gmail.com
[3]Department of Specialistic, Diagnostic and Experimental Medicine (DIMES), Respiratory and Critical Care, University of Bologna, Sant'Orsola Malpighi Hospital building #15, Alma Mater Studiorum, via Massarenti n.15, Bologna 40138, Italy
Full list of author information is available at the end of the article

Table 1 Indications and contraindications for NIV in acute care [4,16,17,35]

Indications:

A- Gas exchange:

- Acute or acute on chronic ventilator failure (best indication), $PaCO_2 > 45$ mmHg
- Ph < 7.35
- Hypoxemia (use with caution), PaO_2/FIO_2 ratio < 200

B- Bedside observations:

- Increased dyspnea- moderate to severe
- Tachypnoea (24 breaths per minute in obstructive, >30 per minute in restrictive)
- Signs of increased work of breathing, accessory muscle use, and abdominal paradox

Absolute contraindications:

- Cardiac or respiratory arrest
- Unable to fit mask

Relative contraindications:

- Non-respiratory organ failure (severe encephalopathy with GCS < 10, severe upper gastrointestinal bleeding, hemodynamic instability or unstable cardiac arrthythmia)
- Inability to cooperate/protect the airway
- Inability to clear respiratory secretions
- High risk of aspiration
- Recent facial surgery, trauma, or deformity
- Upper airway obstruction

NIV: Noninvasive ventilation, GCS: Glasgow coma scale.

Exclusion criteria (any may be present)

Respiratory arrest

Cardiovascular instability (hypotension, arrhythmias, myocardial infarction)

Somnolence, impaired mental status, uncooperative patient

High aspiration risk; viscous or copious secretions

Recent facial or gastroesophageal surgery

Craniofacial trauma, fixed nasopharyngeal abnormalities

Extreme obesity

GOLD 2005

NIV failure

Immediate

Predictors of failure of noninvasive positive pressure ventilation in patients with acute hypoxemic respiratory failure: a multi-centre study.
Antonelli M, et al. Int Care Med 2001

<<… NPPV
… safe and effective …
… selected patients …
… early application …
… not yet meeting criteria for MV …
… avoidance of intubation reduces morbidity and mortality associated with MV>>

"The efficacy of NIV on patient's outcome predominantly depend on the underlying pathology"

Antonelli M, et al. Eur Respir J 2003

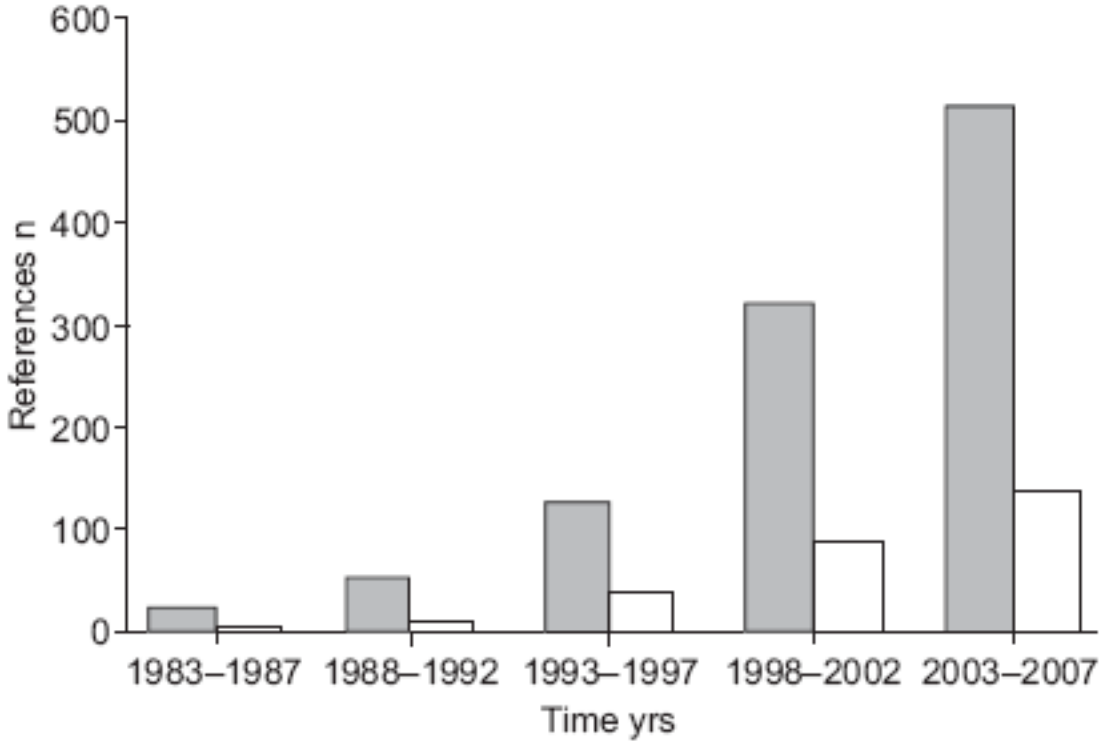
"The application of NPPV in patients suffering from ARF not related to COPD, despite some interesting and very promising preliminary results, still remains controversial. Large, prospective, randomized, multicentre studies are therefore needed."

Antonelli M, et al. Crit Care 2000

Table 2. Evolution of Ventilatory Support in the Acute-Care Setting, Particularly With Respect to Noninvasive Ventilation

Pre-1930s
First clinical use of supplemental oxygen in hospitals
No practical means for supporting ventilation
1930s-1940s
Introduction of tank ventilators
Support of apneic patient possible for first time
1950s
Polio epidemics in Europe and United States
Introduction of positive-pressure ventilation via tracheostomy
Development of special cadre of hospital workers for caring for patients with respiratory problems (inhalation therapists)
Use of supplemental oxygen and IPPB in aviation
1960s
Major progress in understanding pulmonary gas exchange
Widespread use of IPPB in United States hospitals for "breathing treatments"
Experience with IPPB in acute respiratory insufficiency
Widespread introduction of volume ventilators
Availability of improved endotracheal tubes
Use of arterial blood gases in patient assessment
First dedicated ICUs
Recognition of ARDS
First use of PEEP to treat hypoxemia in ARDS
1970s
Major progress in understanding lung physiology and pathology
Use of CPAP in neonates
Presence of ICUs in virtually all acute-care hospitals
More sophisticated and capable ICU ventilators
Introduction of intermittent mandatory ventilation and other new ventilation modes
Increasing awareness of complications of invasive mechanical ventilation
Sugarloaf conference; de-emphasis of IPPB
1980s
Increasing focus on respiratory muscle function in acute care settings
Invasive mechanical ventilation as initial approach in virtually all settings of acute respiratory failure
Widespread use of pulse oximetry and other noninvasive respiratory monitoring
Increasing computerization of ventilators and other respiratory care equipment
Introduction of nasal CPAP for treating obstructive sleep apnea
Increasing experience with long-term NPPV in settings other than polio
First reports of use of NPPV in acute hypercapnic respiratory failure in COPD
Introduction of pressure support
Introduction of modern bi-level pressure-targeted ventilators for NPPV
1990s
Increasing reported experience with NPPV in acute-care settings other than COPD
First randomized controlled trials of NPPV in acute respiratory failure
Incorporation of F_{IO_2} control and better monitoring into bi-level ventilators for NPPV
Increasing variety of patient interfaces for NPPV
RESPIRATORY CARE consensus conference on NPPV in the acute care setting
Rapid worldwide dissemination of research findings
Rise of evidence-based medicine
Increasing focus on ventilator-induced lung injury and concept of lung-protective ventilation
Concept of NPPV as bridge to weaning
Ventilator-associated pneumonia and its relationship to intubation
Increased focus on DNAR/DNI and withdrawal of life support
2000s
Rich database on efficacy of NPPV: multiple RCTs; meta-analyses; evidence-based clinical practice guidelines
NPPV as standard of care for COPD exacerbation
Increasing use of NPPV in other settings
Increased focus on DNI and palliative care in the acute-care setting
Increasing focus on knowledge-transfer and addressing the gap between efficacy and effectiveness

IPPB = intermittent positive-pressure breathing; ICU = intensive care unit; ARDS = acute respiratory distress syndrome; PEEP = positive end-expiratory pressure; CPAP = continuous positive airway pressure; NPPV = noninvasive positive-pressure ventilation; COPD = chronic obstructive pulmonary disease; F_{IO_2} = fraction of inspired oxygen; DNAR = do not attempt resuscitation; DNI = do not intubate; RCT = randomized controlled trial



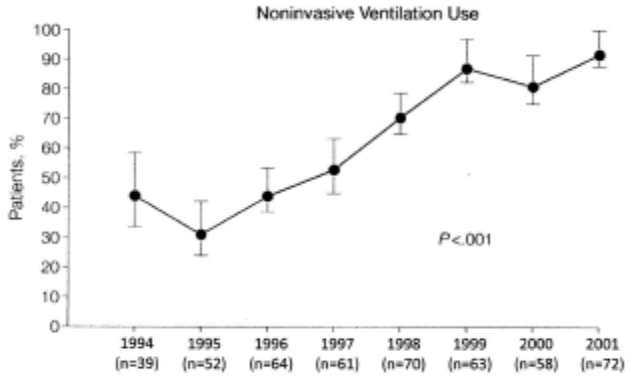


Fig. 5. Increasing use of noninvasive ventilation, as a proportion of all uses of mechanical ventilation, in the management of 479 patients with exacerbations of chronic obstructive pulmonary disease or acute cardiogenic pulmonary edema during a 6-year period in the 26-bed intensive care unit of a French university hospital. The vertical lines represent the 95% confidence limits. (From Reference 75, with permission.)

Panel 2: Recommendations for NIV to treat acute respiratory failure

Recommendations based on levels of evidence[23]

Level 1 evidence

Systematic reviews (with homogeneity) of RCTs and individual RCTs (with narrow CIs)

Evidence of use (favourable)

- COPD exacerbations
- Facilitation of weaning/extubation in patients with COPD
- Cardiogenic pulmonary oedema
- Immunosuppressed patients

Evidence of use (caution)

- None

Level 2

Systematic reviews (with homogeneity) of cohort studies—individual cohort studies (including low quality RCTs; eg, <80% follow-up)

Evidence of use (favourable)

- Do-not-intubate status
- End-stage patients as palliative measure
- Extubation failure (COPD or congestive heart failure) (prevention)
- Community-acquired pneumonia in COPD
- Postoperative respiratory failure (prevention and treatment)
- Prevention of acute respiratory failure in asthma

Evidence of use (caution)

- Severe community acquired pneumonia
- Extubation failure (prevention)

Level 3

Systematic reviews (with homogeneity) of case–control studies, individual case-control study

Evidence of use (favourable)

- Neuromuscular disease/kyphoscoliosis
- Upper airway obstruction (partial)
- Thoracic trauma
- Treatment of acute respiratory failure in asthma

Evidence of use (caution)

- Severe acute respiratory syndrome

Level 4

Case series (and poor quality cohort and case-control studies)

Evidence of use (favourable)

- Very old age, older than age 75 years
- Cystic fibrosis
- Obesity hypoventilation

Evidence of use (caution)

- Idiopathic pulmonary fibrosis

NIV = non-invasive ventilation. RCTs = randomised controlled trials. COPD = chronic obstructive pulmonary disease.

Table 1. Noninvasive ventilation for various types of acute respiratory failure (ARF): Evidence for efficacy and strength of recommendation

Type of ARF	Level of Evidence[a]	Strength of Recommendation[b]
Hypercapnic respiratory failure		
COPD exacerbation	A	Recommended
Asthma	C	Option
Facilitation of extubation (COPD)	A	Guideline
Hypoxemic respiratory failure		
Cardiogenic pulmonary edema	A	Recommended
Pneumonia	C	Option
ALI/ARDS	C	Option
Immunocompromised	A	Recommended
Postoperative respiratory failure	B	Guideline
Extubation failure	C	Guideline
Do not intubate status	C	Guideline
Preintubation oxygenation	B	Option
Facilitation of bronchoscopy	B	Guideline

TABLE 2 Effectiveness and appropriate location for noninvasive positive pressure ventilation in acute respiratory failure (ARF) from different causes

Cause of ARF	Level of evidence*	Location
AECOPD	A	Ward, RIICU, ICU Depending on severity
Weaning (AECOPD)	A	ICU, RIICU
CPO	A	ICU, RIICU
Immunocompromised patient	A	ICU, RIICU
Post-operative respiratory failure	B	ICU
Pre-intubation oxygenation	B	ICU
Endoscopy	B	Depending on severity
Asthma exacerbations	C	ICU, RIICU
ALI/ARDS	C	ICU
Extubation failure	C	ICU
Do-not-intubate status	C	Ward, RIICU
Pneumonia	C	ICU, RIICU

Evidence A: multiple randomised controlled trials and meta-analyses; evidence B: more than one randomised controlled trial, case-control series or cohort studies evidence; C: case series or conflicting data. AECOPD: acute exacerbation of chronic obstructive pulmonary disease; RIICU: respiratory intermediate intensive care unit; ICU: intensive care unit; CPO: cardiogenic pulmonary oedema; ALI: acute lung injury; ARDS: acute respiratory distress syndrome. *: according to [11].

Immediate failure

Weak or depressed cough reflex,
inefficient clearance of excessive secretions or inability to spontaneously remove secretions,
impaired consciousness, …

Fast improvement,
drugs,
respiratory physiotherapists
early fiberoptic bronchoscopy,
early suction,
intrapulmonary percussive ventilation, …

Immediate failure

Impaired consciousness and neurological status,
coma,
hypercapnic encephalopathy,
poor compliance,
risk of aspiration,
intolerance,
psychomotor agitation, …

Immediate failure

Quick reduction of $PaCO_2$ and Kelly Matthay Scale,
modes of ventilation
(high back-up rate,
pressure A/C ventilation,
low FiO_2),
interface rotation,
judicious awaking sedation, …

Prevalence and Severity of Neurologic Dysfunction in Critically Ill Patients*

Influence on Need for Continued Mechanical Ventilation

Brian J. Kelly, M.D.;† and Michael A. Matthay, M.D., F.C.C.P.

Table 1—*Neurologic Status Score*

Grade No.	Description
1	Alert, follows complex three-step command (*ie*, take a sheet of paper, tear it into four pieces, and place three pieces in one pile)
2	Alert, follows simple commands (*ie*, show me two fingers)
3	Lethargic, but arousable and follows simple commands
4	Stuporous, *ie*, only intermittently follows simple command even with vigorous attempts to arouse patient
5	Comatose, brain stem intact
6	Comatose with brain stem dysfunction

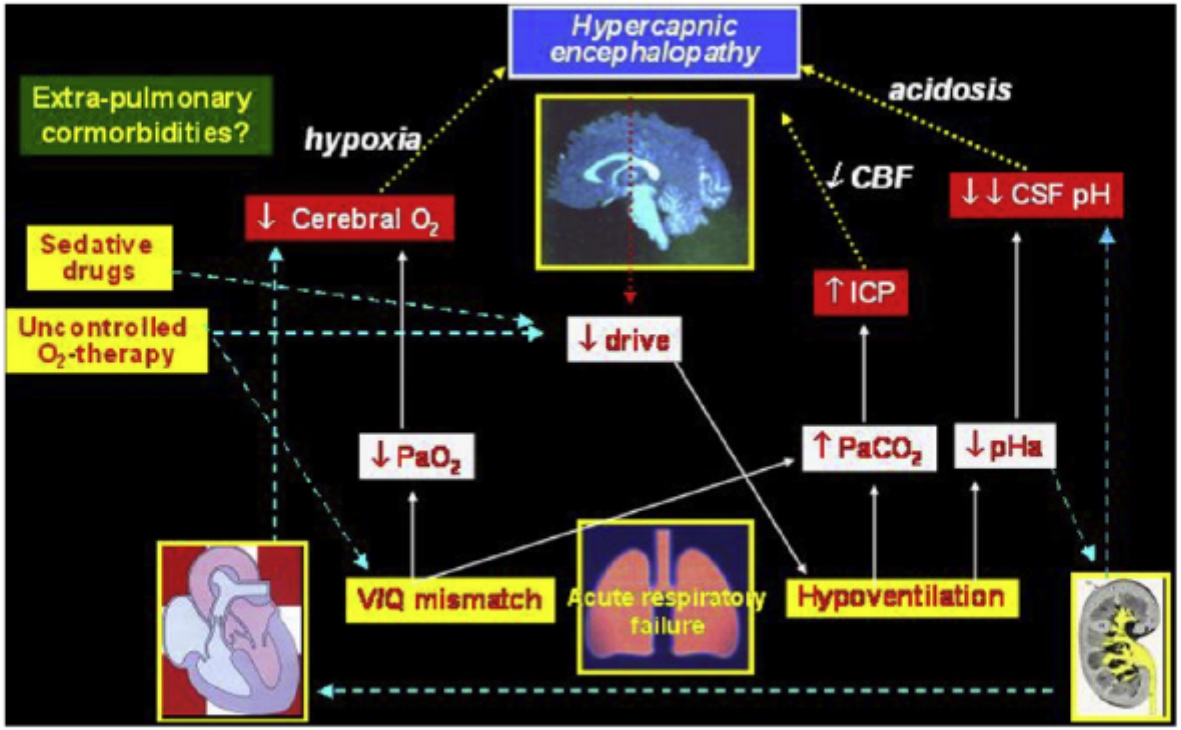


Figure 1 Pathogenesis of Hypercapnic Encephalopathy Syndrome. CBF: cerebral blood flow; CSF: cerebrospinal fluid; ICP: intracranic pressure; V/Q: ventilation/perfusion ratio.

Hypercapnic encephalopathy syndrome: A new frontier for non-invasive ventilation?

Raffaele Scala*

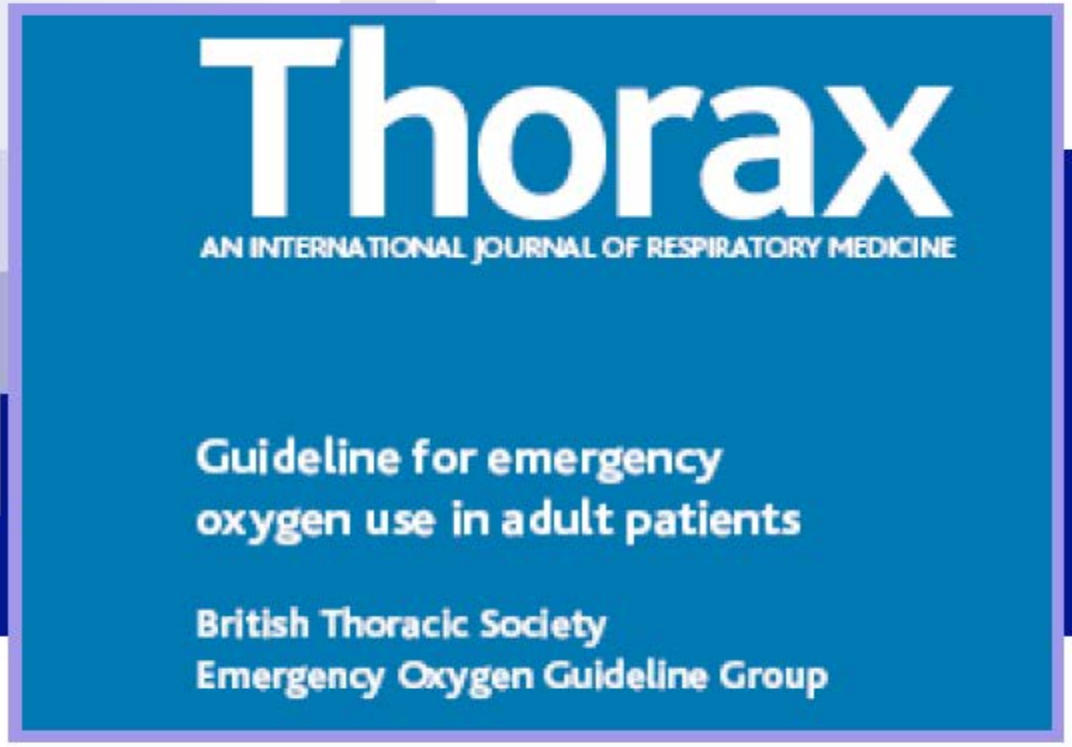
Respiratory Medicine (2011) 105, 1109–1117

Acidosis, non-invasive ventilation and mortality in hospitalised COPD exacerbations

C M Roberts,[1,2] R A Stone,[1,3] R J Buckingham,[1] N A Pursey,[1] D Lowe,[1] On behalf of the National Chronic Obstructive Pulmonary Disease Resources and Outcomes Project (NCROP) implementation group

Conclusions COPD admissions treated with NIV in usual clinical practice were severely ill, many with mixed metabolic acidosis. Some eligible patients failed to receive NIV, others received it inappropriately. NIV appears to be often used as a ceiling of treatment including patient groups in whom efficacy of NIV is uncertain. The audit raises concerns that challenge the respiratory community to lead appropriate clinical improvements across the acute sector.

Thorax 2011;**66**:43–48. doi:10.1136/thx.2010.153114



Per la maggior parte degli argomenti trattati, non più di una “manciata” di studi osservazionali. Raccomandazioni di grado C (Studi caso-controllo o di coorte) o di grado D (opinione di esperti o singoli casi clinici)

Box 1: Medical emergencies where oxygen is likely to be required until patient is stable and within target saturation range[3]

Medical emergencies requiring high concentration oxygen in all cases

- Shock, sepsis, major trauma
- Cardiac arrest and during resuscitation
- Anaphylaxis
- Carbon monoxide or cyanide poisoning

Medical emergencies where patients are likely to need oxygen therapy (ranging from low to high concentration depending on disease severity), with target saturation range 94-98%

- Pneumonia
- Asthma
- Acute heart failure
- Pulmonary embolism

Medical emergencies where patients are likely to need controlled oxygen, with target saturation range 88-92%

- Acute exacerbation of chronic obstructive pulmonary disease (COPD)
- Acute illness in patients with cystic fibrosis
- Acute respiratory illness in patients with obesity hypoventilation syndrome or morbid obesity
- Acute respiratory illness in patients with chronic neuromuscular or musculoskeletal conditions

Box 2: Common medical emergencies for which oxygen was given routinely in the past but is now advised only if the patient is hypoxaemic[3]

- Myocardial infarction or unstable coronary artery syndrome
- Stroke
- Ongoing management of survivors of cardiac arrest with restored spontaneous circulation
- Sickle cell crisis or acute anaemia
- Obstetric emergencies
- Most poisonings (other than carbon monoxide or cyanide poisoning)
- Metabolic and renal disorders with tachypnoea due to acidosis (Kussmaul breathing)

Box 3: Devices for oxygen administration

- Reservoir mask (non-rebreathing mask) for critical illness or severe hypoxaemia (fig1⇓)
- Venturi mask for controlled oxygen therapy (especially for oxygen-sensitive patients) (figs 2⇓ and 3⇓)
- Nasal cannulas for most medium dose oxygen therapy (adjust flow to increase or decrease blood oxygen level) (fig 4⇓)
- Simple facemask—works in a similar manner to nasal cannulas, but most patients prefer nasal cannulas to masks, and some rebreathing may occur (fig 5⇓)
- Tracheostomy masks for "neck breathing" patients (fig 6⇓)

Box 4: Alternative methods to increase tissue oxygen delivery

- Safeguarding the airway
- Optimising circulating volume to maintain tissue perfusion
- Correcting severe anaemia
- Enhancing cardiac output
- Avoiding or reversing respiratory depressants such as benzodiazepines or opiates
- Increasing fraction of inspired oxygen (FIO_2) if the patient is hypoxaemic
- Establishing and treating the underlying cause of hypoxaemia (such as bronchospasm, heart failure)
- More specialised treatments, including non-invasive or invasive ventilation for seriously ill patients after assessment by senior clinicians

Tips for prescribers

- Advise patients not requiring oxygen and their families that oxygen was overused in the past and is not required in most circumstances unless the blood oxygen level is low, even if breathlessness is present
- Excessive oxygen therapy (hyperoxaemia) in seriously ill patients (such as survivors of cardiac arrest or those admitted to intensive care units), may be associated with increased mortality
- Aim for oxygen saturation of 94-98% for most patients and 88-92% for most patients at risk of hypercapnic respiratory failure (some hypercapnic patients may have a lower individualised target range based on previous blood gas results)
- Issue a personal "Oxygen Alert Card" and educational materials to patients with a history of hypercapnic respiratory failure to ensure that they are not endangered by excessive oxygen therapy[3]
- Prescribing oxygen to a target range is simple and safer than trying to prescribe a fixed "dose" of oxygen. The target range needs to be set just once for each patient, although the device and flow rate may need to be changed several times if the patient's condition changes. Document all such changes on the bedside observations chart alongside the oxygen saturation
- Allowing the clinicians who are administering oxygen to select the most appropriate device and flow rate while maintaining the patient within the desired saturation range enhances patient safety and patient comfort
- Ensure that bedside air outlets (which could be mistaken for an oxygen outlet in an emergency) are either removed, covered, or clearly labelled


?
RESPIRONICS

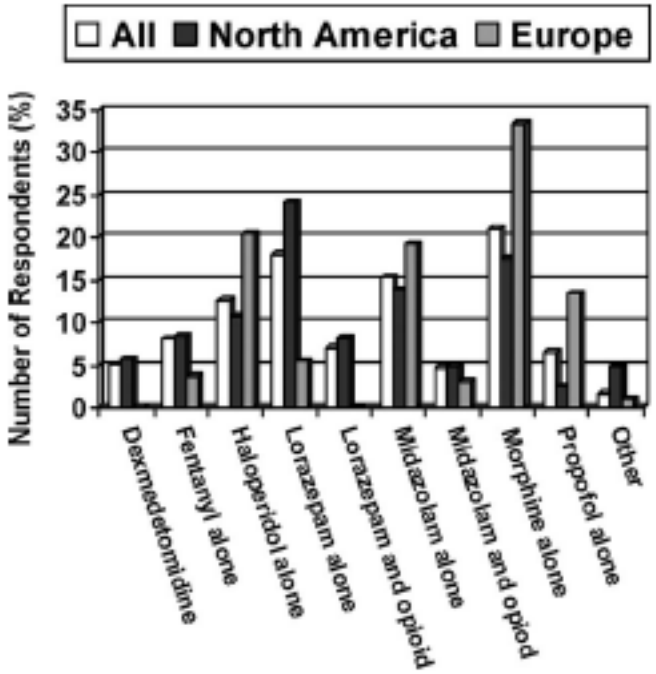


Figure 3. First-choice sedation regimens for patients with acute respiratory failure treated with noninvasive positive pressure ventilation for all respondents, North American respondents, and European respondents.

Table 2. Factors most influencing choice of sedation agents

	% of Total Respondents
Clinical experience with the agent	35
Lack of effect on respiratory drive	22
Safety profile	14
Short duration of action	12
Ability to use the agent as a continuous drip	4
Ease of dose titration	5
Rapid onset	3
Inclusion in institutional sedation protocol	3
Cost	0

Devlin JW et al, Crit Care Med 2006

Immediate failure

Patient – ventilator asynchrony,
fighting, …

Early improvement,
minimizing leaks,
interfaces rotation,
modes of ventilation
(reduced level of support,
optimization of ventilator settings,
evaluate screen waveforms,
more sophisticated ventilators), …

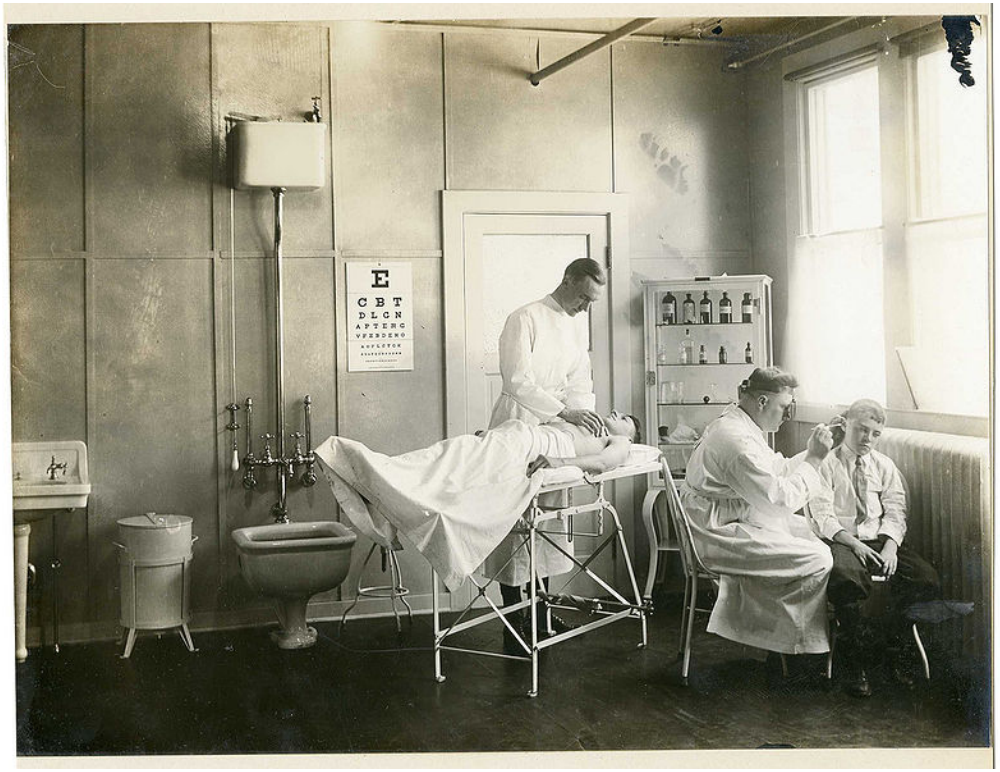
Di Marco et al. Critical Care 2011, 15:R283
http://ccforum.com/content/15/6/R283

CRITICAL CARE

RESEARCH Open Access

Optimization of ventilator setting by flow and pressure waveforms analysis during noninvasive ventilation for acute exacerbations of COPD: a multicentric randomized controlled trial

Fabiano Di Marco[1*], Stefano Centanni[1], Andrea Bellone[2], Grazia Messinesi[3], Alberto Pesci[3], Raffaele Scala[4], Andreas Perren[5] and Stefano Nava[6]


E
C B T
D L C N
A P T E R C
V F E R D E N O

NIV failure

Early

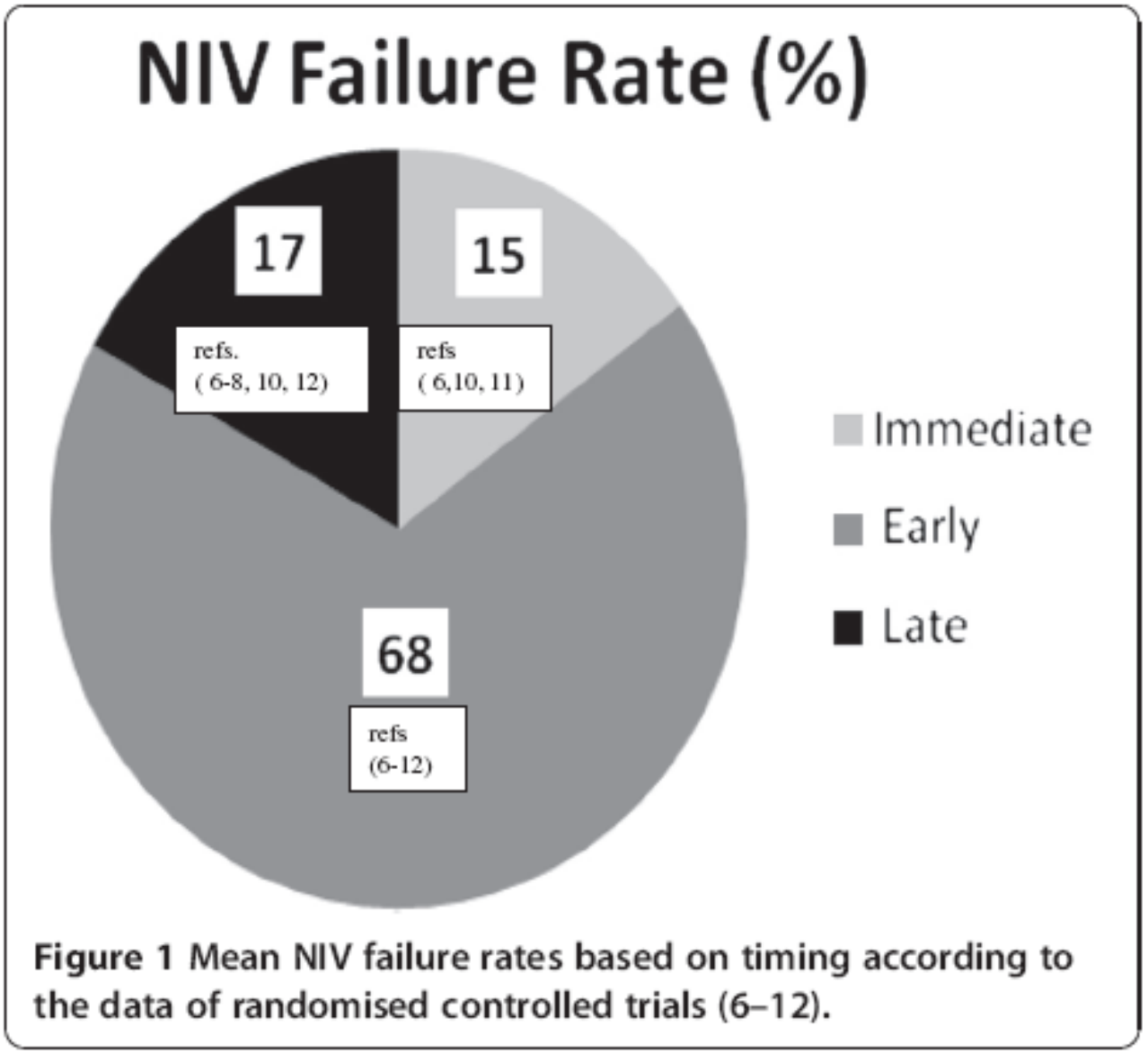


Figure 1 Mean NIV failure rates based on timing according to the data of randomised controlled trials (6–12).

Early failure

Selection,
cause and underlying disease
(de novo versus acute on chronic),
baseline severity
(SOFA, APACHE II, SAPS II),
chronic comorbidities
(glucose, anemia, WHO performance status score, poor nutritional status, white blood cell count, potassium), …

Early failure

baseline pH, low PaO_2 / FiO_2 ratio,

$PaCO_2$,

RR,

HR,

Kelly - Matthay score,

correction of gas exchanges and RR after 1-2 h,

delay,

age, …

Panel 2: Recommendations for NIV to treat acute respiratory failure

Recommendations based on levels of evidence[23]

Level 1 evidence

Systematic reviews (with homogeneity) of RCTs and individual RCTs (with narrow CIs)

Evidence of use (favourable)

- COPD exacerbations
- Facilitation of weaning/extubation in patients with COPD
- Cardiogenic pulmonary oedema
- Immunosuppressed patients

Evidence of use (caution)

- None

Level 2

Systematic reviews (with homogeneity) of cohort studies—individual cohort studies (including low quality RCTs; eg, <80% follow-up)

Evidence of use (favourable)

- Do-not-intubate status
- End-stage patients as palliative measure
- Extubation failure (COPD or congestive heart failure) (prevention)
- Community-acquired pneumonia in COPD
- Postoperative respiratory failure (prevention and treatment)
- Prevention of acute respiratory failure in asthma

Evidence of use (caution)

- Severe community acquired pneumonia
- Extubation failure (prevention)

Level 3

Systematic reviews (with homogeneity) of case–control studies, individual case-control study

Evidence of use (favourable)

- Neuromuscular disease/kyphoscoliosis
- Upper airway obstruction (partial)
- Thoracic trauma
- Treatment of acute respiratory failure in asthma

Evidence of use (caution)

- Severe acute respiratory syndrome

Level 4

Case series (and poor quality cohort and case-control studies)

Evidence of use (favourable)

- Very old age, older than age 75 years
- Cystic fibrosis
- Obesity hypoventilation

Evidence of use (caution)

- Idiopathic pulmonary fibrosis

NIV = non-invasive ventilation. RCTs = randomised controlled trials. COPD = chronic obstructive pulmonary disease.

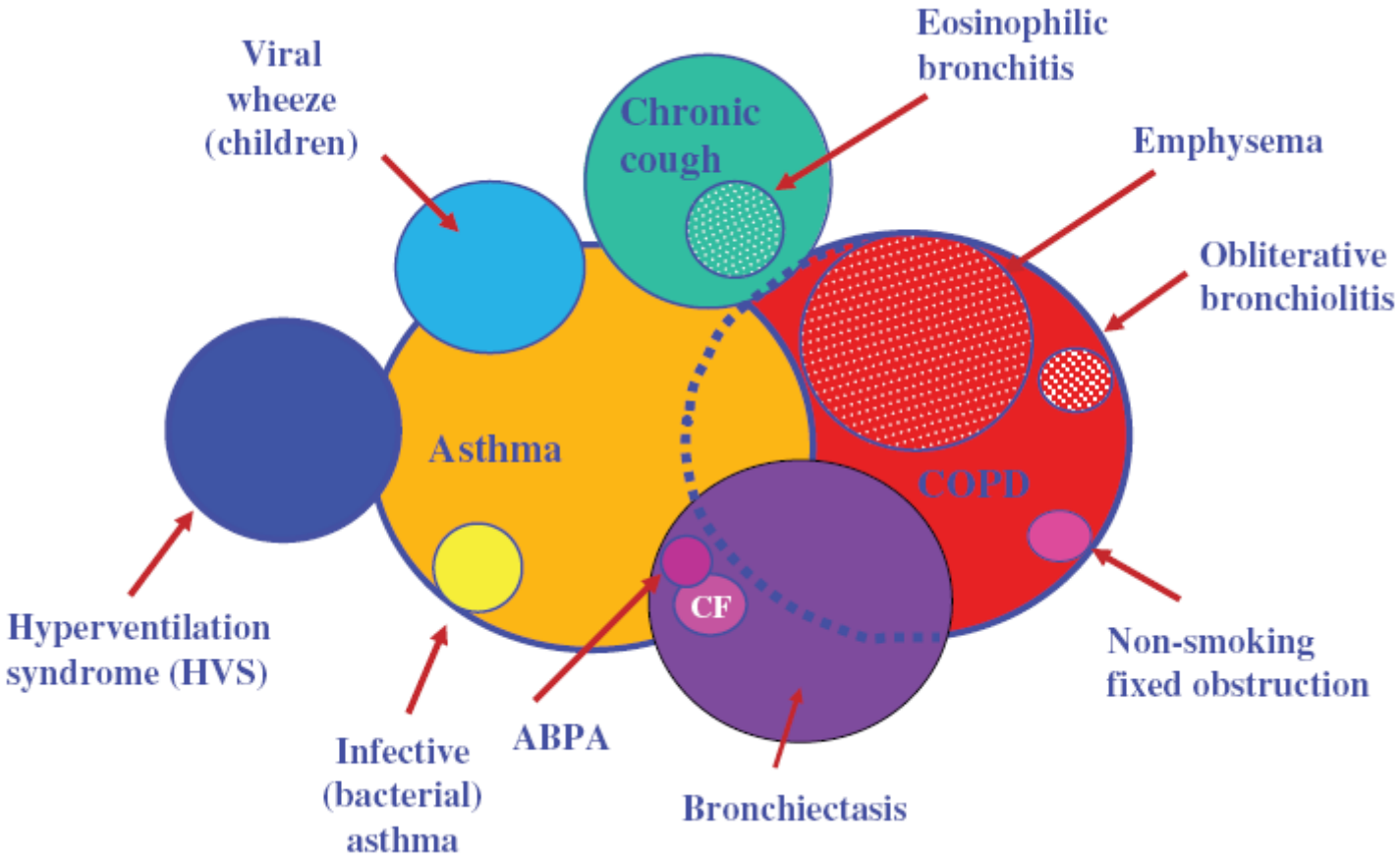
Table 1. Noninvasive ventilation for various types of acute respiratory failure (ARF): Evidence for efficacy and strength of recommendation

Type of ARF	Level of Evidence[a]	Strength of Recommendation[b]
Hypercapnic respiratory failure		
COPD exacerbation	A	Recommended
Asthma	C	Option
Facilitation of extubation (COPD)	A	Guideline
Hypoxemic respiratory failure		
Cardiogenic pulmonary edema	A	Recommended
Pneumonia	C	Option
ALI/ARDS	C	Option
Immunocompromised	A	Recommended
Postoperative respiratory failure	B	Guideline
Extubation failure	C	Guideline
Do not intubate status	C	Guideline
Preintubation oxygenation	B	Option
Facilitation of bronchoscopy	B	Guideline

TABLE 2 Effectiveness and appropriate location for noninvasive positive pressure ventilation in acute respiratory failure (ARF) from different causes

Cause of ARF	Level of evidence*	Location
AECOPD	A	Ward, RIICU, ICU Depending on severity
Weaning (AECOPD)	A	ICU, RIICU
CPO	A	ICU, RIICU
Immunocompromised patient	A	ICU, RIICU
Post-operative respiratory failure	B	ICU
Pre-intubation oxygenation	B	ICU
Endoscopy	B	Depending on severity
Asthma exacerbations	C	ICU, RIICU
ALI/ARDS	C	ICU
Extubation failure	C	ICU
Do-not-intubate status	C	Ward, RIICU
Pneumonia	C	ICU, RIICU

Evidence A: multiple randomised controlled trials and meta-analyses; evidence B: more than one randomised controlled trial, case-control series or cohort studies evidence; C: case series or conflicting data. AECOPD: acute exacerbation of chronic obstructive pulmonary disease; RIICU: respiratory intermediate intensive care unit; ICU: intensive care unit; CPO: cardiogenic pulmonary oedema; ALI: acute lung injury; ARDS: acute respiratory distress syndrome. *: according to [11].



Overlap in disordered airway function
Wardlaw AJ, et al. CEA 2005

Noninvasive positive pressure ventilation in critical and palliative care settings: Understanding the goals of therapy*

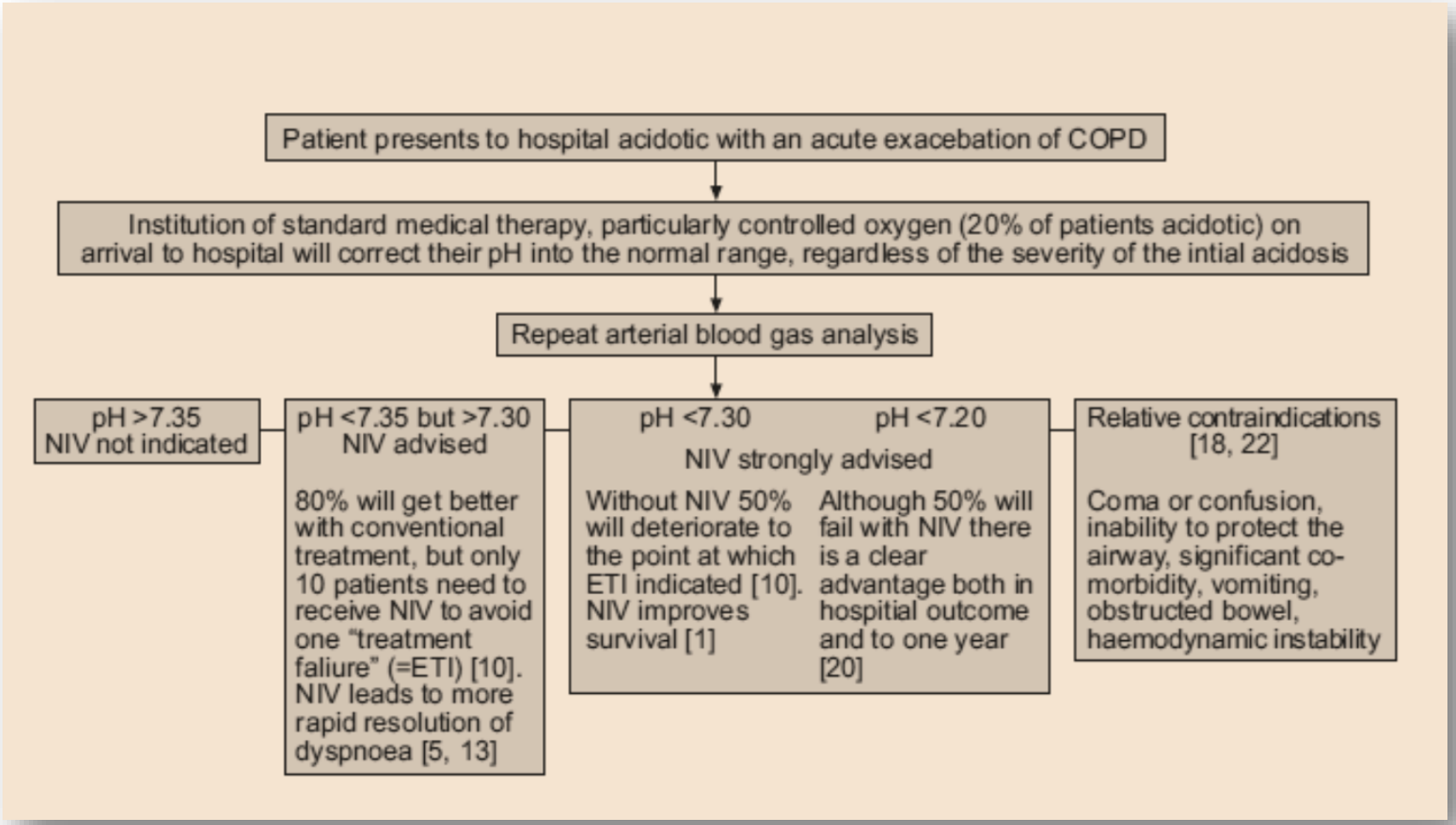
J. Randall Curtis, MD, MPH; Deborah J. Cook, MD; Tasnim Sinuff, MD, PhD; Douglas B. White, MD; Nicholas Hill, MD; Sean P. Keenan, MD, MSc(Epid); Joshua O. Benditt, MD; Robert Kacmarek, PhD, RRT; Karin T. Kirchhoff, RN, PhD, FAAN; Mitchell M. Levy, MD; the Society of Critical Care Medicine Palliative Noninvasive Positive Pressure Ventilation Task Force

Table 1. Overview of the three-category approach to using noninvasive positive pressure ventilation (NPPV) for acute respiratory failure

Approach	Category 1	Category 2	Category 3
Definition	Life Support Without Preset Limits	Life Support With Preset Limit (Do Not Intubate)	Comfort Measures Only
Primary goals of care	Assist ventilation and/or oxygenation Alleviate dyspnea Achieve comfort Reduce risk of intubation Reduce risk of mortality Avoidance of intubation	Includes same as category 1 except intubation declined Also could include briefly prolonging life for a specific purpose (e.g., arrival of family member)	Palliation of symptoms (relief of dyspnea)
Main goals to communicate with patient and family	Goal is to restore health and use intubation if necessary and indicated	Goal is to restore health without using endotracheal intubation and without causing unacceptable discomfort	Goal is to maximize comfort while minimizing adverse effects of opiates
Determination of success	Improved oxygenation and/or ventilation Tolerance of NPPV or minor discomfort that is outweighed by potential benefit	Improved oxygenation and/or ventilation Tolerance of NPPV or minor discomfort that is outweighed by potential benefit	Improved symptoms Tolerance of NPPV
Endpoint for NPPV	Unassisted ventilation adequately supporting life Intolerance of NPPV	Unassisted ventilation adequately supporting life Intolerance of NPPV	Patient is *not* more comfortable having NPPV on or wants NPPV stopped Patient becomes unable to communicate
Response to failure	Intubation and mechanical ventilation (if indicated)	Change to comfort measures only and palliate symptoms without NPPV	Palliate symptoms without NPPV
Likely location of NPPV	ICU but may include step-down unit or acute care bed in some hospitals with appropriately monitored setting and trained personnel	Variable but may include ICU or step-down unit or acute care bed	Acute care bed but could be applied in hospice by appropriately trained personnel

ICU, intensive care unit.

Noninvasive ventilation in acute exacerbations of COPD
M.W. Elliott, et al. Eur Respir Rev 2005



Eur Respir J 2005; 25: 348–355
DOI: 10.1183/09031936.05.00065304

A chart of failure risk for noninvasive ventilation in patients with COPD exacerbation

M. Confalonieri*, G. Garuti#, M.S. Cattaruzza*, J.F. Osborn*, M. Antonelli+, G. Conti+, M. Kodric*, O. Resta§, S. Marchese', C. Gregoretti** and A. Rossi, on behalf of the Italian noninvasive positive pressure ventilation (NPPV) study group##

		pH after 2 h <7.25		pH after 2 h 7.25–7.29		pH after 2 h ≥7.30	
	RR	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29	APACHE ≥29	APACHE <29
GCS 15	<30	72	35	27	7	11	3
	30–34	88	59	49	17	25	7
	≥35	93	73	64	27	38	11
GCS 12–14	<30	84	51	41	13	19	5
	30–34	93	74	65	28	39	12
	>35	96	84	78	42	54	20
GCS ≤11	<30	93	74	65	28	39	12
	30–34	97	86	83	51	63	26
	≥35	99	93	90	66	76	40

FIGURE 3. Failure risk chart of noninvasive positive pressure ventilation after 2 h (the values in the table correspond to the percentage of patients who fail in each category). 0–24%, 25–49%, 50–74%, 75–100%. RR: respiratory rate; APACHE: acute physiology and chronic health evaluation II score; GCS: Glasgow Coma Scale.

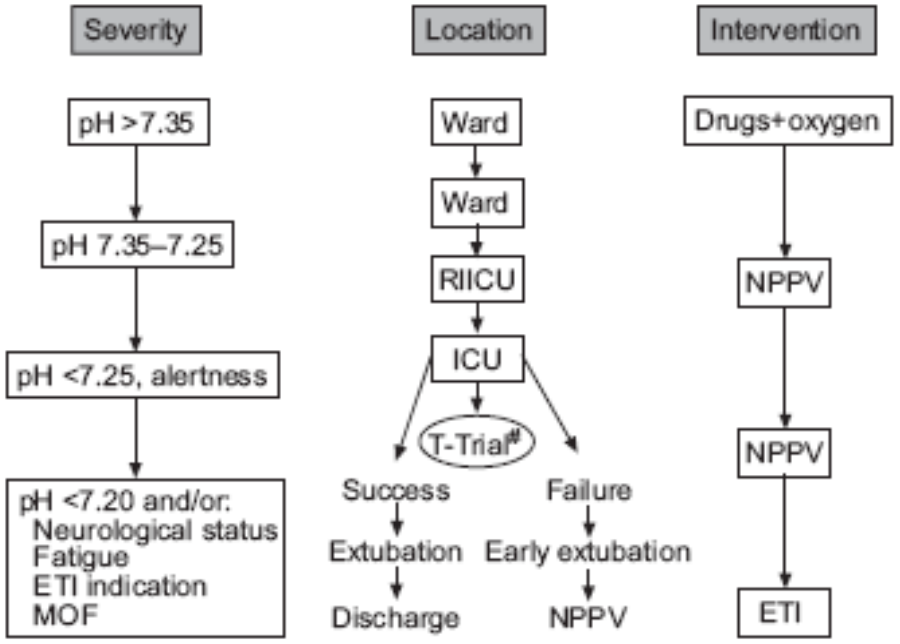


FIGURE 2. Flow chart of the application of noninvasive positive pressure ventilation (NPPV) in acute exacerbations of chronic obstructive pulmonary disease, according to the severity of acute respiratory failure. RIICU: respiratory intermediate intensive care unit; ICU: intensive care unit; ETI: endotracheal intubation; MOF: multiple organ failure. #: as described in [81].

Ambrosino N, et al. Eur Respir J 2008

American Thoracic Society Documents

Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia

This official statement of the American Thoracic Society and the Infectious Diseases Society of America was approved by the ATS Board of Directors, December 2004 and the IDSA Guideline Committee, October 2004

Am J Respir Crit Care Med Vol 171. pp 388–416, 2005
DOI: 10.1164/rccm.200405-644ST
Internet address: www.atsjournals.org

more than $40,000 per patient (9–11). Although HAP is not a reportable illness, available data suggest that it occurs at a rate of between 5 and 10 cases per 1,000 hospital admissions, with the incidence increasing by as much as 6- to 20-fold in mechanically ventilated patients (9, 12, 13). It is often difficult to define the

more than 50% of the antibiotics prescribed (16). VAP occurs in 9–27% of all intubated patients (9, 11). In ICU patients, nearly 90% of episodes of HAP occur during mechanical ventilation.

VAP occur within the first 4 days of mechanical ventilation. The intubation process itself contributes to the risk of infection, and when patients with acute respiratory failure are managed with noninvasive ventilation, nosocomial pneumonia is less common (18–20).

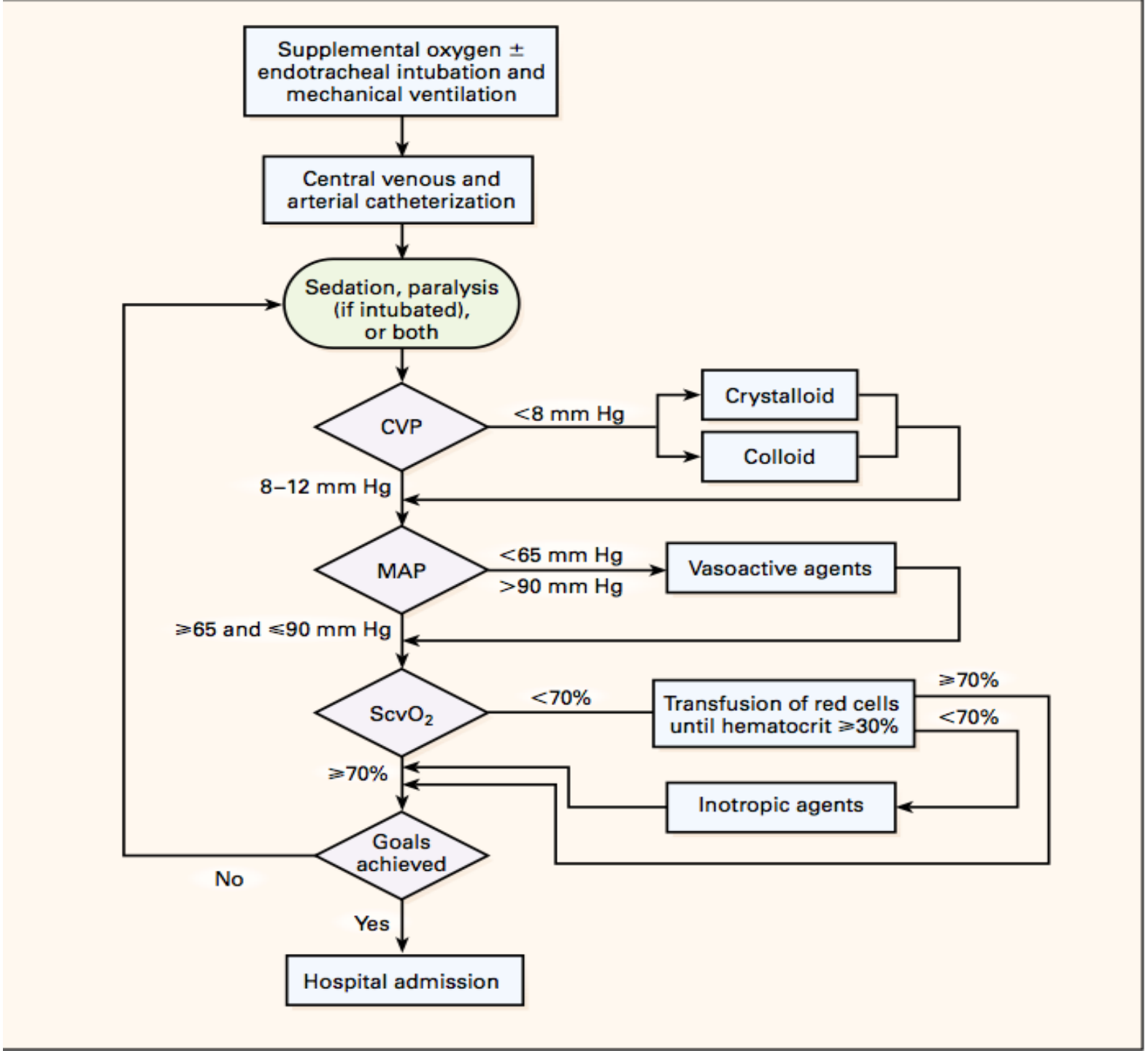
The crude mortality rate for HAP may be as high as 30 to 70%, but many of these critically ill patients with HAP die of their underlying disease rather than pneumonia. The mortality related to the HAP or "attributable mortality" has been estimated to be between 33 and 50% in several case-matching studies of VAP. Increased mortality rates were associated with bacteremia,

Aspiration of oropharyngeal pathogens, or leakage of secretions containing bacteria around the endotracheal tube cuff, are the primary routes of bacterial entry into the lower respiratory tract (**Level II**) (95–98).

Intubation and mechanical ventilation increase the risk of HAP 6- to 21-fold and therefore should be avoided whenever possible (3, 94, 110, 114). Noninvasive positive-pressure ventilation, using a face mask, is an attractive alternative for patients with acute exacerbations of chronic obstructive pulmonary disease or acute hypoxemic respiratory failure, and for some immunosuppressed patients with pulmonary infiltrates and respiratory failure (18, 20, 115–119). Data suggest that use of noninvasive ventilation to

Noninvasive ventilation should be used whenever possible in selected patients with respiratory failure (**Level I**) (18, 20, 115–119).

VAP may also be related to colonization of the ventilator circuit (131). A large number of prospective, randomized trials have shown that the frequency of ventilator circuit change does not affect the incidence of HAP, but condensate collecting in the ventilator circuit can become contaminated from patient secretions (98, 132–135). Therefore, vigilance is needed to pre-

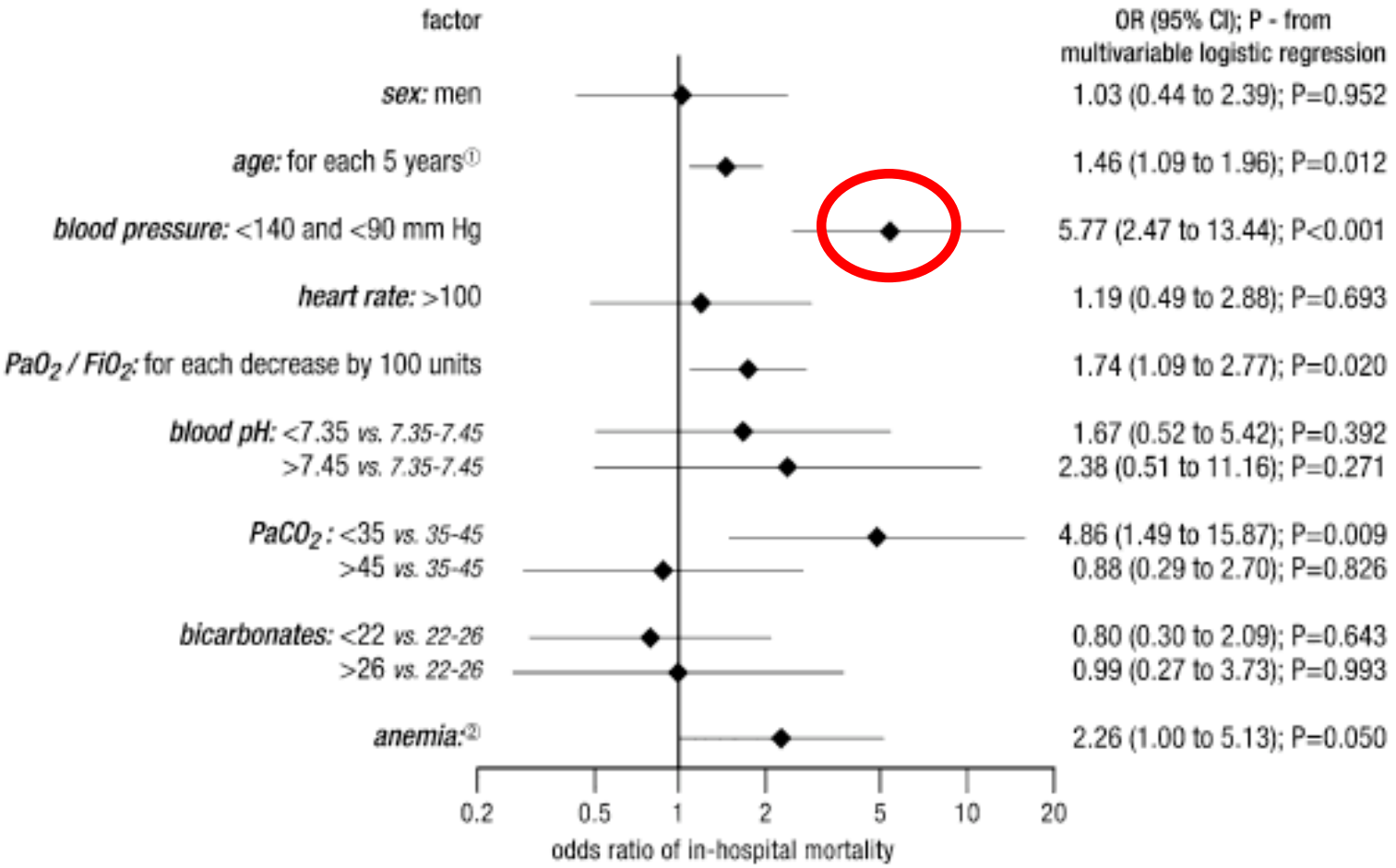

Supplemental oxygen ± endotracheal intubation and mechanical ventilation
Central venous and arterial catheterization
Sedation, paralysis (if intubated), or both
CVP
<8 mm Hg
Crystalloid
Colloid
8–12 mm Hg
MAP
<65 mm Hg
>90 mm Hg
Vasoactive agents
⩾65 and ⩽90 mm Hg
ScvO2
<70%
Transfusion of red cells until hematocrit ⩾30%
⩾70%
<70%
⩾70%
Inotropic agents
Goals achieved
No
Yes
Hospital admission

Intensive Care Med (2009) 35:299–305
DOI 10.1007/s00134-008-1281-7

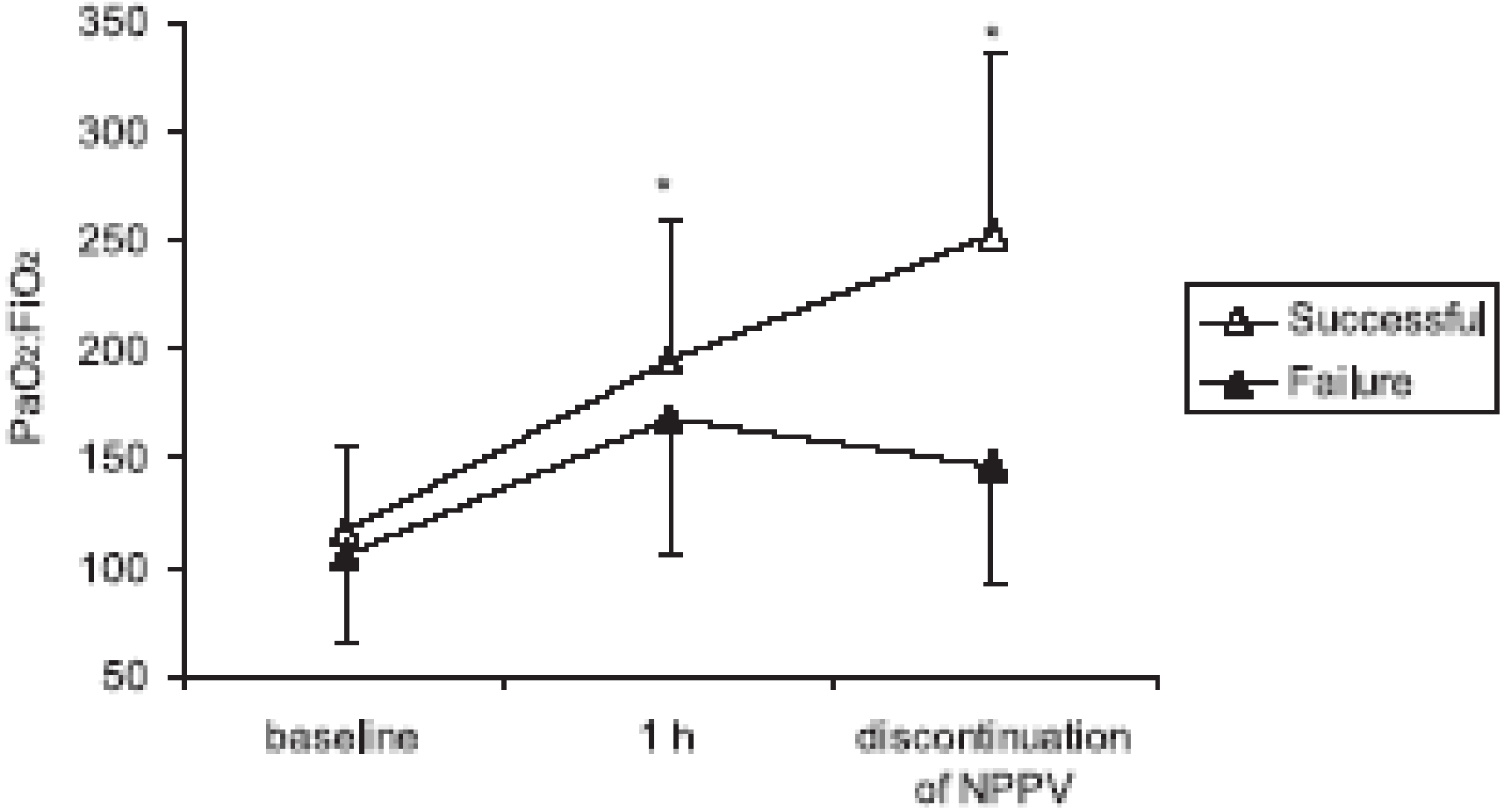
ORIGINAL

Roberto Cosentini
Stefano Aliberti
Angelo Bignamini
Federico Piffer
Anna Maria Brambilla

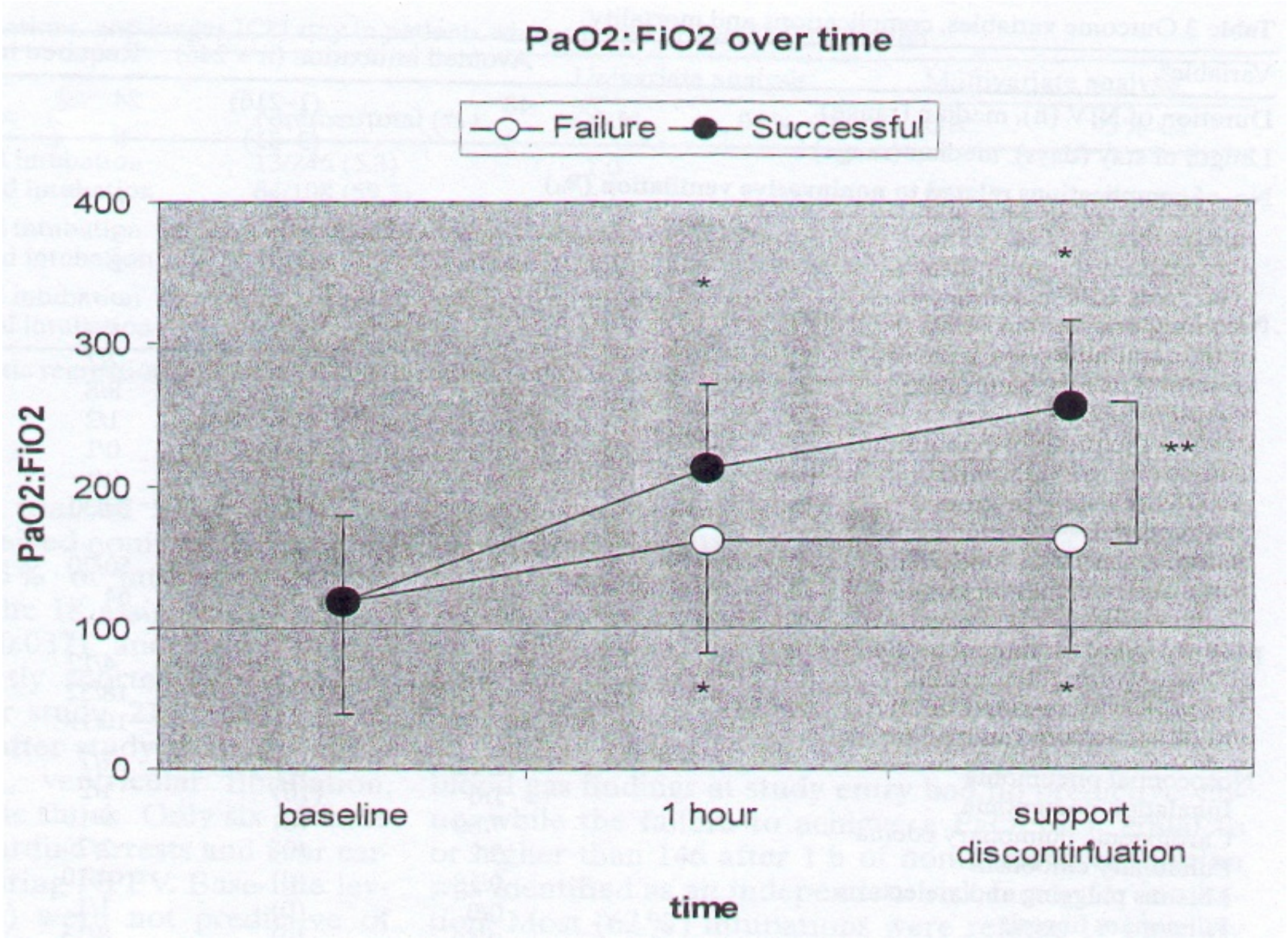
Mortality in acute cardiogenic pulmonary edema treated with continuous positive airway pressure




GOLDEN
HOUR



Antonelli M, et al. Crit Care Med 2007



Antonelli M, et al. Int Care Med 2001

NIV failure

Late

(after initial successful response)

Late failure

After initial successful response,

functional limitation,
lower pH,
decreased attention and monitoring,
infectious complications,
MOF,
sleep disturbances,
increased delirium, …

NIV failure

Timing
Delay
Location
Experience and skills
Choice of ventilator
Interfaces
Rotating strategy
Humidification
Drugs

Predictors of failure of noninvasive positive pressure ventilation in patients with acute hypoxemic respiratory failure: a multi-centre study.

Antonelli M, et al. Int Care Med 2001

<<… Factors vital to the success of NIV include careful selection of patients, properly timed intervention, a comfortable, well-fitting interface, coaching and encouragement of patients, careful monitoring, and a skilled and motivated team. …

… Outcome predictors are important to identify patients who are less likely to improve with noninvasive ventilation, thus requiring closer observation and a readily available means of intubation. This is particularly important for patients with severe hypoxemia, where unnecessary delays in intubation may have serious consequences. …>>

Utilizzo della Ventilazione Meccanica Noninvasiva per il trattamento dell'Insufficienza Respiratoria Acuta nel Dipartimento di Emergenza-Accettazione. Barboni E, et al. Linee guida SIMEU "NIMV nel DEA" 2005

CONCLUSIONI

<<… Anche in "emergenza" la NIMV non può rappresentare un "tentativo", ma parte di un piano terapeutico integrato, che non trascura ipotesi diagnostiche e prognostiche ragionate, l'ottimizzazione della terapia medica, la garanzia della continuità assistenziale attraverso il coinvolgimento di strutture e competenze specialistiche.>>

Table 1. – Where should noninvasive positive-pressure ventilation be carried out?

Factors to be considered
Location of staff with training and expertize in noninvasive positive-pressure ventilation
Adequate staff available throughout 24-h period
Rapid access to endotracheal intubation and invasive mechanical ventilation
Severity of respiratory failure and likelihood of success
Facilities for monitoring

Table 2. – Monitoring during noninvasive positive-pressure ventilation (NPPV)

Essential
Regular clinical observation
Continuous pulse oximetry
Arterial blood gases after 1–4 h NPPV and after 1 h of any change in ventilator settings or F_{I,O_2}
Respiratory rate
Desirable
Electrocardiogram
More detailed physiological information such as leak, expired V_T, and measure of ventilator patient asynchrony

F_{I,O_2}: inspiratory oxygen fraction; V_T: tidal volume.

Table 3. – Training requirements

Understanding rationale for assisted ventilation
Mask and headgear fitting techniques
Ventilator circuit assembly
Theory of operation and adjusting ventilation to achieve desired outcome
Cleaning and general maintenance
Problem solving - the ability to recognise serious situations and act accordingly
Above all medical, nursing and technical staff need to be convinced that the technique works
Specific educational programs may help acceptance of NPPV among personnel

Elliott MW, et al.

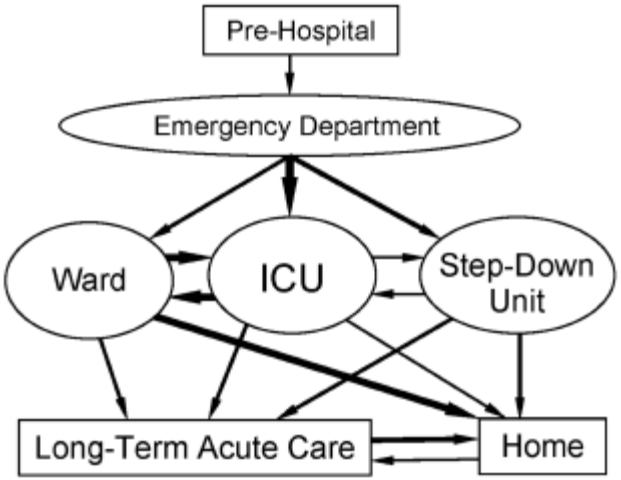
Eur Respir J 2002

Table 1. Advantages and Disadvantages of Locations for NIV in Acute and Subacute Conditions

Location	Advantages	Disadvantages
Pre-hospital	Rapid application	Limited equipment and monitoring Lack of evidence
Emergency department	Rapid application Close monitoring in high-intensity room	Temporary location Staff may lack NIV skill and experience
Intensive care unit	1:1 nurse/patient ratio, usually with dedicated respiratory therapist Maximal monitoring capabilities	Resource-intensive and excessively costly for stable patients Beds in short supply
Step-down unit	1:2 to 1:4 nurse/patient ratio and central monitoring available Often have dedicated respiratory therapist Develop specialized NIV skills and suitable for most acute NIV applications	Many hospitals lack such units Excessive resource-use for stable patients NIV skills differ between units
General ward	Suitable for stable patients for more efficient use of resources Beds more often available than in ICU or step-down unit Some offer central monitoring, have NIV skills	Not suitable for patients who require close monitoring Many lack experience or skill with NIV
Long-term acute care	Good location for transitioning from tracheostomy to NIV More time to initiate stable long-term patients on NIV Rehabilitation and physical therapy services available	Not suitable for acutely ill patients Many lack experience and skill with NIV

Where Should Noninvasive Ventilation Be Delivered?

Nicholas S Hill MD



"… The ideal location for noninvasive positive-pressure ventilation will vary from country to country and indeed from hospital to hospital, depending upon local factors. However, the most important factor is that staff be adequately trained in the technique and be available throughout the 24-h period."

Elliott MW et al, Eur Respir J 2002

"Financial constraints and bed limitations frequently prevent the admission of ill patients to a critical care setting."

Paus-Jenssen ES, et al. Chest 2004

"Although a respiratory intermediate care unit would be ideal, we do not have such a unit in our hospital. An extreme shortage in critical care bed availability at our center often mandates that patients not requiring therapy with vasoactive drugs or ETI be monitored outside the ICU."

"… if an acute NIV service is not provided, the shortage of ICU beds means that some patients will die ..."

British Thoracic Society Standards of Care Committee. Thorax 2002

Noninvasive Ventilation and Survival in Acute Care Settings: A Comprehensive Systematic Review and Meta-Analysis of Randomized Controlled Trials

Luca Cabrini, MD; Giovanni Landoni, MD; Alessandro Oriani, MD; Valentina P. Plumari, MD; Leda Nobile, MD; Massimiliano Greco, MD; Laura Pasin, MD; Luigi Beretta, MD; Alberto Zangrillo, MD

(*Crit Care Med* 2014; XX:00–00)

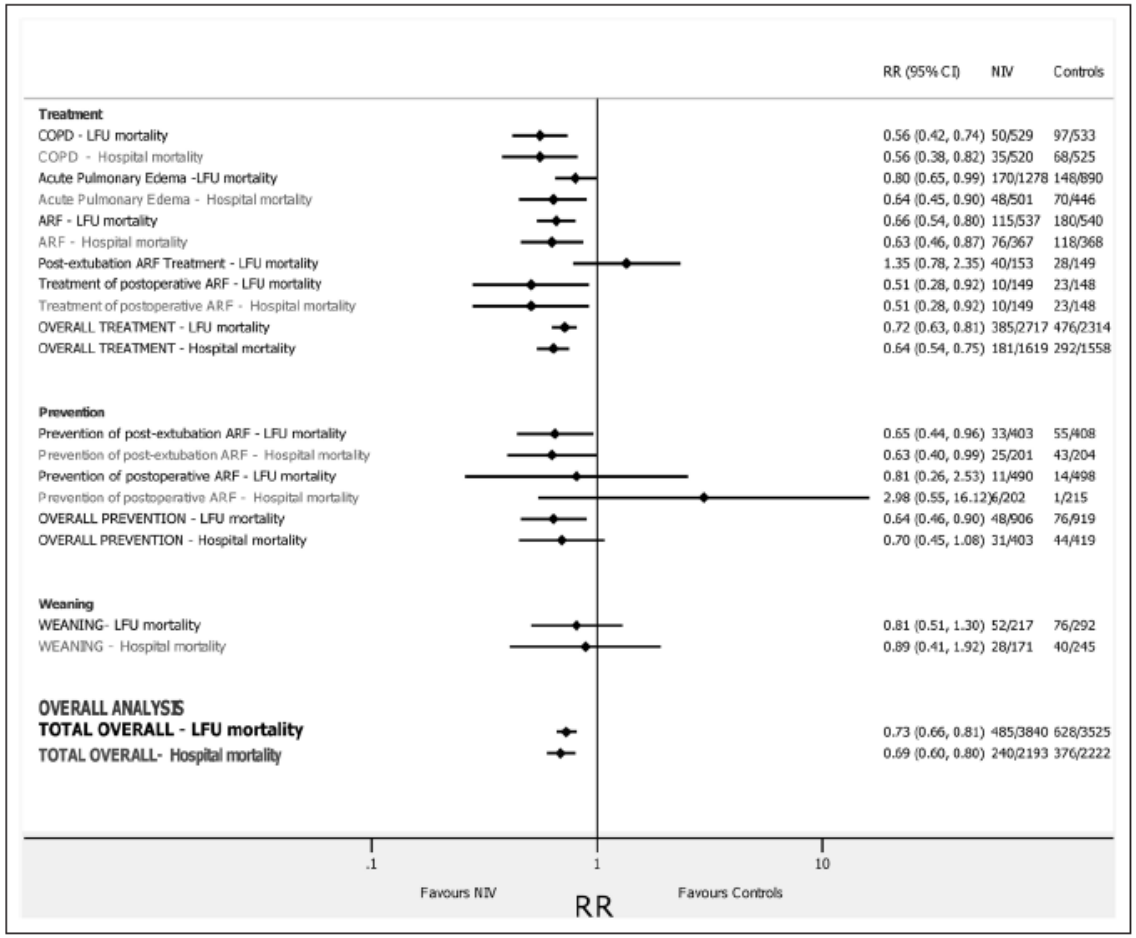


Figure 1. Forest plot for the risk of mortality reporting both mortality at longest follow-up available (*black*) and hospital mortality (*gray*) within summary estimate of subgroup analyses, overall analyses for the type of noninvasive ventilation (NIV) therapy, and total overall analyses. ARF = acute respiratory failure, COPD = chronic obstructive pulmonary disease, LFU mortality = mortality at longest follow-up available, RR = risk ratio.

"NIV works – an evidence based verdict."

BTS GUIDELINE. Thorax 2002;57:192-211

PNEUMOLOGIA 2016

Milano, 16 – 18 giugno 2016 · Centro Congressi Palazzo delle Stelline

MINICORSO | Venerdì, 17 giugno 2016

LA VENTILAZIONE MECCANICA NON INVASIVA: INDICAZIONI E LIMITI OGGI

Coordinatore: *Stefano Nava (Bologna)*
Moderatori: *Stefano Nava (Bologna), Raffaele Scala (Lucca)*

14.30 - 15.00	NIV per lo svezzamento del paziente cronico tracheotomizzato *Piero Ceriana (Pavia)*
15.00 - 15.30	Indicazioni non tradizionali *Raffaele Scala (Lucca)*
15.30 - 16.00	Perché e quando la NIV fallisce *Rodolfo Ferrari (Bologna)*
16.00 - 16.30	Le interfacce: sappiamo già tutto? *Lara Pisani (Bologna)*
16.30 - 17.00	Ossigeno ad alto flusso umidificato: alternativa alla NIV? *Stefano Nava (Bologna)*
17.00 - 17.30	Discussione

15.30 - 16.00 Perché e quando la NIV fallisce
Rodolfo Ferrari (Bologna)

Rodolfo Ferrari

rodolfo.ferrari

@

aosp.bo.it