High-Flow Nasal Cannula Oxygen Therapy in Adults: Physiological Benefits, Indication, Clinical Benefits, and Adverse Effects

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Kaohsiung Chang Gung Memorial Hospital

Outline

1. Mechanism of action
2. Clinical application

History of F&P Humidifiers

- **1934 F&P founded**

MR328	MR500	MR600	MR700	MR850
1972-1986	1982-1986	1985-1992	1992-	1999-

NHF & other acronyms

- **NHF: Nasal High Flow**
- HNHF: **Humidified** Nasal High Flow
- HFT: High Flow Therapy
- HFO: High Flow Oxygen
- HFOT: High Flow Oxygen Therapy
- HFNP: High Flow Nasal Prongs
- $NHFO_2$: Nasal High Flow Oxygen
- HFNC: High Flow Nasal Cannula
- HHFNC: **Humidified** High Flow Nasal Cannula
- HHHFNC: **Heated & Humidified** High Flow Nasal Cannula
- HHFT: **Humidified** High Flow Therapy
- HHFOT: **Humidified** High Flow Oxygen Therapy
- THRIVE: Transnasal **Humidified** Rapid-Insufflation Ventilatory Exchange

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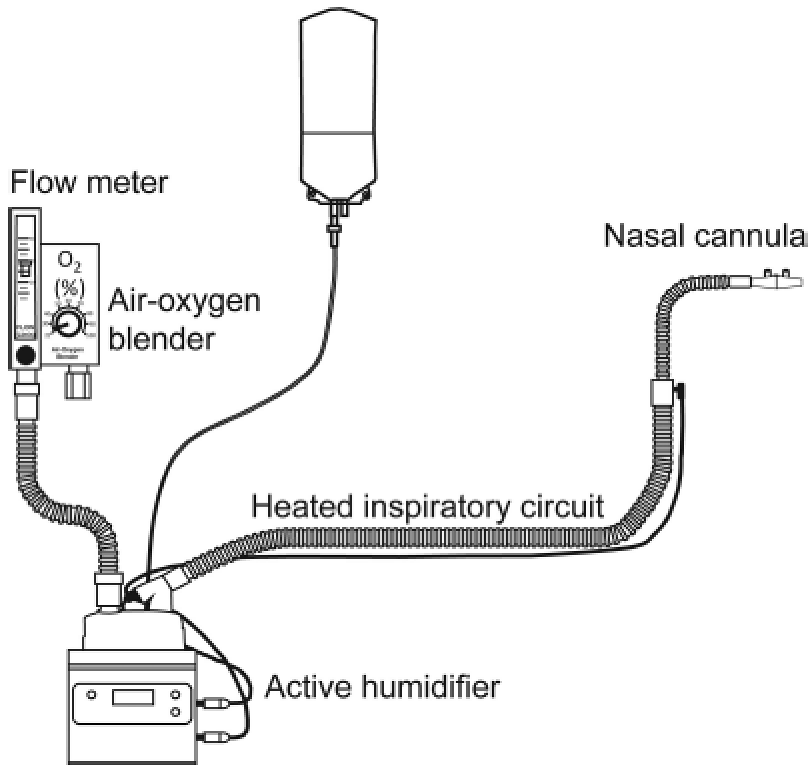

Fig. 1. Basic setup for high-flow nasal cannula oxygen delivery. An air-oxygen blender, allowing from 0.21 to 1.0 F_{IO_2}, generates up to 60 L/min flow. The gas is heated and humidified through an active heated humidifier and delivered via a single-limb heated inspiratory circuit. The patient breathes adequately heated and humidified medical gas through large-diameter nasal cannulas. (Modified from Reference 9.)

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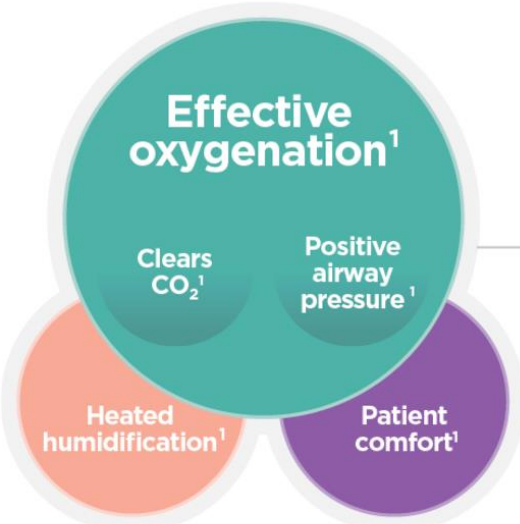
F&P Optiflow THRIVE™

MECHANISMS OF ACTION



Effective oxygenation
- Meet/exceed patient peak inspiratory demand
- Continuously renewed oxygen reservoir

Clears CO_2
- Flushes CO_2 from the upper airway to reduce rebreathing of expired gas

Positive airway pressure
- Positive airway pressure to help prevent airway collapse (3 – 7 cmH_2O)

Heated humidification
- Humidification enables the comfortable delivery of high flows
- Humidification improves mucocilliary clearance

Patient comfort
- Greater comfort than low-flow oxygen

Papazian L et al. *Intensive Care Med.* 2016.

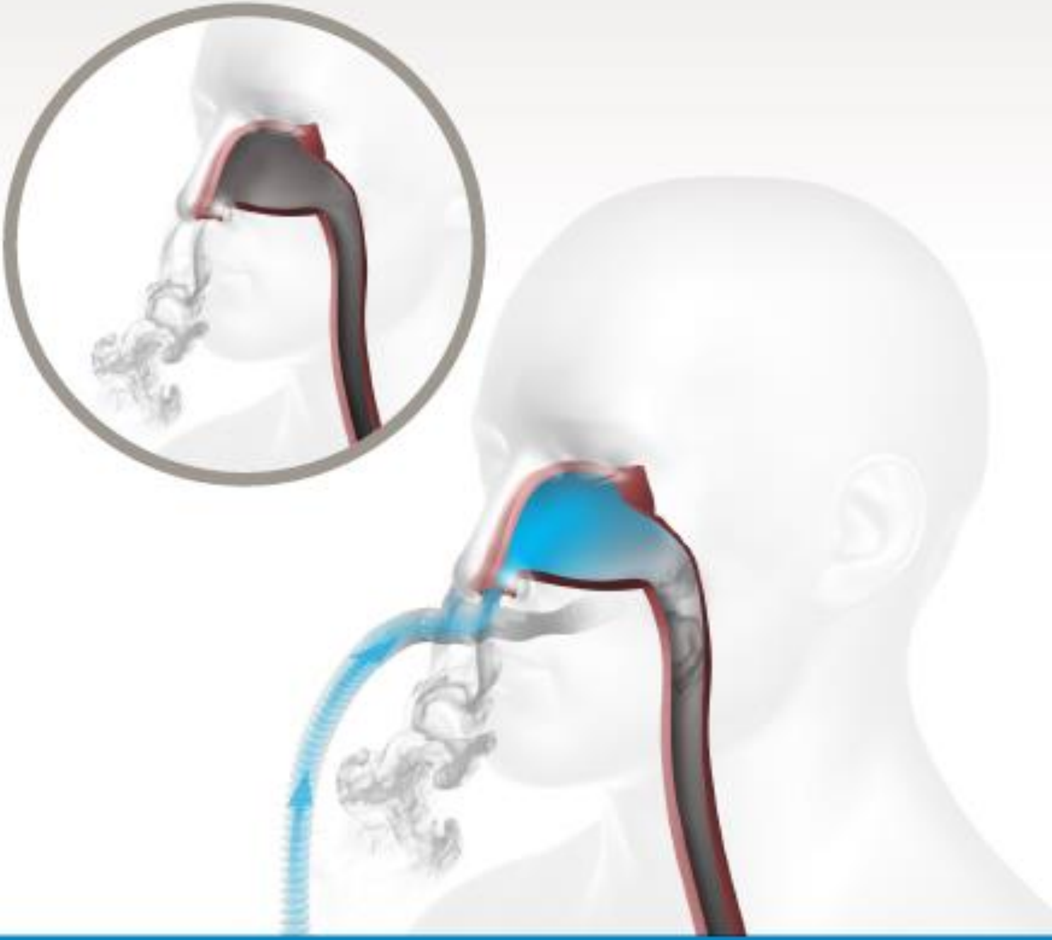
Respiratory support

1. REDUCTION OF DEAD SPACE

Clearance of expired air in the upper airways[7]

Reduces rebreathing of gas with high CO_2 and depleted O_2[7,8]

Increases alveolar ventilation[7]



International Journal of COPD

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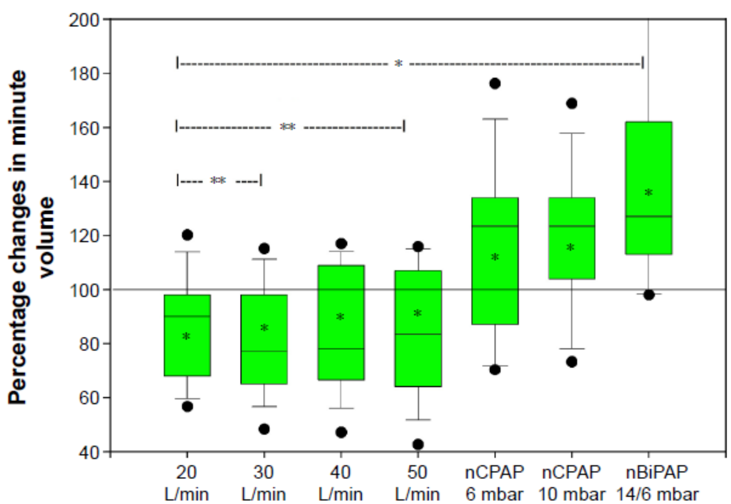
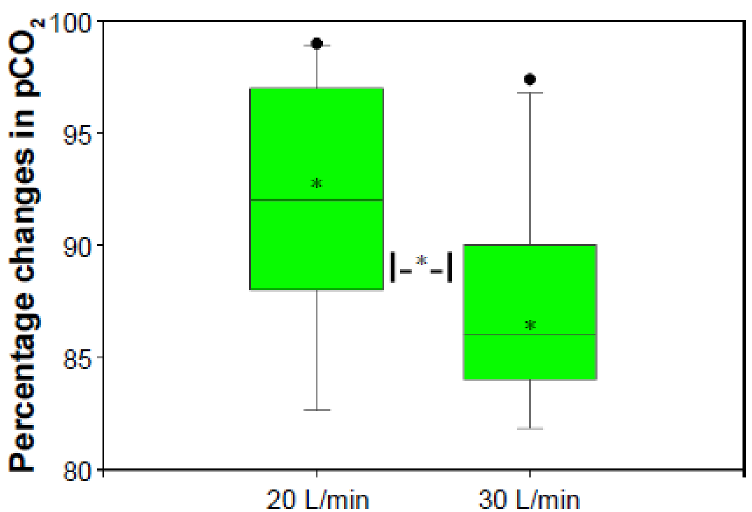
ORIGINAL RESEARCH

Nasal highflow improves ventilation in patients with COPD

Conclusion : NHF leads to flow-dependent reduction in pCO2. VT increased and minute volume decreased with pCO2 surprisingly reduced to more normal values. This is most likely achieved by a washout of the respiratory tract and a functional reduction in dead space.





This article was published in the following Dove Press journal:
International Journal of COPD
25 May 2016

Respiratory support

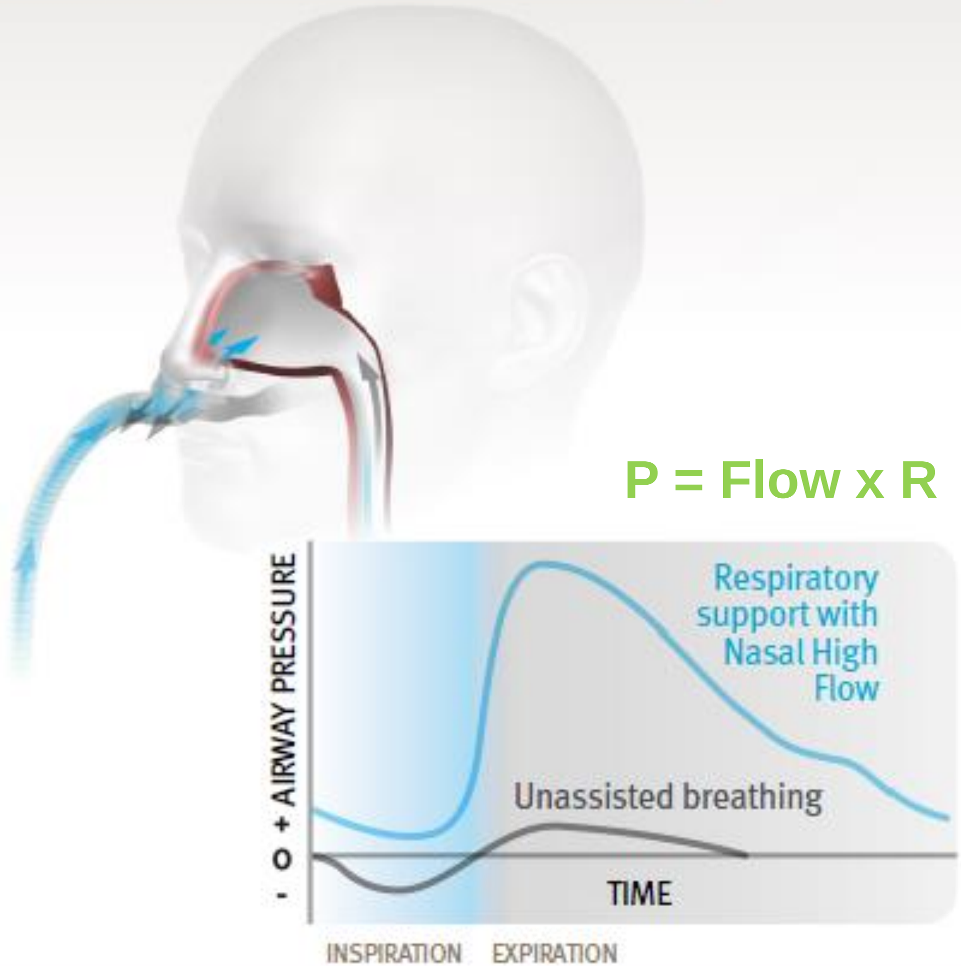
2. DYNAMIC™ POSITIVE AIRWAY PRESSURE

Breath- and flow-dependent airway pressure[7]

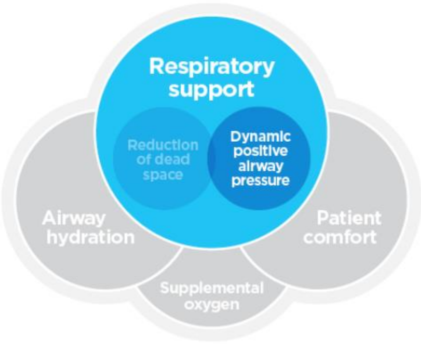
Promotes slow and deep breathing[7]

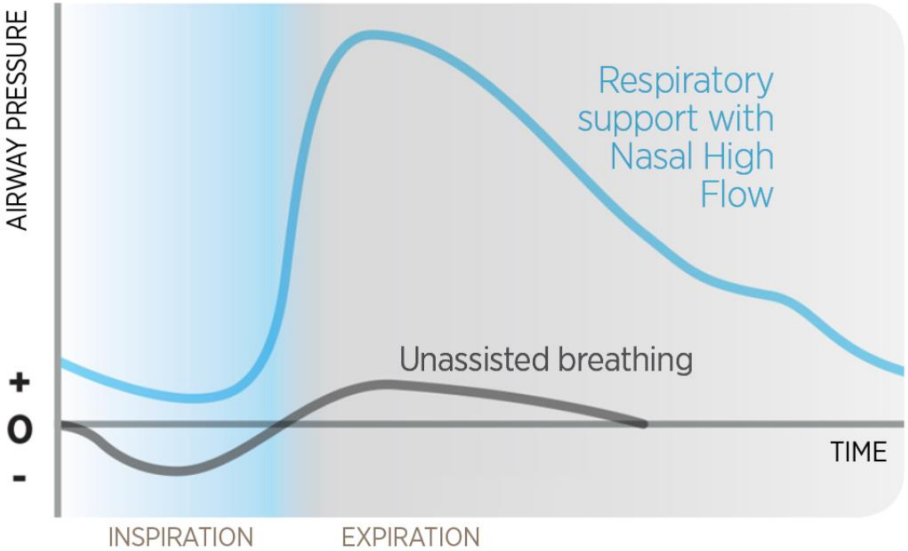
Increases alveolar ventilation[7]

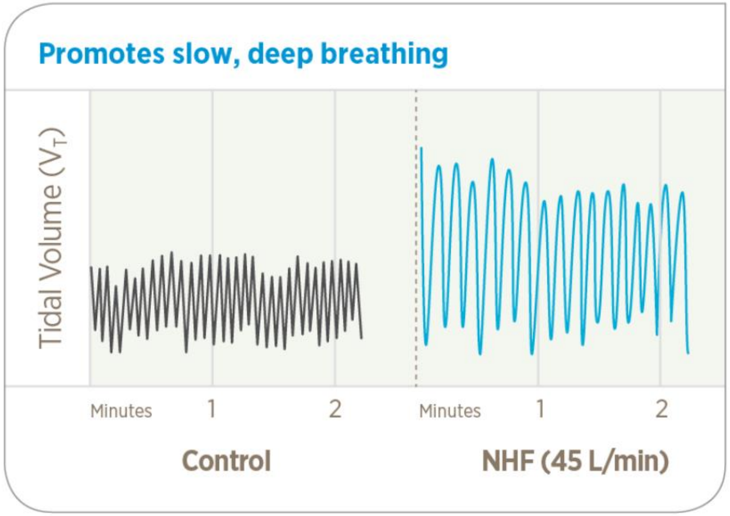
$P = Flow \times R$



Dynamic positive airway pressure





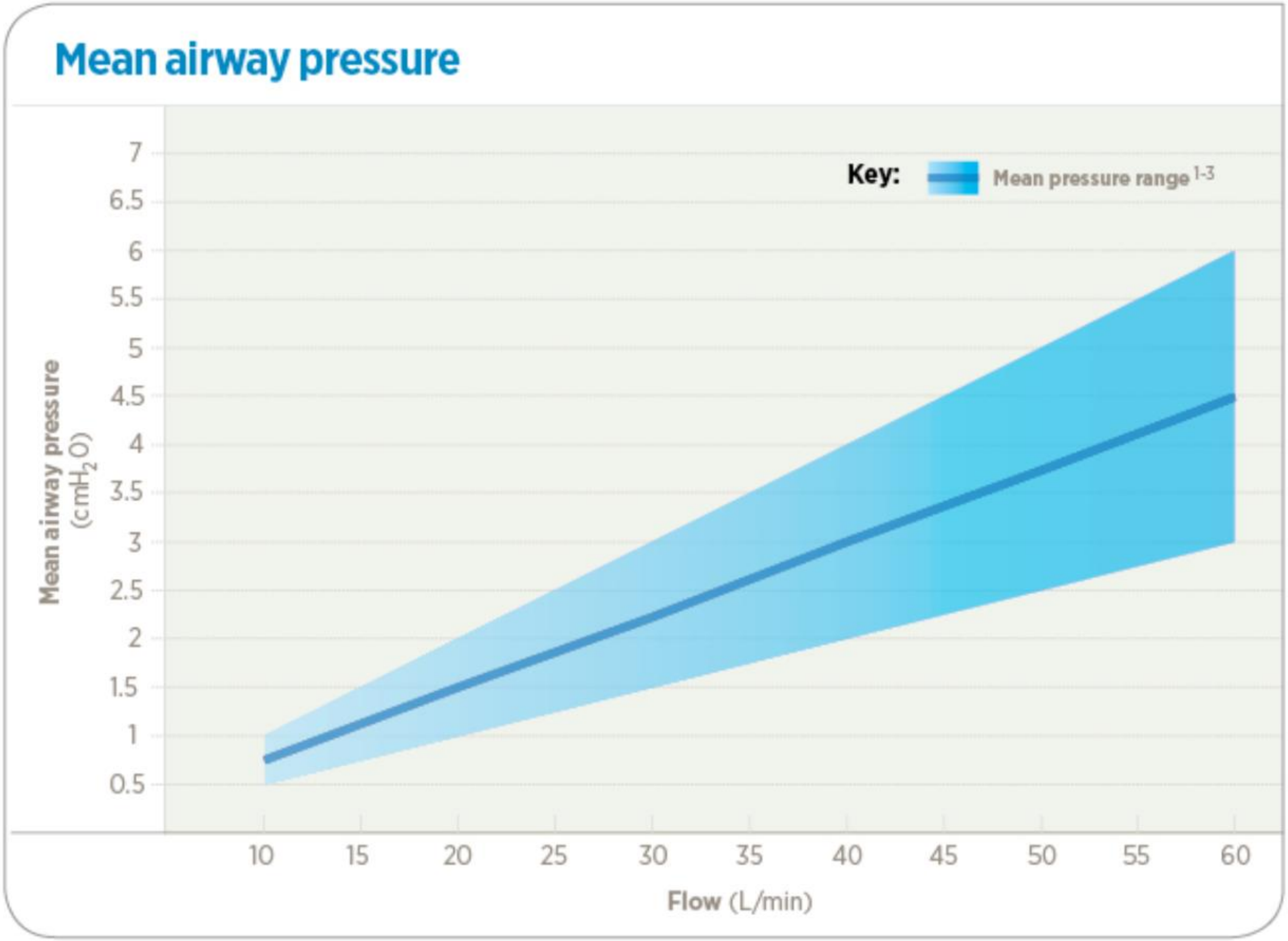


Adapted from Mündel et al.

- Pressure dynamically changes depending on breath and flow
- Inspiratory resistance decreases, making inspiration easier
- Expiratory resistance increases, leading to prolonged expiration

Mündel et al. *J Appl Physiol.* 2013.

Positive Airway Pressure



0.5-1 cmH_2O per 10 L/min[1-3]

ORIGINAL ARTICLE

Physiologic Effects of High-Flow Nasal Cannula in Acute Hypoxemic Respiratory Failure

Tommaso Mauri[1,2], Cecilia Turrini[1,3], Nilde Eronia[4], Giacomo Grasselli[1], Carlo Alberto Volta[3], Giacomo Bellani[4,5], and Antonio Pesenti[1,2]

[1]Department of Anesthesia, Critical Care and Emergency, IRCCS (Institute for Treatment and Research) Ca' Granda Maggiore Policlinico Hospital Foundation, Milan, Italy; [2]Department of Pathophysiology and Transplantation, University of Milan, Milan, Italy; [3]Department of Morphology, Surgery and Experimental Medicine, Section of Anesthesia and Intensive Care, University of Ferrara, Ferrara, Italy; [4]Department of Emergency, San Gerardo Hospital, Monza, Italy; and [5]Department of Medicine and Surgery, University of Milan-Bicocca, Monza, Italy

Mauri et al. 2017

American Journal of Respiratory and Critical Care Medicine

Physiologic Effects of Nasal High-Flow Cannula Treatment in Acute Hypoxemic Respiratory Failure

Methods

N=15

AHRF, Non-intubated, in ICU

P/F = 130±35

Mauri et al. 2017

- 15 Patients
- Completed two study phases with same set FiO_2 for 20 mins in random order:
  1. Standard non-occlusive oxygen face mask (Standard Face Mask) set at 12 L/min
  2. NHF rate set at 40 L/min
- At the end of each phase, researchers collected and analyzed:
  1. Physiologic data (ABG analysis results, respiratory rate and hemodynamics)
  2. Esophageal pressure data
  3. EIT data

Mauri et al. *Am J Respir Crit Care Med*. 2017.

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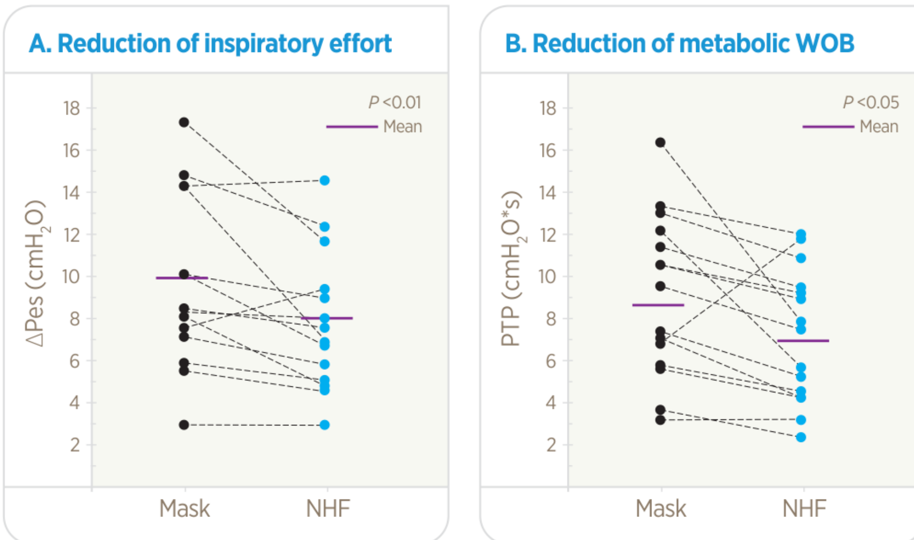
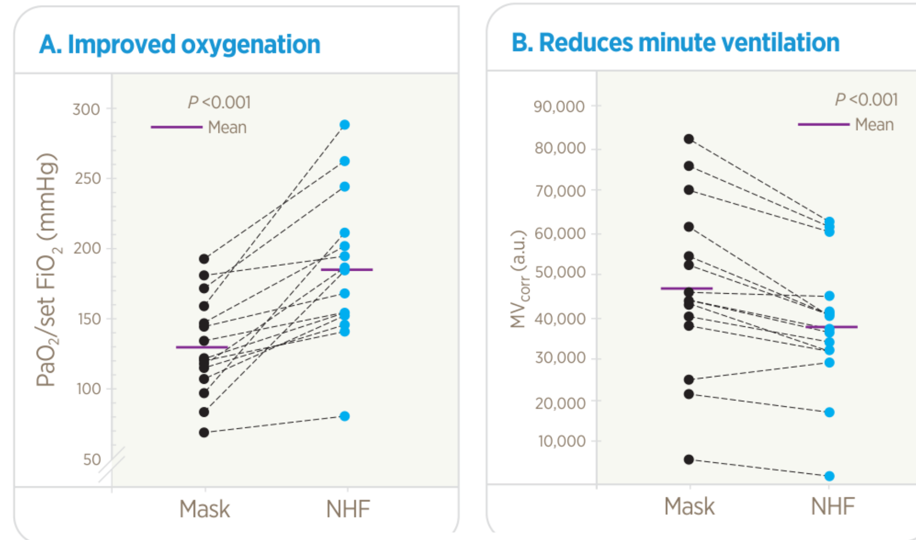
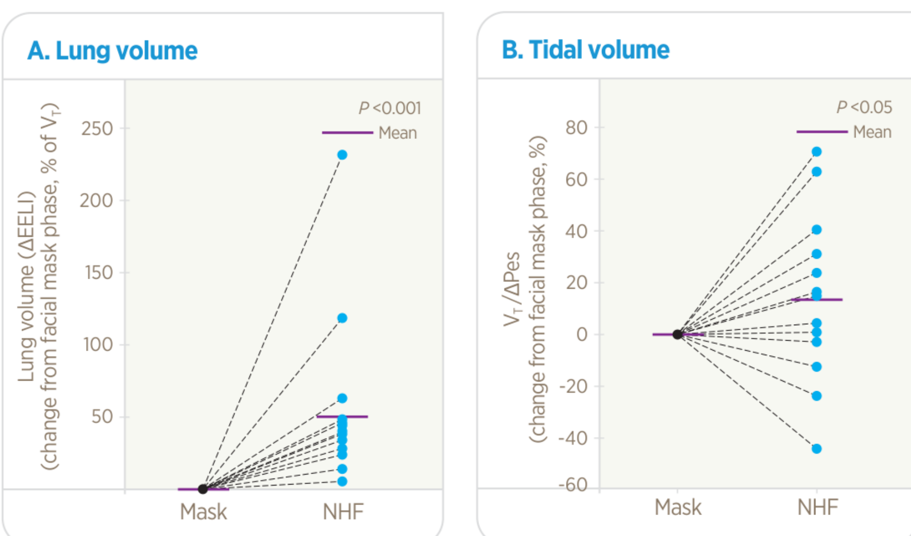
Effects of NHF vs. Standard Face Mask on inspiratory effort (A) and metabolic WOB (B)

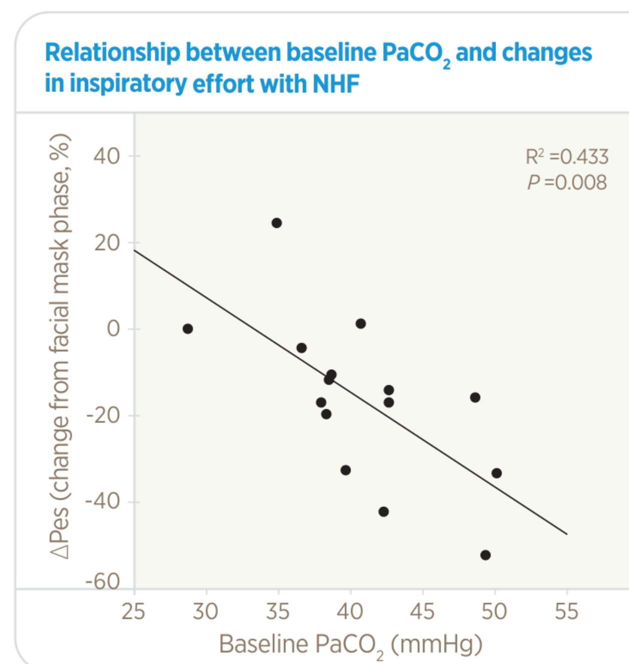


Effects of NHF vs. Standard Face Mask on oxygenation (A) and minute ventilation (B)



Effects of NHF vs. Standard Face Mask on lung volume (A) and tidal volume (B)

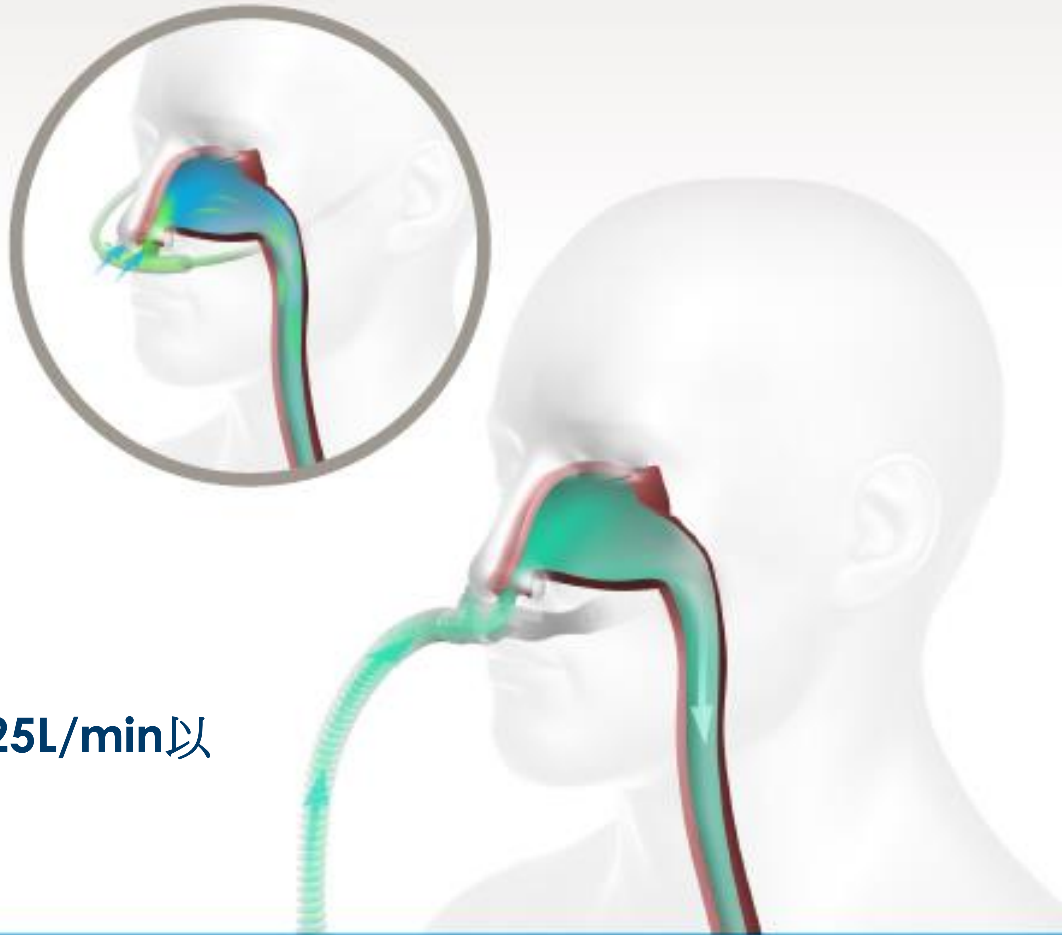




Respiratory support

3. SUPPLEMENTAL OXYGEN AS REQUIRED

Confidence in the delivery of blended, humidified oxygen[9,10]



高流量氧氣濕化治療裝置：

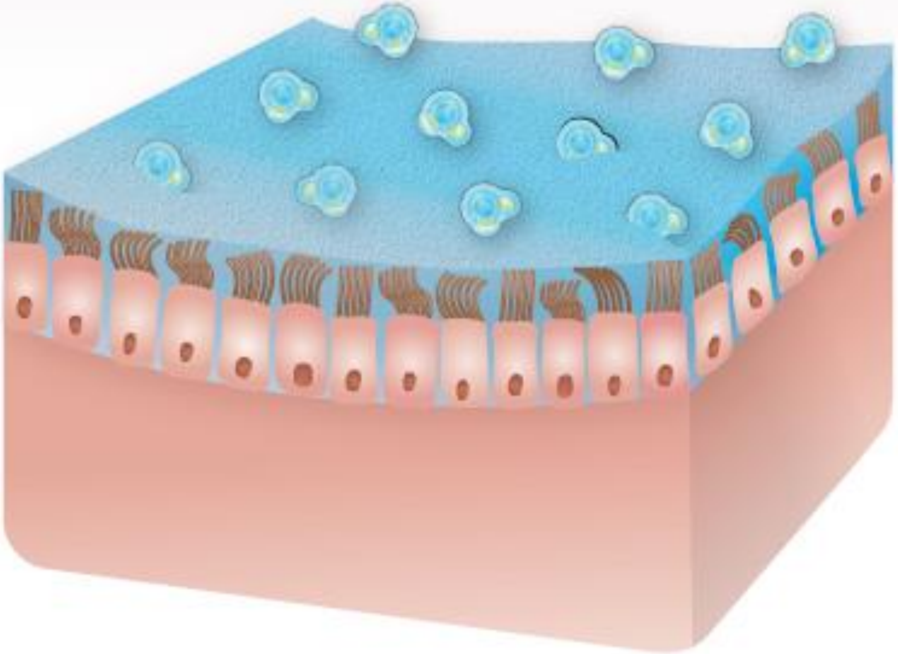
1. FiO_2較低流量裝置精準
2. **提供的氣流 > 吸入的氣流**
3. 設定需**至少達2倍MV**，建議**25L/min**以上

Airway hydration

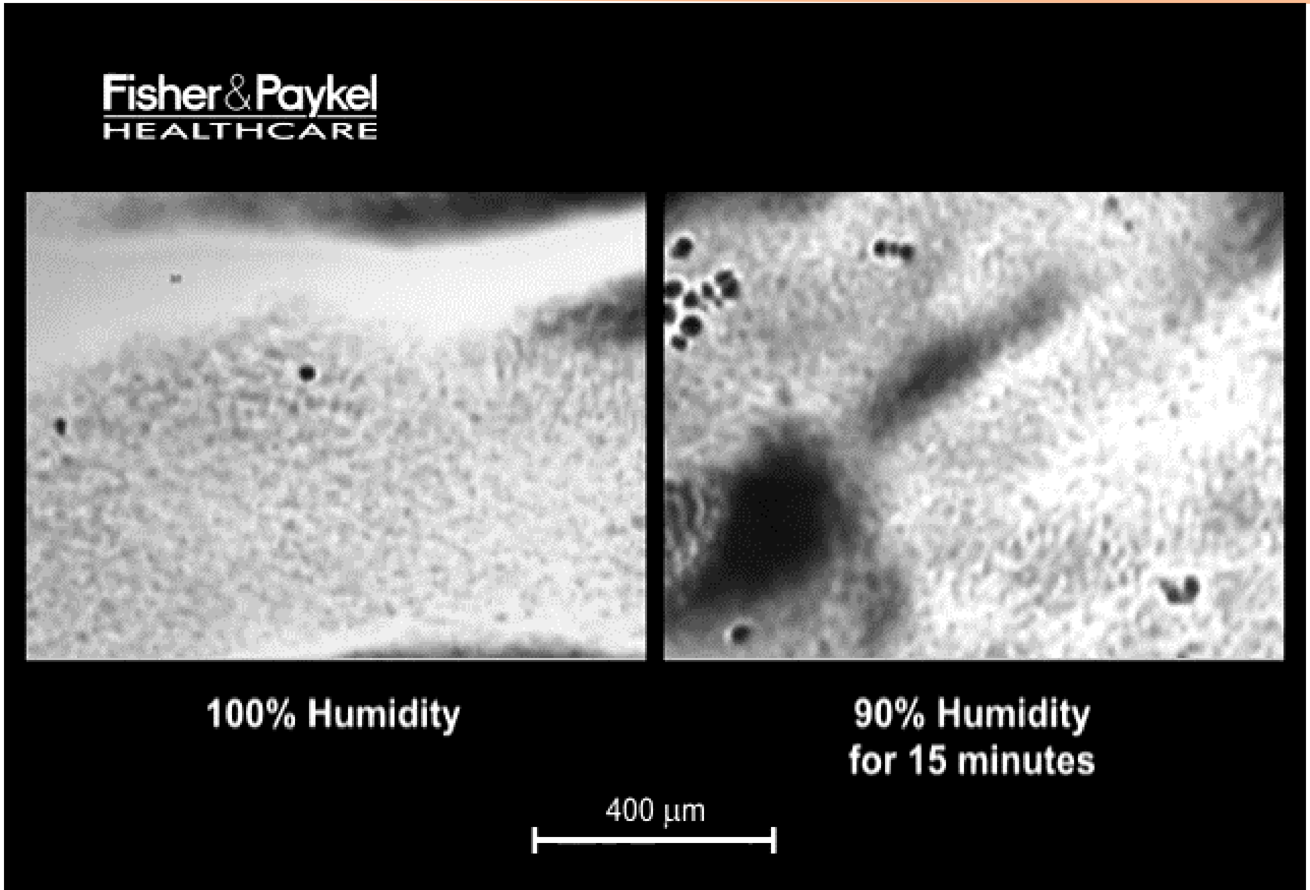
OPTIMAL HUMIDITY

Prevents desiccation of the airway epithelium[10,11]

Improves mucus clearance[10,11]

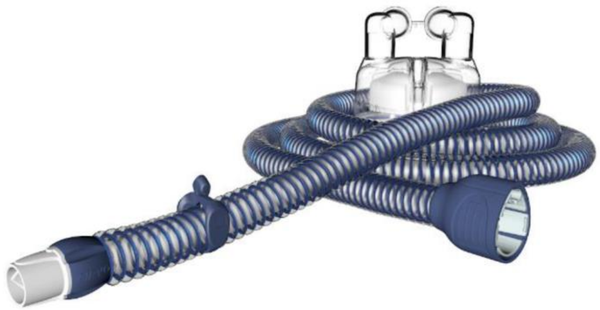


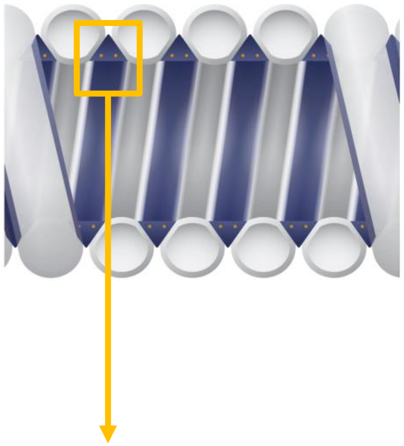
Mucociliary Dysfunction

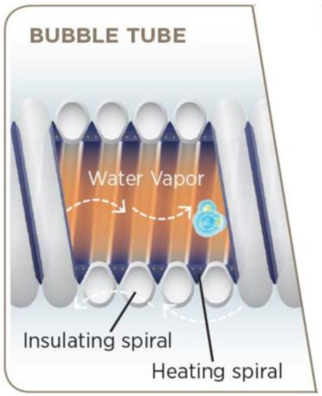


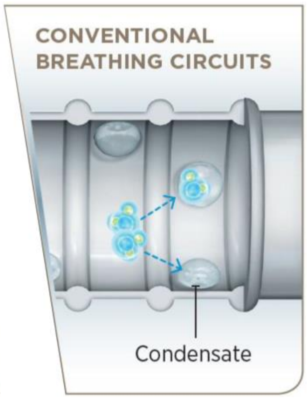
New AIRVO Circuit – 900PT561

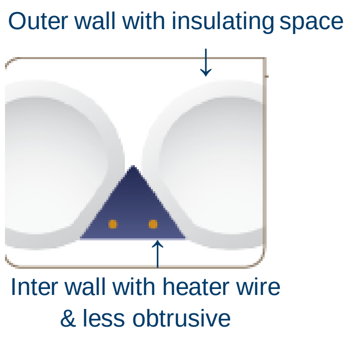
1. 更輕巧！
2. 管路外圈包覆隔熱圈！
3. 加熱線與管路一體成形
   呼吸阻力更小，加熱更均勻！
4. 減少至少**93%**冷凝水！











Evidence outline

1. Hypoxemia ARF
2. Hypercapnia ARF
3. ED
4. Rehabilitation
5. Homecare
6. Palliative Care
7. Immunocompromised
8. Surgical application
9. POR

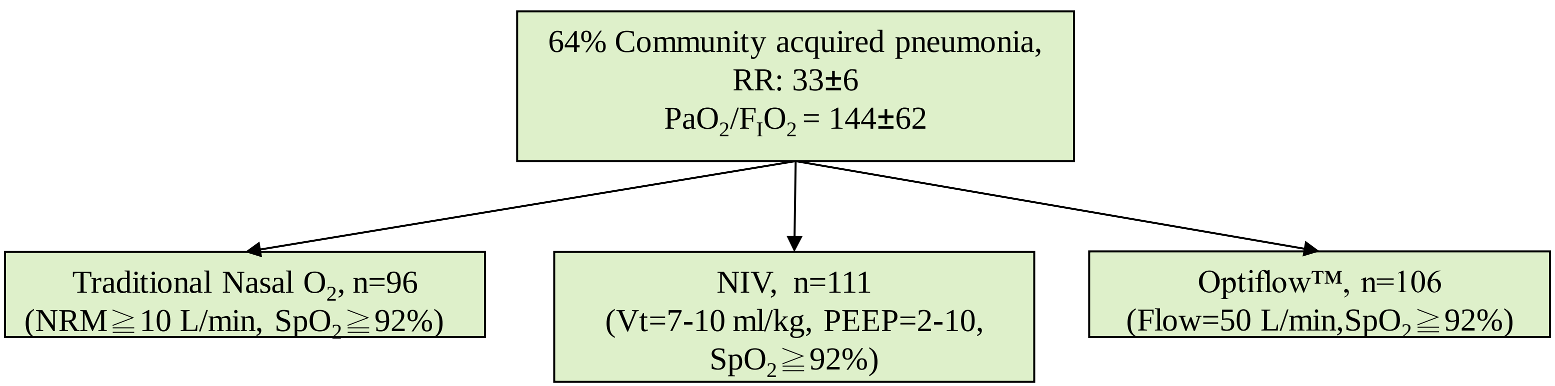
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D.,

- N=313, spontaneous breathing pts with ARF during 02/2011-04/2013 in 23 French and Belgium ICU.
- Excluded: NIV contraindication, COPD, Pul. Edema, Circulatory shock, Glasgow<12



The NEW ENGLAND JOURNAL of MEDICINE

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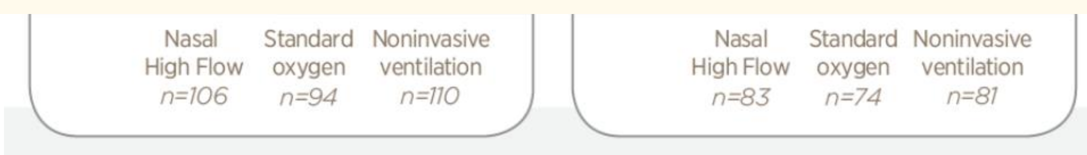
ORIGINAL ARTICLE

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D.,

Outcome	Study Group			P Value†
	High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)	
Cause of death — no./total no. (%)				
Refractory shock	6/13 (46)	12/22 (55)	18/31 (58)	0.04
Refractory hypoxemia	5/13 (38)	6/22 (27)	8/31 (26)	0.73
Cardiac arrest	1/13 (8)	1/22 (5)	3/31 (10)	0.52
Other	1/13 (8)	3/22 (14)	2/31 (6)	0.52



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ORIGINAL ARTICLE

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D.,

Reduced 90-day mortality (%)
P=0.02

Reduced intubation rate (%)*
P=0.009 *Patients with PaO_2:FiO_2 ≤ 200 mmHg

Outcome	Study Group			P Value†
	High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)	
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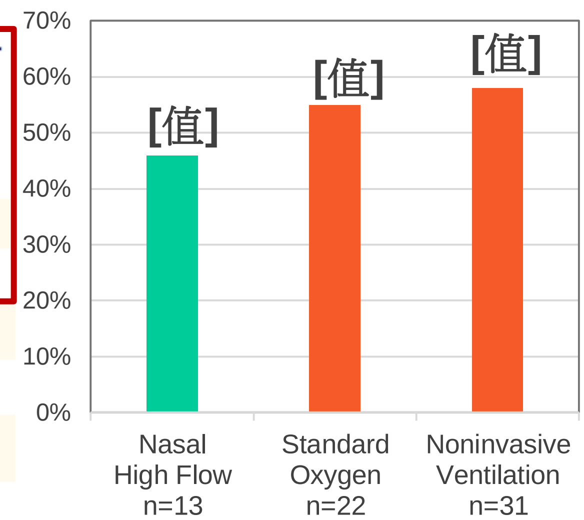
Other	1/13 (8)	3/22 (14)	2/31 (6)	0.52

n=106 n=94 n=110

n=83 n=74 n=81

Cause of Death - Refractory Shock(%) P=0.04



NHF is not inferior to NIV

Research

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients
A Randomized Clinical Trial

Gonzalo Hernández, MD, PhD; Concepción Vaquero, MD; Laura Colinas, MD; Rafael Cuena, MD; Paloma González, MD; Alfonso Canabal, MD, PhD; Susana Sanchez, MD; Maria Luisa Rodriguez, MD; Ana Villasclaras, MD; Rafael Fernández, MD, PhD

CONCLUSIONS AND RELEVANCE Among high-risk adults who have undergone extubation, high-flow conditioned oxygen therapy was not inferior to NIV for preventing reintubation and postextubation respiratory failure. High-flow conditioned oxygen therapy may offer advantages for these patients.

NHF is not inferior to NIV

- Include patient type: Critically ill patients ready for planned extubation with at least 1 of the following high-risk factors for reintubation:
  - >65 y/o
  - APACHE II>12 points on extubation day
  - BMI ≥30
  - Inadequate secretions management
  - Difficult or prolonged weaning
  - >1 comorbidity
  - Heart failure as primary indication for mechanical ventilation
  - Moderate to severe COPD
  - Airway patency problems; or prolonged mechanical ventilation.

Results

Primary outcome: Rate of reintubation

- NHF was found to be non-inferior to NIV for preventing reintubation.

Outcome	NIV	NHF	Risk difference between groups (95% CI)
Reintubated within 72 hours, n (%)	60 (19.1)	66 (22.8)	−3.7 (−9.1 to ∞)

- Non-inferiority margin set at 10%.

Hernández et al. *JAMA.* Oct 2016.

Results

Secondary outcomes:

Outcome	NIV	NHF	Absolute difference between groups (95% CI)
Median time to reintubation, hr (IQR)	21.5 (10 to 47)	26.5 (14 to 39)	-5 (-34 to 24)
Outcome	**NIV**	**NHF**	**P value**
Reintubations due to hypercapnic respiratory failure, n (%)	8 (2.5%)	6 (2%)	$p = 0.63$
Median ICU length of stay, days (IQR)	4 (2 to 9)	3 (2 to 7)	$p = 0.048$
Adverse events requiring treatment discontinuation for >18 hr, n (%)	135 (42.9)	0 (0)	$p < 0.001$

- Other secondary outcomes were similar between groups.

Hernández et al. *JAMA*. Oct 2016.

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Reduced 72 Hrs Reintubation Rate

Research

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Cannula vs Conventional Oxygen Therapy on Reintubation in Low-Risk Patients

A Randomized Clinical Trial

Gonzalo Hernández, MD, PhD; Concepción Vaquero, MD; Paloma González, MD; Carles Subira, MD; Fernando Frutos-Vivar, MD; Gemma Rialp, MD; Cesar Laborda, MD; Laura Colinas, MD; Rafael Cuena, MD; Rafael Fernández, MD, PhD

CONCLUSIONS AND RELEVANCE Among extubated patients at low risk for reintubation, the use of high-flow nasal cannula oxygen compared with conventional oxygen therapy reduced the risk of reintubation within 72 hours.

DNI patient

- Able to eat, drink, speak to family while palliation Tx
- Lessening distress of patient
- Lessening distress of family
- Comfortable death with pink face vs. NRM with pale one
- Warm ad reduce dryness feel to patients

ORIGINAL RESEARCH

Domiciliary High-Flow Nasal Cannula Oxygen Therapy for Patients with Stable Hypercapnic Chronic Obstructive Pulmonary Disease

A Multicenter Randomized Crossover Trial

Kazuma Nagata[1], Takashi Kikuchi[2], Takeo Horie[3], Akira Shiraki[4], Takamasa Kitajima[5], Toru Kadowaki[6], Fumiaki Tokioka[7], Naohiko Chohnabayashi[8], Akira Watanabe[9], Susumu Sato[10], and Keisuke Tomii[1]

Conclusions

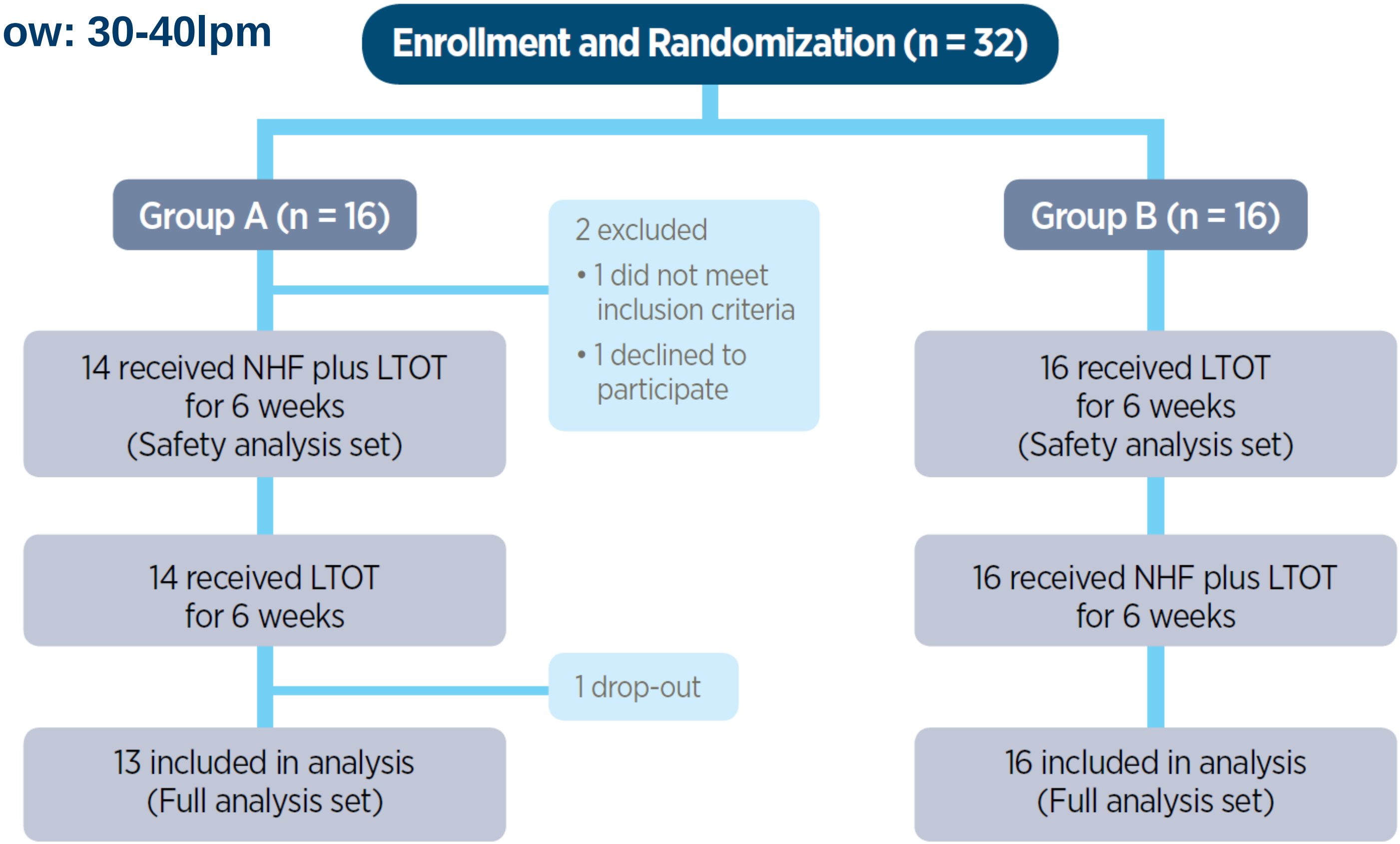
Nagata et al.
2018

- NHF improves QoL and reduces hypercapnia in COPD patients with chronic hypercapnic respiratory failure.
- NHF is well tolerated and no related severe adverse events occurred during therapy.

Methods

Nagata et al.
2018

- **Use ≥ 4hrs/sleep time**
- **Flow: 30-40lpm**



Nagata et al. *Annals of the American Thoracic Society.* 2018.

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Results

Nagata et al. 2018

Secondary outcomes

- **No COPD AE in NHF/LTOT**
- **3 COPD AE in LTOT**

- NHF/LTOT improved the following significantly compared with LTOT alone:
  - Each component of the SGRQ-C
  - Arterial blood gas: pH, $PaCO_2$
  - Nocturnal $PtcCO_2$ (95th percentile and median)

	ADJUSTED TREATMENT EFFECT (95% CONFIDENCE INTERVAL)	P VALUE
Arterial blood gas		
• pH	0.02 (0.01, 0.02)	0.01
• $PaCO_2$ (mmHg)	-4.1 (-6.5, -1.7)	< 0.01
Nocturnal $PtcCO_2$ (mmHg)		
• 95th percentile	-4.8 (-8.1, -1.5)	< 0.01
• Median	-5.1 (-8.4, -1.8)	< 0.01

Nagata et al. *Annals of the American Thoracic Society.* 2018.

Fisher & Paykel HEALTHCARE

Rea et al. 2010

Respiratory Medicine

PATIENT INCLUSIONS | PATIENT DEMOGRAPHICS | EXACERBATIONS

REDUCES exacerbation days

INCREASES time to first exacerbation

REDUCES antibiotic use

STUDY

A comparison of long-term humidification therapy using nasal high flow (NHF) with usual care in COPD and bronchiectatic patients.

METHOD

- 108 patients were randomized to usual care (n = 48) or NHF therapy (n = 60) at a flow rate of 20-25 L/min for ≥ 2 hours per day.
- Primary outcome: rate of exacerbations per patient over a 12-month period.
- Secondary outcomes: time to first exacerbation, no. of exacerbated days and hospital admissions, quality of life, lung function, exercise capacity and inflammatory markers.

RESULTS

- Exacerbation frequency was **3.63 (Usual care) vs 2.97 (NHF)** per patient per year, but was not statistically significant (p=0.067)
- NHF significantly reduced the number of exacerbation days over a 12-month period from **33.5 to 18.2 days** (p=0.045)
- Median time to first exacerbation was significantly longer on NHF: **27 to 52 days** (p=0.0495)
- NHF significantly reduced antibiotic use from **38.5% to 22.8%** of patients (p=0.008). All other medication use was similar.
- There were also significant differences in QoL and lung function measures.
- There were no significant differences in hospital admissions, exercise capacity or inflammatory markers
- The mean use time was **1.6 hours** per day

International Journal of COPD

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CLINICAL TRIAL REPORT

Long-term effects of oxygen-enriched high-flow nasal cannula treatment in COPD patients with chronic hypoxemic respiratory failure

Conclusions

Storgaard et al. 2018

- NHF reduced AECOPD and hospital admission rates in COPD patients with chronic hypoxemic respiratory failure treated with LTOT.
- NHF stabilized the clinical condition of advanced COPD patients as measured by mMRC score, SGRQ, $PaCO_2$, and 6MWT compared to control.

Methods

Storgaard et al. 2018

8hrs/day(Actual~6hrs)

- Night only: 53%
- Day only: 32%
- Mixed: 15%

Flow: 20lpm

Assessed for eligibility (n = 647)

Excluded (n = 447)
- Not meeting inclusion criteria (n = 278)
- Declined to participate (n = 74)
- Other reasons (e.g. no contact obtained (n = 95)

Randomized (n = 200)

Allocated to NHF (n = 100)

Discontinued study (n = 33)
- Death (n = 15)
- Intercurrent serious illness other than AECOPD (n = 7)
- Not compliant to NHF (n = 5)
- Other reasons (n = 6)

Discontinued NHF - stayed in study (n = 17)
- Not compliant to NHF (n = 12)
- Intercurrent serious illness other than AECOPD (n = 2)
- Other reasons (n = 3)

+ 12 MONTHS (n = 67)

Allocated to control (n = 100)

Discontinued study (n = 29)
- Death (n = 12)
- Intercurrent serious illness other than AECOPD (n = 9)
- Stopped smoking (n = 2)
- Other reasons (n = 6)

+ 12 MONTHS (n = 71)

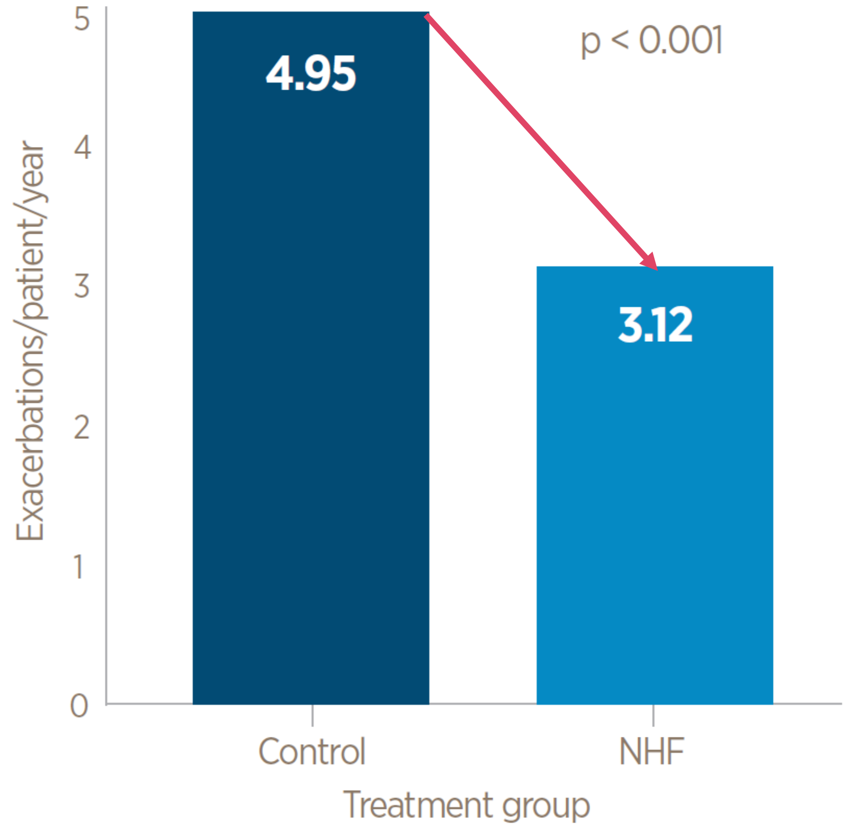
Storgaard et al. *International Journal of Chronic Obstructive Pulmonary Disease*. 2018.

Results

Storgaard et al. 2018

Primary outcome *(intention to treat analysis)*

- AECOPD rates were significantly lower in patients in the NHF + LTOT group compared to the LTOT only group



Storgaard et al. *International Journal of Chronic Obstructive Pulmonary Disease.* 2018.

Fisher & Paykel HEALTHCARE

Results

Storgaard et al.
2018

Secondary outcomes

- NHF with LTOT compared to LTOT alone improved:
  - Hospital admission rates for those who followed the protocol
  - mMRC score
  - SGRQ score
  - $PaCO_2$
  - 6MWT
- Mortality: no difference between the 2 groups

Fisher&Paykel HEALTHCARE

Respiratory Medicine (2014) 108, 329–337

Available online at www.sciencedirect.com

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Nocturnal noninvasive positive pressure ventilation in stable COPD: A systematic review and individual patient data meta-analysis

F.M. Struik [a,b,*], Y. Lacasse [c], R.S. Goldstein [d], H.A.M. Kerstjens [a,b], P.J. Wijkstra [a,b]

Results: Seven trials (245 patients) were included. All studies were considered of moderate to high quality. No significant difference was found between NIPPV and control groups after 3 or 12 months of follow-up when looking at $PaCO_2$ and PaO_2, 6-minute walking distance, health-related quality-of-life, forced expiratory volume in 1 s, forced vital capacity, maximal inspiratory pressure and sleep efficiency. Significant differences in change in $PaCO_2$ after 3 months

Cirio et al. 2016

Respiratory Medicine

- **FEV1< 50%**
- **6MWT<75% predicted**

PATIENT INCLUSIONS

PATIENT DEMOGRAPHICS

INCREASES exercise endurance

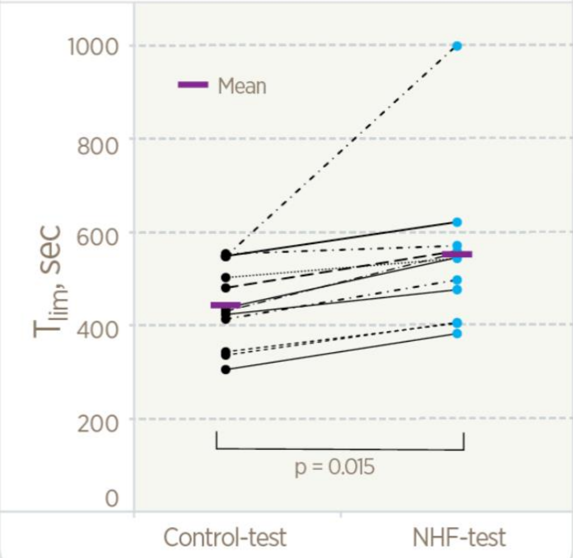
STUDY

A randomized, crossover study, comparing exercise performance with and without nasal high flow (NHF vs Control) in patients with severe COPD admitted to a Pulmonary Rehabilitation program

METHOD

- 12 clinically stable severe COPD patients completed constant-load exercise tests on exercise bicycles, randomized to NHF (55-60 L/min) or Control (Venturi mask connected to compressed air) first. O_2 was added if required
- Primary outcome: Endurance time for each test (T_{lim})
- Secondary outcomes: SaO_2, heart rate, blood pressure, 0-10 Borg scale for dyspnea (Borg-D) and leg fatigue (Borg-F)

Effect of NHF on exercise capacity



RESULTS

- All patients had improved T_{lim} with NHF compared to Control: mean difference (± SD) **109 ± 104 secs** (p = 0.015)
- NHF also showed improved SaO_2, dyspnea and leg fatigue scores compared to Control at iso-time (the maximum time reached by both tests)

Anaesthesia 2015, 70, 323–329 doi:10.1111/anae.12923

Original Article

Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE): a physiological method of increasing apnoea time in patients with difficult airways

A. Patel[1,2] **and S. A. R. Nouraei**[3]

1 Consultant Anaesthetist, The Royal National Throat Nose and Ear Hospital, London, UK
2 Consultant Anaesthetist, 3 Specialist Registrar in Academic Otolaryngology, University College Hospital NHS Foundation Trust, London, UK

PATEL 2015

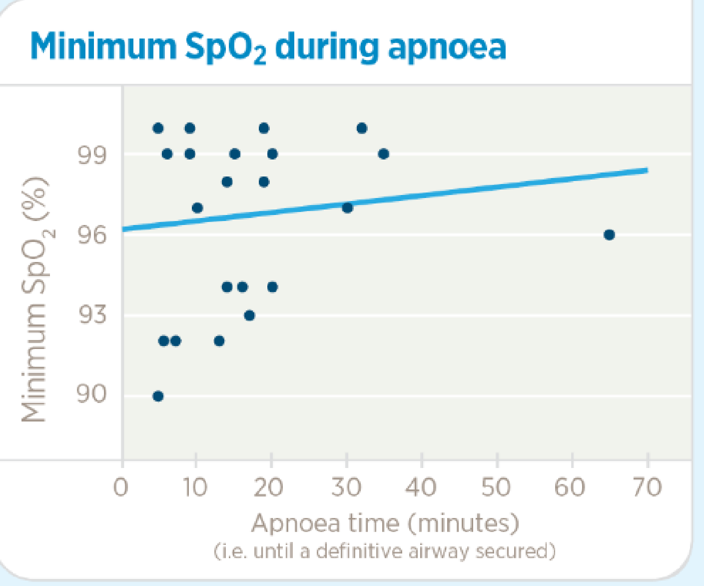
Extend safe apnoea time in difficult airways

METHOD

- Observational study
- 25 patients with difficult airways for hypopharyngeal or laryngotracheal surgery
- Optiflow THRIVE™ used for initial preoxygenation and continued for apnoeic oxygenation (70 L/min, 100 % oxygen) during IV induction
- Jaw thrust used to maintain upper airway patency during apnoea

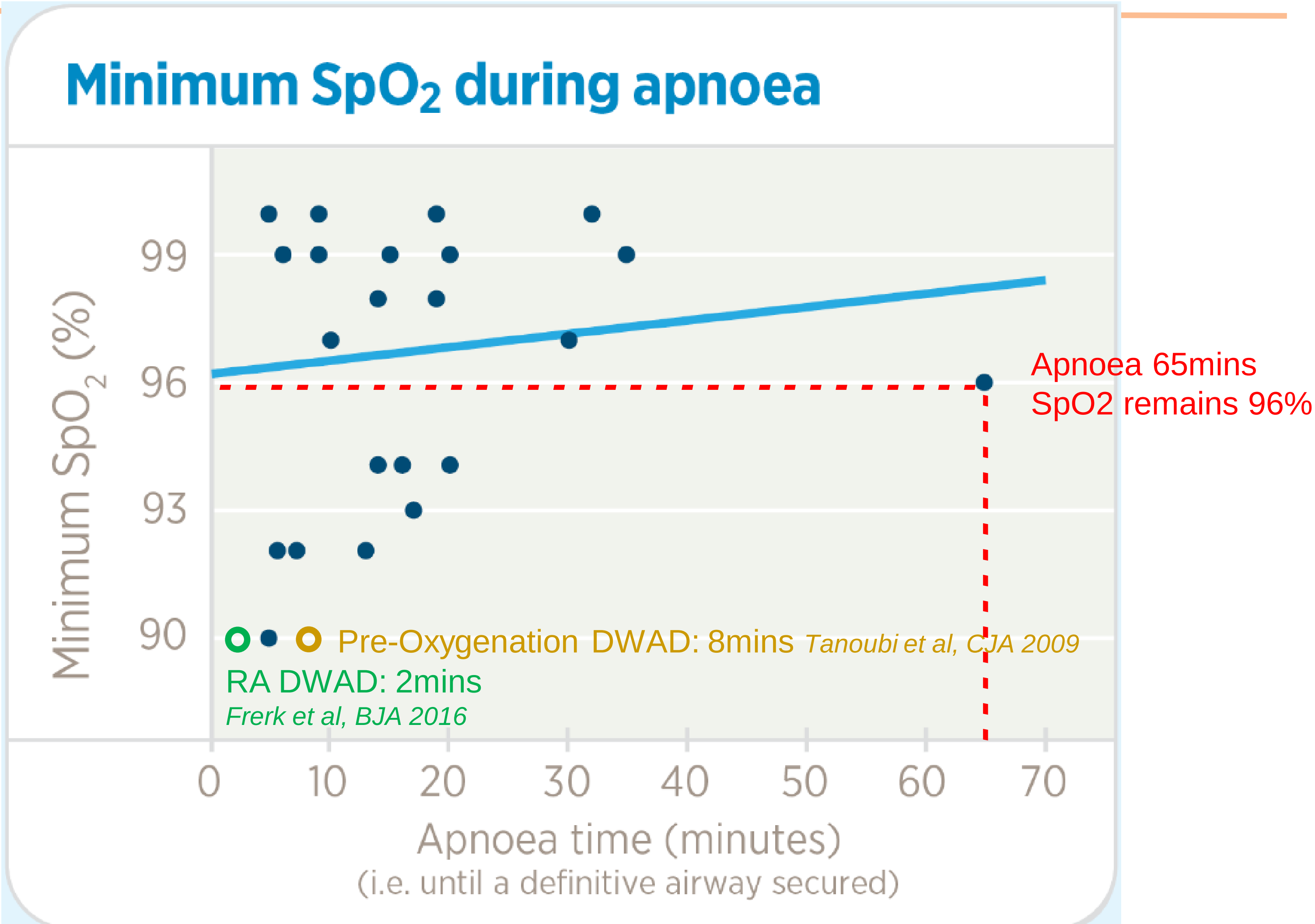
RESULTS

- Prevented desaturation below 90 %
- Increased average apnoea time to 17 minutes



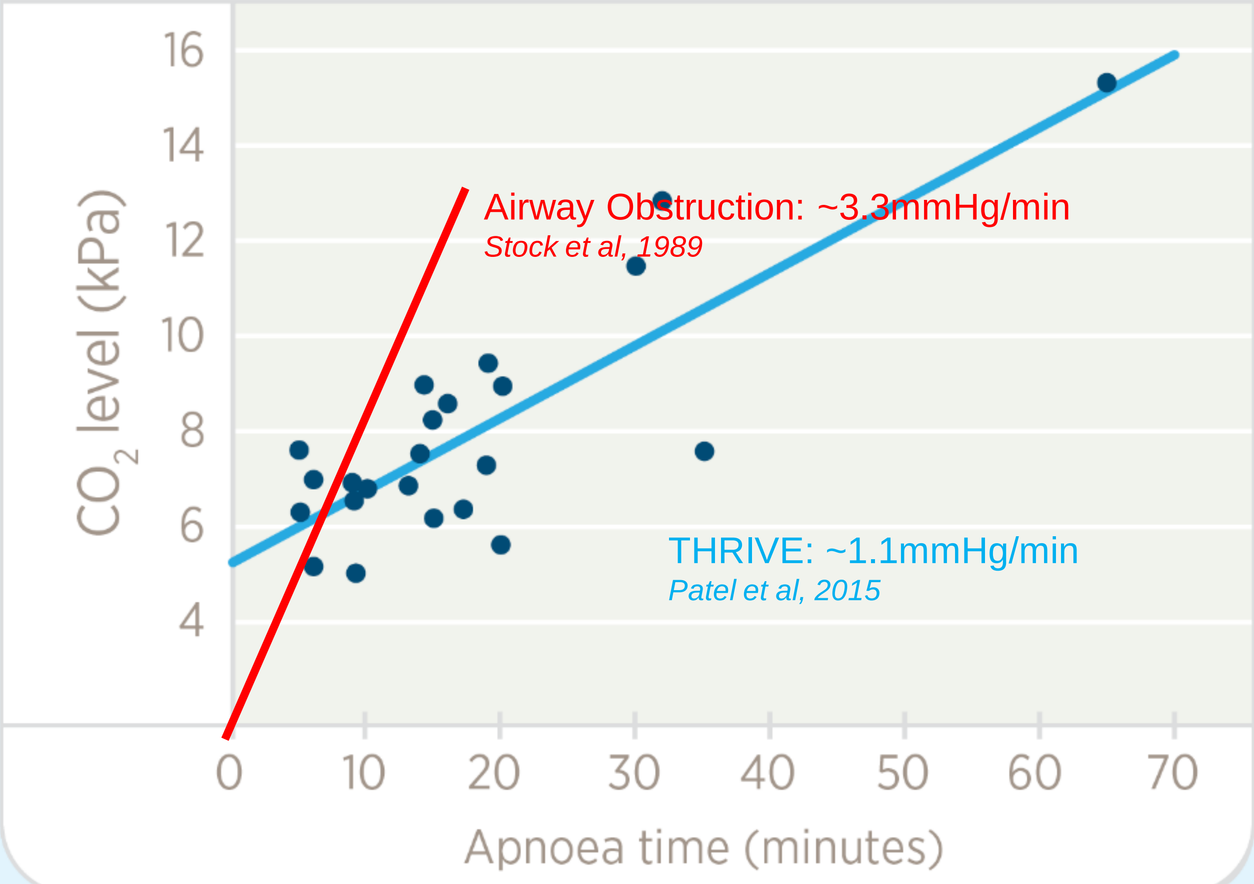
Adapted from Patel & Nouraei, 2015.

F&P Optiflow™ THRIVE



Minimum SpO2 during apnoea
Minimum SpO2 (%)
99
96
93
90
Apnoea 65mins
SpO2 remains 96%
Pre-Oxygenation DWAD: 8mins Tanoubi et al, CJA 2009
RA DWAD: 2mins
Frerk et al, BJA 2016
0
10
20
30
40
50
60
70
Apnoea time (minutes)
(i.e. until a definitive airway secured)

End-tidal CO_2 at end of apnoea



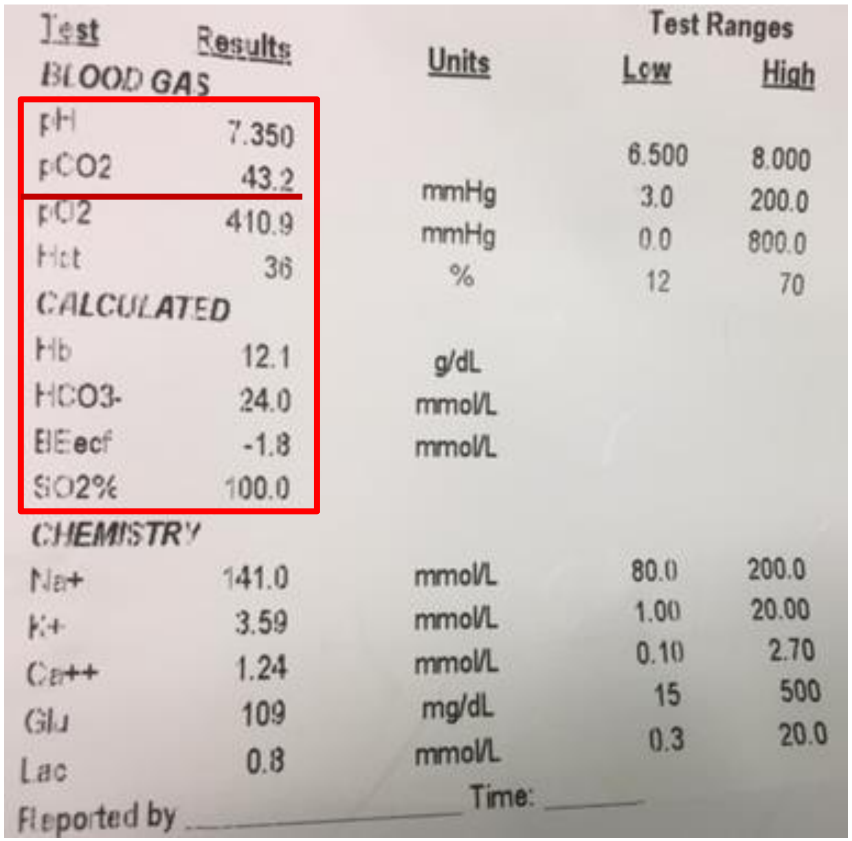
Emergency Airway Obstruction

Optiflow THRIVE™ Application

Transcatheter aortic valve Implantation, TAVI	Junior painless dental surgery	Special needs dental surgery	Drug induced sleep endoscopy, DICE
Non-Intubated VATs	Awake craniotomy	Plastic surgery	Bariatric surgery
PACU recovery (ERAS)	Laryngo micro surgery, LMS	Radio frequent catheter ablation, RFCA	Radiofrequency ablation, RFA
Pre-oxygenation	Health examination	Vertebroplasty	Tendon repair
Ophthalmic surgery	Obstetrics surgery	ERCP	Gynecology
Tympanic membrane repair	Breast surgery	Vasectomy & Ligation surgery	Cryoablation
Urology surgery	Cardiac catheterization	Image-guided biopsy	Embolization
Stent Placement	TOE/TEE	EBUS/EUS	Angioplasty

Non-intubated VATs

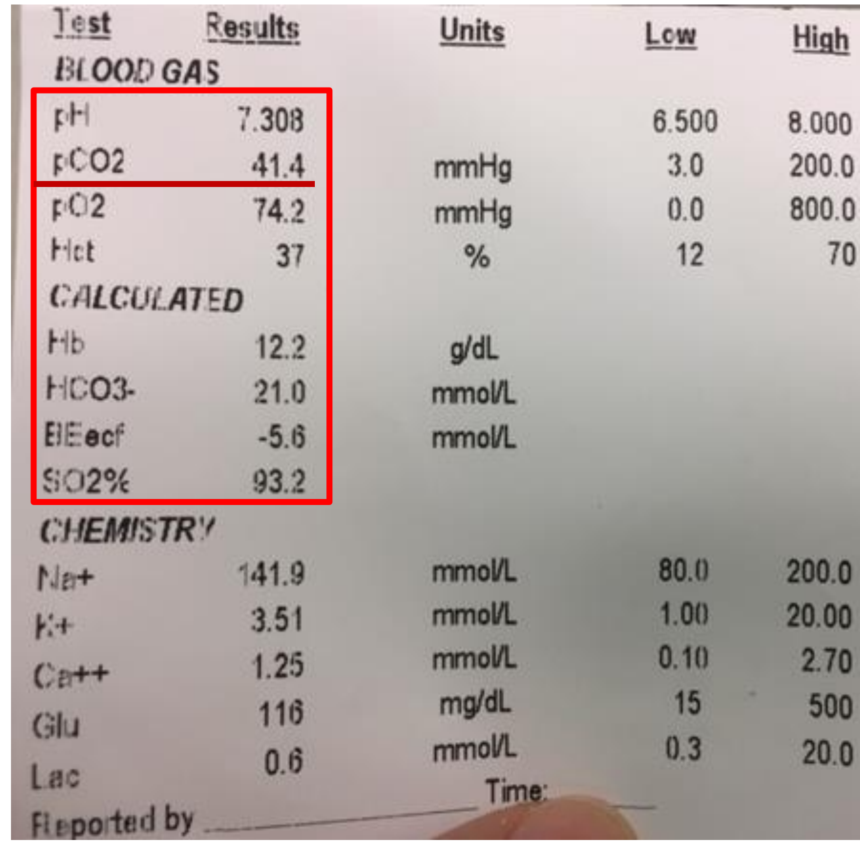
- **Start OP ABG**



Test	Results	Units	Test Ranges Low	High
BLOOD GAS				
pH	7.350		6.500	8.000
pCO2	43.2	mmHg	3.0	200.0
pO2	410.9	mmHg	0.0	800.0
Hct	36	%	12	70
CALCULATED				
Hb	12.1	g/dL		
HCO3-	24.0	mmol/L		
BEecf	-1.8	mmol/L		
SO2%	100.0			
CHEMISTRY				
Na+	141.0	mmol/L	80.0	200.0
K+	3.59	mmol/L	1.00	20.00
Ca++	1.24	mmol/L	0.10	2.70
Glu	109	mg/dL	15	500
Lac	0.8	mmol/L	0.3	20.0

Reported by ____________ Time: ________

- **1 hour later ABG**



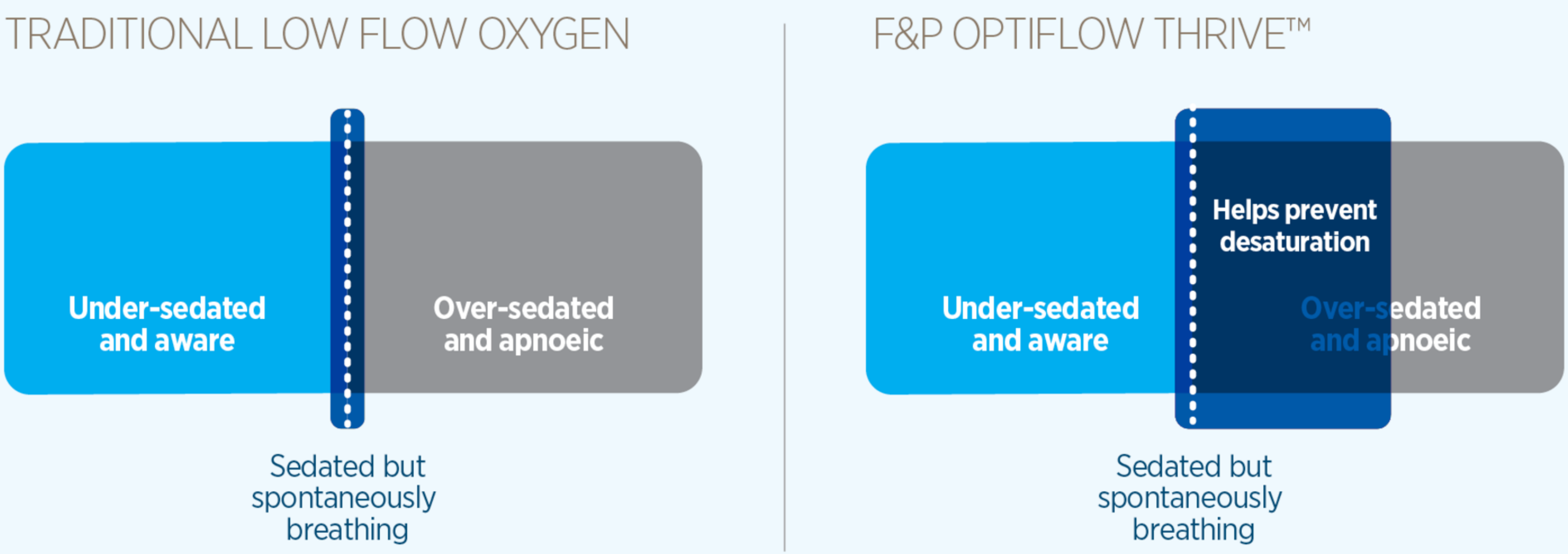
Test	Results	Units	Low	High
BLOOD GAS				
pH	7.308		6.500	8.000
pCO2	41.4	mmHg	3.0	200.0
pO2	74.2	mmHg	0.0	800.0
Hct	37	%	12	70
CALCULATED				
Hb	12.2	g/dL		
HCO3-	21.0	mmol/L		
BEecf	-5.6	mmol/L		
SO2%	93.2			
CHEMISTRY				
Na+	141.9	mmol/L	80.0	200.0
K+	3.51	mmol/L	1.00	20.00
Ca++	1.25	mmol/L	0.10	2.70
Glu	116	mg/dL	15	500
Lac	0.6	mmol/L	0.3	20.0

Reported by ____________ Time: ________

A New Standard Care

During procedural sedation, Optiflow THRIVE™ helps to improve patient safety by helping prevent desaturation and extend the safe apnoeic window should apnoea occur.

Procedural sedation



Optiflow THRIVE in PACU groupings

- 肥胖(Obesity)
- 高齡(Elderly)
- Post-ENT surgery(耳鼻喉科術後)
- Post-Cardiac Surgery(開心術後)
- OSA(睡眠呼吸中止症)
- Special disease Ex: MG, Had fail extubation record, Difficult secretion remove…

LUCANGELO 2012

Procedural sedation (Bronchoscopy)

RESULTS

Outcome	Venturi Mask 40 L/min	Optiflow THRIVE™ 40 L/min	Optiflow THRIVE™ 60 L/min
Bronchoscopy duration (minutes)	15	14	15
Baseline SpO_2 % (median)	94	95	95
End of bronchoscopy SpO_2 % (median)	94	92	98*

*Significantly different from Venturi mask and Optiflow THRIVE™, 40 L/min

CONCLUSION

- Optiflow THRIVE™ at 60 L/min may better protect patients with mild respiratory dysfunctions from desaturations during bronchoscopy

Lucangelo U. et al. *Crit. Care Res. Prac.* 2012.

No Difference in Intubation Rate!

Research

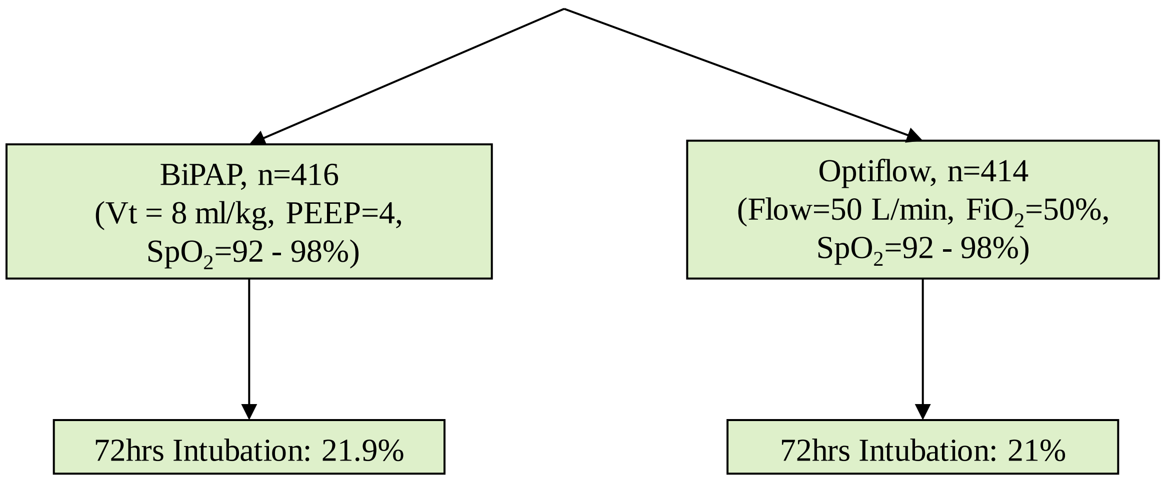
Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in Hypoxemic Patients After Cardiothoracic Surgery
A Randomized Clinical Trial

François Stéphan, MD, PhD; Benoit Barrucand, MD; Pascal Petit, MD; Saida Rézaiguia-Delclaux, MD; Anne Médard, MD; Bertrand Delannoy, MD; Bernard Cosserant, MD; Guillaume Flicoteaux, MD; Audrey Imbert, MD; Catherine Pilorge, MD; Laurence Bérard, MD; for the BiPOP Study Group

Results of the French RCT Study BiPOP JAMA 2015

- N=830, surgical cardiac pts with post=op ARF during 06/2011-12/2013 in 6 French ICU.



Blaudszun et al. 2017

Abstract - Association for Cardiothoracic Anaesthesia and Critical Care Conference, Birmingham, 2017

Cardiac surgical patients are at high risk of postoperative pulmonary complications.

METHOD

- Prospective, randomized, controlled trial
- 99 adult patients with high risk for post-operative pulmonary complications undergoing elective cardiac surgery
- Oxygen therapy administered for 24 hours, post-extubation

  1. Optiflow NHF

  2 Standard oxygen (SO)

RESULTS

- Optiflow NHF led to a 31% relative reduction in mean hospital length of stay by 4.7 days (13.4 days with SO, Optiflow NHF 8.6 days)
- Optiflow NHF was associated with significantly fewer ICU re-admissions (7/48 in SO group, 1/51 in Optiflow NHF group)

CONCLUSION

- ***"When compared with standard care, prophylactic postoperative use of HFNO (Optiflow NHF) in high-risk cardiac surgial patients reduced hospital stay and re-admission to ICU."***

Blaudszun G et al. Association for Cardiothoracic Anaesthesia and Critical Care Conference, Birmingham, 2017 [Abstr].

F&P Optiflow™

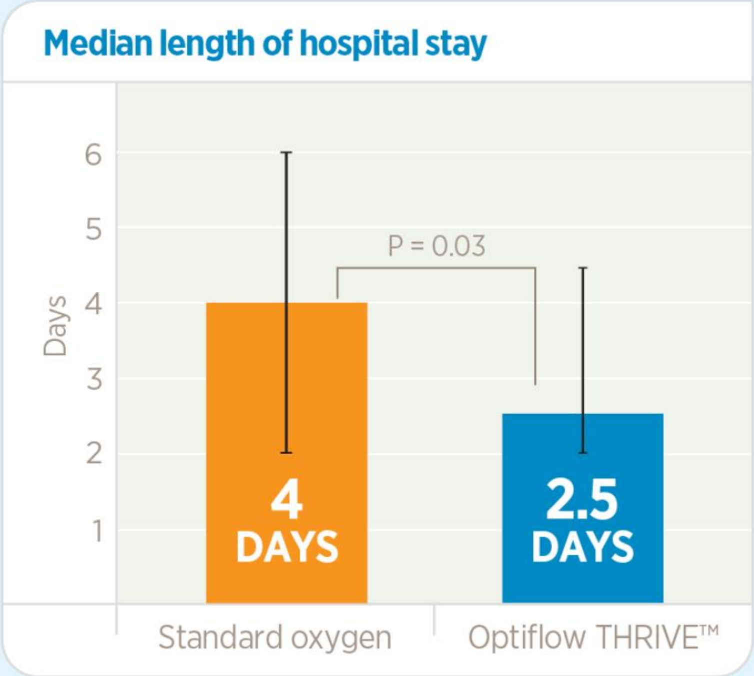
ANSARI 2015
PACU

METHOD

- 59 elective lung resection surgery patients
- Randomized controlled trial
- Compared efficacy of prophylactic use of Optiflow THRIVE™ (20 - 50 L/min, FiO_2 titrated to $SpO_2 \geq 93\%$) and low flow oxygen (2 - 4 L/min face mask or nasal prong, FiO_2 titrated to $SpO_2 \geq 93\%$) for 24 hours post-operatively on early functional outcome (6 Minute Walk Test, 6 MWT)

RESULTS

- Compared to standard care, low flow oxygen:
  - No difference in the 6 MWT
  - Optiflow THRIVE™ significantly reduced length of hospital stay from 4 days (standard care) to 2.5 days



Adapted from Ansari, 2016.

Ansari B. et al. *Ann. Thorac. Surg.* 2016.

F&P Optiflow THRIVE™

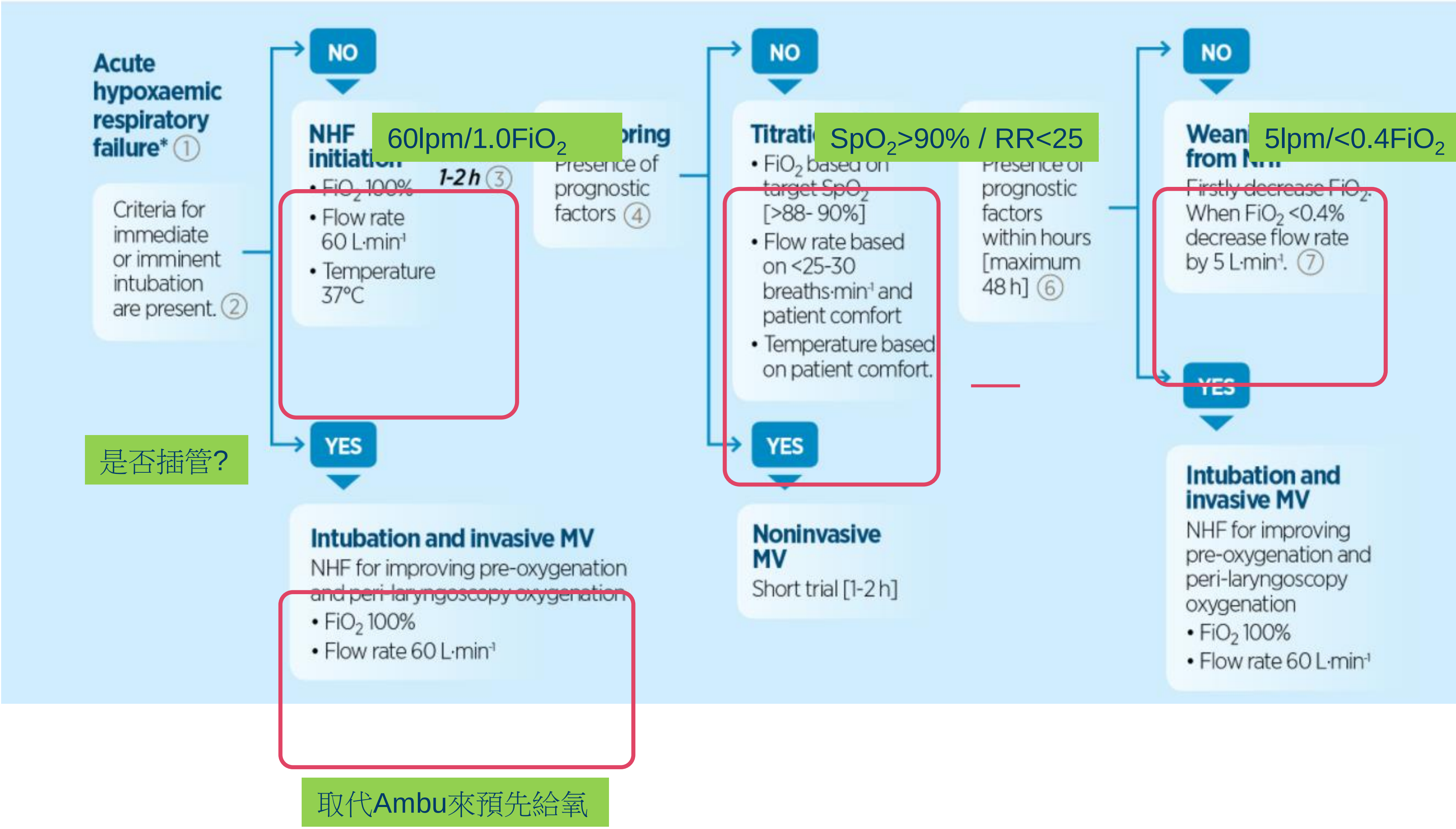
Summary & Flow Setting

*at 12 hours post extubation

1. Hernández et al. *JAMA*. Oct 2016. 2. Hernández et al. *JAMA*. Apr 2016. 3. Bell et al. *Emerg Med Australas*. 2015. 4. Frat et al. *N Engl J Med*. 2015. 5. Stéphan et al. *JAMA*. 2015. 6. Maggiore et al. *Am J Respir Crit Care Med*. 2014. 7. Peters et al. *Respir Care*. 2012. 8. Sztrymf et al. *Intensive Care Med*. 2011. 9. Parke et al. *Respir Care*. 2011. 10. Corley et al. *Br J Anaesth*. 2011. 11. Cirio et al. *Respir med*. 2016. 12. Rea et al. *Respir Med*. 2010. 13. Hasani et al. *Chron Respir Dis*. 2008.

Ischaki et al. 2017

Ischaki. Eur Respir Rev. 2017.



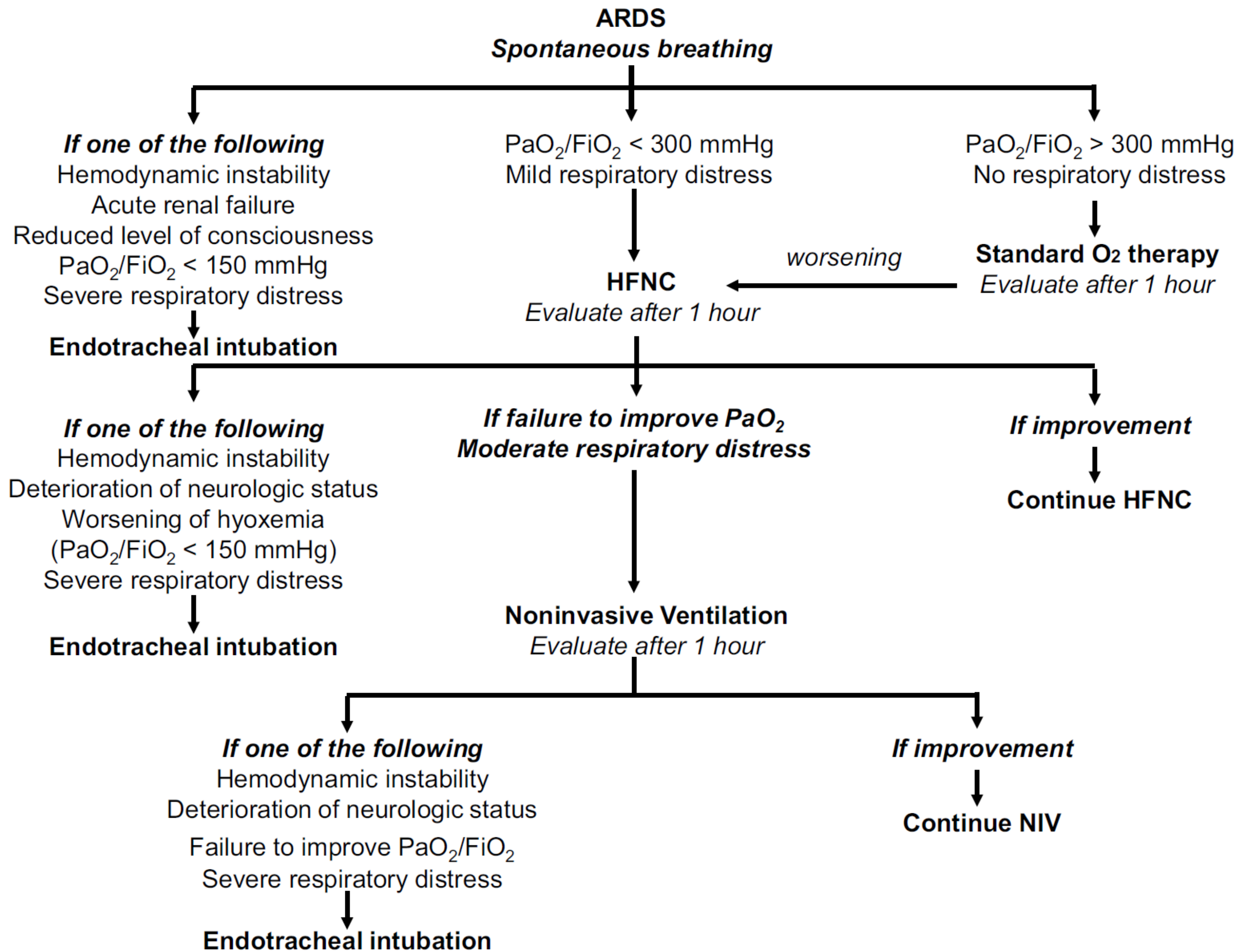


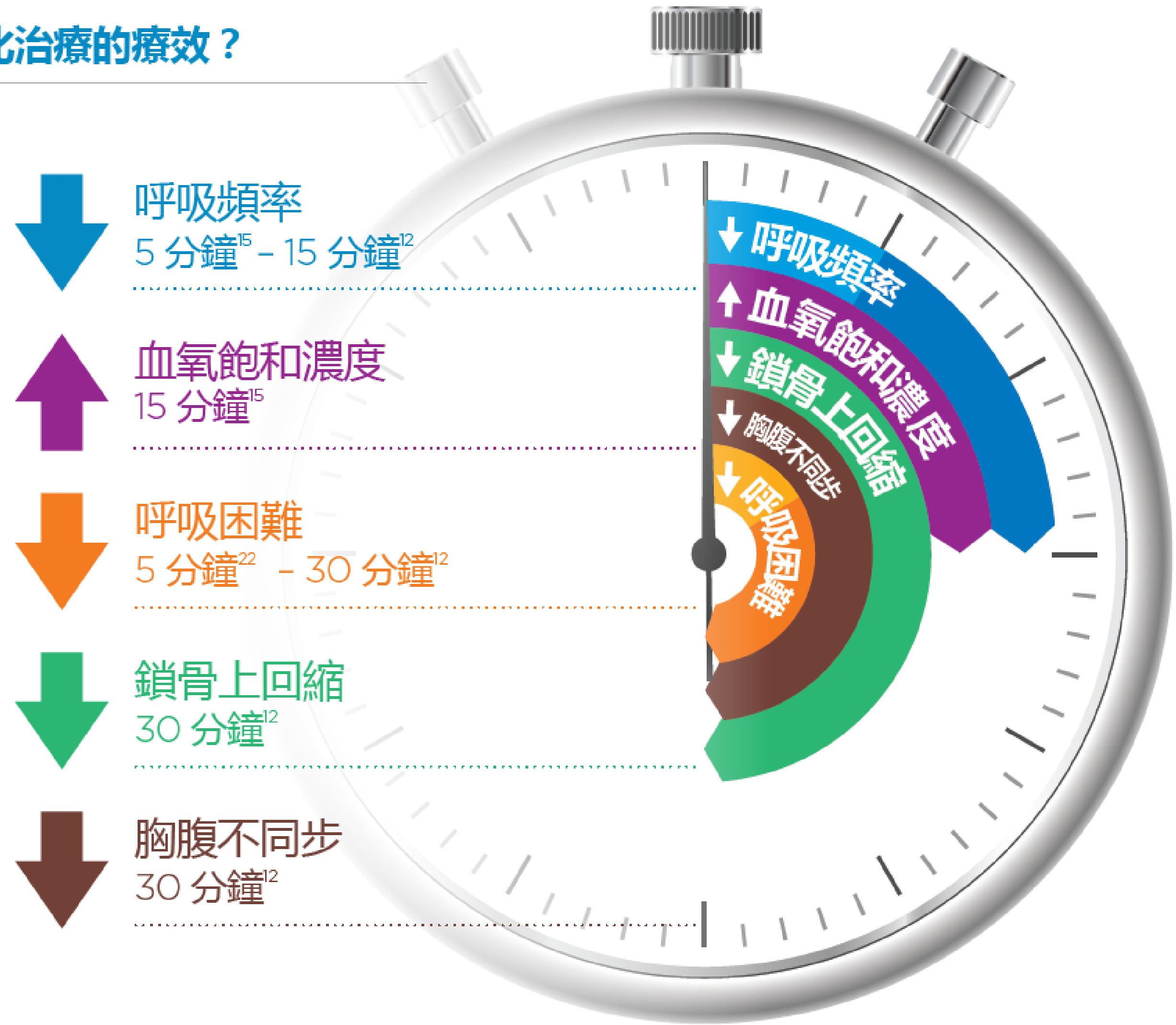
Fig. 1 Algorithm for practical use of high-flow nasal cannula (HFNC) and non-invasive mechanical ventilation (NIV) in acute respiratory distress syndrome (ARDS)

什麼時候可以看到 Optiflow™ 經鼻高流量氧氣濕化治療的療效？

Sztrymf 等人[12]指出， Optiflow 經鼻高流量氧氣濕化治療，能改善急性呼吸衰竭患者的血氧，並能改善生理參數。

同樣地，Rittayamai 等人[15]也發現對拔管後患者有顯著改善。

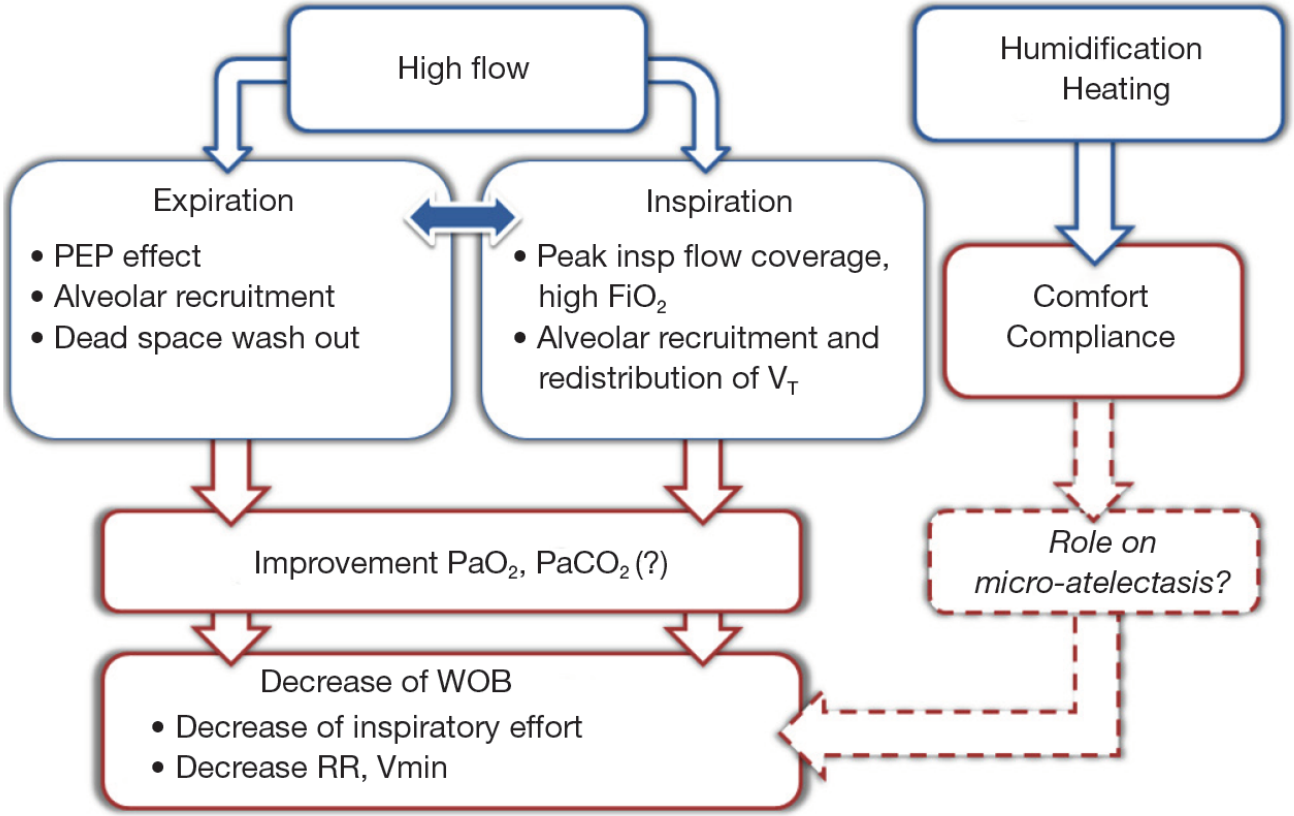
這些研究可以為患者對於治療的反應提供參考。



Review Article

High-flow nasal oxygen therapy and noninvasive ventilation in the management of acute hypoxemic respiratory failure

Jean-Pierre Frat[1,2,3], Rémi Coudroy[1,2,3], Nicolas Marjanovic[2,3,4], Arnaud W. Thille[1,2,3]



Physiological effects of HFNC oxygen therapy. HFNC, high-flow nasal cannula.

Interfaces & Circuits

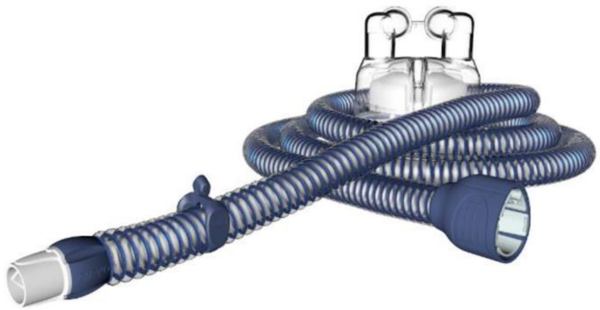
Optiflow – The Power of ONE

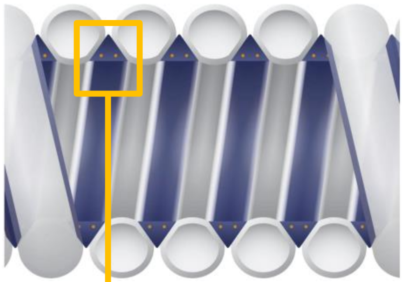
1. 插管前使用，如：呼吸衰竭、急性肺水腫、一氧化碳中毒等
2. 取代部分BIPAP與NC
3. 拔管後使用
4. 一種介面取代所有介面

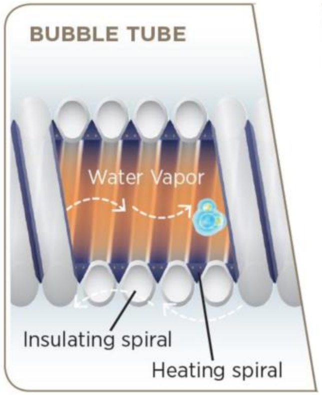
ONE solution for revolutionary Oxygen Therapy

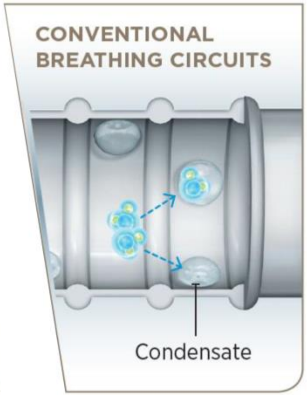
New AIRVO Circuit – 900PT561

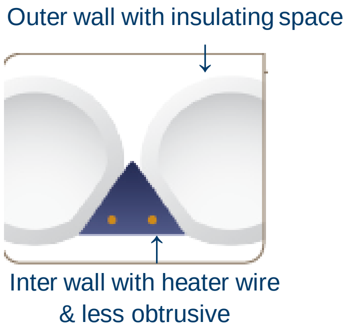
1. 更輕巧！
2. 管路外圈包覆隔熱圈！
3. 加熱線與管路一體成形
   呼吸阻力更小，加熱更均勻！
4. 減少至少**93%**冷凝水！



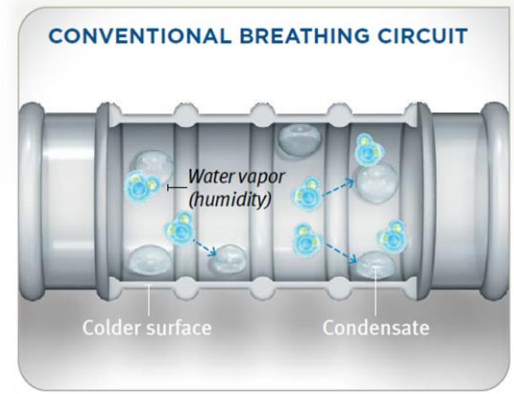


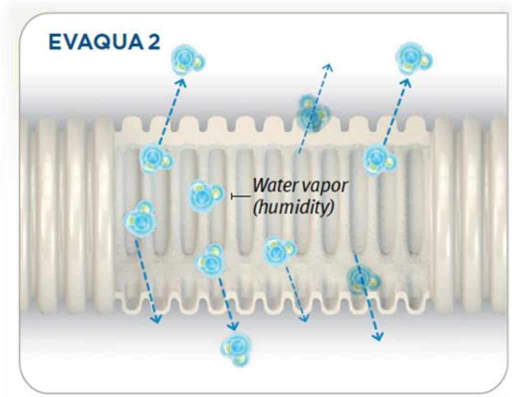






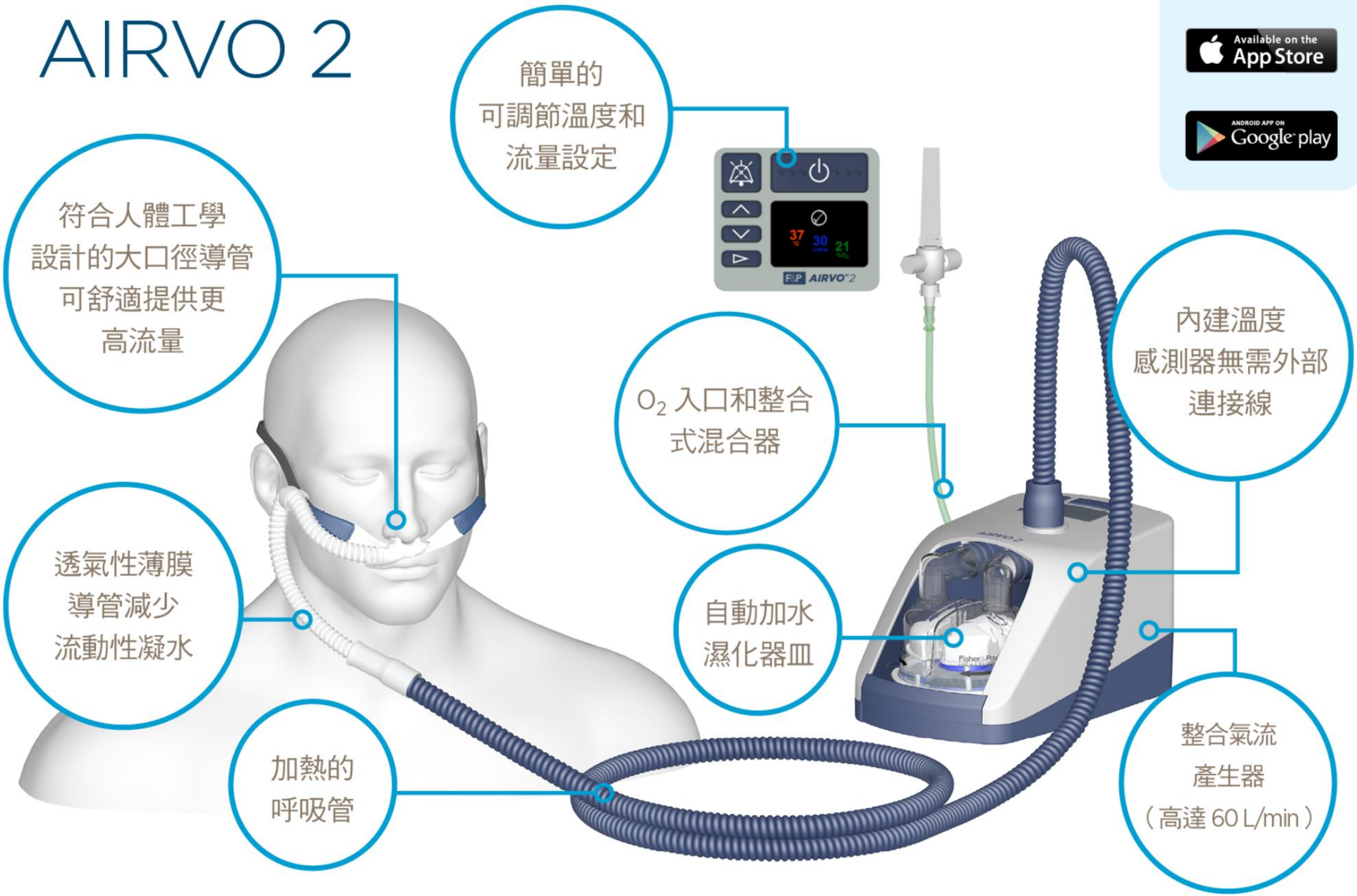
Optiflow+ Interfaces



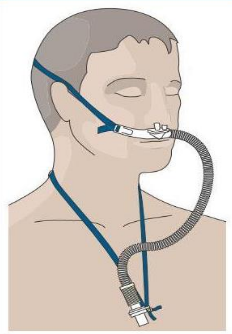
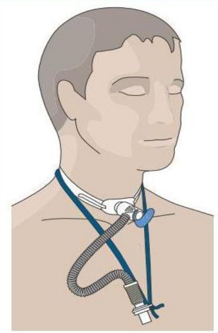
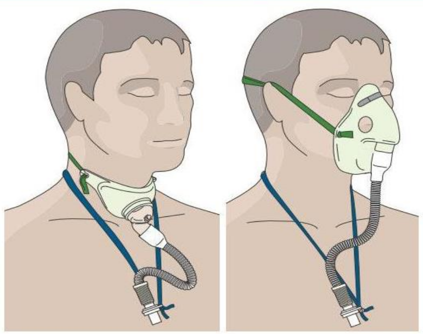


Evaqua minimizes condensate

AIRVO 2



簡單的
可調節溫度和
流量設定
符合人體工學
設計的大口徑導管
可舒適提供更
高流量
37
30
21
AIRVO 2
O2 入口和整合
式混合器
內建溫度
感測器無需外部
連接線
透氣性薄膜
導管減少
流動性凝水
自動加水
濕化器皿
加熱的
呼吸管
整合氣流
產生器
（高達 60 L/min）
Available on the
App Store
ANDROID APP ON
Google play

鼻部導管		氣管插管介面	呼吸罩介面轉接器
			
OPT842 OPT844 OPT846	OPT316 OPT318 （請參閱 “使用 AIRVO 2” - “兒童模式”）	OPT870	RT013 (帶面罩)

除鼻導管介面，也有Endo / Tr 轉介面！符合不同病患需求！

900PT561

900PT501

Patient Interface		°C 31	°C 34	°C 37	L/min
	OPT316		●		2 – 20
	OPT318		●		2 – 25
	OPT942 Ⓢ		●	●	10 – 50
	OPT944 Ⓜ		●	●	10 – 60
	OPT946 Ⓛ		●	●	10 – 60
	OPT970			●	10 – 60
	OPT980	●	●	●	10 – 60
	OPT842 Ⓢ		●	●	10 – 50
	OPT844 Ⓜ		●	●	10 – 60
	OPT846 Ⓛ		●	●	10 – 60
	OPT870			●	10 – 60
	RT013	●	●	●	10 – 60

In conclusion

- **High-flow nasal cannula (HFNC) oxygen therapy is able to deliver adequately heated and humidified medical gas at flows up to 60 L/min, it is considered to have a number of physiological advantages compared with other standard oxygen therapies, including reduced anatomical dead space, PEEP, constant FIO2, and good humidification.**
- **Few large randomized clinical trials have been performed, HFNC has been gaining attention as an alternative respiratory support for critically ill patients, such as hypoxemic respiratory failure, exacerbation of COPD, postextubation, preintubation oxygenation, sleep apnea, acute heart failure, and conditions entailing do-not-intubate orders.**
- **Some important issues remain to be resolved, such as definitive indications for HFNC and criteria for timing the starting and stopping of HFNC and for escalating treatment.**
- **HFNC has emerged as an innovative and effective modality for early treatment of adults with respiratory failure with diverse underlying diseases.**