CREUF 2023

30 & 31 Mars 2023
MULHOUSE ● ALSACE

Quelles indications de la VNI en 2023?

Professeur Arnaud W. THILLE
Chef de service
Médecine Intensive Réanimation
CHU de Poitiers, France.

IS-ALIVE Research group, INSERM CIC 1402,
University of Poitiers.

Conflicts of Interest

Fisher & Paykel provided the high-flow nasal oxygen equipment and masks for non-invasive ventilation in several randomized clinical trials coordinated by our center but had no other involvement in these studies.

My COI

Personal fees from **Fisher & Paykel, GE Healthcare and Sedana Medical**: travel/accommodation expense coverage to attend scientific meetings and payment for lectures.

Beneficial effects of NIV

1. Heated and humidified gas
2. ↗ PaO_2: FiO_2 100% + PEEP effect
3. ↘ $PaCO_2$: Alveolar ventilation
4. ↘ Effort: Pressure-Support
5. Cardiac effects

CPE

Deleterious effects of NIV

1. Poor tolerance
2. Patient-ventilator asynchronies
3. Delayed intubation?
4. Barotrauma: V_T > 9 ml/kg

Which noninvasive respiratory support?

Saving Lives with High-Flow Nasal Oxygen

Michael A. Matthay, M.D.

2015: The FLORALI study

310 patients with acute respiratory failure included in 23 ICUs

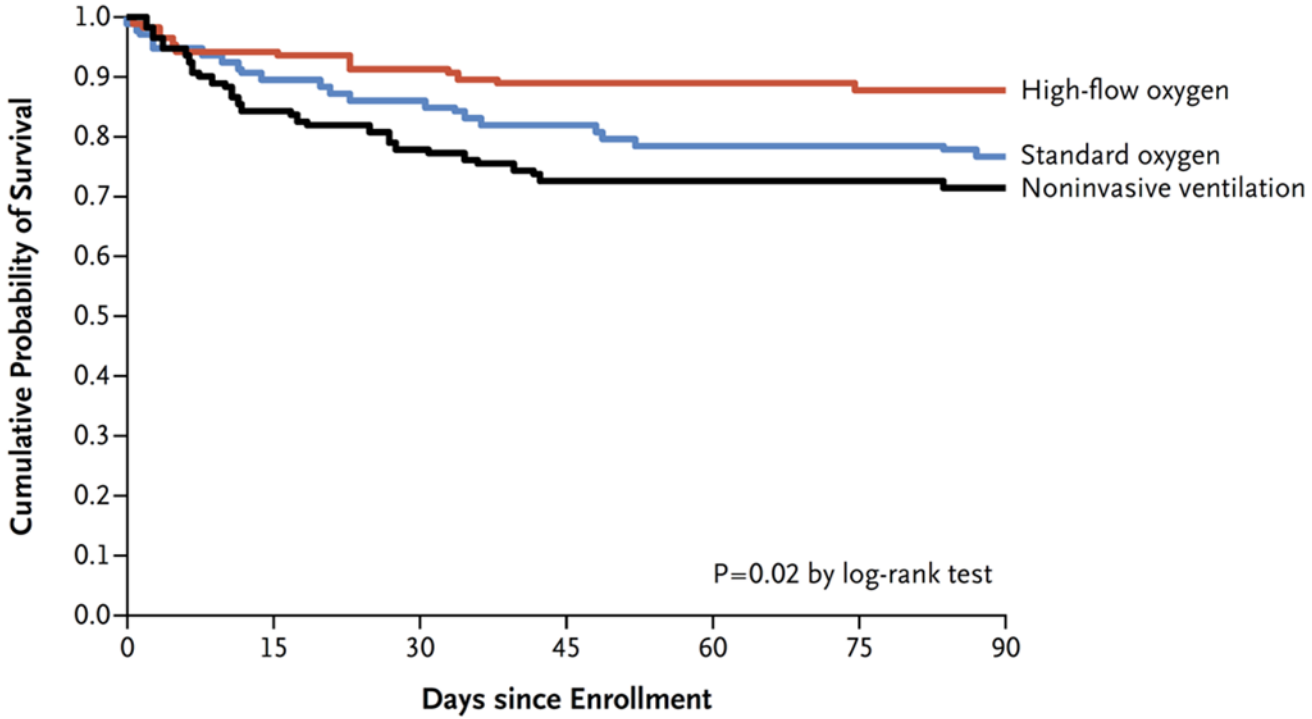
RR >25 /min, $PaO_2/FiO_2 \leq$ 300 mm Hg, and $PaCO_2 \leq 45$ mm Hg

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

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

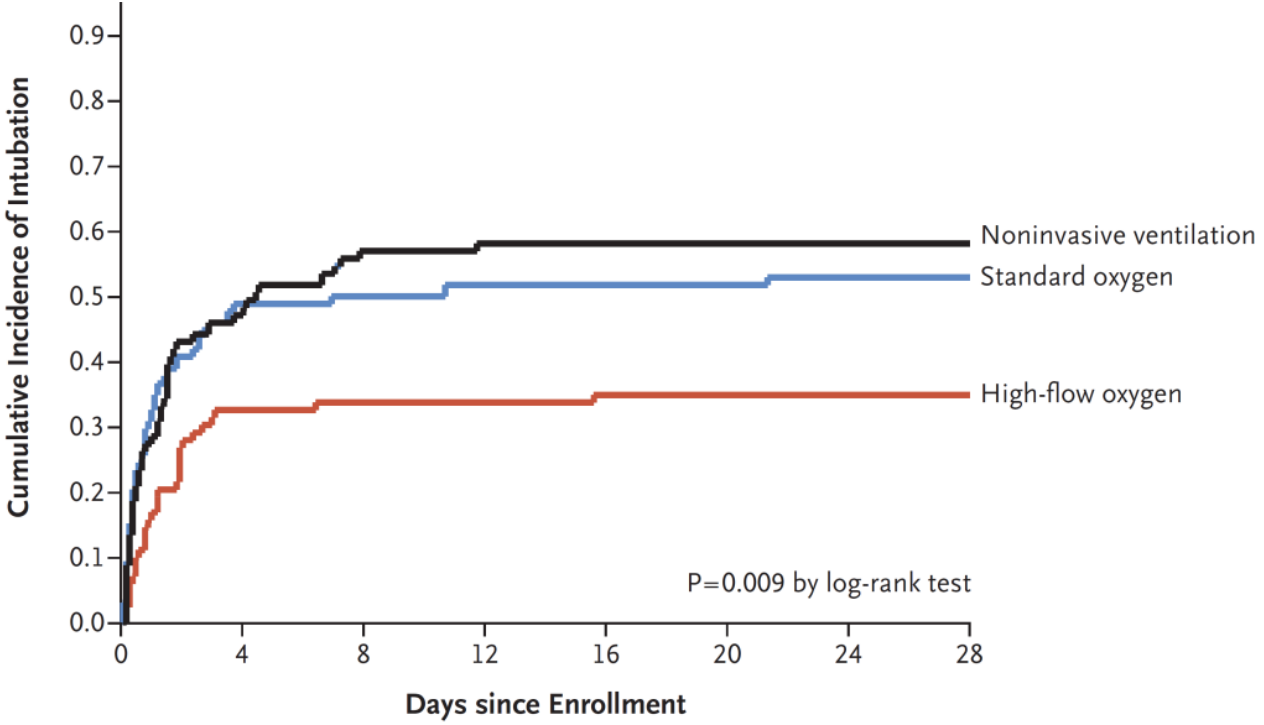
Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D., Sébastien Perbet, M.D., Gwénael Prat, M.D., Thierry Boulain, M.D., Elise Morawiec, M.D., Alice Cottereau, M.D., Jérôme Devaquet, M.D., Saad Nseir, M.D., Ph.D., Keyvan Razazi, M.D., Jean-Paul Mira, M.D., Ph.D., Laurent Argaud, M.D., Ph.D., Jean-Charles Chakarian, M.D., Jean-Damien Ricard, M.D., Ph.D., Xavier Wittebole, M.D., Stéphanie Chevalier, M.D., Alexandre Herbland, M.D., Muriel Fartoukh, M.D., Ph.D., Jean-Michel Constantin, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Marc Pierrot, M.D., Armelle Mathonnet, M.D., Gaëtan Béduneau, M.D., Céline Delétage-Métreau, Ph.D., Jean-Christophe M. Richard, M.D., Ph.D., Laurent Brochard, M.D., and René Robert, M.D., Ph.D., for the FLORALI Study Group and the REVA Network*



Mortality was lower with High-flow nasal oxygen (12%) than with Standard O_2 (23%) or Noninvasive ventilation (28%), p=0.02.

Figure 3. Kaplan–Meier Plot of the Probability of Survival from Randomization to Day 90.

Among the 238 patients with $PaO_2/FiO_2 \leq 200$ mm Hg



Intubation rates were lower with High-flow nasal oxygen (35%) than with Standard O_2 (53%) or Noninvasive ventilation (58%), $p<0.01$.

Frat JP. et al., New England Journal of Medicine 2015;

Table S5. Assessment of tolerance to the oxygenation strategy at inclusion and 1 hour after inclusion *

	High-Flow Oxygen group (n=106)	Standard Oxygen group (n=94)	NIV group (n=110)	P Value
Respiratory patient-discomfort at inclusion – mm †	38±31	44±29	46±30	0.20
Respiratory patient-discomfort at H1– mm †	29	40	43	<0.01
Grade of dyspnea at H1‡				<0.001
Marked improvement – no. (%)	76%	42%	58%	
Slight improvement– no. (%)				
No change– no. (%)	18 (20.9)	33 (44.6)	23 (25.3)	
Slight deterioration – no. (%)	3 (3.5)	9 (12.2)	8 (8.8)	
Marked deterioration – no. (%)	0 (0.0)	1 (1.3)	7 (7.7)	
Respiratory rate– breaths/min				
H1	28	31	31	<0.01
H6	27±7	29±8	29±7	0.13

Patient self-inflicted lung injury (PSILI)

CRITICAL CARE PERSPECTIVE

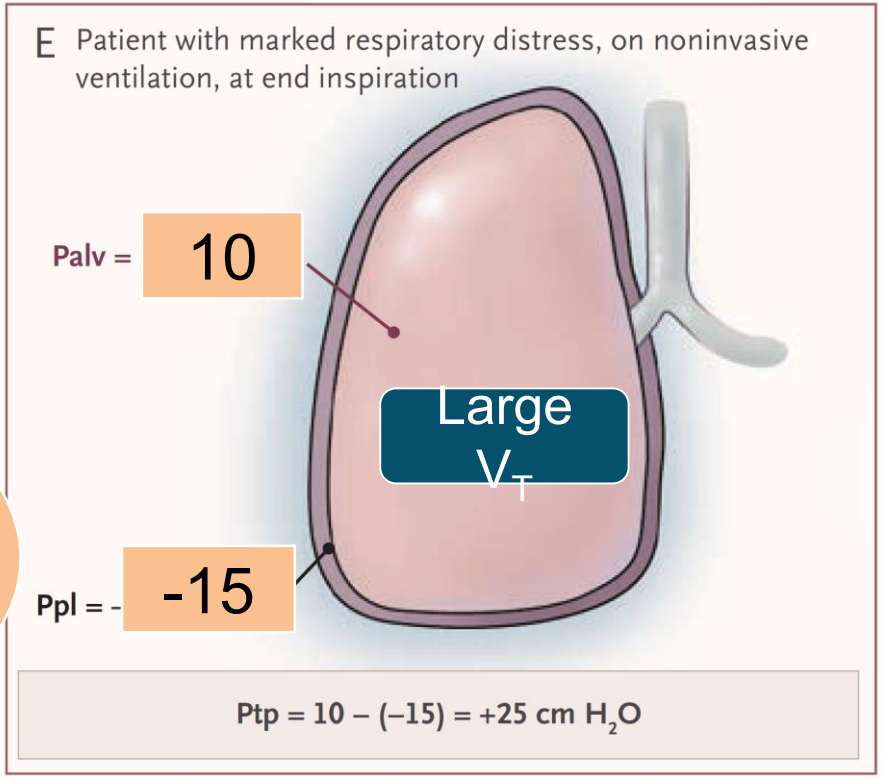
Mechanical Ventilation to Minimize Progression of Lung Injury in Acute Respiratory Failure

Laurent Brochard[1,2], Arthur Slutsky[1,2], and Antonio Pesenti[3,4]

[1]Keenan Research Centre for Biomedical Science of St. Michael's Hospital, Toronto, Ontario, Canada; [2]Interdepartmental Division of Critical Care Medicine, University of Toronto, Toronto, Ontario, Canada; [3]Department of Anesthesia, Critical Care, and Emergency, Fondazione Istituto di Ricovero e Cura a Carattere Scientifico Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy; and [4]Dipartimento di Fisiopatologia Medico–Chirurgica e dei Trapianti, Università degli Studi di Milan, Milan, Italy

Brochard L et al., Am J Respir Crit Care Med 2017; 195:438-442.

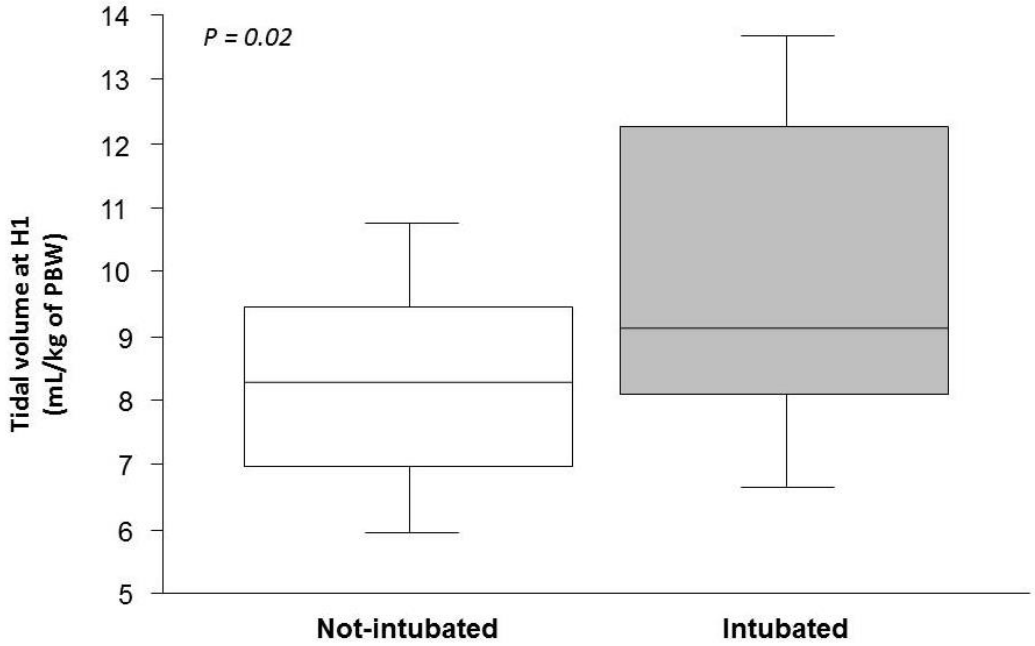
Transpulmonar y pressure 25 cm H_2O!



Slutsky AS. and Ranieri VM., New England Journal of Medicine 2013;

Predictors of Intubation in Patients With Acute Hypoxemic Respiratory Failure Treated With a Noninvasive Oxygenation Strategy*

Jean-Pierre Frat, MD[1,2,3]; Stéphanie Ragot, PhD[4,5,6]; Rémi Coudroy, MD[1,2,3]; Jean-Michel Constantin, PhD[7,8]; Christophe Girault, MD[9]; Gwénael Prat, MD[10]; Thierry Boulain, MD[11]; Alexandre Demoule, PhD[12,13]; Jean-Damien Ricard, PhD[14,15,16]; Keyvan Razazi, MD[17]; Jean-Baptiste Lascarrou, MD[18]; Jérôme Devaquet, MD[19]; Jean-Paul Mira, PhD[20]; Laurent Argaud, PhD[21]; Jean-Charles Chakarian, MD[22]; Muriel Fartoukh, PhD[23]; Saad Nseir, PhD[24]; Alain Mercat, PhD[25]; Laurent Brochard, MD[26,27]; René Robert, PhD[1,2,3]; Arnaud W. Thille, PhD[1,2,3]; for the REVA network



V_T > 9 ml/kg
1h after NIV initiation was independently associated with intubation and mortality.

Frat JP. et al., Critical Care Medicine 2018;

Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerg[1], Laurent Brochard[2,3], Mark W. Elliott[4], Dean Hess[5], Nicholas S. Hill[6], Stefano Nava[7] and Paolo Navalesi[8] (members of the steering committee); Massimo Antonelli[9], Jan Brozek[1], Giorgio Conti[9], Miquel Ferrer[10], Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Keenan[13,14], Jordi Mancebo[15], Sangeeta Mehta[16] and Suhail Raoof[17,18] (members of the task force)

Acute hypoxemic respiratory failure

Recommendation

Given the uncertainty of evidence we are unable to offer a recommendation on the use of NIV for *de novo* ARF.

Recommendation

We suggest early NIV for immunocompromised patients with ARF. (Conditional recommendation, moderate certainty of evidence.)

Rochwerg B. et al., Eur Respir J 2017;

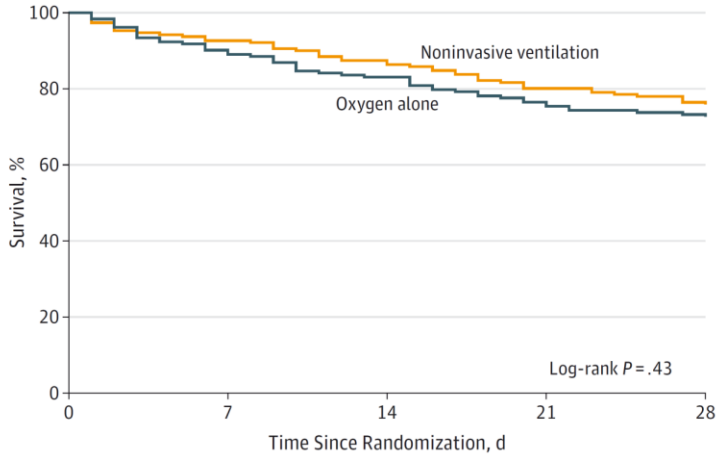
Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Noninvasive Ventilation vs Oxygen Therapy on Mortality Among Immunocompromised Patients With Acute Respiratory Failure

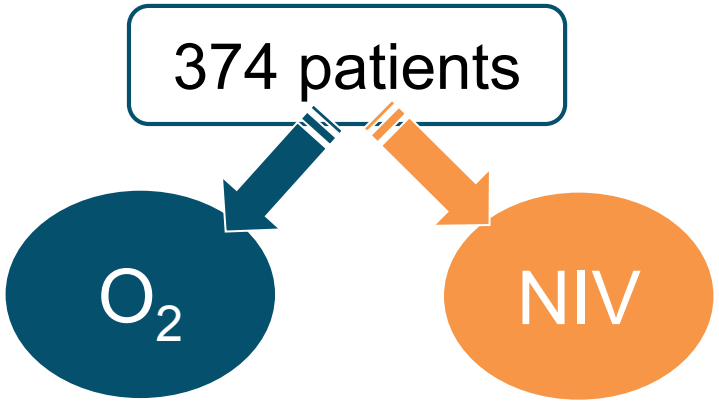
A Randomized Clinical Trial

Virginie Lemiale, MD; Djamel Mokart, MD; Matthieu Resche-Rigon, MD, PhD; Frédéric Pène, MD, PhD; Julien Mayaux, MD; Etienne Faucher, MD; Martine Nyunga, MD; Christophe Girault, MD, PhD; Pierre Perez, MD; Christophe Guitton, MD, PhD; Kenneth Ekpe, MD; Achille Kouatchet, MD; Igor Théodose, MS; Dominique Benoit, MD, PhD; Emmanuel Canet, MD; François Barbier, MD, PhD; Antoine Rabbat, MD; Fabrice Bruneel, MD; Francois Vincent, MD; Kada Klouche, MD, PhD; Kontar Loay, MD; Eric Mariotte, MD; Lila Bouadma, MD, PhD; Anne-Sophie Moreau, MD; Amélie Seguin, MD; Anne-Pascale Meert, MD, PhD; Jean Reignier, MD, PhD; Laurent Papazian, MD, PhD; Ilham Mehzari, MD; Yves Cohen, MD, PhD; Maleka Schenck, MD; Rebecca Hamidfar, MD; Michael Darmon, MD, PhD; Alexandre Demoule, MD, PhD; Sylvie Chevret, MD, PhD; Elie Azoulay, MD, PhD; for the Groupe de Recherche en Réanimation Respiratoire du patient d'Onco-Hématologie (GRRR-OH)

Figure 2. Probability of Survival at Day 28



No. at risk					
Noninvasive ventilation	191	177	167	153	146
Oxygen alone	183	165	152	140	134



Intubation:
O_2 44% vs. VNI 38%
(p=0.20)

Low dosis of NIV
(short sessions 8h/day)
with low PEEP levels…

Lemiale V. et al., JAMA 2015; 314:1711-

FLORALI-IM study

300 immunocompromised patients with acute respiratory failure in 29 ICUs

RR ≥ 25 breaths/min and PaO_2/FiO_2 ≤ 300 mm Hg and $PaCO_2$ ≤ 50 mm Hg.

Randomization
Stratification on Hematological disease

High-flow nasal oxygen **alone**

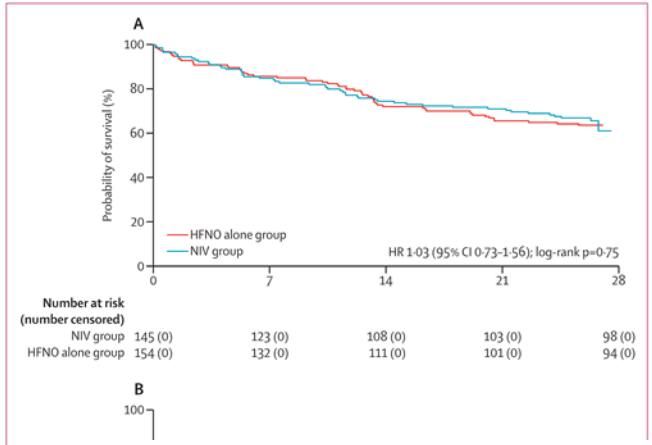
High-flow nasal oxygen **with NIV**

Mortality at day-90

Coudroy R. et al., Lancet Respiratory Medicine 2022;

High-flow nasal oxygen alone or alternating with non-invasive ventilation in critically ill immunocompromised patients with acute respiratory failure: a randomised controlled trial

Rémi Coudroy, Jean-Pierre Frat, Stephan Ehrmann, Frédéric Pène, Maxens Decavèle, Nicolas Terzi, Gwenaël Prat, Charlotte Garret, Damien Contou, Arnaud Gacouin, Jeremy Bourenne, Christophe Girault, Christophe Vinsonneau, Jean Dellamonica, Guylaine Labro, Sébastien Jochmans, Alexandre Herbland, Jean-Pierre Quenot, Jérôme Devaquet, Dalila Benzekri, Emmanuel Vivier, Saad Nseir, Gwenhaël Colin, Didier Thevenin, Giacomo Grasselli, David Bougon, Mona Assefi, Claude Guérin, Thierry Lherm, Achille Kouatchet, Stephanie Ragot, Arnaud W Thille, for the FLORALI-IM study group and the REVA Research Network*

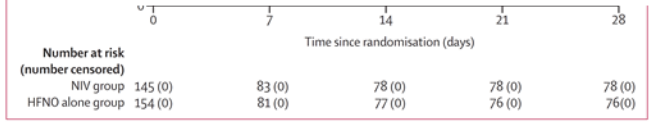


Protective **NIV**
Prolonged sessions > 12h/day
Low PS - High PEEP levels (8-10)

	High-flow	NIV	
Mortality ay day-28	36%	35%	p=0.83
Intubation at day-28	51%	46%	p=0.44

Recommendation

We suggest early NIV for immunocompromised patients with ARF. (Conditional recommendation, moderate certainty of evidence.)



???

Coudroy R. et al., Lancet Respiratory Medicine 2022;

EUROPEAN RESPIRATORY JOURNAL
ERS OFFICIAL DOCUMENTS
S. OCZKOWSKI ET AL.

ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure

Simon Oczkowski[1,2,26], Begüm Ergan[3,26], Lieuwe Bos[4,5], Michelle Chatwin[6], Miguel Ferrer[7], Cesare Gregoretti[8,9], Leo Heunks[10], Jean-Pierre Frat[11,12], Federico Longhini[13], Stefano Nava[14,15], Paolo Navalesi[16,17], Aylin Ozsancak Uğurlu[18], Lara Pisani[14,15], Teresa Renda[19], Arnaud W. Thille[11,12], João Carlos Winck[20], Wolfram Windisch[21], Thomy Tonia[22], Jeanette Boyd[23], Giovanni Sotgiu[24] and Raffaele Scala[25]

Effective on Intubation, Comfort & Dyspnea

HFNC for hypoxaemic acute respiratory failure

PICO question 1: Should HFNC or COT be used in patients with acute hypoxaemic respiratory failure?

Recommendation 1

We suggest the use of HFNC over COT in adults with acute hypoxaemic respiratory failure (conditional recommendation, moderate certainty of evidence).

PICO question 2: Should HFNC or NIV be used in patients with acute hypoxaemic respiratory failure?

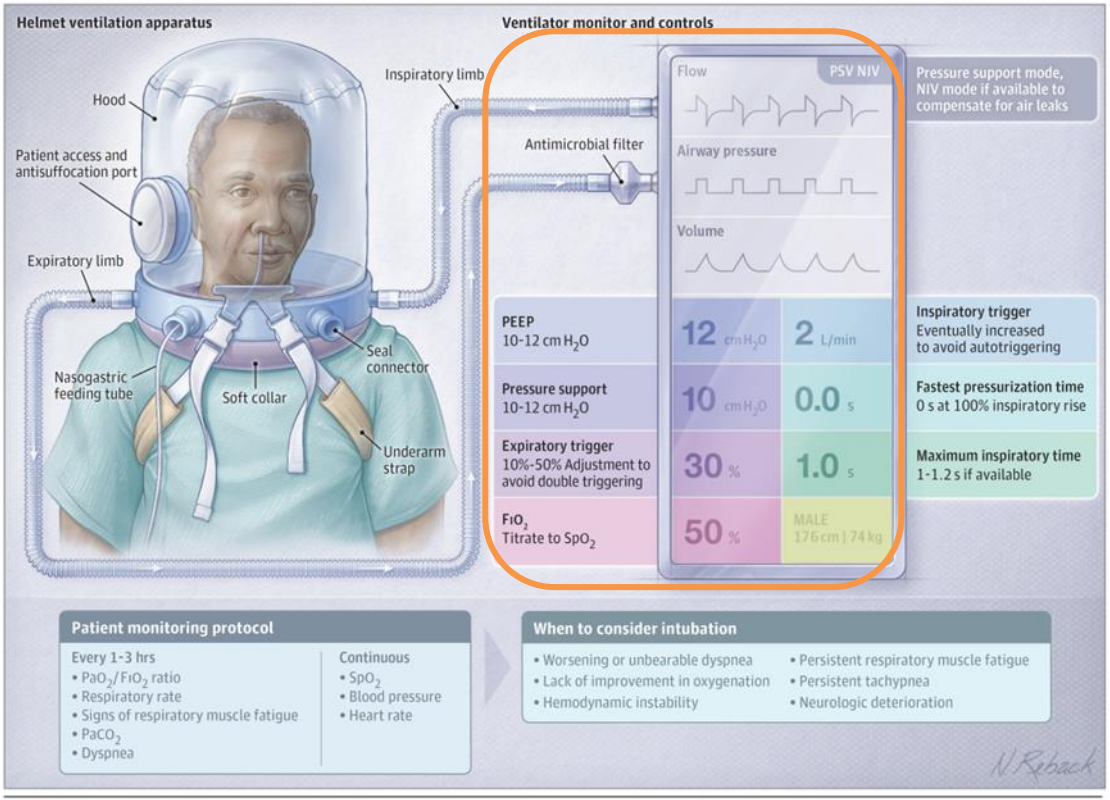
Recommendation 2

We suggest the use of HFNC over NIV in patients with acute hypoxaemic respiratory failure (conditional recommendation, very low certainty of evidence).

Oczkowski S. et al., European Respiratory Journal 2022;

What the future holds ? Helmet?

Figure 1. Noninvasive Helmet Ventilation as Used in the Trial



Physiological Comparison of High-Flow Nasal Cannula and Helmet Noninvasive Ventilation in Acute Hypoxemic Respiratory Failure

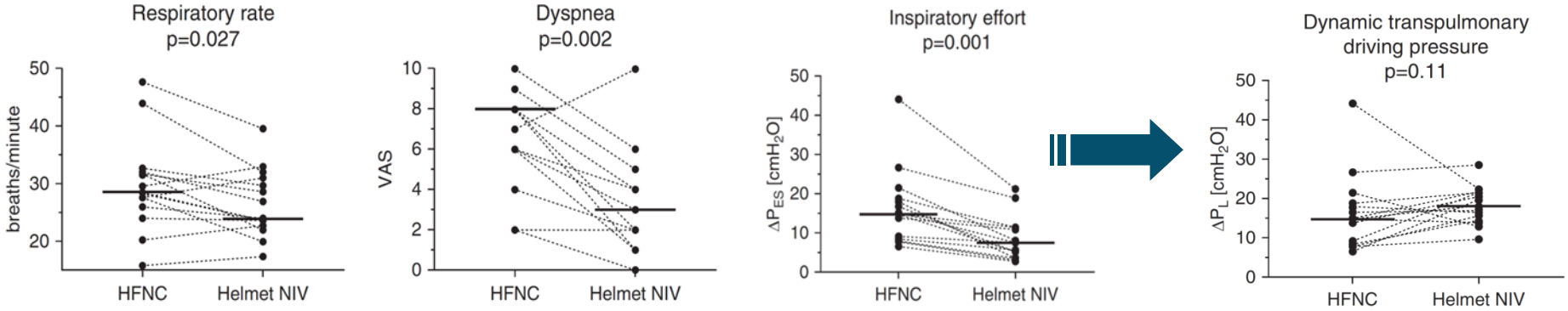
Domenico Luca Grieco[1,2], Luca S. Menga[1,2], Valeria Raggi[1,2], Filippo Bongiovanni[1,2], Gian Marco Anzellotti[1,2], Eloisa S. Tanzarella[1,2], Maria Grazia Bocci[1,2], Giovanna Mercurio[1,2], Antonio M. Dell'Anna[1,2], Davide Eleuteri[1,2], Giuseppe Bello[1,2], Riccardo Maviglia[1,2], Giorgio Conti[1,2], Salvatore Maurizio Maggiore[3], and Massimo Antonelli[1,2]

[1]Dipartimento di Scienze dell'Emergenza, Anestesiologiche e della Rianimazione, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy; [2]Department of Anesthesiology and Intensive Care Medicine, Catholic University of the Sacred Heart, Rome, Italy; and [3]Department of Medical, Oral and Biotechnological Sciences, School of Medicine and Health Sciences, Section of Anesthesia, Analgesia, Perioperative and Intensive Care, SS. Annunziata Hospital, Gabriele d'Annunzio University of Chieti-Pescara, Chieti, Italy

Physiological study,
15 patients with acute hypoxemic respiratory failure

Intervention
Helmet

High-Flow nasal oxygen



Grieco DL. et al., Am J Respir Crit Care Med 2020;

Research

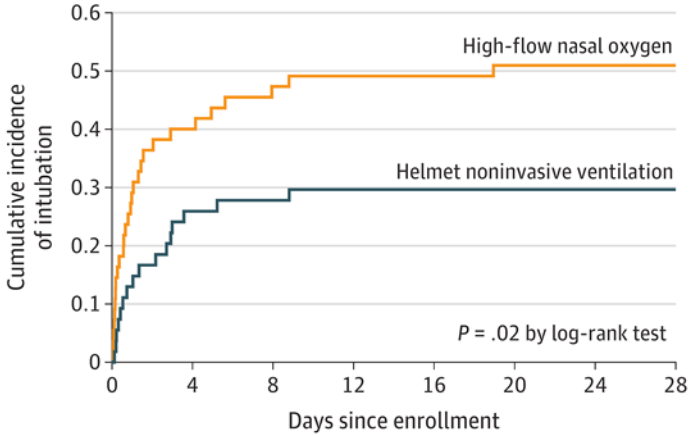
JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Helmet Noninvasive Ventilation vs High-Flow Nasal Oxygen on Days Free of Respiratory Support in Patients With COVID-19 and Moderate to Severe Hypoxemic Respiratory Failure

The HENIVOT Randomized Clinical Trial

Domenico Luca Grieco, MD; Luca S. Menga, MD; Melania Cesarano, MD; Tommaso Rosà, MD; Savino Spadaro, MD, PhD; Maria Maddalena Bitondo, MD; Jonathan Montomoli, MD, PhD; Giulia Falò, MD; Tommaso Tonetti, MD; Salvatore L. Cutuli, MD; Gabriele Pintaudi, MD; Eloisa S. Tanzarella, MD; Edoardo Piervincenzi, MD; Filippo Bongiovanni, MD; Antonio M. Dell'Anna, MD; Luca Delle Cese, MD; Cecilia Berardi, MD; Simone Carelli, MD; Maria Grazia Bocci, MD; Luca Montini, MD; Giuseppe Bello, MD; Daniele Natalini, MD; Gennaro De Pascale, MD; Matteo Velardo, PhD; Carlo Alberto Volta, MD; V. Marco Ranieri, MD; Giorgio Conti, MD; Salvatore Maurizio Maggiore, MD, PhD; Massimo Antonelli, MD; for the COVID-ICU Gemelli Study Group

Figure 3. Cumulative Incidence of Intubation Over Time in the Helmet Noninvasive Ventilation and High-Flow Nasal Oxygen Groups to Day 28



No. at risk								
High-flow nasal oxygen	55	34	30	28	28	27	27	27
Helmet noninvasive ventilation	54	41	39	38	38	38	38	38

HENIVOT study

109 patients Covid-19 included in 4 ICUs between October and December 2020.

Intervention
Helmet

High-Flow nasal oxygen

51 %

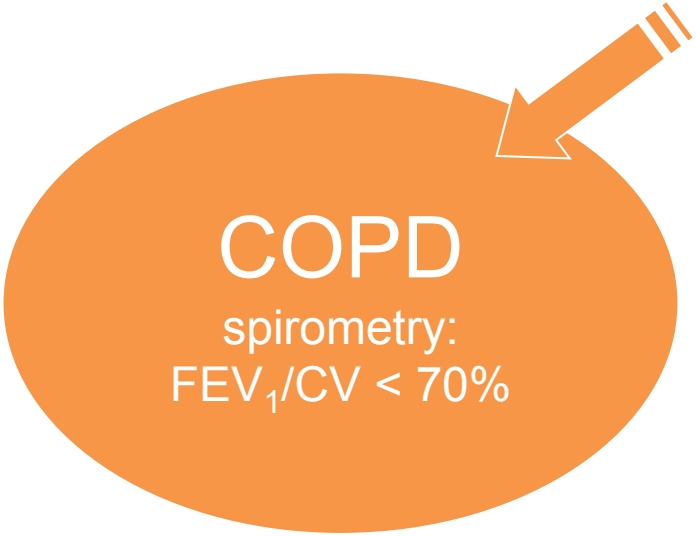
30 %

Mortality	Helmet	High-flow nasal oxygen	
At day-28	8 (15%)	10 (18%)	*P* = 0.80
At day-60	13 (24%)	12 (22%)	*P* = 0.82

Grieco DL. et al., JAMA 2021; 325:1731-

Acute hypercapnic respiratory failure

underlying chronic lung disease



Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerg[1], Laurent Brochard[2,3], Mark W. Elliott[4], Dean Hess[5], Nicholas S. Hill[6], Stefano Nava[7] and Paolo Navalesi[8] (members of the steering committee); Massimo Antonelli[9], Jan Brozek[1], Giorgio Conti[9], Miquel Ferrer[10], Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Keenan[13,14], Jordi Mancebo[15], Sangeeta Mehta[16] and Suhail Raoof[17,18] (members of the task force)

Hypercapnic ARF

Chronic lung disease

Recommendations

We recommend bilevel NIV for patients with ARF leading to acute or acute-on-chronic respiratory acidosis (pH ⩽7.35) due to COPD exacerbation. (Strong recommendation, high certainty of evidence.)

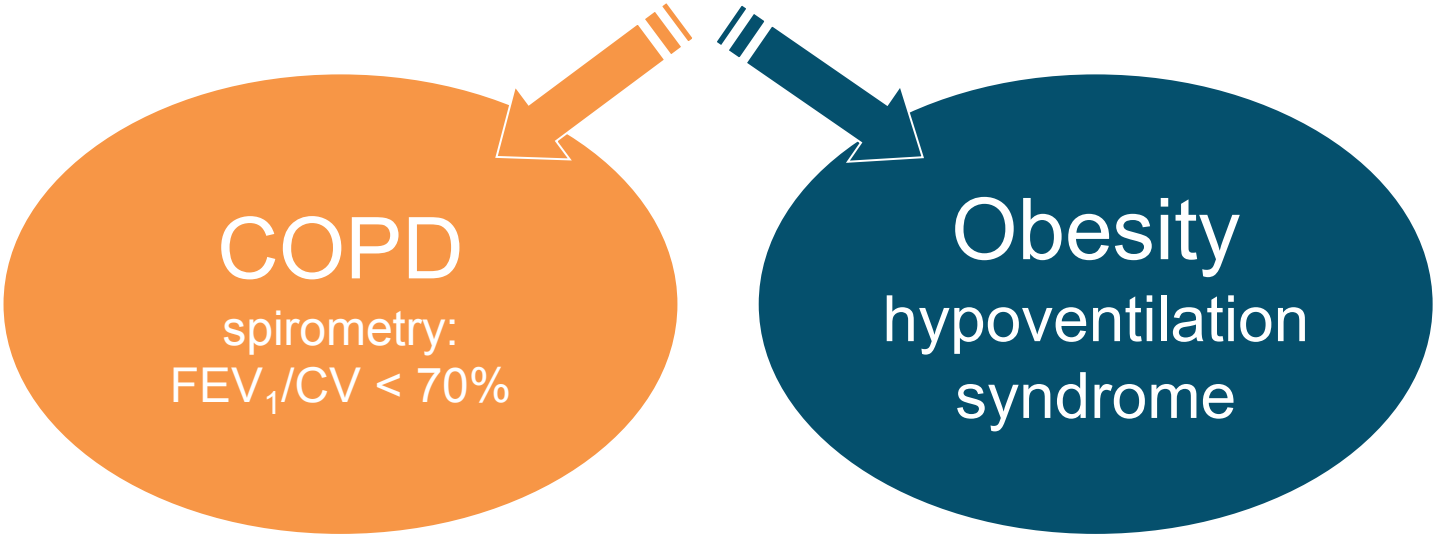
We recommend a trial of bilevel NIV in patients considered to require endotracheal intubation and mechanical ventilation, unless the patient is immediately deteriorating. (Strong recommendation, moderate certainty of evidence.)

$PaCO_2$ > 45 mm Hg and pH ≤ 7.35

Rochwerg B. et al., Eur Respir J 2017;

Acute hypercapnic respiratory failure

underlying chronic lung disease

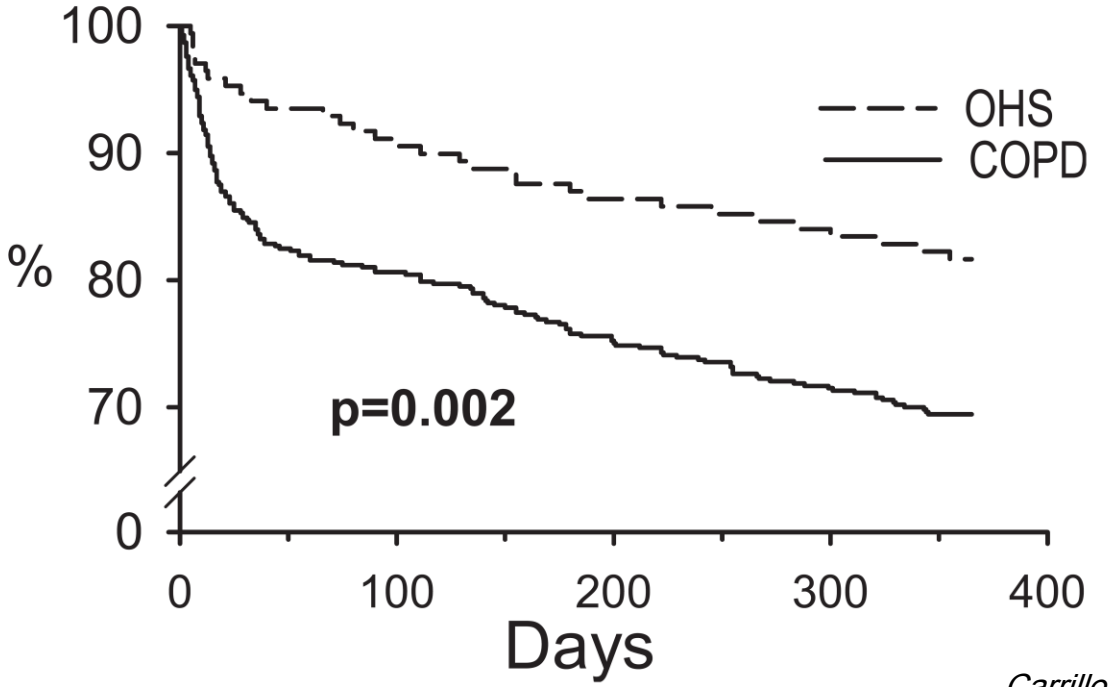


Noninvasive Ventilation in Acute Hypercapnic Respiratory Failure Caused by Obesity Hypoventilation Syndrome and Chronic Obstructive Pulmonary Disease

Andres Carrillo[1], Miquel Ferrer[2,3], Gumersindo Gonzalez-Diaz[1], Antonia Lopez-Martinez[1], Noemi Llamas[1], Maravillas Alcazar[1], Lucia Capilla[1], and Antoni Torres[2,3]

[1]Intensive Care Unit, Hospital JM Morales Meseguer, Murcia, Spain; [2]UVIIR, Servei de Pneumologia, Institut del Tòrax, Hospital Clinic, IDIBAPS, Universitat de Barcelona, Barcelona, Spain; and [3]Centro de Investigación Biomedica En Red-Enfermedades Respiratorias (CibeRes, CB06/06/0028), Instituto de Salud Carlos III, Madrid, Spain

Single center
716 patients
543 COPD & 173 OHS



Better survival in obese patients

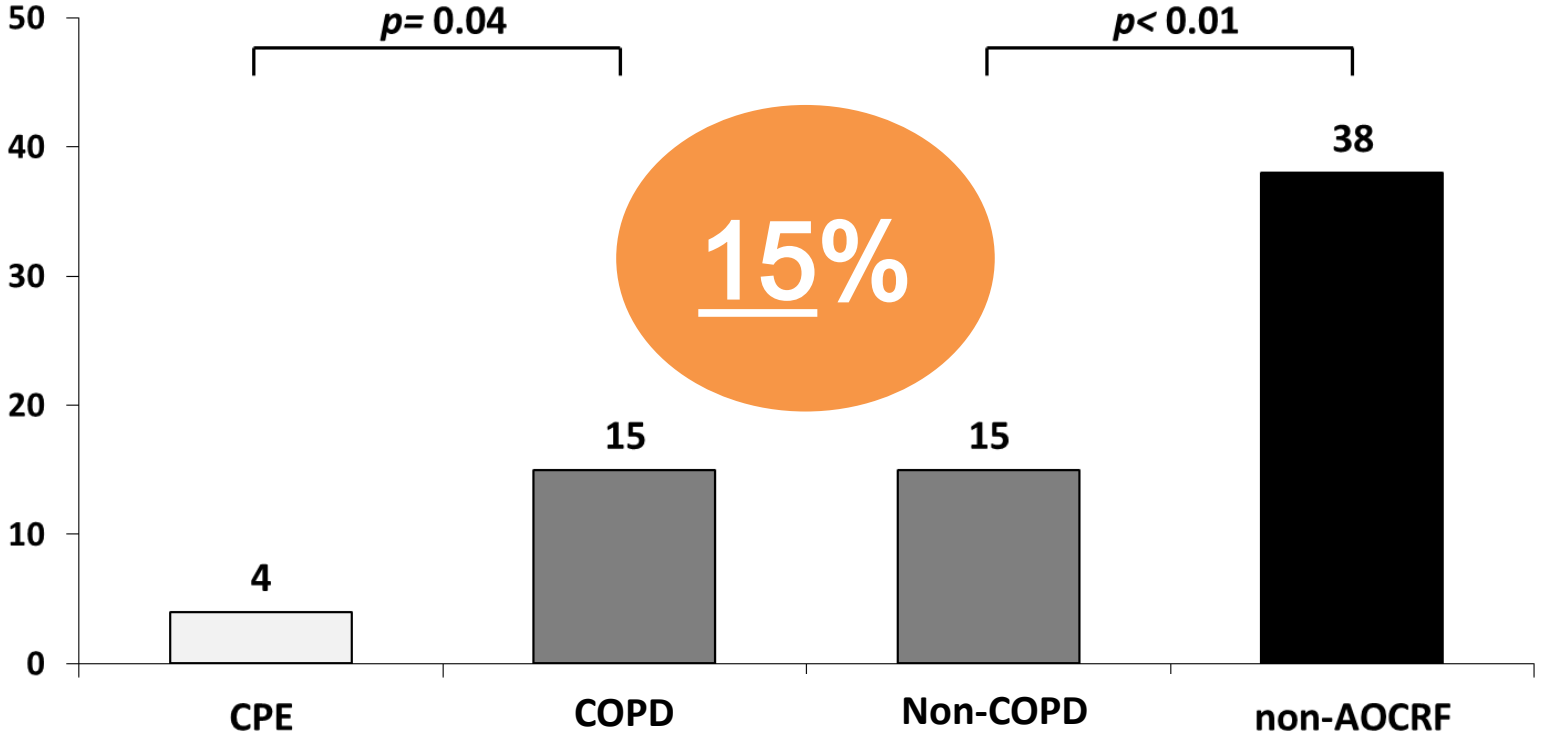
Carrillo A. et al., Am J Respir Crit Care Med 2012, 186:

Noninvasive Ventilation for Acute Hypercapnic Respiratory Failure: Intubation Rate in an Experienced Unit

Damien Contou MD, Chiara Fragnoli MD, Ana Córdoba-Izquierdo MD, Florence Boissier MD, Christian Brun-Buisson MD, and Arnaud W Thille MD PhD

Respiratory Care, 2013; 58:2045-2052

Single center
242 patients



Noninvasive Ventilation for Acute Hypercapnic Respiratory Failure: Intubation Rate in an Experienced Unit

Damien Contou MD, Chiara Fragnoli MD, Ana Córdoba-Izquierdo MD, Florence Boissier MD, Christian Brun-Buisson MD, and Arnaud W Thille MD PhD

Respiratory Care, 2013; 58:2045-2052

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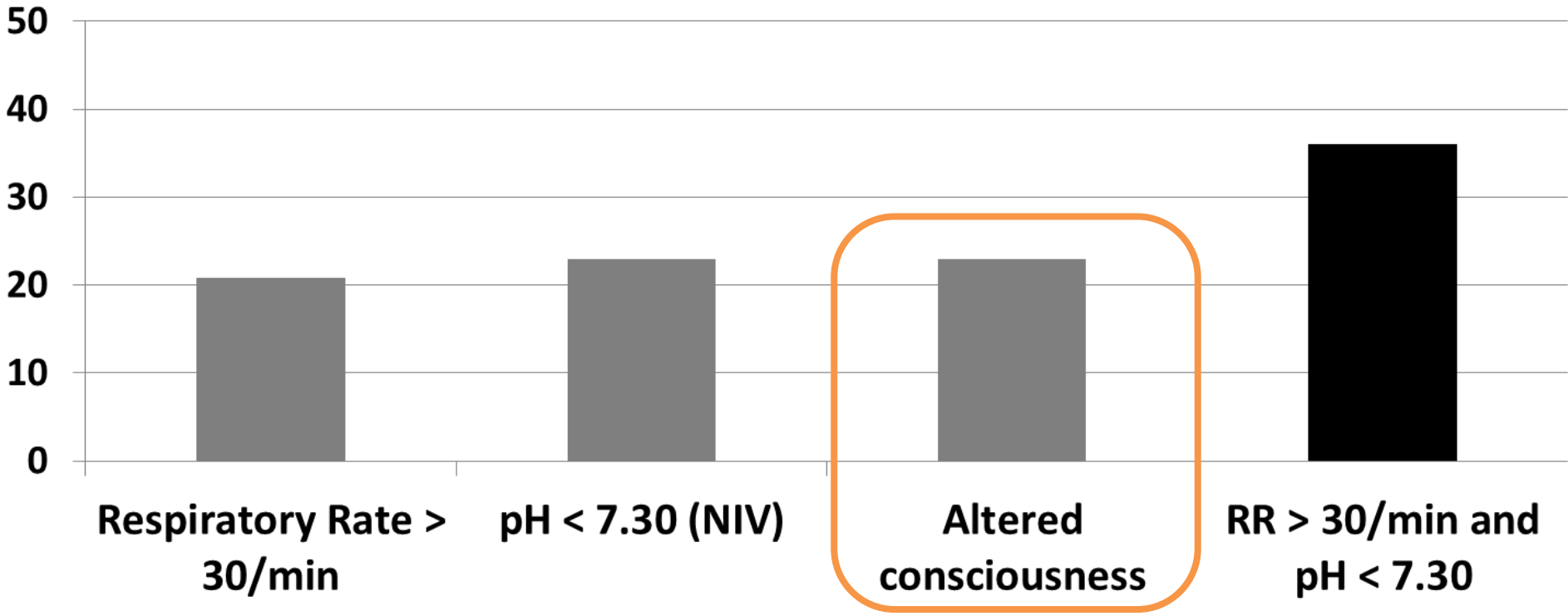
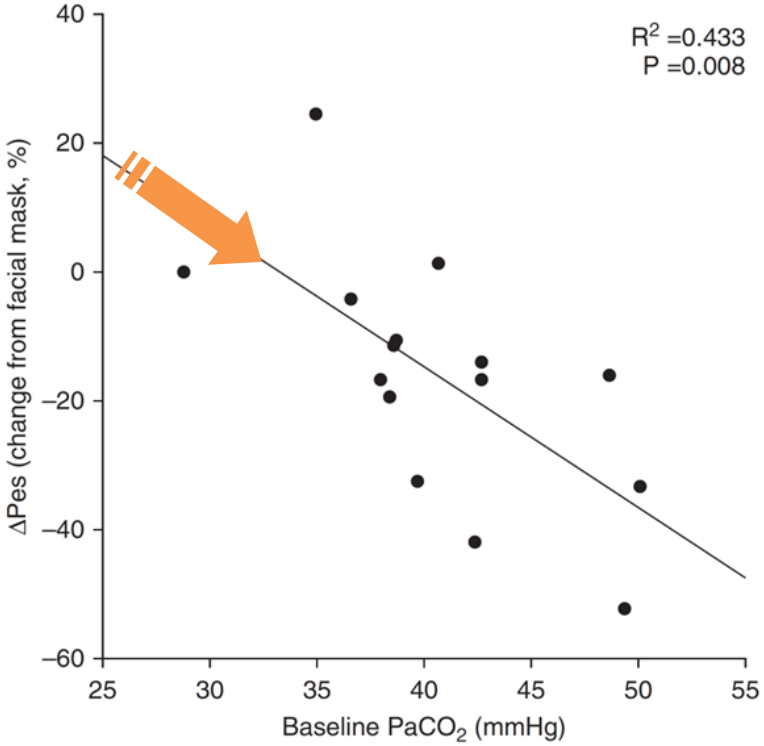


Physiologic Effects of High-Flow Nasal Cannula in Acute Hypoxemic Respiratory Failure

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]

Physiological study,
15 patients with acute hypoxemic respiratory failure



The higher the $PaCO_2$, the greater the reduction in work of breathing

Mauri T. et al., Am J Respir Crit Care Med 2017; 195:1207-

Change in pulmonary mechanics and the effect on breathing pattern of high flow oxygen therapy in stable hypercapnic COPD

Thorax 2017;**51**:373–375.

Lara Pisani*, Luca Fasano#, Nadia Corcione*, Vittoria Comellini*, Muriel Assunta Musti^, Maria Brandao°, Damiano Bottone+, Edoardo Calderini&, Paolo Navalesi§, Stefano Nava*

High-flow nasal oxygen
Decreased patient respiratory effort++

Table 1 Breathing pattern, inspiratory effort and lung mechanics in different settings

	Baseline	HFOT 20 (closed)	HFOT 20 (open)	HFOT 30 (closed)	HFOT 30 (open)	NIV
TI,p (seconds)		0.85±0.4	0.96±0.2		0.92±0.3	
TE,p (seconds)		2.35±0.4*	2.19±0.5*		2.20±0.3*	
Breathing frequency (breaths/min)		19.01±5.2†	20.8±5.8		19.64±2.8	
Tidal volume (mL)		391.22±106‡				
Pdi swing (cmH_2O)	283 cmH_2O	8.7±4.1§	12±5.8	143	10.2±5.2§	102
PTPdi/min (cmH_2Oxs/min)		164.2±51.3**	172.7±45.4**		157.3±56.9**	
PEEPi,dyn (cmH_2O)	xs/min	1.48±0.7‡‡		1.03±0.6‡‡		0.9±0.02‡‡

High-Velocity Nasal Insufflation in the Treatment of Respiratory Failure: A Randomized Clinical Trial

Pratik Doshi, MD*; Jessica S. Whittle, MD; Michael Bublewicz, MD; Joseph Kearney, MD; Terrell Ashe, RRT; Russell Graham, RRT; Suesann Salazar, RRT; Terry W. Ellis, Jr, RRT; Dianna Maynard, RRT; Rose Dennis, RRT; April Tillotson, RRT; Mandy Hill, DrPH; Misha Granado, MPH; Nancy Gordon, MS; Charles Dunlap, RRT; Sheldon Spivey, RRT; Thomas L. Miller, PhD

*Corresponding Author. E-mail: pratik.b.doshi@uth.tmc.edu.

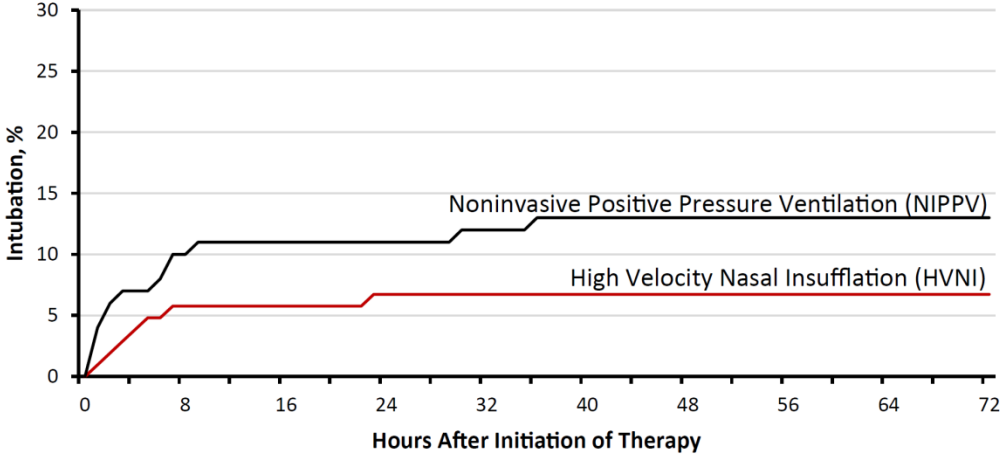


Table 1. Baseline characteristics of the patients, according to study group.

Characteristic	HVNI (N=104)	NIPPV (N=100)
Age (SD), y	63.4 (13.6)	63.3 (14.8)
Body mass index (SD), kg/m^2	31.8 (11.2)	31.2 (11.3)
APACHE II score (SD)*	31.2 (6.3)	30.7 (6.5)
Male sex, No. (%)	44 (42)	46 (46)
Discharge diagnosis, No. (%)		
Asthma	4 (4)	3 (3)
Acute decompensated heart failure	22 (21)	20 (20)
Acute COPD exacerbation	48 %	24 (24)
Acute hypercapnic respiratory failure		7 (7)
Acute hypoxic respiratory failure		13 (13)
Acute hypercapnic and hypoxic respiratory failure		13 (13)
Pneumonia/sepsis	15 (14)	20 (20)
Time to initiation of therapy (SD), min	69.9 (128.3)	76.9 (133.8)
Time to setup of therapy (SD), min	11.1 (7.7)	11.2 (8.8)
Pulse rate (SD), beats/min	100.4 (21.2)	101.0 (21.3)
Respiratory rate (SD), breaths/min	31.3 (8.0)	29.3 (8.2)
SpO_2 (SD), %	93.2 (7.0)	93.5 (8.9)
PCO_2 (SD), mm Hg	53.4 (20.6)	58.7 (25.0)
Arterial pH (SD)	7.35 (0.10)	7.33 (0.08)
Modified Borg score† (SD)	6.3 (3.0)	6.4 (2.6)

Doshi P. et al., Annals of Emergency Medicine 2018;

EUROPEAN RESPIRATORY JOURNAL
ERS OFFICIAL DOCUMENTS
S. OCZKOWSKI ET AL.

ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure

Simon Oczkowski[1,2,26], Begüm Ergan[3,26], Lieuwe Bos[4,5], Michelle Chatwin[6], Miguel Ferrer[7], Cesare Gregoretti[8,9], Leo Heunks[10], Jean-Pierre Frat[11,12], Federico Longhini[13], Stefano Nava[14,15], Paolo Navalesi[16,17], Aylin Ozsancak Uğurlu[18], Lara Pisani[14,15], Teresa Renda[19], Arnaud W. Thille[11,12], João Carlos Winck[20], Wolfram Windisch[21], Thomy Tonia[22], Jeanette Boyd[23], Giovanni Sotgiu[24] and Raffaele Scala[25]

Hypercapnic ARF
Chronic lung disease

HFNC in hypercapnic respiratory failure

PICO question 8: Should HFNC or NIV be used in patients with acute hypercapnic respiratory failure?

Recommendation 8

We suggest a trial of NIV prior to use of HFNC in patients with COPD and acute hypercapnic respiratory failure (conditional recommendation, low certainty of evidence).

Oczkowski S. et al., European Respiratory Journal 2022;

△-Syndrome d'Apnées du Sommeil

LETTER

High prevalence of sleep apnea syndrome in patients admitted to ICU for acute hypercapnic respiratory failure: a preliminary study

Arnaud W. Thille[1,2*], Ana Córdoba-Izquierdo[3], Bernard Maitre[4,5], Laurent Boyer[5,6], Laurent Brochard[7,8] and Xavier Drouot[9,10]

Single center - Patients included: N = 35

Not Studied:

Death within the 3 months following ICU discharge: N = 5

➤ PSG + spirometry at 3 months (N = 16)

Sleep apneas 100%
Severe in 56% (> 30/h)

↗ PEEP 8-10 cm H_2O

Thille AW. et al., Intensive Care Medicine 2018;

EUROPEAN RESPIRATORY JOURNAL
ERS OFFICIAL DOCUMENTS
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ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure

Simon Oczkowski[1,2,26], Begüm Ergan[3,26], Lieuwe Bos[4,5], Michelle Chatwin[6], Miguel Ferrer[7], Cesare Gregoretti[8,9], Leo Heunks[10], Jean-Pierre Frat[11,12], Federico Longhini[13], Stefano Nava[14,15], Paolo Navalesi[16,17], Aylin Ozsancak Uğurlu[18], Lara Pisani[14,15], Teresa Renda[19], Arnaud W. Thille[11,12], João Carlos Winck[20], Wolfram Windisch[21], Thomy Tonia[22], Jeanette Boyd[23], Giovanni Sotgiu[24] and Raffaele Scala[25]

Prophylactic NIV after extubation

PICO question 7: Should HFNC or NIV be used in nonsurgical patients after extubation?

Recommendation 7

We suggest the use of NIV over HFNC after extubation for patients at high risk of extubation failure unless there are relative or absolute contraindications to NIV (conditional recommendation, moderate certainty of evidence).

Oczkowski S. et al., European Respiratory Journal 2022;

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Oxygen With Noninvasive Ventilation vs High-Flow Nasal Oxygen Alone on Reintubation Among Patients at High Risk of Extubation Failure

A Randomized Clinical Trial

Arnaud W. Thille, MD, PhD; Grégoire Muller, MD; Arnaud Gacouin, MD; Rémi Coudroy, MD; Maxens Decavèle, MD; Romain Sonneville, MD, PhD; François Beloncle, MD; Christophe Girault, MD; Laurence Dangers, MD; Alexandre Lautrette, MD, PhD; Séverin Cabasson, MD; Anahita Rouzé, MD; Emmanuel Vivier, MD; Anthony Le Meur, MD; Jean-Damien Ricard, MD, PhD; Keyvan Razazi, MD; Guillaume Barberet, MD; Christine Lebert, MD; Stephan Ehrmann, MD, PhD; Caroline Sabatier, MD; Jeremy Bourenne, MD; Gael Pradel, MD; Pierre Bailly, MD; Nicolas Terzi, MD, PhD; Jean Dellamonica, MD, PhD; Guillaume Lacave, MD; Pierre-Éric Danin, MD; Hodanou Nanadoumgar, MD; Aude Gibelin, MD; Lassane Zanre, MD; Nicolas Deye, MD, PhD; Alexandre Demoule, MD, PhD; Adel Maamar, MD; Mai-Anh Nay, MD; René Robert, MD, PhD; Stéphanie Ragot, PharmD, PhD; Jean-Pierre Frat, MD; for the HIGH-WEAN Study Group and the REVA Research Network

High-Wean study
30 ICUs in France

JAMA Network

QUESTION Among mechanically ventilated patients at high risk of extubation failure, does the use of high-flow nasal oxygen with noninvasive ventilation (NIV), vs high-flow nasal oxygen alone, after extubation reduce the risk of reintubation?

CONCLUSION Compared with high-flow nasal oxygen alone, the use of high-flow nasal oxygen with NIV after extubation significantly decreased the risk of reintubation in patients at high risk of failure to extubate.

POPULATION

425 Men 216 Women

Adults at high risk of failure to extubate, ie, older than 65 years or with an underlying cardiac or respiratory disease

Mean age: 70 years

LOCATIONS

30 ICUs in France

INTERVENTION

648 Patients randomized
641 Patients analyzed

306

High-flow nasal oxygen alone

High-flow nasal oxygen alone for at least 48 hours with a flow of 50 L/min

342

High-flow nasal oxygen with NIV

High-flow nasal oxygen with NIV with a first session ≥4 hours and minimal duration ≥12 hours/day within 48 hours

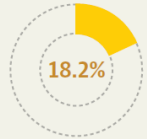
PRIMARY OUTCOME

Proportion of patients reintubated at day 7

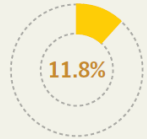
FINDINGS

Reintubation rate at day 7

High-flow nasal oxygen alone
55 of 302 patients



High-flow nasal oxygen with NIV
40 of 339 patients



Between-group difference,
−6.4%
(95% CI, −12.0% to −0.9%)

Thille AW. et al., JAMA 2019; 322: 1465-

The HIGH-WEAN study

650 Patients at high-risk of extubation failure

Age > 65y or with any underlying cardiac or respiratory disease

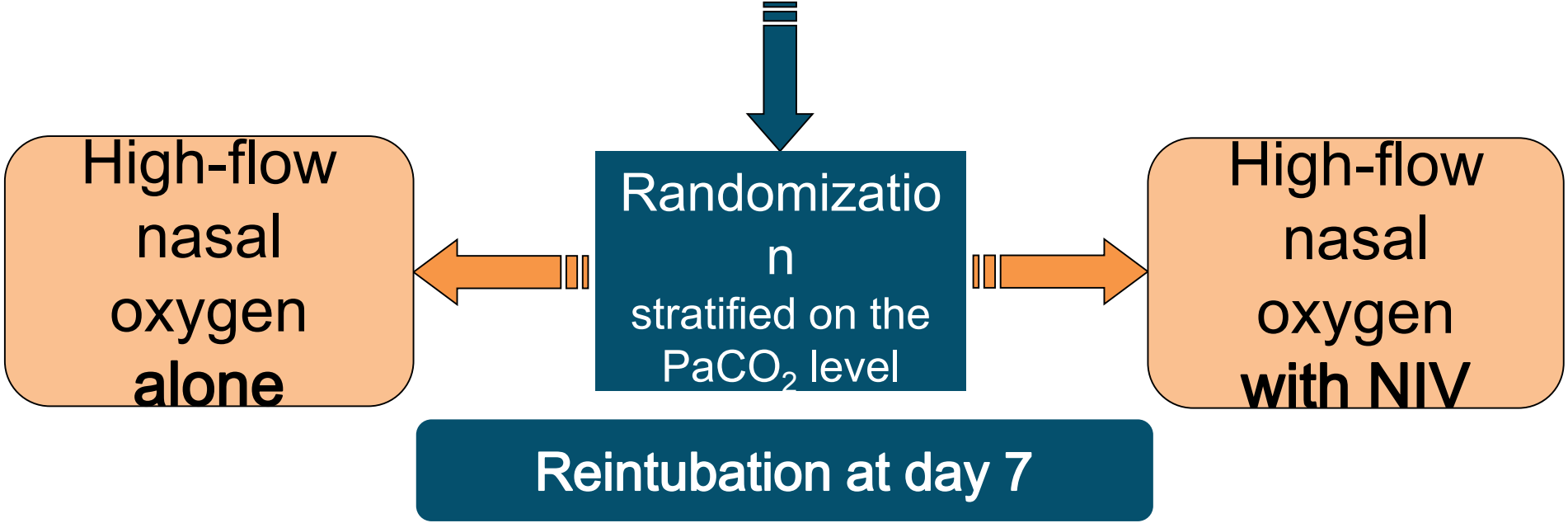
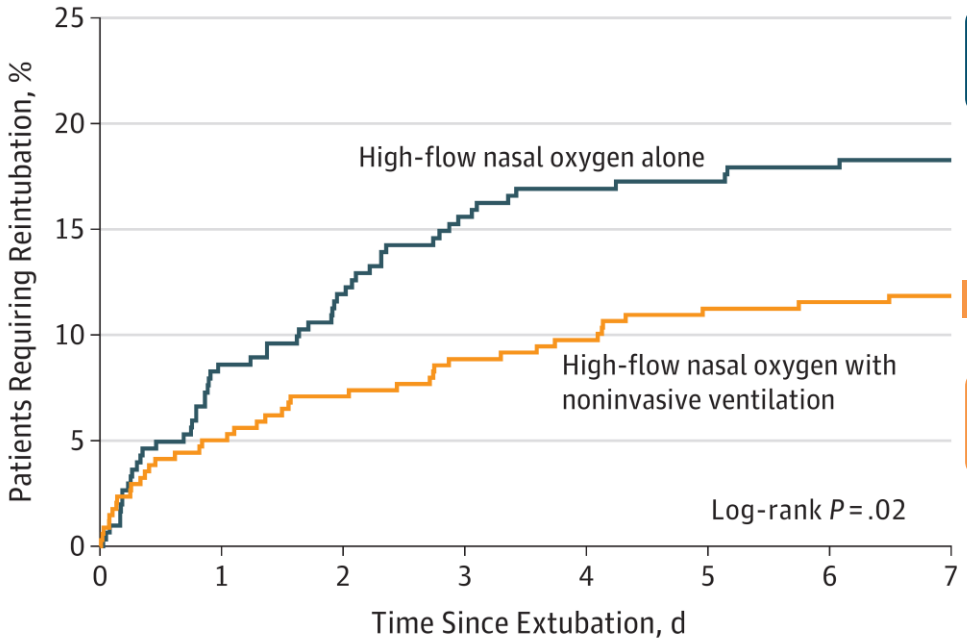


Figure 2. Kaplan-Meier Analysis of Time From Extubation to Reintubation for the Overall Study Population



No. at risk

High-flow nasal oxygen								
Alone	302	276	265	253	248	246	244	243
With noninvasive ventilation	339	321	314	308	305	294	292	291

18.2 %

11.7 %

NIV

- PS 8 ± 2 cm H_2O
- PEEP 5 ± 1 cm H_2O

13 hours in mean within the first 24h

Thille AW. et al., JAMA 2019; 322: 1465-

NIV in patients with obesity?

ORIGINAL ARTICLE

Beneficial Effects of Noninvasive Ventilation after Extubation in Obese or Overweight Patients

A *Post Hoc* Analysis of a Randomized Clinical Trial

Arnaud W. Thille[1,2], Rémi Coudroy[1,2], Mai-Anh Nay[3], Arnaud Gacouin[4], Maxens Decavèle[5], Romain Sonneville[6], François Beloncle[7], Christophe Girault[8], Laurence Dangers[9], Alexandre Lautrette[10], Quentin Levrat[11], Anahita Rouzé[12], Emmanuel Vivier[13], Jean-Baptiste Lascarrou[14], Jean-Damien Ricard[15,16], Armand Mekontso-Dessap[17], Guillaume Barberet[18], Christine Lebert[19], Stephan Ehrmann[20], Alexandre Massri[21], Jeremy Bourenne[22], Gael Pradel[23], Pierre Bailly[24], Nicolas Terzi[25], Jean Dellamonica[26], Guillaume Lacave[27], René Robert[1,2], Jean-Pierre Frat[1,2], and Stéphanie Ragot[2]; for the HIGH-WEAN Study Group and the REVA Research Network

Interaction test

Heterogeneity of treatment effects with NIV on reintubation according to BMI

Normal or underweight: BMI < 25

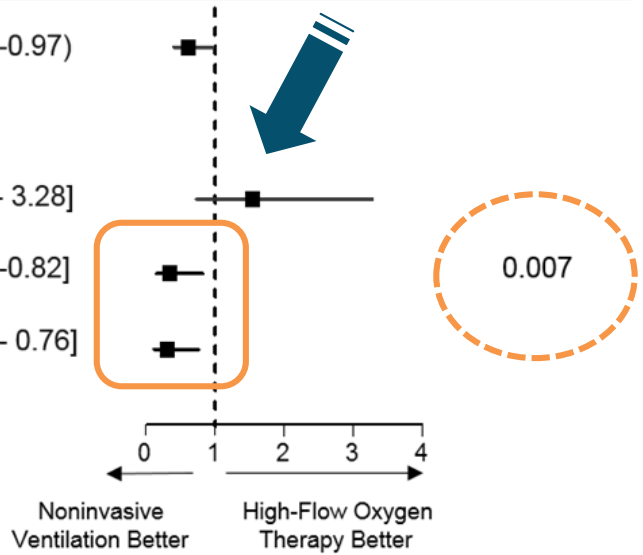
Overweight: 25 ≤ BMI < 30

Obesity: BMI ≥ 30

Thille AW. et al., Am J Respir Crit Care Med 2022;

Normal or underweight BMI < 25 N = 213	Overweight 25 ≤ BMI < 30 N = 204	Obesity BMI ≥ 30 N = 206

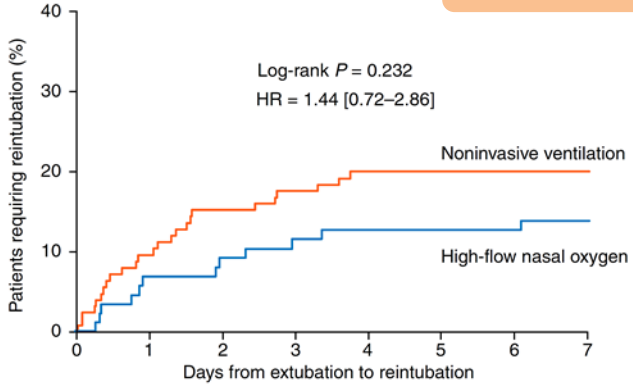
Subgroup	Intubation at day 7 / total number of patients Noninvasive ventilation group	High-Flow Oxygen Therapy group	Odds Ratio (95% CI)	Interaction P Value
All patients	40/330 (12%)	53/293 (18%)	0.62 (0.40-0.97)	
Body mass index				
< 25 kg/m^2	25/126 (20%)	12/87 (14%)	1.55 [0.73- 3.28]	
25 to 29 kg/m2	8/92 (9%)	24/112 (21%)	0.35 [0.15-0.82]	0.007
≥ 30 kg/m2	7/112 (6%)	17/94 (18%)	0.30 [0.12 - 0.76]	



Reintubation rates according to the BMI according to the BMI

Normal or underweight

BMI < 25 kg/m²



20 %

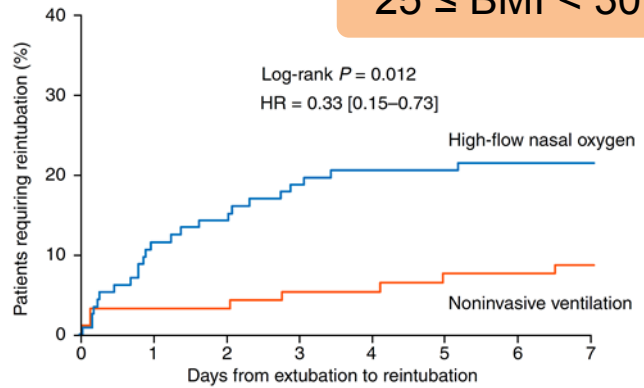
14 %

Number at risk

Noninvasive ventilation	126	113	106	103	100	98	98	98
High-flow nasal oxygen	87	81	79	76	74	74	74	73

Overweight

25 ≤ BMI < 30 kg/m²



21 %

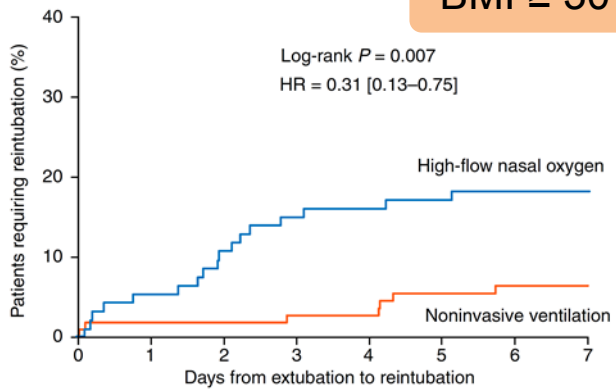
9%

Number at risk

Noninvasive ventilation	92	89	89	87	87	84	82	82
High-flow nasal oxygen	112	99	96	91	89	88	87	87

Obese

BMI ≥ 30 kg/m²



18 %

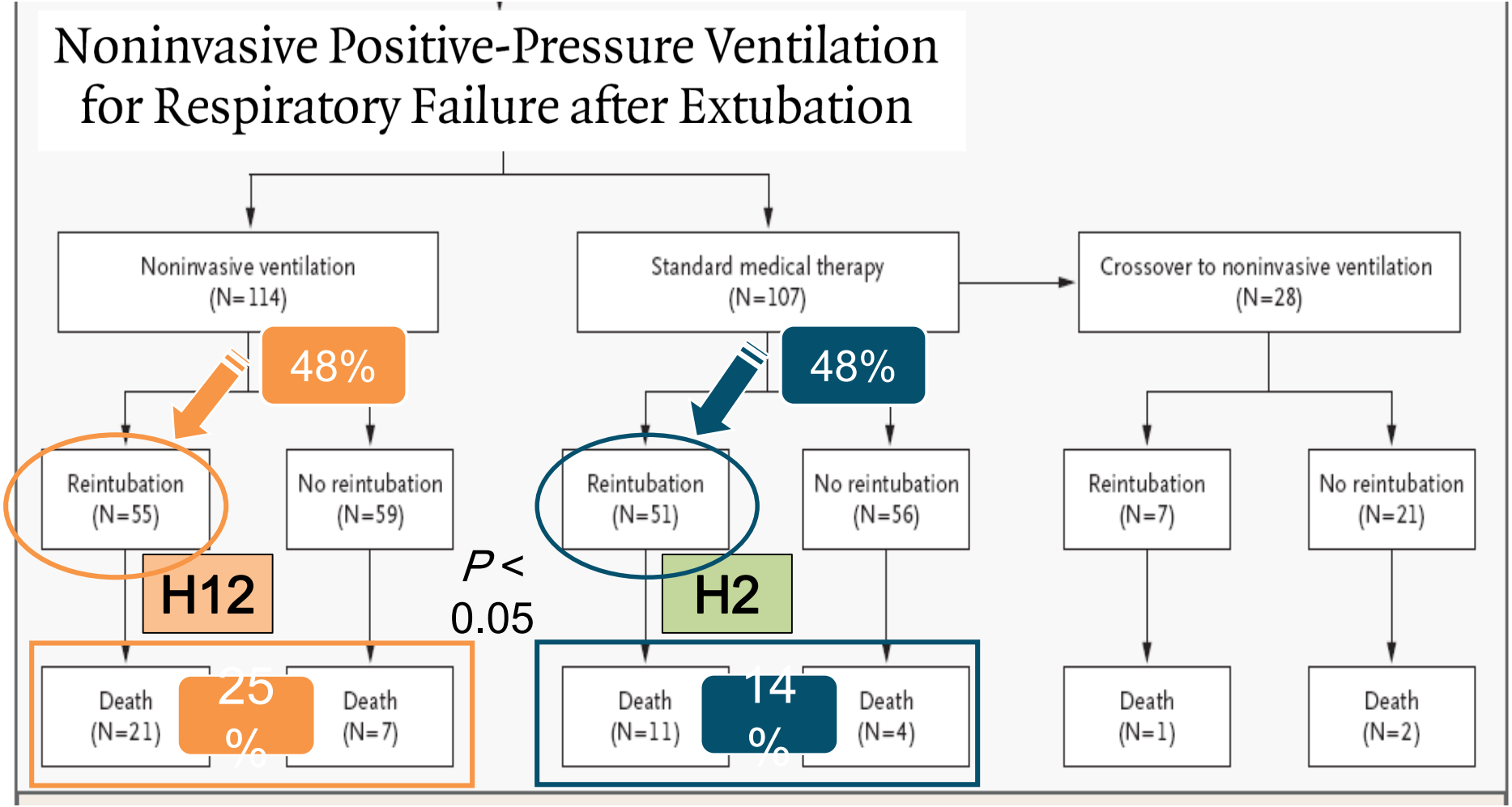
6%

Number at risk

Noninvasive ventilation	112	110	110	109	109	103	102	102
High-flow nasal oxygen	94	89	83	79	78	77	76	76

NIV for postextubation respiratory failure

Noninvasive Positive-Pressure Ventilation for Respiratory Failure after Extubation



Esteban A. et al., New England Journal of Medicine 2004;

Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerg[1], Laurent Brochard[2,3], Mark W. Elliott[4], Dean Hess[5], Nicholas S. Hill[6], Stefano Nava[7] and Paolo Navalesi[8] (members of the steering committee); Massimo Antonelli[9], Jan Brozek[1], Giorgio Conti[9], Miquel Ferrer[10], Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Keenan[13,14], Jordi Mancebo[15], Sangeeta Mehta[16] and Suhail Raoof[17,18] (members of the task force)

NIV for post-extubation respiratory failure

Recommendation

We suggest that NIV should not be used in the treatment of patients with established post-extubation respiratory failure. (Conditional recommendation, low certainty of evidence.)

NIV used as rescue therapy could increase the risk of death by delaying reintubation

High-flow nasal oxygen has never been specifically studied in this setting.

Rochwerg B et al., Eur Respir J 2017;

Thille et al. Crit Care (2021) 25:221
https://doi.org/10.1186/s13054-021-03621-6

Critical Care

High-Wean study

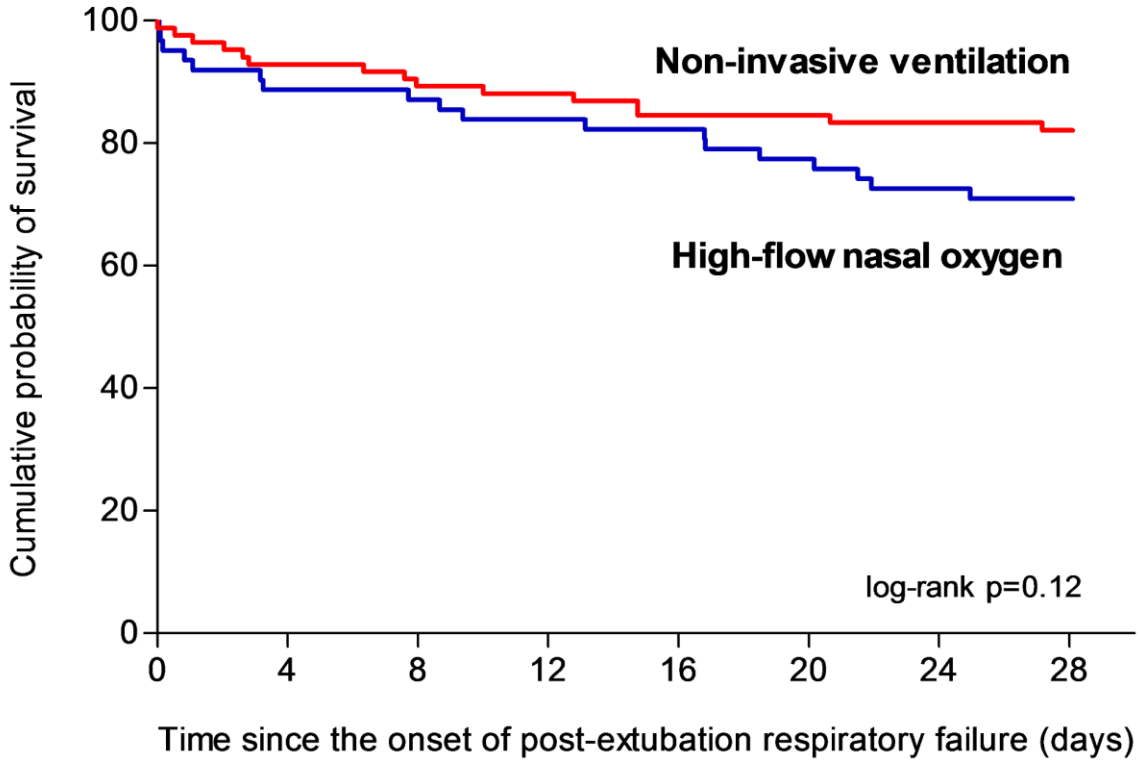
RESEARCH Open Access

Non-invasive ventilation versus high-flow nasal oxygen for postextubation respiratory failure in ICU: a post-hoc analysis of a randomized clinical trial

Arnaud W. Thille[1,2*], Grégoire Monseau[1], Rémi Coudroy[1,2], Mai-Anh Nay[3], Arnaud Gacouin[4], Maxens Decavèle[5], Romain Sonneville[6], François Beloncle[7], Christophe Girault[8], Laurence Dangers[9], Alexandre Lautrette[10], Quentin Levrat[11], Anahita Rouzé[12], Emmanuel Vivier[13], Jean-Baptiste Lascarrou[14], Jean-Damien Ricard[15], Keyvan Razazi[16], Guillaume Barberet[17], Christine Lebert[18], Stephan Ehrmann[19], Alexandre Massri[20], Jeremy Bourenne[21], Gael Pradel[22], Pierre Bailly[23], Nicolas Terzi[24], Jean Dellamonica[25], Guillaume Lacave[26], René Robert[1,2], Stéphanie Ragot[2] and Jean-Pierre Frat[1,2]for the HIGH-WEAN Study Group and the REVA research network

Post-hoc analysis focusing on the 158 patients who experienced respiratory failure within the 7 days following extubation.
Primary outcome: Mortality at day 28

Thille AW. et al., Critical Care 2021; 25:

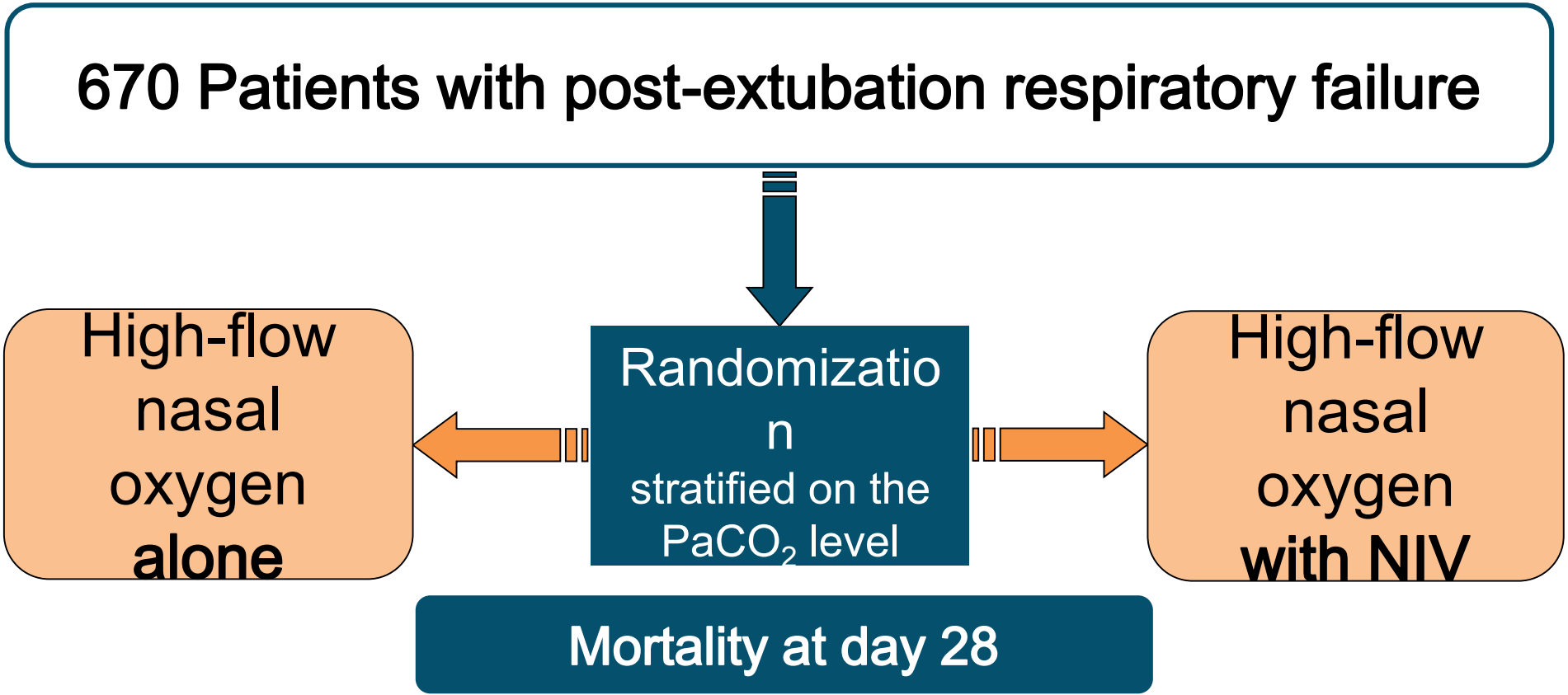


18%

29%

Number at risk								
High flow nasal oxygen	62	55	54	52	51	48	45	44
Non-invasive ventilation	84	78	75	74	71	71	70	69

The Ventilo study: NCT 05686850



Postoperative ≠ Hypoxemic ARF/ARDS

Causes of acute respiratory failure, No. (%)[b]		
Atelectasis[c]	94/143 (65.7)	93/148 (62.8)
Tracheal secretions	54/143 (37.8)	58/148 (39.1)
Pneumonia	36/143 (25.2)	27/148 (18.2)
Pulmonary edema	23/143 (16.1)	21/148 (14.2)
Pleural effusion	19/143 (13.3)	18/148 (12.2)
Pulmonary embolism	11/143 (7.7)	6/148 (4.1)

Extubated < 6h after end of surgery: 63% (184/293)

Jaber S. et al., JAMA 2016; 315:1345-

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

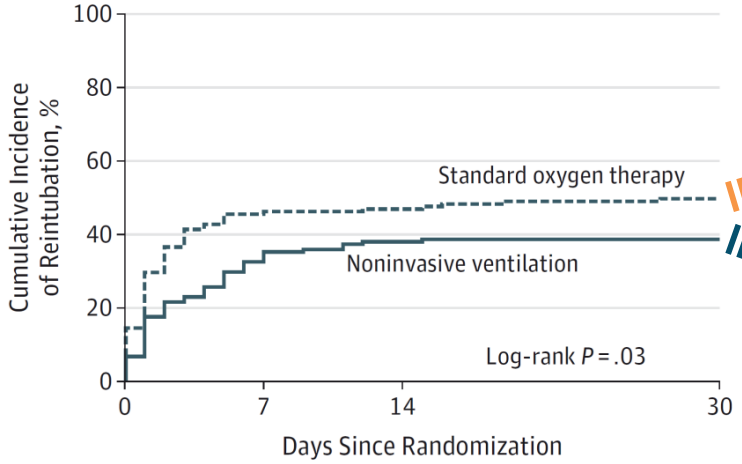
Effect of Noninvasive Ventilation on Tracheal Reintubation Among Patients With Hypoxemic Respiratory Failure Following Abdominal Surgery

A Randomized Clinical Trial

Samir Jaber, MD, PhD; Thomas Lescot, MD, PhD; Emmanuel Futier, MD, PhD; Catherine Paugam-Burtz, MD, PhD; Philippe Seguin, MD, PhD; Martine Ferrandiere, MD; Sigismond Lasocki, MD, PhD; Olivier Mimoz, MD, PhD; Baptiste Hengy, MD; Antoine Sannini, MD; Julien Pottecher, MD; Paër-Sélim Abback, MD; Beatrice Riu, MD; Fouad Belafia, MD; Jean-Michel Constantin, MD, PhD; Elodie Masseret, MD; Marc Beaussier, MD, PhD; Daniel Verzilli, MD; Audrey De Jong, MD; Gerald Chanques, MD, PhD; Laurent Brochard, MD, PhD; Nicolas Molinari, PhD; for the NIVAS Study Group

20 ICUs
293 patients
NIV (n=148) vs. O_2 (n=145)
Abdominal surgery

Figure 2. Cumulative Incidence of Reintubation Between Randomization and Day 30 According to Study Group



No. at risk

Standard oxygen therapy	145	79	76	71
Noninvasive ventilation	148	99	90	87

O_2 50%

VNI 39%

Jaber S. et al., JAMA 2016; 315:1345-

Good indications for VNI

1. Acute hypercapnic respiratory failure

2. Postoperative respiratory failure

3. After extubation in patients at high risk of extubation failure