

# High flow oxygen therapy bibliography

This bibliography is a literature reference for users and represents selected relevant publications, without any claim to completeness.

## Table of Contents

1	Effects of High-Flow Nasal Cannula on the Work of Breathing in Patients Recovering from Acute Respiratory Failure .....	4
2	High-Flow Nasal Cannula Therapy Versus Intermittent Noninvasive Ventilation in Obese Subjects after Cardiothoracic Surgery .....	5
3	Effect of non-invasive oxygenation strategies in immunocompromised patients with severe acute respiratory failure: a post-hoc analysis of a randomised trial .....	6
4	High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in hypoxemic patients after cardiothoracic surgery: A Randomized Clinical Trial .....	7
5	High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure .....	8
6	The effect of high-flow nasal oxygen on hospital length of stay in cardiac surgical patients at high risk for respiratory complications: a randomised controlled trial .....	9
7	Effect of High-Flow Nasal Oxygen vs Standard Oxygen on 28-Day Mortality in Immunocompromised Patients with Acute Respiratory Failure: The HIGH Randomized Clinical Trial .....	9
8	Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients: A Randomized Clinical Trial .....	10
9	Effect of postextubation high-flow nasal cannula vs. conventional oxygen therapy on reintubation in low-risk patients: a randomized clinical trial .....	11
10	Use of high-flow nasal cannula oxygen therapy to prevent desaturation during tracheal intubation of intensive care patients with mild-to-moderate hypoxemia .....	12
11	Nasal high-flow versus Venturi mask oxygen therapy after extubation. Effects on oxygenation, comfort, and clinical outcome. ....	13
12	High-flow nasal cannula oxygen therapy versus noninvasive ventilation in immunocompromised patients with acute respiratory failure: an observational cohort study .....	14
13	Effect of Very-High-Flow Nasal Therapy on Airway Pressure and End-Expiratory Lung Impedance in Healthy Volunteers .....	15
14	Efficacy of high-flow nasal cannula therapy in acute hypoxemic respiratory failure: decreased use of mechanical ventilation .....	16
15	Pressures delivered by nasal high flow oxygen during all phases of the respiratory cycle .....	17
16	Evaluation of a humidified nasal high-flow oxygen system, using oxygraphy, capnography and measurement of upper airway pressures .....	18
17	High-flow nasal cannula oxygen therapy decreases postextubation neuroventilatory drive and work of breathing in patients with chronic obstructive pulmonary disease .....	19
18	A randomised controlled trial comparing high-flow nasal oxygen with standard management for conscious sedation during bronchoscopy .....	19

19	Hypoxemic Patients With Bilateral Infiltrates Treated With High-Flow Nasal Cannula Present a Similar Pattern of Biomarkers of Inflammation and Injury to Acute Respiratory Distress Syndrome Patients .....	20
20	Physiologic Effects of High-Flow Nasal Cannula in Acute Hypoxemic Respiratory Failure .....	20
21	High-Flow Nasal Cannula Oxygenation in Immunocompromised Patients with Acute Hypoxemic Respiratory Failure: A Groupe de Recherche Respiratoire en Réanimation Onco-Hématologique Study.....	21
22	Predicting success of high-flow nasal cannula in pneumonia patients with hypoxemic respiratory failure: The utility of the ROX index .....	21
23	Physiologic Effects of High-Flow Nasal Cannula Oxygen in Critical Care Subjects.....	22
24	Comparison of the effectiveness of high flow nasal oxygen cannula vs. standard non-rebreather oxygen face mask in post-extubation intensive care unit patients.....	22
25	Effect of high-flow nasal cannula on thoraco-abdominal synchrony in adult critically ill patients .....	23
26	Effect of high-flow nasal cannula and body position on end-expiratory lung volume: a cohort study using electrical impedance tomography.....	23
27	High-flow nasal cannula therapy in do-not-intubate patients with hypoxemic respiratory distress... ..	24
28	Humidified high flow nasal oxygen during respiratory failure in the emergency department: feasibility and efficacy .....	24
29	Impact of high-flow nasal cannula oxygen therapy on intensive care unit patients with acute respiratory failure: a prospective observational study .....	25
30	Oxygen delivery through high-flow nasal cannulae increased end-expiratory lung volume and reduce respiratory rate in post cardiac surgical patients .....	26
31	Beneficial effects of humidified high flow nasal oxygen in critical care patients: a prospective pilot study .....	27
32	A preliminary randomized controlled trial to assess effectiveness of nasal high-flow oxygen in intensive care patients .....	27
33	High-flow nasal oxygen vs high-flow face mask: a randomized crossover trial in extubated patients .....	28
34	High-flow nasal cannula oxygen during endotracheal intubation in hypoxemic patients: a randomized controlled clinical trial .....	29
35	High-flow nasal cannula versus conventional oxygen therapy after endotracheal extubation: a randomized crossover physiological study .....	30
36	Nasal high-flow oxygen therapy in ICU: A before-and-after study.....	31
37	The effects of a 2-h trial of high-flow oxygen by nasal cannula versus Venturi mask in immunocompromised patients with hypoxemic acute respiratory failure: a multicenter randomized trial.....	32

38	High-Flow Nasal Cannula in a Mixed Adult ICU .....	33
39	Failure of high-flow nasal cannula therapy may delay intubation and increase mortality .....	33
40	Nasal high-flow oxygen therapy in patients with hypoxic respiratory failure: effect on functional and subjective respiratory parameters compared to conventional oxygen therapy and non-invasive ventilation (NIV) .....	34
41	Open-label, phase II study of routine high-flow nasal oxygen therapy in cardiac surgical patients .	35
42	Patients with New York Heart Association class III heart failure may benefit with high flow nasal cannula supportive therapy: high flow nasal cannula in heart failure .....	36
43	The effects of flow on airway pressure during nasal high-flow oxygen therapy .....	36
44	High-flow oxygen therapy in acute respiratory failure .....	37
	Additional files .....	38
45	Effect of high-flow nasal cannula oxygen therapy compared with conventional oxygen therapy in postoperative patients: a systematic review and meta-analysis .....	38
46	Comparison of high-flow nasal oxygen therapy with conventional oxygen therapy and noninvasive ventilation in adult patients with acute hypoxemic respiratory failure: A meta-analysis and systematic review .....	38
47	High-Flow Nasal Cannula Oxygen Therapy in Adults: Physiological Benefits, Indication, Clinical Benefits, and Adverse Effects .....	39
48	Current evidence for the effectiveness of heated and humidified high flow nasal cannula supportive therapy in adult patients with respiratory failure .....	39
49	Use of high-flow nasal cannula oxygenation in ICU adults: a narrative review .....	39
50	Effect of high-flow nasal cannula oxygen therapy vs conventional oxygen therapy on adult post-cardiothoracic operation: A meta-analysis .....	40
51	High-Flow Nasal Cannula Oxygen in Adults: An Evidence-based Assessment .....	40
52	High-flow oxygen administration by nasal cannula for adult and perinatal patients .....	40
53	High-flow nasal interface improves oxygenation in patients undergoing bronchoscopy .....	41
54	Discomfort associated with underhumidified high-flow oxygen therapy in critically ill patients .....	41
55	Use of High-Flow Nasal Cannula for Acute Dyspnea and Hypoxemia in the Emergency Department .....	42

# Effects of High-Flow Nasal Cannula on the Work of Breathing in Patients Recovering from Acute Respiratory Failure

Delorme M, Bouchard PA, Simon M, Simard S, Lellouche F

Crit Care Med. 2017 Dec;45(12):1981-1988

PMID 28857852, <http://www.ncbi.nlm.nih.gov/pubmed/28857852>

<b>Design</b>	Randomized controlled crossover study: conventional oxygen therapy and HFNC at 20, 40, and 60 l/min
<b>Patients</b>	12 patients with moderate respiratory distress
<b>Objectives</b>	Assess the effects of HFNC on indexes of respiratory effort
<b>Main Results</b>	Esophageal pressure variations, esophageal pressure-time product/min, and work of breathing decreased from baseline (conventional oxygen therapy) up to 60 l/min, lung compliance increased, and inspiratory resistance decreased from baseline up to 60 l/min.
<b>Conclusion</b>	HFNC set at 60 l/min reduced the indexes of respiratory effort in patients recovering from acute respiratory failure. This effect is associated with an improvement in respiratory mechanics

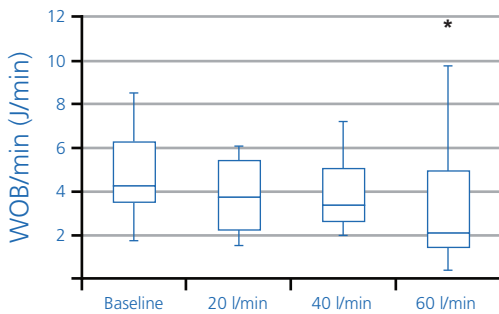


Figure 1: HFNC set at 60 l/min decreased WOB in comparison to standard oxygen

# High-Flow Nasal Cannula Therapy Versus Intermittent Noninvasive Ventilation in Obese Subjects after Cardiothoracic Surgery

Stéphan F, Bérard L, Rézaiguia-Delclaux S, Amaru P; for the BiPOP Study Group

Respir Care. 2017 Sep;62(9):1193-1202

PMID 28807988, <http://www.ncbi.nlm.nih.gov/pubmed/28807988>

<b>Design</b>	Post-hoc analysis of a randomized, controlled trial
<b>Patients</b>	136 patients with NIV and 135 patients with HFNC
<b>Objectives</b>	Compare NIV and HFNC for preventing or resolving acute respiratory failure after cardiothoracic surgery in obese patients
<b>Main Results</b>	No differences were found for treatment failure (re-intubation, switch to the other treatment, or premature discontinuation), dyspnea and comfort scores. Skin breakdown was more common with NIV after 24 h. No differences for ICU mortality.
<b>Conclusion</b>	Among obese cardiothoracic surgery subjects, the use of HFNC compared to NIV did not result in a worse rate of treatment failure. As HFNC presents some advantages, it may be used instead of NIV in these patients

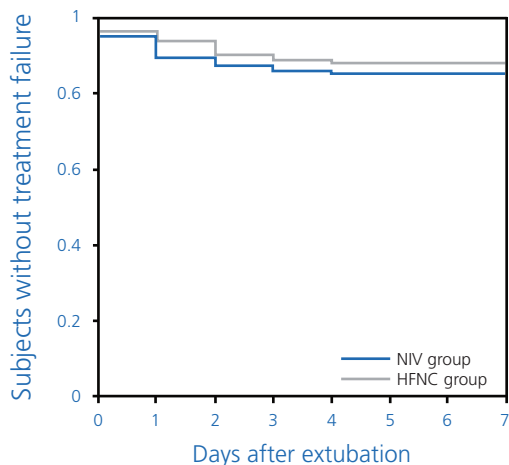


Figure 2: HFNC did not increase the number of treatment failures in comparison to NIV

# Effect of non-invasive oxygenation strategies in immunocompromised patients with severe acute respiratory failure: a post-hoc analysis of a randomised trial

Frat JP, Ragot S, Girault C, Perbet S, Prat G, Boulain T, Demoule A, Ricard JD, Coudroy R, Robert R, Mercat A, Brochard L, Thille AW; REVA network

Lancet Respir Med. 2016 Aug;4(8):646-652

PMID 27245914, <http://www.ncbi.nlm.nih.gov/pubmed/27245914>

<b>Design</b>	Post-hoc subgroup analysis from a multicentre, randomised, controlled trial
<b>Patients</b>	Subset of 82 immunocompromised patients with non-hypercapnic acute respiratory failure
<b>Objectives</b>	Compare the proportion of patients who required endotracheal intubation within 28 days after randomisation
<b>Main Results</b>	30 patients were treated with standard oxygen, 26 with HFNC alone, and 26 with NIV plus interspaced HFNC. 31% of the patients were treated with HFNC alone, 43% with standard oxygen, and 65% with NIV required intubation at 28 days ( $p = 0.04$ ). Odds ratios (ORs) for intubation were higher in patients treated with non-invasive ventilation than in those treated with high flow nasal cannula: OR 4.25 (95% confidence interval 1.33-13.56). ORs were not significantly different between patients treated with high flow nasal cannula alone and standard oxygen: OR 1.72 (0.57-5.18). After multivariable logistic regression, the two factors independently associated with endotracheal intubation and mortality were age and use of non-invasive ventilation as first-line therapy.
<b>Conclusion</b>	Non-invasive ventilation might be associated with an increased risk of intubation and mortality and should be used cautiously in immunocompromised patients with acute hypoxaemic respiratory failure.

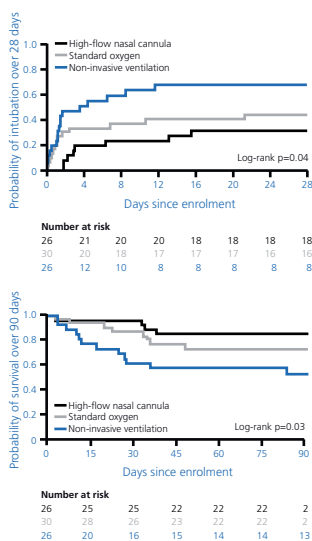


Figure 3: NIV increased intubation rate and decreased survival rate compared with HFNC

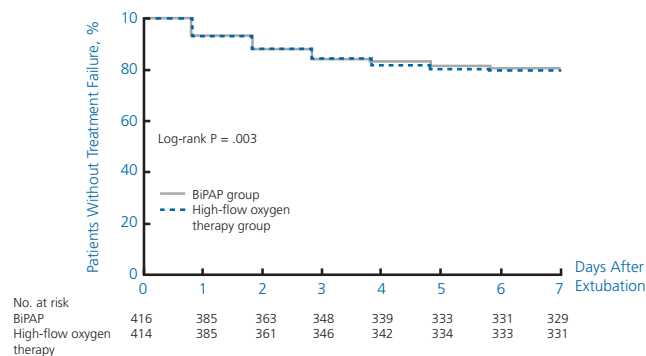
# High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in hypoxemic patients after cardiothoracic surgery: A Randomized Clinical Trial

Stéphan F, Barrucand B, Petit P, Rézaiguia-Delclaux S, Médard A, Delannoy B, Cosserant B, Flicoteaux G, Imbert A, Pilorge C, Bérard L; BiPOP Study Group.

JAMA. 2015 Jun 16;313(23):2331-9.

PMID 25980660, <http://www.ncbi.nlm.nih.gov/pubmed/25980660>

<b>Design</b>	Multicenter, randomized, noninferiority trial comparing high-flow oxygen (flow = 50 l/min) and NIV (PS = 8 cmH <sub>2</sub> O; PEEP = 4 cmH <sub>2</sub> O)
<b>Patients</b>	830 patients after cardiothoracic surgery
<b>Objectives</b>	Compare the treatment failure, defined as reintubation, switch to the other study treatment, or premature treatment discontinuation between groups
<b>Main Results</b>	The treatment failed in 87 of 414 patients with high-flow oxygen (21.0%) and 91 of 416 patients with NIV (21.9%). No significant differences were found for intensive care unit mortality (23 patients with NIV [5.5%] and 28 with high-flow oxygen [6.8%]; p = 0.66). Skin breakdown was significantly more common with NIV.
<b>Conclusion</b>	High-flow oxygen was not inferior to NIV in cardiothoracic surgery patients
<b>Comment</b>	Noninferiority study



## High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure

Frat JP, Thille AW, Mercat A, Girault C, Ragot S, Perbet S, Prat G, Boulain T, Morawiec E, Cottureau A, Devaquet J, Nseir S, Razazi K, Mira JP, Argaud L, Chakarian JC, Ricard JD, Wittebole X, Chevalier S, Herbland A, Fartoukh M, Constantin JM, Tonnelier JM, Pierrot M, Mathonnet A, Béduneau G, Delétage-Métreau C, Richard JC, Brochard L, Robert R; FLORALI Study Group; REVA Network.

N Engl J Med. 2015 Jun 4;372(23):2185-96.

PMID 25981908, <http://www.ncbi.nlm.nih.gov/pubmed/25981908>

**Design** Randomized controlled trial : high-flow oxygen therapy, standard oxygen therapy delivered through a face mask, or noninvasive positive-pressure ventilation

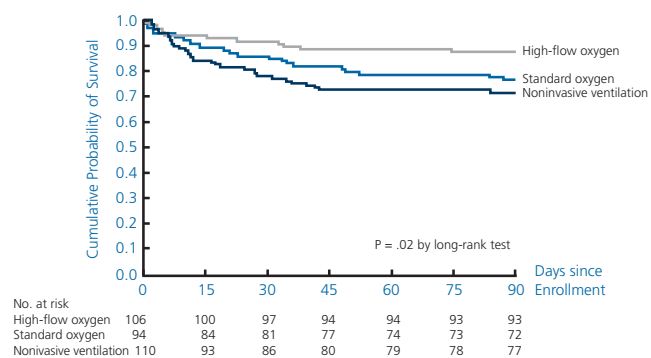
**Patients** 310 patients with acute hypoxemic respiratory failure without hypercapnia

**Objectives** Compare outcomes (intubation, ventilator-free days, and mortality) between group

**Main Results** The intubation rate was 38% in the high-flow-oxygen group, 47% in the standard group, and 50% in the noninvasive-ventilation group ( $p = 0.18$  for all comparisons). In the subgroup of patients with a  $\text{PaO}_2:\text{FiO}_2$  of 200 mmHg or less, the intubation rate was significantly lower in the high flow oxygen group than in the other two groups. The number of ventilator-free days at day 28 was significantly higher in the high-flow-oxygen group ( $24 \pm 8$  days, vs.  $22 \pm 10$  in the standard-oxygen group and  $19 \pm 12$  in the noninvasive-ventilation group;  $p = 0.02$  for all comparisons). The hazard ratio for death at 90 days was 2.01 (95% CI, 1.01 to 3.99) with standard oxygen versus high flow oxygen ( $p = 0.046$ ) and 2.50 (95% CI, 1.31 to 4.78) with noninvasive ventilation versus high flow oxygen ( $p = 0.006$ ).

**Conclusion** Treatment with high flow oxygen decreased intubation rates in the most severe patients. There was a significant difference in favor of high flow oxygen in 90-day mortality.

**Comment** This study shows more intubation and mortality in the group treated by NIV. The hypothesis is that NIV could induce lung injuries by applying high tidal volumes.





## The effect of high-flow nasal oxygen on hospital length of stay in cardiac surgical patients at high risk for respiratory complications: a randomised controlled trial

Zochios V, Collier T, Blaudszun G, Butchart A, Earwaker M, Jones N, Klein AA

Anaesthesia. 2018 Dec;73(12):1478-1488

PMID 30019747, <http://www.ncbi.nlm.nih.gov/pubmed/30019747>

<b>Design</b>	Randomized controlled trial
<b>Patients</b>	100 adult patients with pre-existing respiratory disease undergoing elective cardiac surgery
<b>Objectives</b>	Compare HFNC and standard oxygen therapy after cardiac surgery
<b>Main Results</b>	The hospital length of stay was 7 (6-9) d in the HFNC group and 9 (7-16) d in the standard oxygen group (p=0.012). HFNC was associated with fewer intensive care unit re-admissions (1/49 vs. 7/45; p = 0.026).
<b>Conclusion</b>	After cardiac surgery, HFNC reduced the length of stay

## Effect of High-Flow Nasal Oxygen vs Standard Oxygen on 28-Day Mortality in Immunocompromised Patients with Acute Respiratory Failure: The HIGH Randomized Clinical Trial

Azoulay E, Lemiale V, Mokart D, Nseir S, Argaud L, Pène F, Kontar L, Bruneel F, Klouche K, Barbier F, Reignier J, Berrahil-Meksen L, Louis G, Constantin JM, Mayaux J, Wallet F, Kouatchet A, Peigne V, Théodose I, Perez P, Girault C, Jaber S, Oziel J, Nyunga M, Terzi N, Bouadma L, Lebert C, Lautrette A, Bigé N, Raphaelen JH, Papazian L, Darmon M, Chevret S, Demoule A

JAMA. 2018 Nov 27;320(20):2099-2107

PMID 30357270, <http://www.ncbi.nlm.nih.gov/pubmed/30357270>

<b>Design</b>	Multicenter randomized controlled trial
<b>Patients</b>	776 adult immunocompromised patients with acute hypoxemic respiratory failure (AHRF)
<b>Objectives</b>	Determine whether HFNC decreases mortality among immunocompromised patients with AHRF in comparison to standard oxygen therapy
<b>Main Results</b>	Mortality on day 28 was not different between groups (35.6% vs 36.1%; p = 0.94). The intubation rate was not significantly different between groups (38.7% vs 43.8%). There was no difference in ICU length of stay (8 vs 6 d), ICU-acquired infections (10.0% vs 10.6%), hospital length of stay (24 vs 27 d) or patient comfort and dyspnea scores.
<b>Conclusion</b>	HFNC did not change outcomes in immunocompromised patients in comparison to standard oxygen

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

Hernández G, Vaquero C, Colinas L, Cuenca R, González P, Canabal A, Sanchez S, Rodriguez ML, Vilasclaras A, Fernández R

JAMA. 2016 Oct 18;316(15):1565-1574

PMID 27706464, <http://www.ncbi.nlm.nih.gov/pubmed/27706464>

<b>Design</b>	Multicenter randomized controlled trial
<b>Patients</b>	604 patients with at least one of the following high-risk factors for reintubation: > 65 years; APACHE II > 12 points on extubation day, BMI > 30; inadequate secretions management; difficult or prolonged weaning; more than 1 comorbidity; heart failure as the primary indication for mechanical ventilation; moderate to severe COPD; airway patency problems; or prolonged mechanical ventilation. 314 patients received NIV and 290 HFNC
<b>Objectives</b>	Test if high-flow conditioned oxygen therapy is noninferior to NIV for preventing postextubation respiratory failure and reintubation
<b>Main Results</b>	There was no difference regarding the reintubation rate or median time to reintubation. Median postrandomization ICU length of stay was lower in the high-flow group. Adverse effects requiring withdrawal of the therapy were observed in none of patients in the high-flow group vs 42.9% patients in the NIV group ( $P < .001$ ).
<b>Conclusion</b>	Among high-risk patients, HFNC was not inferior to NIV for preventing reintubation and postextubation respiratory failure
<b>Comment</b>	Noninferiority study

## Effect of postextubation high-flow nasal cannula vs. conventional oxygen therapy on reintubation in low-risk patients: a randomized clinical trial

Hernández G, Vaquero C, González P, Subira C, Frutos-Vivar F, Rialp G, Laborda C, Colinas L, Cuenca R, Fernández R

JAMA. 2016 Apr 5;315(13):1354-61

PMID 26975498, <http://www.ncbi.nlm.nih.gov/pubmed/26975498>

<b>Design</b>	Multicenter randomized clinical trial
<b>Patients</b>	527 patients at low risk for reintubation fulfilling extubation criteria
<b>Objectives</b>	Determine whether high-flow nasal cannula oxygen therapy is superior to conventional oxygen therapy for preventing reintubation
<b>Main Results</b>	Reintubation rate within 72 hours was lower in the high flow group compared with the conventional oxygen group (13 patients [4.9%] vs 32 [12.2%]; $p = 0.004$ ). Postextubation respiratory failure was lower in the high flow group compared with the conventional oxygen group (22/264 patients [8.3%] vs 38/263 [14.4%]; $p = 0.03$ ). Time to reintubation was not significantly different between the high flow group (19 h [12-28] vs 15 h [9-31] in the conventional oxygen group; $p = 0.66$ ).
<b>Conclusion</b>	The use of HFNC oxygen reduced the risk of reintubation in low risk of reintubation patients

## Use of high-flow nasal cannula oxygen therapy to prevent desaturation during tracheal intubation of intensive care patients with mild-to-moderate hypoxemia

Miguel-Montanes R, Hajage D, Messika J, Bertrand F, Gaudry S, Rafat C, Labbé V, Dufour N, Jean-Baptiste S, Bedet A, Dreyfuss D, Ricard JD.

Crit Care Med. 2015 Mar;43(3):574-83.

PMID 25479117, <http://www.ncbi.nlm.nih.gov/pubmed/25479117>

<b>Design</b>	Prospective before/after study
<b>Patients</b>	101 ICU patients requiring tracheal intubation
<b>Objectives</b>	Compare pre- and per-procedure oxygenation with either a standard oxygen therapy or a high-flow nasal cannula oxygen (HFNC)
<b>Main Results</b>	Median lowest SpO <sub>2</sub> during intubation were 94% (83-98.5) with the standard oxygen therapy versus 100% (95-100) with HFNC oxygen ( $p < 0.0001$ ). SpO <sub>2</sub> values at the end of preoxygenation were higher with HFNC oxygen. There were more episodes of severe hypoxemia in the standard oxygen therapy group (2% vs 14%, $p = 0.03$ ).
<b>Conclusion</b>	HFNC oxygen improved patient safety during intubation

## Nasal high-flow versus Venturi mask oxygen therapy after extubation. Effects on oxygenation, comfort, and clinical outcome.

Maggiore SM, Idone FA, Vaschetto R, Festa R, Cataldo A, Antonicelli F, Montini L, De Gaetano A, Navalesi P, Antonelli M.

Am J Respir Crit Care Med. 2014 Aug 1;190(3):282-8.

PMID 25003980, <http://www.ncbi.nlm.nih.gov/pubmed/25003980>

<b>Design</b>	Randomized controlled trial: HFNC versus Venturi mask
<b>Patients</b>	105 hypoxemic patients
<b>Objectives</b>	Compare the effects of the Venturi mask and the NHFC on PaO <sub>2</sub> /FiO <sub>2</sub> after extubation
<b>Main Results</b>	PaO <sub>2</sub> /FiO <sub>2</sub> was higher with the HFNC (287 ±74 vs. 247 ±81 at 24 h; p = 0.03). Discomfort related both to the interface and to airway dryness was better with NHF (respectively, p = 0.006; and p = 0.002). Fewer patients had interface displacements, oxygen desaturations, required reintubation, or any form of ventilator support in the HFNC group.
<b>Conclusion</b>	HFNC resulted in better oxygenation, better comfort, fewer desaturations and interface displacements, and a lower reintubation rate
<b>Comment</b>	HFNC decreased the reintubation rate

# High-flow nasal cannula oxygen therapy versus noninvasive ventilation in immunocompromised patients with acute respiratory failure: an observational cohort study

Coudroy R, Jamet A, Petua P, Robert R, Frat JP, Thille AW

Ann Intensive Care. 2016 Dec;6(1):45

PMID 27207177, <http://www.ncbi.nlm.nih.gov/pubmed/27207177>

<b>Design</b>	Observational cohort study over an 8-year period
<b>Patients</b>	115 immunocompromised patients with acute respiratory failure
<b>Objectives</b>	Compare outcomes between patients treated using HFNC or NIV as a first-line therapy
<b>Main Results</b>	52% were treated with HFNC alone and 48% with NIV as first-line therapy with 55% receiving HFNC and 45% standard oxygen between NIV sessions. The rates of intubation and 28-day mortality were higher in patients treated with NIV than with HFNC (55 vs. 35%, $p = 0.04$ , and 40 vs. 20%, $p = 0.02$ , respectively). Using propensity score-matched analysis, NIV was associated with mortality. Using multivariate analysis, NIV was independently associated with intubation and mortality.
<b>Conclusion</b>	In immunocompromised patients intubation and mortality rates could be lower in patients treated with HFNC alone than with NIV. The use of NIV remained independently associated with poor outcomes.

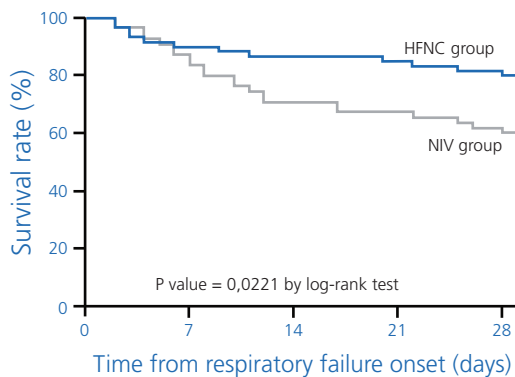


Figure 6: Survival was higher with HFNC alone than with NIV

# Effect of Very-High-Flow Nasal Therapy on Airway Pressure and End-Expiratory Lung Impedance in Healthy Volunteers

Parke RL, Bloch A, McGuinness SP.

Respir Care. 2015 Oct;60(10):1397-403

PMID 26329355, <http://www.ncbi.nlm.nih.gov/pubmed/26329355>

<b>Design</b>	Physiological study using EIT
<b>Patients</b>	15 healthy volunteers
<b>Objectives</b>	Assess the relationship between flows of up to 100 l/min and changes in lung physiology
<b>Main Results</b>	Flows ranged from 30 to 100 l/min with resulting airway pressures of $2.7 \pm 0.7$ to $11.9 \pm 2.7$ cmH <sub>2</sub> O. A cumulative and linear increase in end-expiratory lung impedance was observed with increasing flows and a decrease in breathing frequency.
<b>Conclusion</b>	Very high flow oxygen therapy could be an acceptable alternative to CPAP

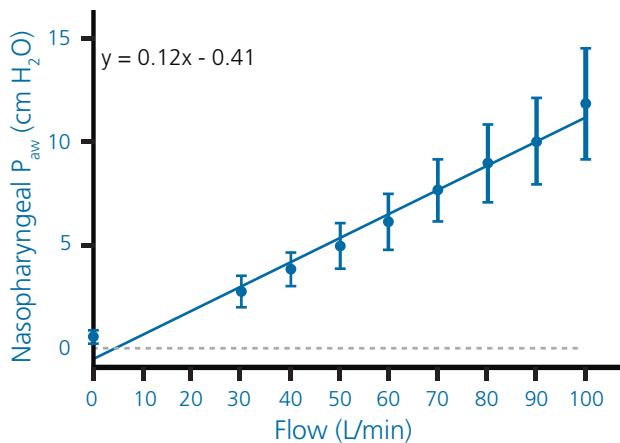


Figure 7: Airway pressure increased with flow

## Efficacy of high-flow nasal cannula therapy in acute hypoxemic respiratory failure: decreased use of mechanical ventilation

Nagata K, Morimoto T, Fujimoto D, Otoshi T, Nakagawa A, Otsuka K, Seo R, Atsumi T, Tomii K.

Respir Care. 2015 Oct;60(10):1390-6

PMID 26106206, <http://www.ncbi.nlm.nih.gov/pubmed/26106206>

<b>Design</b>	Retrospective single-center cohort study comparing the periods before and after HFNC introduction
<b>Patients</b>	83 before and 89 after HFNC introduction
<b>Objectives</b>	Evaluate the efficacy of high-flow oxygen as a support method for acute hypoxemic respiratory failure
<b>Main Results</b>	In the post-HFNC period, significantly fewer subjects required mechanical ventilation (NIV or invasive ventilation). There were significantly fewer ventilator days and more ventilator-free days.
<b>Conclusion</b>	High flow decreased mechanical ventilation requirement in patients with respiratory failure
<b>Comment</b>	Retrospective study with a before and after analysis

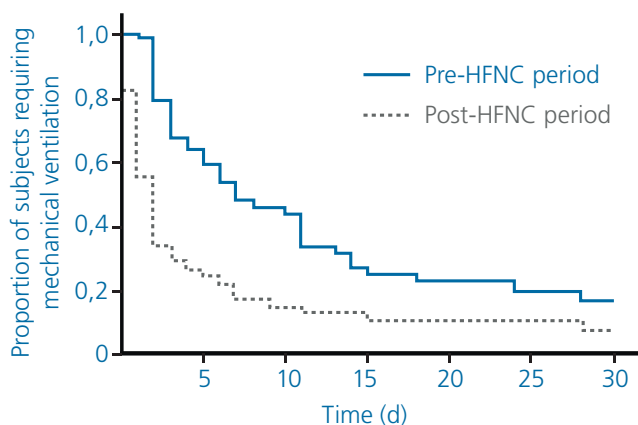


Figure 8: Mechanical ventilation before and after HFNC introduction



## Pressures delivered by nasal high flow oxygen during all phases of the respiratory cycle

Parke RL, McGuinness SP.

Respir Care. 2013 Oct;58(10):1621-4.

PMID 23513246, <http://www.ncbi.nlm.nih.gov/pubmed/23513246>

<b>Design</b>	Prospective observational study
<b>Patients</b>	15 patients after elective cardiac surgery
<b>Objectives</b>	Measure and compare the airway pressure generated during different phases of the respiratory cycle in patients receiving HFNC oxygen at various gas flows, by a nasopharyngeal catheter
<b>Main Results</b>	During HFNC oxygen therapy, the mean $\pm$ SD nasopharyngeal airway pressures were $1.5 \pm 0.6$ , $2.2 \pm 0.8$ , and $3.1 \pm 1.2$ at 30, 40, and 50 l/min.
<b>Conclusion</b>	HFNC oxygen therapy generated positive airway pressure

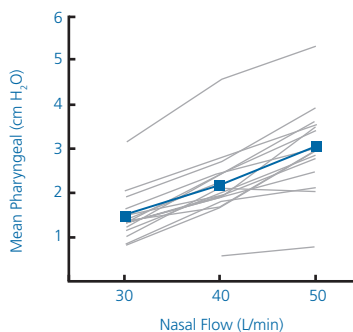


Figure 9: Increasing flow increased airway pressure

## Evaluation of a humidified nasal high-flow oxygen system, using oxygraphy, capnography and measurement of upper airway pressures

Ritchie JE, Williams AB, Gerard C, Hockey H.

Anaesth Intensive Care. 2011 Nov;39(6):1103-10.

PMID 22165366, <http://www.ncbi.nlm.nih.gov/pubmed/22165366>

<b>Design</b>	Randomized crossover study
<b>Patients</b>	10 healthy patients
<b>Objectives</b>	Evaluate the performance of HFNC by measuring delivered FiO <sub>2</sub> and Paw (airway pressure)
<b>Main Results</b>	Hypopharyngeal pressure increased with increasing delivered gas flow rate with mouth closed. At 50 l/min, the system delivered a mean airway pressure of up to 7.1 cmH <sub>2</sub> O.
<b>Conclusion</b>	The positive Paw created by the high flow increased the efficacy of this system and may serve as a bridge to formal positive pressure systems
<b>Comment</b>	Healthy patients

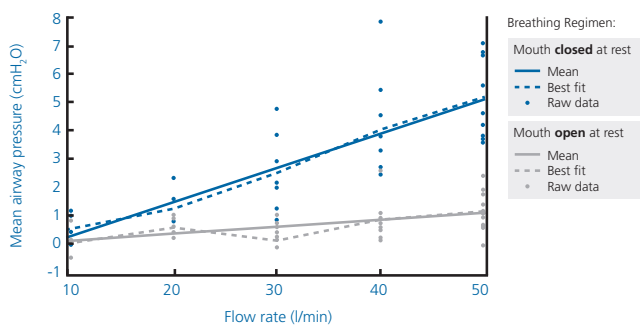


Figure 10: Paw increase with the flow rate when mouth is closed

## High-flow nasal cannula oxygen therapy decreases postextubation neuroventilatory drive and work of breathing in patients with chronic obstructive pulmonary disease

Di Mussi R, Spadaro S, Stripoli T, Volta CA, Trerotoli P, Pierucci P, Staffieri F, Bruno F, Camporota L, Grasso S

Crit Care. 2018 Aug 2;22(1):180

PMID 30071876, <http://www.ncbi.nlm.nih.gov/pubmed/30071876>

<b>Design</b>	Single-center, unblinded, crossover study: 1 h of HFNC(1), then 1 h of conventional oxygen via a face mask, then 1 h of HFNC(2)
<b>Patients</b>	14 postextubation COPD patients who had received mechanical ventilation for hypercapnic respiratory failure
<b>Objectives</b>	Compare the effects of HFNC and conventional low-flow O <sub>2</sub> therapy on the neuroventilatory drive and work of breathing
<b>Main Results</b>	EAdi peak and PTPDI/min increased with the transition from HFNC(1) to conventional oxygen, and then decreased during HFNC(2).
<b>Conclusion</b>	In patients with COPD, the application of HFNC after extubation decreased the neuroventilatory drive and work of breathing when compared with conventional oxygen

## A randomised controlled trial comparing high-flow nasal oxygen with standard management for conscious sedation during bronchoscopy

Douglas N, Ng I, Nazeem F, Lee K, Mezzavia P, Krieser R, Steinfert D, Irving L, Segal R

Anaesthesia. 2018 Feb;73(2):169-176

PMID 29171661, <http://www.ncbi.nlm.nih.gov/pubmed/29171661>

<b>Design</b>	Parallel-group randomised controlled trial: HFNC at a flow rate of 30–70 l/min, compared with standard oxygen therapy at 10 l/min
<b>Patients</b>	60 adult patients; 30 in each group
<b>Objectives</b>	Compare oxygenation during conscious sedation for bronchoscopy
<b>Main Results</b>	Desaturation occurred in 4 out of 30 patients allocated to the HFNC group compared with 10 out of 30 allocated to the standard oxygenation group ( $p = 0.047$ using a per-protocol analysis). Oxygen saturation after pre-oxygenation and the lowest oxygen saturation during the procedure were higher in the HFNC group.
<b>Conclusion</b>	HFNC may prevent desaturation during bronchoscopy

## Hypoxemic Patients With Bilateral Infiltrates Treated With High-Flow Nasal Cannula Present a Similar Pattern of Biomarkers of Inflammation and Injury to Acute Respiratory Distress Syndrome Patients

García-de-Acilu M, Marin-Corral J, Vázquez A, Ruano L, Magret M, Ferrer R, Masclans JR, Roca O  
Crit Care Med. 2017 Nov;45(11):1845-1853  
PMID 28806218, <http://www.ncbi.nlm.nih.gov/pubmed/28806218>

<b>Design</b>	Prospective, multicenter study
<b>Patients</b>	170 patients with acute hypoxemia ( $\text{PaO}_2/\text{FIO}_2 \leq 300$ ) and bilateral opacities, 127 intubated and 43 nonintubated patients
<b>Objectives</b>	Examine whether patients with acute hypoxemia and bilateral opacities treated with HFNC and ARDS patients mechanically ventilated are similar in terms of lung epithelial, endothelial, and inflammatory biomarkers
<b>Main Results</b>	No differences were observed in any of the biomarkers, nor in mortality or length of stay.
<b>Conclusion</b>	Patients treated with HFNC should be considered as ARDS patients

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

Mauri T, Turrini C, Eronia N, Grasselli G, Volta CA, Bellani G, Pesenti A  
Am J Respir Crit Care Med. 2017 May 1;195(9):1207-1215  
PMID 27997805, <http://www.ncbi.nlm.nih.gov/pubmed/27997805>

<b>Design</b>	Prospective randomized crossover study: HFNC set at 40 l/min compared with a standard, nonocclusive facial mask
<b>Patients</b>	15 nonintubated patients with acute hypoxemic respiratory failure (AHRF) ( $\text{PaO}_2/\text{setFiO}_2 \leq 300$ mm Hg)
<b>Objectives</b>	Assess the effects of HFNC on gas exchange, inspiratory effort, minute ventilation, end-expiratory lung volume, dynamic compliance, and ventilation homogeneity in patients with acute hypoxemic respiratory failure
<b>Main Results</b>	HFNC improved oxygenation, lowered the respiratory rate, minute ventilation, $\Delta\text{Pes}$ , and pressure time product, and increased end-expiratory lung volume in comparison to the facial mask. The tidal volume did not change, but the ratio of tidal volume to $\Delta\text{Pes}$ (an estimate of lung compliance) increased; ventilation distribution was more homogeneous.
<b>Conclusion</b>	In patients with AHRF, HFNC exerts multiple beneficial physiologic effects, including less inspiratory effort, and improved lung volume and compliance

## High-Flow Nasal Cannula Oxygenation in Immunocompromised Patients with Acute Hypoxemic Respiratory Failure: A Groupe de Recherche Respiratoire en Réanimation Onco-Hématologique Study

Lemiale V, Resche-Rigon M, Mokart D, Pène F, Argaud L, Mayaux J, Guitton C, Rabbat A, Girault C, Kouatchet A, Vincent F, Bruneel F, Nyunga M, Seguin A, Klouche K, Colin G, Kontar L, Perez P, Meert AP, Benoit DD, Papazian L, Demoule A, Chevret S, Azoulay E

Crit Care Med. 2017 Mar;45(3):e274-e280

PMID 27655324, <http://www.ncbi.nlm.nih.gov/pubmed/27655324>

<b>Design</b>	Post-hoc analysis of a randomized controlled trial
<b>Patients</b>	353 immunocompromised patients with hypoxemic acute respiratory failure: 127 treated with HFNC, 226 treated with standard oxygen
<b>Objectives</b>	Assess outcomes in immunocompromised patients with hypoxemic acute respiratory failure treated with HFNC
<b>Main Results</b>	HFNC was associated with neither a lower intubation rate nor day 28 mortality
<b>Conclusion</b>	In immunocompromised patients with hypoxemic acute respiratory failure, HFNC did not reduce intubation or survival rates when compared with standard oxygen

## Predicting success of high-flow nasal cannula in pneumonia patients with hypoxemic respiratory failure: The utility of the ROX index

Roca O, Messika J, Caralt B, García-de-Acilu M, Sztrymf B, Ricard JD, Masclans JR

J Crit Care. 2016 May 31;35:200-205

PMID 27481760, <http://www.ncbi.nlm.nih.gov/pubmed/27481760>

<b>Design</b>	Prospective observational 2-center cohort study
<b>Patients</b>	157 patients
<b>Objectives</b>	Describe early predictors and to develop a prediction tool that accurately identifies the need for intubation in patients with hypoxemic acute respiratory failure (ARF) treated with high-flow nasal cannula (HFNC)
<b>Main Results</b>	ROX index was defined as the ratio of pulse oximetry/fraction of inspired oxygen to respiratory rate. 44 (28%) required MV. After 12 h of HFNC, the ROX index demonstrated good prediction accuracy. The best cutoff point for the ROX index was estimated to be 4.88.
<b>Conclusion</b>	In patients with ARF and pneumonia, the ROX index can identify patients at low risk for HFNC failure

## Physiologic Effects of High-Flow Nasal Cannula Oxygen in Critical Care Subjects

Vargas F, Saint-Leger M, Boyer A, Bui NH, Hilbert G.

Respir Care. 2015 Oct;60(10):1369-76

PMID 25944940, <http://www.ncbi.nlm.nih.gov/pubmed/25944940>

<b>Design</b>	Comparative study (conventional therapy, high flow oxygen and CPAP)
<b>Patients</b>	12 ICU patients with acute hypoxemic respiratory failure
<b>Objectives</b>	Assess the short-term physiologic effects (inspiratory muscle effort, gas exchange, dyspnea score, and comfort) of HFNC
<b>Main Results</b>	HFNC reduced inspiratory effort and breathing frequency and increased PaO <sub>2</sub> /FiO <sub>2</sub> compared with conventional ventilation.
<b>Conclusion</b>	In hypoxemic respiratory failure, high flow improve a physiological patterns compare to conventional therapy

## Comparison of the effectiveness of high flow nasal oxygen cannula vs. standard non-rebreather oxygen face mask in post-extubation intensive care unit patients

Brotfain E, Zlotnik A, Schwartz A, Frenkel A, Koyfman L, Gruenbaum SE, Klein M.

Isr Med Assoc J. 2014 Nov;16(11):718-22.

PMID 25558703, <http://www.ncbi.nlm.nih.gov/pubmed/25558703>

<b>Design</b>	Retrospective study
<b>Patients</b>	67 ICU patients after extubation
<b>Objectives</b>	Compare clinical effects of HFNC with standard oxygen face masks
<b>Main Results</b>	The use of HFNC improved PaO <sub>2</sub> /FiO <sub>2</sub> ( $p < 0.05$ ). There were more ventilator-free days in the HFNC group ( $p < 0.05$ ) and fewer patients required reintubation (1 vs. 6).
<b>Conclusion</b>	HFNC may be more effective than standard oxygen supply devices for oxygenation in the post-extubation period
<b>Comment</b>	Retrospective study

## Effect of high-flow nasal cannula on thoraco-abdominal synchrony in adult critically ill patients

Itagaki T, Okuda N, Tsunano Y, Kohata H, Nakataki E, Onodera M, Imanaka H, Nishimura M.

Respir Care. 2014 Jan;59(1):70-4.

PMID 23737548., <http://www.ncbi.nlm.nih.gov/pubmed/23737548>.

<b>Design</b>	Prospective crossover study
<b>Patients</b>	40 ICU patients requiring oxygen therapy, low-flow oxygen (up to 8 l/min) was administered via oronasal mask for 30 min, followed by HFNC at 30-50 l/min
<b>Objectives</b>	Compare effects of HFNC on thoraco-abdominal synchrony, using respiratory inductive plethysmography
<b>Main Results</b>	During HFNC, RR (respiratory rate) significantly decreased from 25 breaths/min (IQR 22-27 breaths/min) to 21 breaths/min (IQR 18-24 breaths/min) ( $p < 0.001$ ), and thoraco-abdominal synchrony ( $p < 0.001$ ) significantly improved.
<b>Conclusion</b>	HFNC improved thoraco-abdominal synchrony in patients with respiratory failure

## Effect of high-flow nasal cannula and body position on end-expiratory lung volume: a cohort study using electrical impedance tomography

Riera J, Pérez P, Cortés J, Roca O, Masclans JR, Rello J.

Respir Care. 2013 Apr;58(4):589-96.

PMID 23050520, <http://www.ncbi.nlm.nih.gov/pubmed/23050520>

<b>Design</b>	Prospective observational study
<b>Patients</b>	20 healthy adults
<b>Objectives</b>	Investigate the effects of HFNC and body position on global and regional end-expiratory lung impedance variation ( $\Delta$ EELI)
<b>Main Results</b>	HFNC increased global EELI by 1.26 units ( $p < 0.001$ ) in a supine position, and by 0.87 units ( $p < 0.001$ ) in a prone position. The distribution of $\Delta$ EELI was homogeneous in the prone position, with no difference between ventral and dorsal lung regions, while in the supine position, a significant difference was found with increased EELI in ventral areas.
<b>Conclusion</b>	HFNC increased global EELI
<b>Comment</b>	Healthy patients

## High-flow nasal cannula therapy in do-not-intubate patients with hypoxemic respiratory distress

Peters SG, Holets SR, Gay PC.

Respir Care. 2013 Apr;58(4):597-600.

PMID 22781059, <http://www.ncbi.nlm.nih.gov/pubmed/22781059>

<b>Design</b>	Prospective observational study
<b>Patients</b>	50 do-not-intubate patients with hypoxemic respiratory failure
<b>Objectives</b>	Determine the need for escalation to NIV
<b>Main Results</b>	Mean O2 saturations went from 89.1% to 94.7% ( $p < 0.001$ ), and breathing frequency went from 30.6 breaths/min to 24.7 breaths/min ( $p < 0.001$ ). Nine of the 50 subjects (18%) escalated to NIV, while 82% were maintained on HFNC. The median duration of HFNC was 30 hours (range 2-144 h).
<b>Conclusion</b>	HFNC provided adequate oxygenation and may be an alternative to NIV for DNI patients

## Humidified high flow nasal oxygen during respiratory failure in the emergency department: feasibility and efficacy

Lenglet H, Sztrymf B, Leroy C, Brun P, Dreyfuss D, Ricard JD.

Respir Care. 2012 Nov;57(11):1873-8.

PMID 22417844, <http://www.ncbi.nlm.nih.gov/pubmed/22417844>

<b>Design</b>	Prospective observational study
<b>Patients</b>	17 patients with acute respiratory failure requiring $> 9$ l/min oxygen or with ongoing clinical signs of respiratory distress
<b>Objectives</b>	Study the HFNC oxygen feasibility and efficiency in patients exhibiting acute respiratory failure presenting to the ED
<b>Main Results</b>	HFNC was associated with a significant decrease in dyspnea. RR (respiratory rate) decreased from 28 breaths/min (25-32 breaths/min) to 25 breaths/min (21-28 breaths/min) ( $p < 0.01$ ), and SpO2 increased from 90% (88.5%-94%) to 97% (92.5%-100%) ( $p < .001$ ). HFNC was well tolerated and no adverse event was noted. Altogether, 76% of healthcare givers declared preferring HFNC as compared to conventional oxygen therapy.
<b>Conclusion</b>	HFNC was feasible in the ED and improved respiratory parameters in subjects with acute hypoxemic respiratory failure
<b>Comment</b>	Small number of patients



## Impact of high-flow nasal cannula oxygen therapy on intensive care unit patients with acute respiratory failure: a prospective observational study

Sztrymf B, Messika J, Mayot T, Lenglet H, Dreyfuss D, Ricard JD.

J Crit Care. 2012 Jun;27(3):324.e9-13.

PMID 21958974, <http://www.ncbi.nlm.nih.gov/pubmed/21958974>

<b>Design</b>	Prospective observational study
<b>Patients</b>	20 patients with acute respiratory failure
<b>Objectives</b>	Determine the impact of HFNC in comparison with conventional oxygen therapy
<b>Main Results</b>	Use of HFNC enabled a significant reduction of respiratory rate, 28 (26-33) vs 24.5 (23-28.5) breaths per minute ( $p = 0.006$ ), and a significant increase in oxygen saturation measured by pulse oximetry 93.5% (90-98.5) vs 98.5% (95.5-100) ( $p = 0.0003$ ). Use of HFNC significantly increased PaO <sub>2</sub> from 8.73 (7.13-11.13) to 15.27 (9.66-25.6) kPa ( $p = 0.001$ ) and moderately increased PaCO <sub>2</sub> , 5.26 (4.33-5.66) to 5.73 (4.8-6.2) kPa ( $p = 0.005$ ) without affecting pH.
<b>Conclusion</b>	HFNC in patients with persistent ARF was associated with improvement of both clinical and biologic parameters

## Oxygen delivery through high-flow nasal cannulae increased end-expiratory lung volume and reduce respiratory rate in post cardiac surgical patients

Corley A, Caruana LR, Barnett AG, Tronstad O, Fraser JF.

Br J Anaesth. 2011 Dec;107(6):998-1004.

PMID 21908497, <http://www.ncbi.nlm.nih.gov/pubmed/21908497>

<b>Design</b>	Prospective observational study
<b>Patients</b>	20 post cardiac surgery patients
<b>Objectives</b>	Investigate the effects of HFNC on Paw (airway pressure) and end-expiratory lung volume (EELV)
<b>Main Results</b>	A strong and significant correlation existed between Paw and end-expiratory lung impedance (EELI) ( $r = 0.7$ , $p < 0.001$ ). Compared with low-flow oxygen, HFNC significantly increased EELI by 25.6% and Paw by 3.0 cmH <sub>2</sub> O. RR (respiratory rate) reduced by 3.4 bpm with HFNC, tidal impedance variation increased by 10.5%. HFNC improved subjective dyspnea scoring ( $P = 0.023$ ). Increases in EELI were significantly influenced by body mass index (BMI), with larger increases associated with higher BMIs ( $P < 0.001$ ).
<b>Conclusion</b>	HFNC reduced RR and improved oxygenation by increasing both EELV and tidal volume, and are most beneficial in patients with higher BMI

## Beneficial effects of humidified high flow nasal oxygen in critical care patients: a prospective pilot study

Sztrymf B, Messika J, Bertrand F, Hurel D, Leon R, Dreyfuss D, Ricard JD.

Intensive Care Med. 2011 Nov;37(11):1780-6.

PMID 21946925, <http://www.ncbi.nlm.nih.gov/pubmed/21946925>

<b>Design</b>	Prospective pilot study
<b>Patients</b>	38 ICU patients with acute respiratory failure
<b>Objectives</b>	Evaluate the efficiency, safety, and outcome of HFNC
<b>Main Results</b>	HFNC significantly reduced the respiratory rate, heart rate, dyspnea score, supraclavicular retraction and thoraco-abdominal asynchrony, and increased pulse oxymetry. HFNC was used for a mean duration of 2.8 days and a maximum of 7 days. These improvements lasted throughout the study period. It was never interrupted for intolerance. No nosocomial pneumonia occurred during HFNC.
<b>Conclusion</b>	HFNC had a beneficial effect on clinical signs and oxygenation
<b>Comment</b>	Pilot study

## A preliminary randomized controlled trial to assess effectiveness of nasal high-flow oxygen in intensive care patients

Parke RL, McGuinness SP, Eccleston ML.

Respir Care. 2011 Mar;56(3):265-70.

PMID 21255498, <http://www.ncbi.nlm.nih.gov/pubmed/21255498>

<b>Design</b>	Randomized controlled trial: HFNC versus standard oxygen therapy
<b>Patients</b>	60 cardiothoracic and vascular ICU patients with mild to moderate hypoxemic respiratory failure
<b>Objectives</b>	Compare HFNC oxygen therapy and standard high-flow face mask (HFFM) oxygen therapy
<b>Main Results</b>	The rate of noninvasive ventilation in the NHF group was 3/29 (10%), compared with 8/27 (30%) in the HFFM group ( $p = 0.10$ ). The NHF patients had significantly fewer desaturations ( $p = .009$ ).
<b>Conclusion</b>	HFNC oxygen therapy may be more effective than HFFM

## High-flow nasal oxygen vs high-flow face mask: a randomized crossover trial in extubated patients

Tiruvoipati R, Lewis D, Haji K, Botha J.

J Crit Care. 2010 Sep;25(3):463-8.

PMID 19781896, <http://www.ncbi.nlm.nih.gov/pubmed/19781896>

<b>Design</b>	Randomized crossover study
<b>Patients</b>	50 patients after extubation
<b>Objectives</b>	Compare the efficiency of HFNC oxygen to HFFM (high flow face mask) in maintaining gas exchange
<b>Main Results</b>	There was a significant difference ( $p = 0.01$ ) in tolerance, HFNC being well tolerated. There was a trend ( $p = 0.09$ ) toward better patient comfort with HFNP.
<b>Conclusion</b>	HFNC was as effective as HFFM and better tolerated

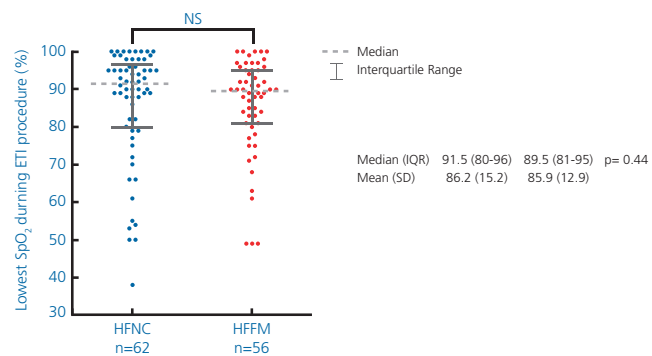
## High-flow nasal cannula oxygen during endotracheal intubation in hypoxemic patients: a randomized controlled clinical trial

Vourc'h M, Asfar P, Volteau C, Bachoumas K, Clavieras N, Egreteau PY, Asehnoune K, Mercat A, Reignier J, Jaber S, Prat G, Roquilly A, Brule N, Villers D, Bretonniere C, Guitton C.

Intensive Care Med. 2015 Sep;41(9):1538-48.

PMID 25869405, <http://www.ncbi.nlm.nih.gov/pubmed/25869405>

<b>Design</b>	Multicenter randomized controlled trial: HFNC versus standard oxygen therapy
<b>Patients</b>	124 acute hypoxemic adults requiring intubation
<b>Objectives</b>	Evaluate the efficiency of HFNC for preoxygenation: HFNC was maintained throughout the procedure, whereas HFFM (high flow face mask) was removed at the end of general anaesthesia induction.
<b>Main Results</b>	The median lowest saturation was 91.5% (80-96) for HFNC and 89.5% (81-95) for the HFFM group ( $p = 0.44$ ). There was no difference for difficult intubation, intubation difficulty scale, ventilation-free days, intubation-related adverse events including desaturation $<80\%$ or mortality.
<b>Conclusion</b>	HFNC did not significantly reduce the lowest level of desaturation in hypoxemic patients



## High-flow nasal cannula versus conventional oxygen therapy after endotracheal extubation: a randomized crossover physiological study

Rittayamai N, Tscheikuna J, Rujjwit P.

Respir Care. 2014 Apr;59(4):485-90.

PMID 24046462, <http://www.ncbi.nlm.nih.gov/pubmed/24046462>

<b>Design</b>	Randomized crossover study
<b>Patients</b>	17 respiratory care patients after extubation
<b>Objectives</b>	Compare the short-term benefit of HFNC with standard oxygen therapy in terms of change in dyspnea, physiologic variables, and patient comfort in subjects after endotracheal extubation
<b>Main Results</b>	HFNC was associated with less dyspnea ( $p = 0.04$ ) and lower breathing respiratory rate ( $p = 0.009$ ) and heart rate ( $p = 0.006$ ) compared with standard oxygen therapy. Most of the subjects (88.2%) preferred HFNC to a non-rebreathing mask.
<b>Conclusion</b>	HFNC improved dyspnea and physiologic parameters after extubation
<b>Comment</b>	Small number of patients

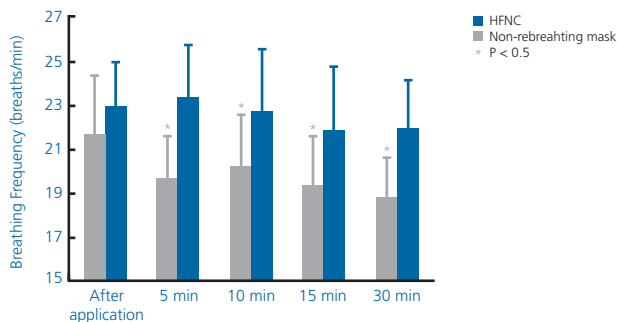


Figure 12: HFNC decreased respiratory rate during its application compared with conventional oxygen therapy

## Nasal high-flow oxygen therapy in ICU: A before-and-after study

Fealy N, Osborne C, Eastwood GM, Glassford N, Hart G, Bellomo R.

Aust Crit Care. 2016 Feb;29(1):17-22

PMID 26092213, <http://www.ncbi.nlm.nih.gov/pubmed/26092213>

<b>Design</b>	Prospective 4-week before-and-after study
<b>Patients</b>	117 adult patients (57 before, 60 after) admitted to a 22-bed tertiary ICU in Melbourne, Australia
<b>Objectives</b>	Assess the feasibility, safety and cost-effectiveness of introducing a protocol in which HFNP was the primary oxygen delivery device for non-intubated intensive care patients
<b>Main Results</b>	86 patients (73.5%) received mechanical ventilation. Feasibility revealed a significant reduction in standard oxygen therapy during the after period. Costing was in favour of the after period with a consumable cost saving per patient (AUD \$32.56 vs. \$17.62, $p < .05$ ). During the after period, fewer patients (5 vs. 14 patients) used three or more oxygen delivery devices. Safety outcomes demonstrated no significant difference.
<b>Conclusion</b>	Using HFNC as the primary oxygen delivery method for non-intubated intensive care patients was feasible, safe, and the oxygen device costs were reduced
<b>Comment</b>	Before after single center study in Australia

## The effects of a 2-h trial of high-flow oxygen by nasal cannula versus Venturi mask in immunocompromised patients with hypoxemic acute respiratory failure: a multicenter randomized trial

Lemiale V, Mokart D, Mayaux J, Lambert J, Rabbat A, Demoule A, Azoulay E.

Crit Care. 2015 Nov 2;19(1):380

PMID 26521922, <http://www.ncbi.nlm.nih.gov/pubmed/26521922>

<b>Design</b>	Multicenter, parallel-group randomized controlled trial
<b>Patients</b>	100 immunocompromised patients with acute respiratory failure
<b>Objectives</b>	Compare HFNC and Venturi mask oxygen to avoid mechanical ventilation during a 2-hour period
<b>Main Results</b>	During the 2-h study treatment period, 12 patients required IMV or NIV, and we found no significant difference between the two groups.
<b>Conclusion</b>	No difference between short term high flow oxygen and conventional therapy in immunocompromised patients
<b>Comment</b>	The study was underpowered because of the low event rate and the one-sided hypothesis. Two hours is too short a time to get to endpoint.



## High-Flow Nasal Cannula in a Mixed Adult ICU

Gaunt KA, Spilman SK, Halub ME, Jackson JA, Lamb KD, Sahr SM.  
Respir Care. 2015 Oct;60(10):1383-9  
PMID 26060320, <http://www.ncbi.nlm.nih.gov/pubmed/26060320>

<b>Design</b>	Retrospective study
<b>Patients</b>	145 medical and trauma ICU patients
<b>Objectives</b>	Evaluate timing of HFNC on patient outcomes
<b>Main Results</b>	24.1% received mechanical ventilation before HFNC, 14.5% received mechanical ventilation after HFNC, and 61.3% never received mechanical ventilation. Delay to first HFNC was strongly correlated with the development of ventilator-associated pneumonia. Subjects with a greater length of time between ICU admission and first use of HFNC experienced significantly longer stays in the ICU and post-ICU periods.
<b>Conclusion</b>	HFNC should be considered early in the ICU as first-line oxygen therapy

## Failure of high-flow nasal cannula therapy may delay intubation and increase mortality

Kang BJ, Koh Y, Lim CM, Huh JW, Baek S, Han M, Seo HS, Suh HJ, Seo GJ, Kim EY, Hong SB.  
Intensive Care Med. 2015 Apr;41(4):623-32.  
PMID 25691263, <http://www.ncbi.nlm.nih.gov/pubmed/25691263>

<b>Design</b>	Retrospective observational study
<b>Patients</b>	175 ICU patients
<b>Objectives</b>	Assess mortality and outcomes of patients who received HFNC therapy that failed
<b>Main Results</b>	130 (74.3%) and 45 (25.7%) were intubated before and after 48 h of HFNC, respectively. The early intubated patients had better overall ICU mortality (39.2% vs. 66.7%; $p = 0.001$ ), extubation success (37.7% vs. 15.6%; $p = 0.006$ ), ventilator weaning (55.4% vs. 28.9%; $p = 0.002$ ), and ventilator-free days ( $8.6 \pm 10.1$ vs. $3.6 \pm 7.5$ ; $p = 0.011$ ) than late intubated patients.
<b>Conclusion</b>	Failure of HFNC might cause worse clinical outcomes in patients with respiratory failure
<b>Comment</b>	Large prospective and randomized controlled studies on HFNC failure are needed to draw a definitive conclusion

## Nasal high-flow oxygen therapy in patients with hypoxic respiratory failure: effect on functional and subjective respiratory parameters compared to conventional oxygen therapy and non-invasive ventilation (NIV)

Schwabbauer N, Berg B, Blumenstock G, Haap M, Hetzel J, Riessen R.

BMC Anesthesiol. 2014 Aug 7;14:66.

PMID 25110463, <http://www.ncbi.nlm.nih.gov/pubmed/25110463>

<b>Design</b>	Randomized crossover study
<b>Patients</b>	14 patients with acute hypoxic respiratory failure
<b>Objectives</b>	Compare the short-term effects of oxygen therapy via HFNC on respiratory parameters in patients with acute hypoxic respiratory failure with NIV and standard treatment via a Venturi mask
<b>Main Results</b>	Dyspnea was significantly reduced using an HFNC compared to NIV ( $p < 0.05$ ). Patients gave the best ratings to HFNC, followed by Venturi mask (NS vs. HFNC) and NIV ( $p < 0.01$ vs. HFNC and $p < 0.05$ vs. VM). For further treatment, 10 patients chose HFNC, 3 VM, and 1 NIV.
<b>Conclusion</b>	HFNC decreased dyspnea and was well tolerated by patients
<b>Comment</b>	Small number of patients

## Open-label, phase II study of routine high-flow nasal oxygen therapy in cardiac surgical patients

Parke R, McGuinness S, Dixon R, Jull A.

Br J Anaesth. 2013 Dec;111(6):925-31.

PMID 23921199, <http://www.ncbi.nlm.nih.gov/pubmed/23921199>

<b>Design</b>	Randomized controlled trial: HFNC oxygen (45 l/min) versus usual care from extubation to day 2 after surgery
<b>Patients</b>	340 patients after cardiac surgery
<b>Objectives</b>	Determine whether the routine administration of HFNC oxygen improves pulmonary function
<b>Main Results</b>	The number of patients with an SpO <sub>2</sub> /FiO <sub>2</sub> ≥ 445 on Day 3 was 78 (46.4%) in the NHF group vs 72 (42.4%) standard care [OR 1.18, 95% CI 0.77-1.81, p=0.45]. Escalation in respiratory support at any time in the study occurred in 47 patients (27.8%) allocated to NHF compared with 77 (45%) standard care (OR 0.47, 95% CI 0.29-0.7, p=0.001).
<b>Conclusion</b>	Routine use of NHF reduced the requirement for escalation of respiratory support

## Patients with New York Heart Association class III heart failure may benefit with high flow nasal cannula supportive therapy: high flow nasal cannula in heart failure

Roca O, Pérez-Terán P, Masclans JR, Pérez L, Galve E, Evangelista A, Rello J.

J Crit Care. 2013 Oct;28(5):741-6.

PMID 23602035, <http://www.ncbi.nlm.nih.gov/pubmed/23602035>

<b>Design</b>	Prospective observational study
<b>Patients</b>	10 patients with NYHA III heart failure
<b>Objectives</b>	Describe the hemodynamic and respiratory effects of HFNC oxygen
<b>Main Results</b>	Respiratory rate was significantly reduced from 23 breaths per minute at baseline to 13 breaths per minute at HFNC with 40 l/min.
<b>Conclusion</b>	Patients with NYHA class III heart failure may benefit with HFNC supportive therapy
<b>Comment</b>	Small number of patients

## The effects of flow on airway pressure during nasal high-flow oxygen therapy

Parke RL, Eccleston ML, McGuinness SP.

Respir Care. 2011 Aug;56(8):1151-5.

PMID 21496369, <http://www.ncbi.nlm.nih.gov/pubmed/21496369>

<b>Design</b>	Prospective observational study
<b>Patients</b>	15 post cardiac surgery patients
<b>Objectives</b>	Determine the relationship between flow and pressure with HFNC
<b>Main Results</b>	With the mouth closed, the mean $\pm$ SD airway pressures at 30, 40, and 50 l/min were 1.93 $\pm$ 1.25 cmH <sub>2</sub> O, 2.58 $\pm$ 1.54 cmH <sub>2</sub> O, and 3.31 $\pm$ 1.05 cmH <sub>2</sub> O, respectively. There was a positive linear relationship between flow and pressure.
<b>Conclusion</b>	The mean nasopharyngeal pressure during nasal high-flow oxygen increases as flow increases

## High-flow oxygen therapy in acute respiratory failure

Roca O, Riera J, Torres F, Masclans JR.

Respir Care. 2010 Apr;55(4):408-13.

PMID 20406507, <http://www.ncbi.nlm.nih.gov/pubmed/20406507>

<b>Design</b>	Prospective observational study
<b>Patients</b>	20 patients with acute respiratory failure
<b>Objectives</b>	Compare the comfort of oxygen therapy via HFNC versus HFFM (high flow face mask)
<b>Main Results</b>	The HFNC was associated with less dyspnea ( $p = .001$ ) and mouth dryness ( $p < .001$ ), and was more comfortable ( $p < .001$ ). HFNC was associated with higher PaO <sub>2</sub> (127 [83-191] mmHg vs 77 [64-88] mmHg, $p = .002$ ) and lower RR (respiratory rate) (21 [18-27] breaths/min vs 28 [25-32] breaths/min, $p < .001$ ), but no difference in PaCO <sub>2</sub> .
<b>Conclusion</b>	HFNC was better tolerated and more comfortable than HFFM, associated with better oxygenation and lower RR

# Additional files

## Effect of high-flow nasal cannula oxygen therapy compared with conventional oxygen therapy in postoperative patients: a systematic review and meta-analysis.

Lu Z, Chang W, Meng SS, Zhang X, Xie J, Xu JY, Qiu H, Yang Y, Guo F  
BMJ Open. 2019 Aug 2;9(8):e027523  
PMID 31377696, <http://www.ncbi.nlm.nih.gov/pubmed/31377696>

<b>Design</b>	Systematic review and meta-analysis
<b>Conclusion</b>	HFNC is associated with a significantly lower reintubation rate and rate of escalation of respiratory support compared with conventional oxygen therapy in postextubation adult surgical patients, but there is no difference in the incidence of postoperative pulmonary complications or mortality.

## Comparison of high-flow nasal oxygen therapy with conventional oxygen therapy and noninvasive ventilation in adult patients with acute hypoxemic respiratory failure: A meta-analysis and systematic review

Maitra S, Som A, Bhattacharjee S, Arora MK, Baidya DK.  
J Crit Care. 2016 May 25;35:138-144.  
PMID 27481749, <http://www.ncbi.nlm.nih.gov/pubmed/27481749>

<b>Design</b>	Meta-analysis of prospective randomized controlled trials
<b>Patients</b>	7 randomized controlled trials
<b>Objectives</b>	Compare HFNO with NIV and conventional oxygen therapy in adult patients with acute hypoxemic respiratory failure
<b>Main Results</b>	HFNC did not decrease the requirement for higher respiratory support compared with the control group, however it was associated with an improved respiratory rate, dyspnea score and better comfort.
<b>Conclusion</b>	HFNC improved patient comfort and dyspnea

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

Nishimura M.

Respir Care. 2016 Apr;61(4):529-41.

PMID 27016353, <http://www.ncbi.nlm.nih.gov/pubmed/27016353>

**Design** Review

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**Conclusion** HFNC has emerged as an innovative and effective modality for early treatment of adults with respiratory failure with diverse underlying diseases

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## Current evidence for the effectiveness of heated and humidified high flow nasal cannula supportive therapy in adult patients with respiratory failure

Roca O, Hernández G, Díaz-Lobato S, Carratalá JM, Gutiérrez RM, Masclans JR; Spanish Multidisciplinary Group of High Flow Supportive Therapy in Adults (HiSpaFlow)

Crit Care. 2016 Apr 28;20(1):109

PMID 27121707, <http://www.ncbi.nlm.nih.gov/pubmed/27121707>

**Design** Review

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**Conclusion** HFNC is safe and useful in patients with respiratory failure, improving oxygenation and comfort in different clinical situations

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## Use of high-flow nasal cannula oxygenation in ICU adults: a narrative review

Papazian L, Corley A, Hess D, Fraser JF, Frat JP, Guitton C, Jaber S, Maggiore SM, Nava S, Rello J, Ricard JD, Stephan F, Trisolini R, Azoulay E.

Intensive Care Med. 2016 Sep;42(9):1336-49

PMID 26969671, <http://www.ncbi.nlm.nih.gov/pubmed/26969671>

**Design** Review

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**Conclusion** The main aim of this review is to guide clinicians towards evidence-based clinical practice guidelines

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## Effect of high-flow nasal cannula oxygen therapy vs conventional oxygen therapy on adult postcardiothoracic operation: A meta-analysis

Wu X, Cao W, Zhang B, Wang S

Medicine (Baltimore). 2018 Oct;97(41):e12783

PMID 30313100, <http://www.ncbi.nlm.nih.gov/pubmed/30313100>

<b>Design</b>	Meta-analysis
<b>Patients</b>	4 studies, 649 patients
<b>Main Results</b>	Compared with conventional oxygen treatment, HFNC was associated with a reduction in the escalation of respiratory support and pulmonary complications. There were no differences in reintubation rate, ICU length of stay or hospital length of stay.
<b>Conclusion</b>	HFNC could reduce respiratory support and pulmonary complications in postcardiothoracic surgery, and could be safely administered for adult postcardiothoracic surgery

## High-Flow Nasal Cannula Oxygen in Adults: An Evidence-based Assessment

Drake MG

Ann Am Thorac Soc. 2018 Feb;15(2):145-155

PMID 29144160, <http://www.ncbi.nlm.nih.gov/pubmed/29144160>

<b>Design</b>	Review
<b>Conclusion</b>	This review examines the evidence for HFNC, with a focus on the effects on respiratory physiology and keys to tailoring the flow for specific clinical scenarios

## High-flow oxygen administration by nasal cannula for adult and perinatal patients

Ward JJ.

Respir Care. 2013 Jan;58(1):98-122.

PMID 23271822, <http://www.ncbi.nlm.nih.gov/pubmed/23271822>

<b>Design</b>	Review
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## High-flow nasal interface improves oxygenation in patients undergoing bronchoscopy

Lucangelo U, Vassallo FG, Marras E, Ferluga M, Beziza E, Comuzzi L, Berlot G, Zin WA.

Crit Care Res Pract. 2012;2012:506382

PMID 22666567, <http://www.ncbi.nlm.nih.gov/pubmed/22666567>

<b>Design</b>	Prospective study comparing HFNC 60 l/min, HFNC40 l/min, and Venturi mask 40l/min
<b>Patients</b>	45 patients undergoing bronchoscopy and BAL
<b>Objectives</b>	To determine the effects of high-flow devices on gas exchange and cardiovascular variables in patients undergoing bronchoscopy and BAL
<b>Main Results</b>	At the end of bronchoscopy, HFNC60 presented higher PaO <sub>2</sub> , PaO <sub>2</sub> /FiO <sub>2</sub> , and SpO <sub>2</sub> than Venturi 40 and HFNC40 that did not differ between them. Nasal cannula associated with a 60 l/min flow produced the better results.
<b>Conclusion</b>	Under a flow rate of 40 l/min both the Venturi mask and HFNC behaved similarly, but nasal cannula associated with a 60 l/min flow produced the better results, thus indicating its use in mild respiratory dysfunctions

## Discomfort associated with underhumidified high-flow oxygen therapy in critically ill patients

Chanques G, Constantin JM, Sauter M, Jung B, Sebbane M, Verzilli D, Lefrant JY, Jaber S.

Intensive Care Med. 2009 Jun;35(6):996-1003

PMID 19294365, <http://www.ncbi.nlm.nih.gov/pubmed/19294365>

<b>Design</b>	Randomized crossover study
<b>Patients</b>	30 ICU patients, during 3 days
<b>Objectives</b>	Compare discomfort in nonintubated patients under high-flow oxygen therapy humidified with bubble (BH) to heated humidifiers (HH)
<b>Main Results</b>	The median intensities of both mouth and throat dryness were significantly lower with the heated humidifiers than with those humidified with bubble [7.8 (5.0-9.4) vs. 5.0 (3.1-7.0), p = 0.001 and 5.8 (2.3-8.5) vs. 4.3 (2.0-5.0), p = 0.005, respectively].
<b>Conclusion</b>	The use of a heated-humidifier in patients with high-flow oxygen therapy is associated with a decrease of dryness symptoms, compared to a bubble humidifier

## Use of High-Flow Nasal Cannula for Acute Dyspnea and Hypoxemia in the Emergency Department

Rittayamai N, Tscheikuna J, Praphruetkit N, Kijpinyochai S.

Respir Care 2015;60(10):1377–1382.

PMID 26060321, <http://www.ncbi.nlm.nih.gov/pubmed/26060321>

<b>Design</b>	Prospective randomized comparative study
<b>Patients</b>	40 patients with acute dyspnea and hypoxemia in the emergency room
<b>Objectives</b>	Investigated the physiologic effects of high-flow nasal oxygen cannula (HFNC) compared with conventional oxygen therapy (COT) in subjects with acute dyspnea and hypoxemia in the emergency room
<b>Main Results</b>	HFNC significantly improved dyspnea ( $2.0 \pm 1.8$ vs $3.8 \pm 2.3$ , $p = .01$ ) and subject comfort ( $1.6 \pm 1.7$ vs $3.7 \pm 2.4$ , $p = .01$ ) compared with COT.
<b>Conclusion</b>	HFNC improved dyspnea and comfort in subjects presenting with acute dyspnea and hypoxemia in the emergency department

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