RAPHAEL

Intelligent Ventilation

Noninvasive ventilation made simple

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RAPHAEL

Your vision of noninvasive ventilation

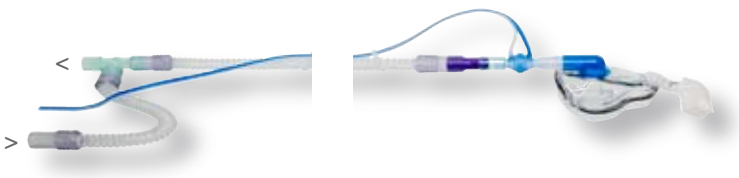
You want a noninvasive ventilator with the performance of an ICU device, at an affordable price. You want the ease of a single-limb circuit.

But you also know the reality – that noninvasive ventilation fails in 30 to 50% of all cases, and that you may have to intubate at a moment's notice. You want one ventilator that can do it all.

The RAPHAEL is an Intelligent Ventilation solution for full-featured noninvasive and invasive ventilation and is designed for:

> superior performance in complex environments
> improved patient outcomes
> reduced costs of ownership

It combines the competitively priced RAPHAEL with the LiteCircuit single-limb breathing circuit*. It is the ideal solution for step-down or subacute care centers, ICUs, recovery rooms, or transit and is suitable for adults and children.
To adapt to the frequently changing leakage conditions of noninvasive ventilation, the RAPHAEL incorporates the innovative IntelliTrig technology to automatically and continuously adjust the trigger threshold to the leakage.

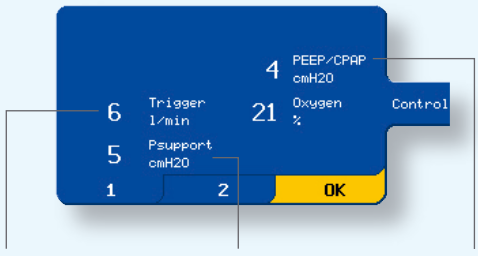


Patient interfaces and LiteCircuit single-limb breathing circuit

Criterion	Face mask (non-vented)	Nasal mask (non-vented)	Helmet*
Mouth breather	●		●
For claustrophobic patients		●	●
Promotes communication		●	
Access to mouth		●	
Less deadspace		●	
Requires little cooperation	●		●
Less leakage	●		●
Face abnormalities			●

*May not be approved for use in all markets

Start noninvasive ventilation



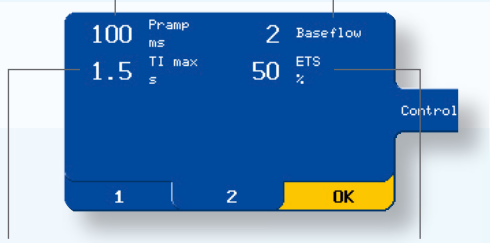
4 – 8 l/min
Adjust to obtain appropriate tidal volumes (6 – 8 ml/kg).

5 – 10 cmH_2O[1]
Adjust to achieve the right balance between the desired exhaled tidal volume and leakage.

Minimum setting[1]**, or 4 cmH_2O for single-limb circuit**[2]
Adjust further, considering oxygenation and AutoPEEP (< 10)[1].

100 ms
Reduce if patient is air-hungry.

≥ 2
Increase to reduce work of breathing.



0.25 to 0.5 s longer than actual spontaneous inspiration time
Set it long enough so that ETS has a chance to cycle ventilator.

50%
Increase for larger leaks. Find the optimal ETS that lets the ventilator cycle into exhalation with a Ti of 1.0 to 1.2 s.

Determine if patient is a candidate for NPPV[1]

The patient must be able to breathe spontaneously without mechanical ventilation for a period of several minutes in case of mask displacement. They should also meet at least one of the following criteria:

> They demonstrate respiratory distress, displaying moderate to severe dyspnea, increased over usual, and respiratory rate > 24 with accessory muscle use and paradoxical breathing
> They demonstrate one of the following gas exchange abnormalities:
  – $PaCO_2$ > 45 and pH < 7.35
  – PaO_2/FiO_2 < 200

Select and install patient interface and breathing circuit

Select the patient interface according to the table on the bottom left. Set up the RAPHAEL with a breathing circuit. Select the LiteCircuit or a double-limb circuit**, as clinically appropriate.

Manage patient anxiety

> Explain the goal of noninvasive ventilation
> Prearrange how the patient will communicate his needs
> Use disconnection suppression when starting ventilation
> Let the patient grow accustomed to the mask by starting with low pressure settings and by holding the mask to the patient's face before tightening the strap. Let the patient remove the mask for a short time to speak or drink.

Set the controls

1. Set the mode to NIV.
2. Make initial settings. Set PEEP/CPAP to adjust the expiratory airway pressure (EPAP). Set Psupport to adjust the inspiratory airway pressure (IPAP).
3. Adjust the settings as needed to optimize synchronization, to optimize breath volume and/or PCO_2, to minimize fatigue of accessory muscles, to relieve dyspnea, and to reduce respiratory rate. Frequency should be ≤ 25 b/min.
4. Titrate ventilation and oxygenation. Adjust settings as patient's condition and leak change.
5. Adjust the alarms appropriately.

**For example, a double-limb circuit may be most effective in cases of severe hypercapnia.

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Help the patient accept therapy

Optimize patient comfort

> Make sure the mask fits properly. Use a sizing gauge to measure the face for the best fitting mask. Check whether the headband is uniformly and firmly fastened. Change the mask type if the mask still feels uncomfortable. Check repeatedly that the mask is comfortably positioned.
> Maintain an acceptable leak tolerance. A small leak is well compensated and should be present to prevent pressure necrosis. Noninvasive ventilation becomes ineffective with a Leak parameter greater than 50%.

Minimize adverse effects

Pressure sores

> Check whether the mask is the right size and is properly positioned
> Loosen the straps
> Verify that the leak is acceptable
> Use a wound care dressing

Inadequate upper airway humidification

> Use a full face mask and a heated humidifier
> Use a saline nasal spray

Skin rash

> Apply an oilless salve to the affected areas

Excessive leakage

> Adjust the interface, adjust the straps, and/or change to another type of mask

Asynchrony

> Readjust these control settings: Trigger, Pramp, and PEEP/CPAP

Disconnection of mask and ventilator

> Reapply and secure mask
> Where applicable, insert false teeth (greatly improves mask positioning)

Monitor the patient and the therapy

Closely observe the patient

> Blood gases (check for hypoxia and hypercapnia)
> Respiratory pattern
> Patient tolerance/sensitivity

You should observe improvement within 30 to 60 minutes. If the patient is not improving, adjust settings; increase pressure support. If you don't see improvement within 2 hours, consider intubating.

Monitor the therapy to determine whether it is meeting its intended goals

Determine whether the patient is ready for weaning

> Clinically stable for > 6 hours
> Respiratory rate < 24 b/min, heart rate < 110/min, compensated pH > 7.35, SpO_2 > 90% (with maximum of 50% FiO_2)

Start weaning

> Titrate Psupport in 2 - 4 cmH_2O steps, or
> Trial patient on routine oxygen therapy

Monitor the patient/ventilation parameters to determine

> Whether to end NPPV
> Whether to provide only nocturnal NPPV support,
> Whether to continue NPPV at current settings, or
> Whether to intubate

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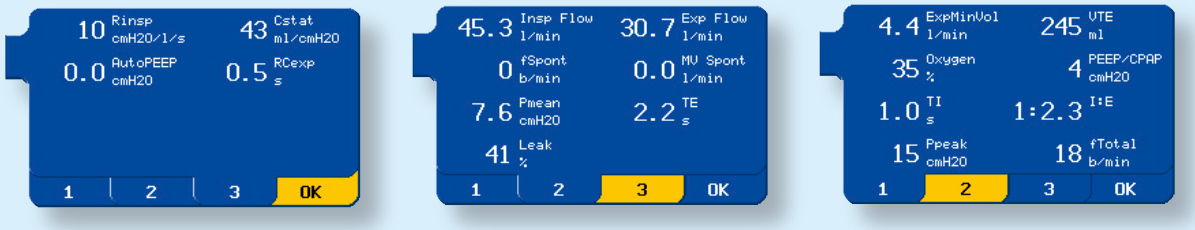
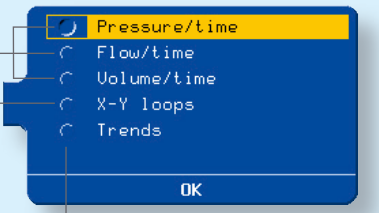
The RAPHAEL at a glance



Numeric patient data

Pay particular attention to Ppeak, fTotal, and Leak.
Ppeak should equal Psupport + PEEP/CPAP.



Curves

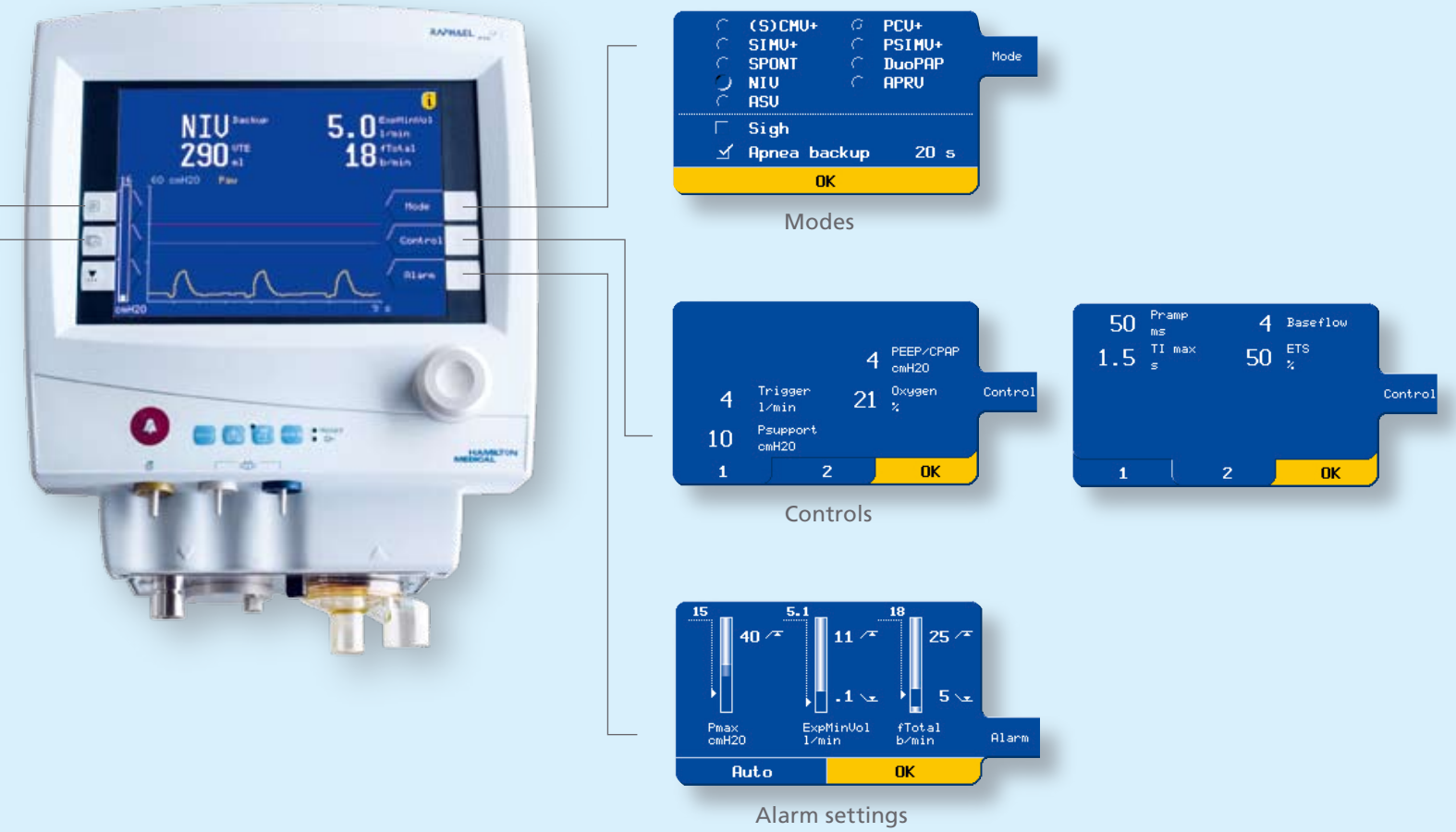
Loops

Trends

Monitored parameters		
BiPAP® Vision®	**RAPHAEL**	**Description**
PIP	Ppeak	Peak airway pressure
EPAP	PEEP/CPAP	Constant pressures applied to both inspiratory and expiratory phases
Ti/Ttot.	I:E	The RAPHAEL shows this as inspiratory: expiratory ratio
Rate	fTotal/fSpont	Breathing frequency, total or spontaneous
Tot Leak	Leak	The RAPHAEL shows Leak as the percentage of the delivered gas not returned during exhalation

Alarm settings		
BiPAP® Vision®	**RAPHAEL**	**Description**
Hi P	Pmax	Maximum pressure allowed in the patient breathing circuit
Lo MinVent	Low ExpMinVol	Low expiratory minute volume
HiRate	High fTotal	High total breathing frequency
LoRate	Low fTotal	Low total breathing frequency

This table is for reference only. Parameters, settings and controls may not be exactly equal in all cases. Use your clinical judgment when applying this information.



		Control settings
BiPAP® Vision®	RAPHAEL	Description
S/T mode	NIV mode with Apnea backup	Apnea backup time in NIV establishes breath rate
CPAP mode	NIV mode with Psupport set to 1 cmH_2O	With very low Psupport, NIV simulates CPAP in the Vision
EPAP	PEEP/CPAP	Constant pressures applied to both inspiratory and expiratory phases
IPAP	PEEP/CPAP + Psupport	Psupport is pressure (additional to PEEP/CPAP) to be applied during the inspiratory phase
[Not user-adjustable]	Trigger	The patient's inspiratory flow that causes the ventilator to deliver a breath
[Not user-adjustable]	TI max	Maximum time interval from the start of inspiratory flow to the start of expiratory flow
[Not user-adjustable]	ETS	Expiratory trigger sensitivity. The percent of peak inspiratory flow at which the ventilator cycles from inspiration to exhalation.
IPAP Rise Time	Pramp	The time required for the inspiratory pressure to rise to the set (target) pressure
[Not user-adjustable]	Baseflow	A continuous and constant gas flow from the inspiratory outlet to the expiratory outlet
Rate	Apnea backup time	In the RAPHAEL, you set an apnea backup time in s equivalent to the Rate in the Vision
[Not user-adjustable]	Oxygen	± 3% accuracy. Important for PaO_2/FiO_2 calculation.

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References
1. American Respiratory Care Foundation. Consensus Conference: noninvasive positive pressure ventilation. Respir Care 1997;42:364-9.
2. Respironics, Inc. BiPAP Vision Ventilator Support System Clinical Manual. Murrysville, Pennsylvania USA: Respironics, Inc.; 2000; 9-4.

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