



**Non-Invasive Ventilation (NIV)**  
with the Oxylog<sup>®</sup> 2000 plus and Oxylog<sup>®</sup> 3000 plus

D-370-2010

#### WARNING

This booklet is not a substitute for the Instructions for Use of the Oxylog® 2000 plus and Oxylog® 3000 plus. Before any use of the devices, the user must carefully read and fully understand the Instructions for Use of the devices.

#### IMPORTANT NOTE

Medical knowledge is subject to constant change due to research and clinical experience. This booklet focuses on Non-Invasive Ventilation during transport and emergency care. The authors have taken great care to make certain that the views, opinions and assertions included, particularly those concerning applications and effects, correspond with the current state of knowledge. However, this does not absolve readers from their obligation to take clinical measures on their own responsibility.

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## Non-Invasive Ventilation (NIV)

### INTRODUCTION TO NIV

“Non-Invasive Ventilation (NIV) is the delivery of mechanically-assisted breathing without placement of an artificial airway such as an endotracheal tube or tracheostomy.

During the first decades of the 20th century, negative-pressure ventilation (iron lung) provided mechanical ventilatory assistance. By the 1960s, however, invasive (i.e., by means of an endotracheal tube) positive-pressure ventilation superseded negative-pressure ventilation as the primary mode of support for ICU patients because of its superior delivery of support and better airway protection.

Over the past decade, the use of NIV has been integrated into the treatment of many medical diseases, largely because the development of nasal ventilation in the home care market. NIV has the potential benefit of providing ventilatory assistance with greater convenience, comfort, safety, and less cost than invasive ventilation. NIV is delivered by a tightly fitted mask or helmet that covers the nose, face, or head. NIV is used in various clinical settings and is beneficial in acute medical situations<sup>(1)</sup>.”

Non-Invasive Ventilation has received increased attention in emergency care situations in recent years as researchers and practitioners provide proof of benefited patients outcome:

- NIV has been shown to be effective in acute respiratory failure of various etiologies. It is complementary to invasive ventilation, as an adjunct therapy to usual medical care. NIV as a first line intervention prevents patients from deteriorating to the point at which intubation is needed<sup>(2, 5)</sup>.
- An important benefit of NIV includes the reduction of complications associated with intubation, particularly endotracheal tube associated infections. In intubated patients there is a 1% risk per day of developing pneumonia. This complication is associated with longer ICU stays, increased cost and increased morbidity and mortality<sup>(2)</sup>.
- NIV has proven to have the potential to avoid intubation for 1 in every 4 patients, to reduce the number of complications up to 68% and reduce treatment failure up to 20%<sup>(3)</sup>.

- NIV failure is still relatively high because of patient intolerance, particularly due to the choice of interface and ventilator settings. Improved patient ventilator synchronization reduces intolerance and improves the chance of successful NIV treatment<sup>(5, 7)</sup>.
- NIV can be successfully initiated in the Emergency Department<sup>(7, 8)</sup> and delaying the initiation of NIV reduces the possibility of success of treatment<sup>(2, 3, 4, 5, 6)</sup>.
- NIV is a complex and labor intensive venture. It requires experienced staff to closely monitor the patient. Therefore after initiation of NIV in the Emergency Department, it is worthwhile to transfer the patient to an observation unit or intermediate care unit, preventing admission to the ICU<sup>(3, 6)</sup>.
- Patients that were successfully treated with NIV during their hospital admission also exhibited lower mortality rates, a reduction in hospital re-admissions and in the need for long-term oxygen therapy<sup>(2)</sup>.
- NIV is feasible and improves emergency management of acute cardiogenic pulmonary edema when initiated in pre-hospital settings<sup>(9)</sup>.

**POTENTIAL NIV ADVANTAGES**

- Reduce the risk of Ventilator Associated Pneumonia (VAP)<sup>(2)</sup>
- Reduce work of breathing<sup>(7)</sup>
- Decrease mortality<sup>(2)</sup>
- Decrease the intubation rate<sup>(3)</sup>
- Reduction in health care costs<sup>(2)</sup>
- Decrease length of stay in the hospital<sup>(8)</sup>
- Decrease hospital re-admission<sup>(2)</sup>

**NIV INDICATIONS<sup>(13)</sup>**

- Acute exacerbation of COPD
- Facilitate extubation in COPD
- Cardiogenic pulmonary edema
- Immuno-suppression
- Postoperative patients
- Palliative care

**SUCCESS METRICS OF NIV<sup>(13)</sup>**

<u>Criterion</u>	<u>Success Criterions of NIV</u>
<u>Dyspnoea</u>	<u>Reduction</u>
<u>Vigilance</u>	<u>Increasing improvement</u>
<u>Respiratory Rate (RR)</u>	<u>Reduction</u>
<u>Ventilation</u>	<u>PaCO<sub>2</sub>-reduction</u>
<u>pH-value</u>	<u>Increase</u>
<u>Oxygenation</u>	<u>Increase of SaO<sub>2</sub> ≥ 85%</u>
<u>Heart Rate (HR)</u>	<u>Reduction</u>

### **ABSOLUTE CONTRAINDICATIONS<sup>(13)</sup>**

- Lack of spontaneous breathing
- Gaspings
- Partial or complete airway blocking
- Aspiration, gastrointestinal bleeding or ileus

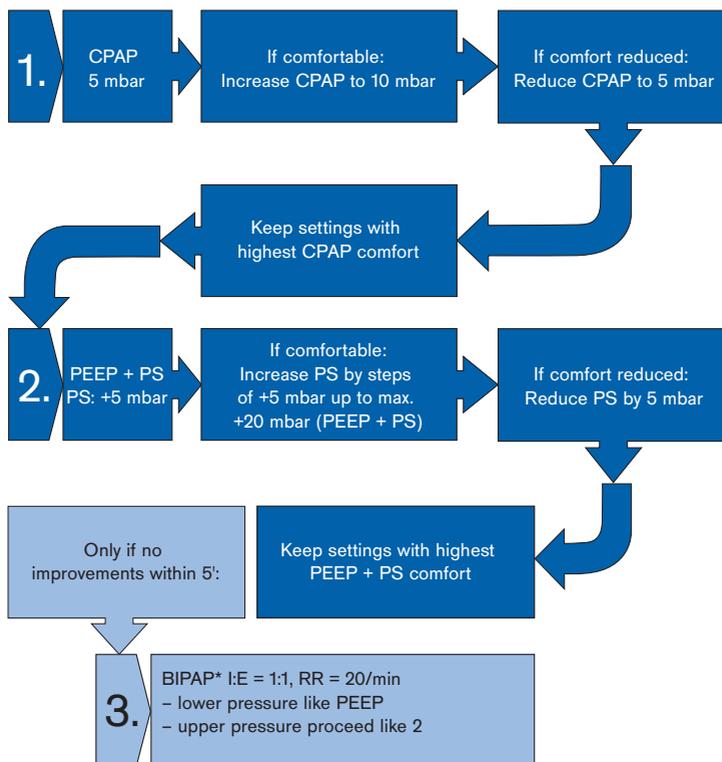
### **RELATIVE CONTRAINDICATIONS<sup>(13)</sup>**

- Coma
- Massive retention of secretions despite bronchoscopy
- Massive agitation
- Acidosis (pH < 7.1)
- Hemodynamic instability (cardiogenic shock, myocardial infarction)
- Status post: upper gastrointestinal surgery

### **POTENTIAL SIDE EFFECTS**

- Excessive leakage<sup>(1)</sup>
- Patient discomfort as a result of asynchrony and increased work of breathing<sup>(8)</sup>
- Gastric distension<sup>(2)</sup>
- Facial skin necrosis<sup>(1)</sup>
- Eye irritation (conjunctivitis)<sup>(1)</sup>
- Increased risk of aspiration<sup>(2)</sup>
- Anxiety<sup>(8)</sup>

## FLOW CHART FOR ADJUSTING NON-INVASIVE VENTILATION PARAMETERS<sup>(12)</sup>



MIT-0853-2008

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#### NIV APPLICATION WITH THE OXYLOG 2000 PLUS AND OXYLOG 3000 PLUS

Time and time again, Dräger has contributed to major advances in emergency medicine with innovations of medical engineering. Back in 1907, the portable Pulmotor was the world's first emergency ventilator and resuscitator. In 1978 Dräger again set new standards in primary care with the first Oxylog ventilator. The new benchmarks in emergency and transport ventilation are the Oxylog 2000 plus and Oxylog 3000 plus, both supporting the application of NIV.

### OPTIMAL PATIENT VENTILATION WITH AUTOMATIC LEAKAGE COMPENSATION

Both the Oxylog 2000 plus and Oxylog 3000 plus automatically adjust to meet the requirements of mask ventilation. Mask leakages are automatically compensated up to a maximum level of 100 L/min. Furthermore, the triggering is compensated in case of mask leakages enabling optimal support during ventilation. The measured values for  $V_{T_e}$  and  $M_{V_e}$  are also compensated to show the delivered volumes the patient receives.

### WORK SMARTER WITH OPTIMIZED ALARM SYSTEM

When activating the NIV function of the Oxylog 2000 plus or Oxylog 3000 plus, the leakage alarm will be deactivated automatically, eliminating unnecessary alarms. Monitoring of ventilatory parameters is possible during NIV.

#### WARNING

Dead space increases when using masks. Note the mask manufacturer's instructions!

#### WARNING

Ensure that NIV is not activated for intubated patients. Risk of undetected leaks and inadequate ventilation!

#### WARNING

Check MV alarm limits after deactivating NIV mode!

#### WARNING

Avoid high airway pressure. Risk of aspiration!

#### WARNING

Set the lower alarm limit MV  $\sqrt{\quad}$  according to the minimum ventilation required for the patient. Otherwise, there is a risk of the patient receiving insufficient ventilation.

#### WARNING

If NIV is not activated, measured values for  $V_{T_e}$  and  $M_{V_e}$  will be inconsistent if there are leakages during ventilation.



## NIV with the Oxylog 2000 plus

### ONE DEVICE FOR INVASIVE AND NON-INVASIVE VENTILATION

The Oxylog 2000 plus is specifically targeted for medical professionals who are ready to take the next step in emergency ventilation. It is designed for mobile application in ambulances and emergency departments.

The Oxylog 2000 plus combines controlled and support modes of ventilation for patients requiring mandatory or assisted ventilation with a tidal volume of 100 mL upwards.

## VENTILATION MODES

NIV can be activated as a supplementary function in the pressure controlled ventilation modes Spn-CPAP and Spn-CPAP/PS. The Spn-CPAP mode can supply the spontaneously breathing patient with inspiratory flow and Pressure Support when an inspiratory effort is initiated.

Mask leakages are detected by the device, compensated and included in the measured values for  $V_{T_e}$  and  $M_{V_e}$ .

## SYNCHRONIZATION WITH SPONTANEOUSLY BREATHING PATIENTS

The following spontaneous breathing capabilities are optional in the Oxylog 2000 plus:

- NIV
- Pressure Support

## OPERATION OF THE OXYLOG 2000 PLUS

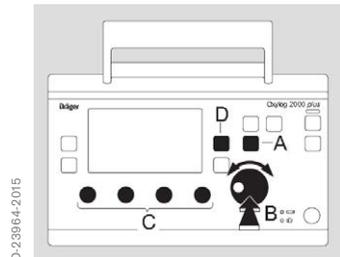


As per protocol (refer to page 8)

### Step 1: Setting CPAP basics

#### Continuous Positive Airway Pressure

1. Press & hold the Spn-CPAP (A) key for approximately 3 seconds or press and confirm with rotary knob (B) to activate mode.
2. Set and confirm the ventilation parameters with the controls below the display:
  - Maximum airway pressure  $P_{\max}$  (C)
  - Setting for oxygen concentration  $FiO_2$  (C)
3. Press the settings key (D) and select and confirm PEEP with the rotary knob (B) to set the PEEP level.
- 4a.  $\Delta P_{\text{supp}}$  can be set above PEEP: press the settings key (D) and select and confirm  $\Delta P_{\text{supp}}$  with the rotary knob (B) to set the  $\Delta P_{\text{supp}}$  level.
- 4b. The trigger can also be set on the display for synchronization with the patient's spontaneous breathing efforts: select trigger with the rotary knob (B) to set and confirm. Successful patient triggering is briefly indicated by an asterisk (\*) in the middle of the status alarm messages window.
- 4c. Pressure rise time Slope (for Pressure Support  $\Delta P_{\text{supp}}$ ) can additionally be set on the display: select and confirm Slope with the rotary knob (B) to set.



D-23864-2015

CPAP/PS \*

MVe	3.1	Paw	mbar	PEEP	[mbar]	5
1/2	L/min	60		$\Delta P_{\text{supp}}$	[mbar]	3
		40		Trigger	[L/min]	3
		20		Slope		
		0				
1/5	mbar					1/5
Gas consump. = 2.1 L/min						

MT-0885-2008

Apnea back-up ventilation is only applicable when using the Spn-CPAP mode. In the event of an apnea, the ventilator will automatically activate volumecontrolled mandatory ventilation (VC-CMV).

### Step 2: Setting NIV in CPAP

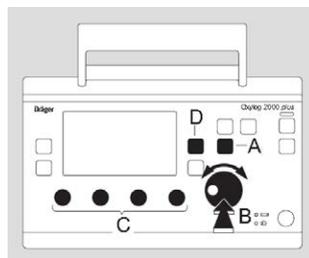
NIV – Non-Invasive (mask) Ventilation (optional) NIV can only be activated as a supplementary function in the pressure controlled ventilation modes Spn-CPAP and Spn-CPAP/PS. Mask leakages are calculated by the device, trigger and measured values for  $V_{Te}$  and  $M_{Ve}$  are compensated.

#### To switch on NIV

1. Press the Settings key (D) until page 2/3 in the display appears.
2. Select the NIV option on by confirming with the rotary knob (B).
  - The supplement NIV appears in the upper section of the display.

Apnea ventilation is not available when NIV is active.

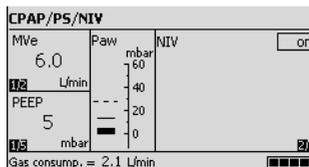
Oxylog 2000 plus automatically adjusts to the requirements of mask ventilation when leakage is present. Leakage flows are compensated automatically and the leakage alarm is inactive.



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#### WARNING

If NIV is not activated, measured values for  $V_{Te}$  and  $M_{Ve}$  will be inconsistent if there are leakages during ventilation.



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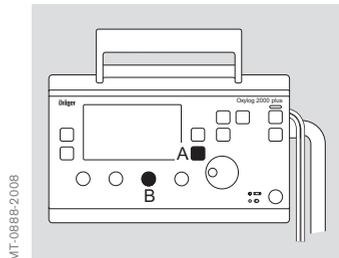
#### WARNING

Set the lower alarm limit MV  $\sqrt{\quad}$  according to the minimum ventilation required for the patient. Otherwise, there is a risk of the patient receiving insufficientventilation.

### Step 3: Setting alarm limits with CPAP/PS

The following alarm options are possible with Oxylog 2000 plus:

- Pressure limitation with  $P_{max}$ :  
use knob (B) to set
- Alarm limits for MV and RRsp  
(example: upper alarm limit for MV):
  - Press the key Alarms (A)
  - Select and activate the line MV on the display
  - Set and confirm the value with the rotary knob
- Setting alarm limits automatically
  - Press the key alarms (A)
  - Select and activate the line auto alarm and confirm with the rotary knob.



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CPAP/PS		!!! Paw high	
MVe	7.1	Paw	mbar
	1.2 L/min		60
PEEP	5		40
	mbar		20
			0
Gas consump. = 2.1 L/min		1.2	

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Please refer to the Oxylog® 2000 plus Instructions for Use for information about using alarms and settings.



## NIV with the Oxylog 3000 plus

### OPTIMAL PATIENT CARE

The Oxylog 3000 plus offers sophisticated ventilation for patients in emergency situations and during transport in and between hospitals. Designed to support a wide range of patients and medical conditions, Oxylog 3000 plus offers volume and pressure based modes, for controlled, synchronized or spontaneous ventilation. When transporting critical care patients, the need of interrupting ventilation therapy is therefore eliminated.

## VENTILATION MODES

The Oxylog 3000 plus offers a wide range of advanced ventilation modes, including VC-CMV, VC-AC, VC-SIMV, PC-BIPAP\* and Spn-CPAP, allowing the user to adapt the ventilator to the condition of the patient. Also AutoFlow® is as option available.

## SYNCHRONIZATION WITH SPONTANEOUSLY BREATHING PATIENTS

Spontaneous breathing is actively supported through the Pressure Support (PS) option in the VC-SIMV, Spn-CPAP and PC-BIPAP modes.

## NIV

NIV can be activated as a supplemental function in the ventilation modes Spn-CPAP (/PS), PC-BIPAP (/PS), VC-CMV/AF, VC-AC/AF and VC-SIMV/AF.

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Please refer to the Oxylog® 3000 plus Instructions for Use for information about using alarms and settings.

## OPERATION OF THE OXYLOG 3000 PLUS

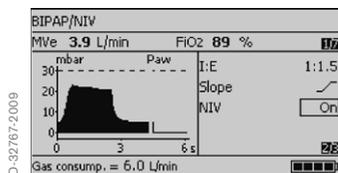
### Setting Non-invasive (mask) Ventilation

To switch on NIV

- Press **“Settings”** key  
until screen page 2 appears
- Activate line **“NIV off”**
- Select **“on”** and confirm

The supplement NIV appears in the top line of the screen.

The Oxylog 3000 plus automatically adjusts to the requirements of mask ventilation. Mask leakages are detected by the device and compensated for. Therefore, the displayed measured values  $V_{Te}$  and  $M_{Ve}$  do not include the leakage. The leakage alarm is inactive.



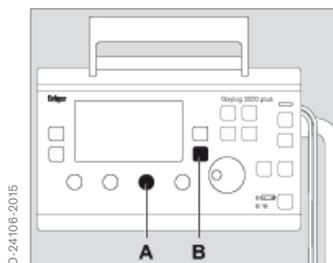
### Setting the alarm limits

The following alarm settings are possible with Oxylog 3000 plus:

- Pressure limitation with Pmax (A).
- Alarm limits for MVe, RRsp and etCO<sub>2</sub> (option)

Example: upper alarm limit for MVe:

- Press the key Alarms (B).
- Select and activate the line MVe on the display
- Set and confirm the value with the rotary knob.
- Setting alarm limits automatically
  - press the key Alarms (B).
  - select and activate the line “Alarms: Autoset” and confirm with the rotary knob.



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Information about using alarms and settings are available in the Oxylog® 3000 plus Instructions for Use.

## Dräger Medical Accessories for Non-Invasive Ventilation using Oxylog ventilators

Dräger also provides accessories for its Oxylog ventilators. These accessories improve economical, clinical, and process values, and offer excellence in performance and therapeutic benefits. As an integral part of the Dräger solution, these accessories are specific to the devices.

We offer a wide variety of new disposable breathing circuits. The VentStar Oxylog circuits are dedicated accessories to be used with the Dräger Oxylog family.

Furthermore Dräger offers a large portfolio of filters/HMEs. The TwinStar filter/HMEs efficiently humidify and heat the inspired air and at the same time support protection of the patient from potentially present microorganisms in the inspired air.

In order to guarantee correct measurement by the Dräger device, it is very important to use the correct accessories. We have designed and tested various products used with our Oxylog range of ventilators and have now added to our wide portfolio of products the new disposable CO<sub>2</sub> cuvette for non-invasive measurement of CO<sub>2</sub>. Prerequisite is the installation of the CO<sub>2</sub> option. In the clinical environment, but also emergency situation capnography is applied as a non-invasive way for evaluating a patient's ventilatory status.



D-99328-2014

VentStar®



MT-11164-2/008

TwinStar®

Minimizing leakage is the most important challenge in NIV. Leaks often result from a poor seal between the mask and the skin, reducing alveolar ventilation and synchrony between the patient and the ventilator.<sup>(10)</sup> The next major challenge is finding an interface which is comfortable, and free of unwanted side-effects. Although NIV is generally perceived as more comfortable for patients than invasive ventilation, mask intolerance remains a major cause of NIV failure. Failure rates range from below 10% to over 40%, despite the best efforts of skilled caregivers.<sup>(11)</sup>

Fitting the mask to the patient rather than making the patient fit the mask was the goal of a new line of Dräger patient interfaces: The ClassicStar and NovaStar non-invasive ventilation full-face masks.

The ClassicStar mask cushion can be inflated or deflated to match the patient's facial contours, resulting in an improved, anatomical fit. The NovaStar mask has a fine silicone gel-filled cushion as well as a pliable ring built into the transparent mask shell. This pliable ring allows the NovaStar mask to be shaped to match the individual patient's face, providing a truly customized fit, which, together with the fine gel-filled cushion, maximize patient comfort.

Additional features (e.g. access for nasogastric tube, adjustable forehead support etc.) further improve the performance of the ClassicStar and NovaStar NIV full-face masks.



D-585-2009

CO<sub>2</sub> Cuvettes

MT-0575-2007

ClassicStar®

Combining ventilation accessories such as our dedicated Oxylog circuits with outstanding products like the NovaStar NIV masks and certain general commodities such as filter/HMEs etc. then together with e.g. Dräger Oxylog 3000 plus ventilator, enables Dräger to offer a “one-step” and “one-stop” solution for the entire non-invasive ventilation therapy in emergency care. This allows the caregiver to improve efficiency and increase effectiveness, which in turn may lead to improved therapy for the patient.

Dräger offers compatibility certificates for its systems. This means that Dräger Oxylog ventilators and Dräger ventilation accessories are tested as a system to ensure your device is performing to the maximum efficiency and to reduce compatibility risk thus ensuring patient safety.

## ACCESSORIES FOR OXYLOG 3000 PLUS AND OXYLOG 2000 PLUS

ACCESSORIES	ORDER NO.
<b>Breathing Circuits</b>	
VentStar® Oxylog® 2000 plus and Oxylog® 3000 plus, 1.5 m, disp., 5 pcs.	5703041*
VentStar® Oxylog® 2000 plus and Oxylog® 3000 plus, 3 m, disp., 5 pcs.	MP00335*
VentStar® Oxylog® 3000 plus (P), 1.9 m, disp., 5 pcs.	5704964
<b>Filter/HMEs</b>	
Filter SafeStar® 80, 50 pcs.	MP01785
Filter SafeStar® 55, 50 pcs.	MP01790
Filter SafeStar® 60A, 50 pcs.	MP01795
Filter/HME TwinStar® 90, 50 pcs.	MP01800
Filter/HME TwinStar® 55, 50 pcs.	MP01805
Filter/HME TwinStar® 65 A, 50 pcs.	MP01810
Filter/HME TwinStar® 25, 50 pcs.	MP01815
Filter CareStar® 45, 50 pcs.	MP01755
Filter CareStar® 40A, 50 pcs.	MP01765
Filter CareStar® 30, 50 pcs.	MP01770
<b>CO<sub>2</sub> Cuvettes</b>	
Disposable CO <sub>2</sub> Cuvette—adults, 10 pcs.	MP01062
Disposable CO <sub>2</sub> Cuvette—pediatrics, 10 pcs.	MP01063
Reusable CO <sub>2</sub> Cuvette—adults, 1 pcs.	6870279
Reusable CO <sub>2</sub> Cuvette—pediatrics, 1 pcs.	6870280
<b>Breathing Masks</b>	
ClassicStar® SE NIV full-face mask, size S, 1 pcs.	MP01573
ClassicStar® SE NIV full-face mask, size M, 1 pcs.	MP01574
ClassicStar® SE NIV full-face mask, size L, 1 pcs.	MP01575
NovaStar® SE NIV full-face mask, size S, 1 pcs.	MP01579
NovaStar® SE NIV full-face mask, size M, 1 pcs.	MP01580
NovaStar® SE NIV full-face mask, size L, 1 pcs.	MP01581

\* Product is compatible with Oxylog® 2000 plus and Oxylog® 3000 plus

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- <sup>(12)</sup> Roessler, M.S.: Early out-of-hospital non-invasive ventilation is superior to standard medical treatment in patients with acute respiratory failure: a pilot study in: *Emerg. Med. J.* 2012;29:409e414.
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## Abbreviations

COPD	Chronic Obstructive Pulmonary Disease
ED	Emergency Department
FiO <sub>2</sub>	Fraction of inspiratory oxygen
HME	Heat and Moisture Exchanger
ICU	Intensive Care Unit
MV	Minute Volume
MVe	Total expiratory minute volume
NIV	Non-Invasive ventilation
Paw	Airway pressure
PC-BIPAP	Pressure Controlled – Biphasic Positive Airway Pressure
PEEP	Positive end expiratory pressure
P <sub>insp</sub>	Set value of the upper pressure level
P <sub>max</sub>	Maximum airway pressure
PS	Pressure Support
PS	Pressure Support
RR	Respiratory Rate (frequency)
RR <sub>sp</sub>	Spontaneous Respiratory Rate
Spn-CPAP	Spontaneous Continuous Positive Airway Pressure
VC-AC	Volume Controlled–Assist Control
VC-CMV	Volume Controlled–Controlled Mandatory Ventilation
VC-SIMV	Volume Controlled–Synchronized Intermittent Mandatory Ventilation
VT	Set tidal volume
VTe	Expiratory Tidal Volume
ΔP <sub>supp</sub>	Positive pressure above PEEP









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