Ventilator Weaning Strategies in the ICU

RENA LALIBERTE BS, RRT, CPFT, FAARC

CLINICAL EDUCATION SPECIALIST – HENRY FORD HOSPITAL



Disclosures

- Any reference to any medical device during this lecture is strictly for educational purposes and not an endorsement
- I have no conflicts

Objectives

- Examine current data supporting use of non-invasive ventilation (NIV) post-extubation in high-risk patients
- Discuss clinical outcomes that are improved by NIV
- Demonstrate that current data supports use of high flow nasal cannula (HFNC) post-extubation in low to high-risk patients
- Review evidence for NIV + HFNC vs HFNC post-extubation
- Summarize the current available data

Case 1.

67 y/o male with COPD, CHF with EF 35%, HTN, HLD who is admitted to ICU and mechanically ventilated > 3 days for acute respiratory failure secondary to community acquired pneumonia.

Vitals: T 38.6 F; BP 140/84; HR 89; RR 22; SpO2 98% on FiO2 30% and PEEP 5

Case 1.

Physical Exam

Intubated, sedated but easily arousable

CV: Regular rate and rhythm

Resp: Mild crackles at the bases, no rhonchi

Abd: Soft, good bowel sounds

Neuro: A&O X 3, strong cough and gag

Passed SBT



Case 1.

Which of the following is true regarding extubation strategy for this patient?

1. Post-extubation NIV will only reduce rate of reintubation
2. Post-extubation NIV does not change any clinical outcomes
3. Post-extubation NIV will reduce rate of intubation and 60 d mortality
4. Post-extubation NIV is contraindicated in this patient

The Evidence

[Evidence-Based Medicine]

CHEST

Liberation From Mechanical Ventilation in Critically Ill Adults: An Official American College of Chest Physicians/American Thoracic Society Clinical Practice Guideline

Inspiratory Pressure Augmentation During Spontaneous Breathing Trials, Protocols Minimizing Sedation, and Noninvasive Ventilation Immediately After Extubation

Daniel R. Ouellette, MD, FCCP; Sheena Patel, MPH; Timothy D. Girard, MD; Peter E. Morris, MD, FCCP; Gregory A. Schmidt, MD, FCCP; Jonathon D. Truwit, MD, FCCP; Waleed Alhazzani, MD; Suzanne M. Burns, RN, MSN, ACNP, RRT; Scott K. Epstein, MD, FCCP; Andres Esteban, MD, PhD; Eddy Fan, MD, PhD; Miguel Ferrer, MD, PhD; Gilles L. Fraser, PharmD; Michelle Ng Gong, MD; Catherine L. Hough, MD; Sangeeta Mehta, MD; Rahul Nanchal, MD, FCCP; Amy J. Pawlik, DPT; William D. Schweickert, MD; Curtis N. Sessler, MD, FCCP; Thomas Strøm, MD; and John P. Kress, MD, FCCP

PICO

KQ 3: Extubation to NIV		
Populations	Patients ventilated for > 24 h who have passed an SBT but are at high risk for extubation failure	None
Interventions	Extubation to preventive NIV	None
Comparators	Extubation without preventive NIV	None
Outcomes	Duration of ventilation Ventilator-free d Extubation success Duration of ICU stay Short-term mortality (< 60 d) Long-term mortality	None
Study design	Systematic reviews, RCT, observational	None

KQ = key question; NIV = noninvasive ventilation; PICO = population, intervention, comparator, outcome; RCT = randomized controlled trial; SBT = spontaneous breathing trial.

Ouellette et al, Chest. 2017 Jan;151(1):166-180

Evidence

TABLE 6] Evidence Profile for Extubation to Noninvasive Ventilation Compared With Extubation Without Noninvasive Ventilation[35-39]

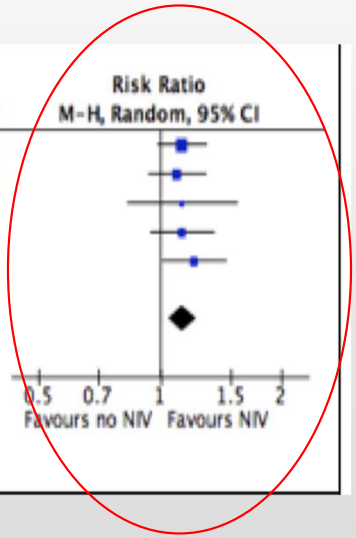
Quality Assessment							No. of Patients		Effect			
No. of Studies	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Extubation to Noninvasive Ventilation	Extubation Without Noninvasive Ventilation	Relative (95% CI)	Absolute (95% CI)	Quality	Importance
Extubation success												
5	Randomized trials	Serious[a]	Not serious	Not serious	Not serious	None	230 of 261 (88.1%)	204 of 264 (77.3%)	RR, 1.14 (1.05-1.23)	11 less per 100 (from 4 less to 18 less)	Moderate	Critical
ICU LOS												
4	Randomized trials	Serious[a]	Not serious	Not serious	Not serious	None	241	244	. . .	MD 2.48 d less (4.03 d less to 0.93 d less)	Moderate	Important
Short-term mortality (ICU mortality)												
4	Randomized trials	Serious[a]	Not serious	Not serious	Serious[b]	None	12 of 241 (5.0%)	35 of 244 (14.3%)	RR, 0.37 (0.19-0.70)	9 less per 100 (from 4 less to 12 less)	Low	Important
Long-term mortality (follow-up: 90 d)												
2	Randomized trials	Not serious	Serious[c]	Not serious	Serious[d]	None	24 of 133 (18.0%)	40 of 135 (29.6%)	RR, 0.58 (0.27-1.22)	12 less per 100 (from 7 more to 22 less)	Low	Important

Ouellette et al, Chest. 2017 Jan;151(1):166-180

Evidence

NIV improves extubation success

		Extubation to NIV		Extubation w/o NIV			Risk Ratio	Risk Ratio
		Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
NIV, 3	Extubation Success	Ferrer 2006	70	79	65	83	32.4%	1.13 [0.99, 1.30]	
		Ferrer 2009	48	54	42	52	23.4%	1.10 [0.94, 1.30]	
		Khilnani 2011	17	20	15	20	6.3%	1.13 [0.83, 1.55]	
		Mohamed 2013	51	60	45	60	19.0%	1.13 [0.95, 1.36]	
		Nava 2005	44	48	37	49	18.9%	1.21 [1.01, 1.45]	
		Total (95% CI)		**261**		**264**	**100.0%**	**1.14 [1.05, 1.23]**	
		Total events	230		204				
		Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.66$, df = 4 (P = 0.96); $I^2 = 0\%$							
		Test for overall effect: Z = 3.26 (P = 0.001)							

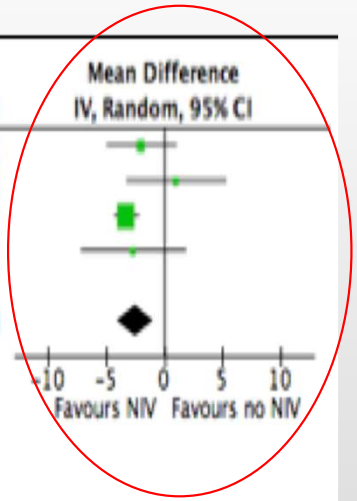


Ouellette et al, Chest. 2017 Jan;151(1):166-180

Evidence

NIV improves ICU LOS

		Extubation to NIV			Extubation w/o NIV				Mean Difference	Mean Difference
		Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
NIV, 3	ICU LOS	Ferrer 2006	11	8	79	13	11	83	20.3%	-2.00 [-4.95, 0.95]	
		Ferrer 2009	11	13	54	10	9	52	11.4%	1.00 [-3.24, 5.24]	
		Mohamed 2013	8.3	3.1	60	11.6	2.6	60	57.9%	-3.30 [-4.32, -2.28]	
		Nava 2005	8.9	5.7	48	11.6	14.9	49	10.4%	-2.70 [-7.17, 1.77]	
		Total (95% CI)			**241**			**244**	**100.0%**	**-2.48 [-4.03, -0.93]**	
		Heterogeneity: $Tau^2 = 0.81$; $Chi^2 = 4.19$, df = 3 (P = 0.24); $I^2 = 28\%$									
		Test for overall effect: Z = 3.14 (P = 0.002)									



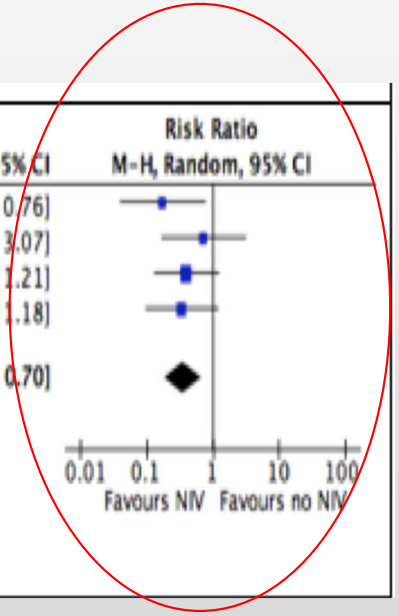
Ouellette et al, Chest. 2017 Jan;151(1):166-180

Four studies examined the outcomes of ICU length of stay and short- term mortality, with the finding that NIV was significantly better than conventional therapy for each outcome (ICU length of stay: mean difference, –2.48 days; 95% CI, –4.03 to –0.93; short-term mortality: RR, 0.37; 95% CI, 0.19-0.70).

Evidence

NIV improves short term mortality

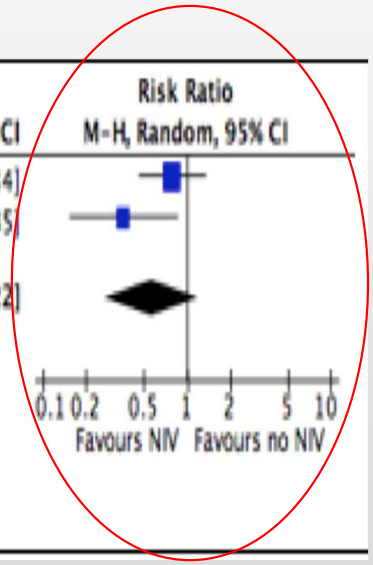
		Extubation to NIV		Extubation w/o NIV			Risk Ratio	Risk Ratio
		Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
NIV, 3	Short-term Mortality	Ferrer 2006	2	79	12	83	19.3%	0.18 [0.04, 0.76]	
		Ferrer 2009	3	54	4	52	19.8%	0.72 [0.17, 3.07]	
		Mohamed 2013	4	60	10	60	34.1%	0.40 [0.13, 1.21]	
		Nava 2005	3	48	9	49	26.8%	0.34 [0.10, 1.18]	
		Total (95% CI)		**241**		**244**	**100.0%**	**0.37 [0.19, 0.70]**	
		Total events	12		35				
		Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.89$, df = 3 (P = 0.60); $I^2 = 0\%$							
		Test for overall effect: Z = 3.05 (P = 0.002)							



Evidence

NIV improves long term mortality

		Extubation to NIV		Extubation w/o NIV			Risk Ratio	Risk Ratio
	Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
NIV, 3	Ferrer 2006	18	79	24	83	59.7%	0.79 [0.46, 1.34]	
Long-term Mortality	Ferrer 2009	6	54	16	52	40.3%	0.36 [0.15, 0.85]	
	Total (95% CI)		**133**		**135**	**100.0%**	**0.58 [0.27, 1.22]**	
	Total events	24		40				
	Heterogeneity: $Tau^2 = 0.18$; $Chi^2 = 2.33$, df = 1 (P = 0.13); $I^2 = 57\%$							
	Test for overall effect: Z = 1.44 (P = 0.15)							



Two studies[36,37] demonstrated significantly lower long-term mortality with NIV compared with standard care in high-risk patients following extubation (RR, 0.58; 95% CI, 0.27-1.22). There was heterogeneity between studies in defining the high- risk patient.

Return to Case 1.

Which of the following is true regarding extubation strategy for this patient?

1. Post-extubation NIV will only reduce rate of reintubation
2. Post-extubation NIV does not change any clinical outcomes
3. Post-extubation NIV will reduce rate of intubation and 60 d mortality
4. Post-extubation NIV is contraindicated in this patient

Who qualifies as a high-risk patient?

Studies are heterogenous:

1. **Nava et al (2005)**: Failed >1 SBT, $PaCO_2$ > 45 mm Hg after extubation, > 1 comorbid condition, weak cough, or upper airway stridor that did not require immediate reintubation
2. **Ferrer et al (2006)**: Age > 65 years, cardiac failure as a cause for respiratory failure, an APACHE II score > 12 on the day of extubation
3. **Ferrer et al (2009)**: Mechanically ventilated patients who had hypercapnia with a $PaCO_2$ > 45 mm Hg during a successful SBT
4. **Khilani et al (2011)**: Any age, acute COPD exacerbation, type 2 respiratory failure requiring mechanical ventilation >48 hours
5. **Mohamed et al (2013)**: >18 years of age suffering respiratory failure and mechanically ventilated for 48 h or more and tolerated a weaning trial after recovery of their disease that caused respiratory failure

Who qualifies as a high-risk patient?

Think of .....

Age >65

COPD

Chronic hypercapnia ($PaCO_2$ >45 mmHg)

CHF

Failed SBTs

Significant comorbidities

Severity of illness

Case 2

Does our patient qualify as high risk?

67 y/o male with COPD, CHF with EF 35%, HTN, HLD who is admitted to ICU and mechanically ventilated > 3 days for acute respiratory failure secondary to community acquired pneumonia.

YES

Case 3

Does this patient qualify as high risk?

40 y/o female with HTN intubated for angioedema secondary to lisinopril. 36 hours post intubation, she is awake and alert, passes SBT, +ve cuff leak test. ABG is within normal range. Would she benefit from extubation to NIV?

NO

Case 4

Does this patient qualify as high risk?

82 y/o male with BPH, HTN, and HLD admitted with influenza A pneumonia requiring intubation for 3 days. Now on minimal vent settings, passes SBT.

ABG → pH 7.37 $PaCO_2$ 40 PaO_2 98 HCO_3 24.

Would he benefit from extubation to NIV?

NO

Case 5

70 y/o male with COPD on 2 L O2 at home, CHF, HTN, and HLD.

Intubated due to acute hypercapnic respiratory failure secondary to acute COPD exacerbation. After 2 days, he is no longer wheezing. ABG is normalized. Passes SBT trial and is subsequently extubated. Ten hours later patient has worsening respiratory distress with worsening hypercapnia.

Case 5

Which of the following is true?

1. Application of NIV will improve mortality
2. Application of NIV is associated with increased mortality
3. Application of NIV will reduce rate of reintubation compared to supplemental O2 therapy
4. Application of NIV will decrease ICU LOS

Evidence

ORIGINAL ARTICLE

Noninvasive Positive-Pressure Ventilation for Respiratory Failure after Extubation

Andrés Esteban, M.D., Ph.D., Fernando Frutos-Vivar, M.D.,
Niall D. Ferguson, M.D., Yaseen Arabi, M.D.,
Carlos Apezteguía, M.D., Marco González, M.D., Scott K. Epstein, M.D.,
Nicholas S. Hill, M.D., Stefano Nava, M.D., Marco-Antonio Soares, M.D.,
Gabriel D'Empaire, M.D., Inmaculada Alía, M.D., and Antonio Anzueto, M.D.

Esteban et al. New England Journal of Medicine. 2004 Jun 10;350(24):2452-60

Evidence

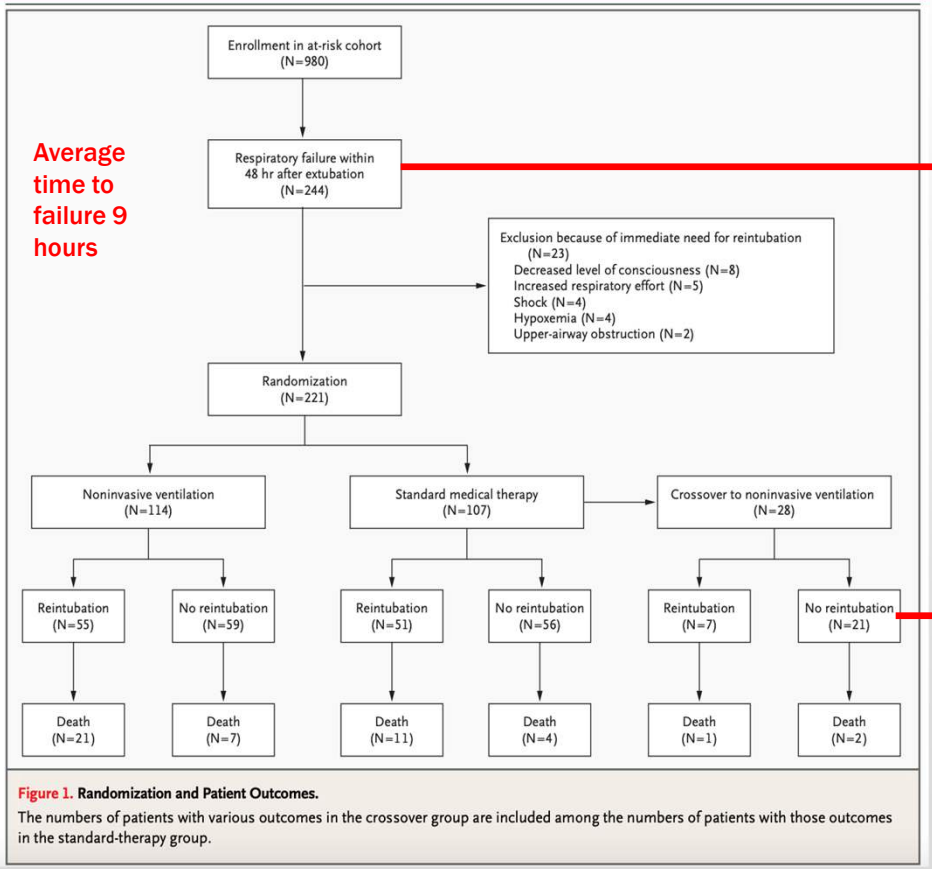


Figure 1. Randomization and Patient Outcomes.
The numbers of patients with various outcomes in the crossover group are included among the numbers of patients with those outcomes in the standard-therapy group.

Average time to failure 9 hours

Respiratory Failure: 2 out of 4

1. Resp Acidosis (defined as an arterial pH < 7.35 with pCO2 >45 mmHg)
2. clinical signs of respiratory muscle fatigue or increased respiratory effort
3. RR > 25 for two consecutive hours
4. O2 sat <90% or PaO2 <80 mmHg with FiO2 >0.5

Reintubation was considered if at least 1 hour of NIV or standard therapy and 1 of the following:

1. Lack of improvement in the pH or PaCo2
2. Change in mental status → cannot use NIV
3. O2 sat < 85% despite high FiO2
4. Lack of improvement in signs of respiratory-muscle fatigue
5. Hypotension
6. Copious secretions that could not be adequately cleared or that were associated with acidosis, hypoxemia, or changes in mental status.

Evidence

- Primary Outcome - Mortality
- 28/114 pts in NIV (25%, 95% CI 17-34)
- Vs
- 15/107 in standard medical therapy
- (14%; 95% CI 8-23)

- **P=0.048**

Worse mortality in NIV group

Table 4. Reasons for Reintubation, as Defined in the Protocol Guidelines, According to Study Group.

Reason	Non-invasive Ventilation (N=55)	Standard Medical Therapy (N=51)	P Value
	no. (%)		
Lack of improvement in signs of muscle fatigue	25 (45)	23 (45)	0.97
Hypoxemia	9 (16)	15 (29)	0.11
Copious secretions	5 (9)	6 (12)	0.65
Lack of improvement in pH or partial pressure of carbon dioxide	8 (15)	3 (6)	0.13
Changes in mental status	4 (7)	2 (4)	0.45
Hypotension	4 (7)	2 (4)	0.45

No difference in rate of reintubation
No difference in ICU LOS

Case 5

Which of the following is true?

1. Application of NIV will improve mortality
2. Application of NIV is associated with increased mortality 
3. Application of NIV will reduce rate of reintubation compared to supplemental O2 therapy
4. Application of NIV will decrease ICU LOS

Question

Which of the following is true?

1. Extubation to HFNC will reduce rate of reintubation as compared to standard O2 therapy.

2. Extubation to HFNC will reduce time to reintubation

3. Extubation to HFNC will not reduce rate of intubation as compared to standard O2 therapy

4. Extubation to HFNC will reduce rate of intubation but does not reduce time to reintubation.

Case 6

42 y/o male with BMI 27 and PMH of seizures who was intubated for airway protection in the setting of seizures and AMS. Patient was loaded with antiepileptics and 24 hours later, patient was awake on the vent and following commands. Vitals were stable. Labs showed mild hyponatremia to 130 but otherwise unremarkable. APACHE II score is 5.

Passes SBT.

Evidence

Original Investigation | Caring for the Critically Ill Patient

FREE

April 5, 2016

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

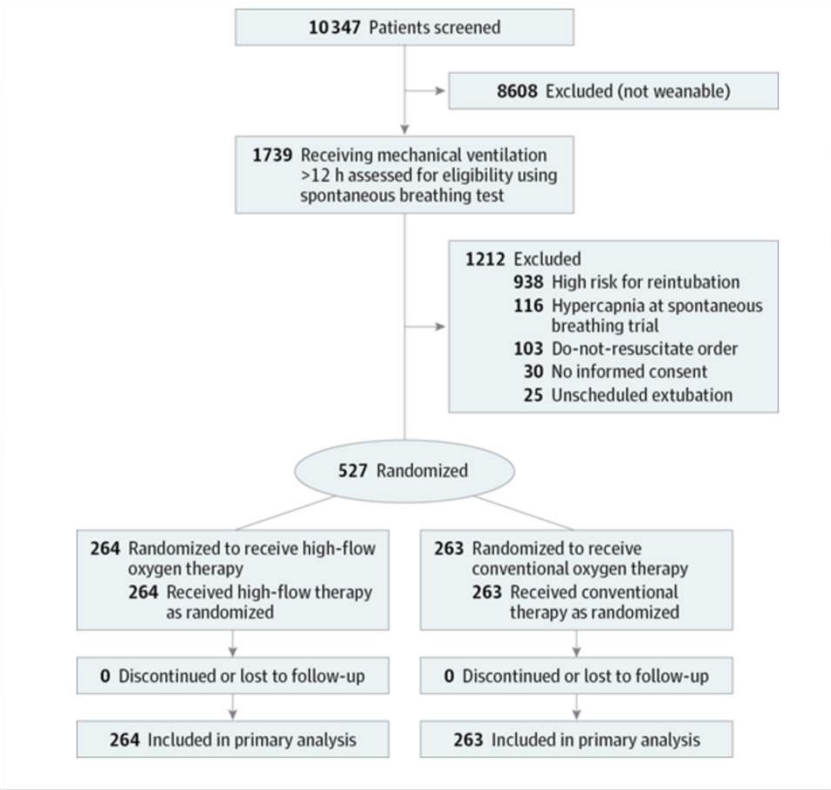
A Randomized Clinical Trial

Gonzalo Hernández, MD, PhD[1]; Concepción Vaquero, MD[2]; Paloma González, MD[3]; et al

» Author Affiliations | Article Information

JAMA. 2016;315(13):1354-1361. doi:10.1001/jama.2016.2711

Evidence



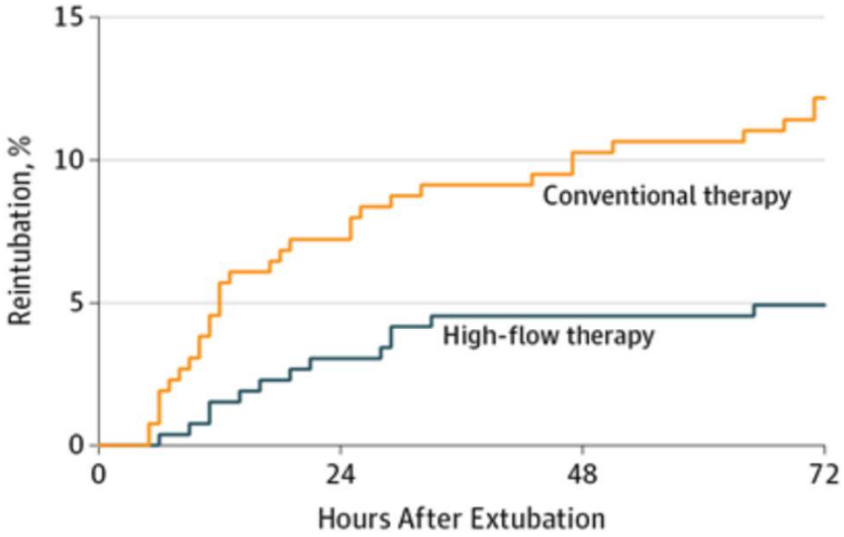
Low Risk of Intubation: All of the following

1. < 65 years
2. APACHE II < 12 on day of extubation
3. BMI < 30
4. Adequate secretions management
5. Simple weaning
6. 0 or 1 comorbidity
7. No CHF, COPD, airway obstruction, prolonged MV

HF versus NC for 24 hours

Evidence

Figure 2. Kaplan-Meier Analysis of Time From Extubation to Reintubation



No. at risk				
Conventional therapy	263	244	236	231
High-flow therapy	264	256	252	251

Evidence

Table 2. Primary and Secondary Outcomes

Variable	Oxygen Therapy: High-Flow (n = 264)	Oxygen Therapy: Conventional (n = 263)	Difference Between Groups (95% CI)	*P* Value
Primary Outcome				
All-cause reintubation, No. (%)	13 (4.9)	32 (12.2)	7.2 (2.5 to 12.2)	.004[a]
Secondary Outcomes				
Postextubation respiratory failure, No. (%)	22 (8.3)	38 (14.4)	6.1 (0.7 to 11.6)	.03[a]
Respiratory infection, No. (%)	6 (2.3)	13 (4.9)	2.7 (−0.6 to 6.2)	.07[a]
Ventilator-associated tracheobronchitis	3 (1.1)	7 (2.6)	1.5 (−1.0 to 4.4)	.22[a]
Ventilator-associated pneumonia	3 (1.1)	6 (2.3)	1.2 (−1.3 to 3.9)	.31[a]
Causes of postextubation respiratory failure, No. (%)				
Respiratory acidosis[c]	1 (4.5)	4 (10.5)		
Hypoxia[c]	7 (31.8)	6 (15.8)		
Unbearable dyspnea	9 (40.9)	14 (28.9)		.10[b]
Decreased level of consciousness	2 (9)	0		
Inability to clear secretions	3 (13.6)	14 (36.8)		
Reasons for reintubation, No. (%)				
Respiratory causes for reintubation				
Cardiorespiratory arrest	0	1 (0.4)		
Agitation	1 (0.4)	0		
Inability to clear secretions	0	5 (1.9)		
Hemodynamic impairment[d]	1 (0.4)	1 (0.4)		.02[b]
Persistent postextubation respiratory failure	2 (0.8)	16 (6)		
Nonrespiratory causes for reintubation				
Surgery	4 (1.5)	6 (2.3)		
Low level of consciousness[e]	5 (1.9)	3 (1.1)		
Sepsis, No. (%)	2 (0.7)	1 (0.4)	−0.4 (−2.4 to 1.5)	.99[b]
Multiorgan failure, No. (%)	1 (0.4)	0	−0.4 (−2.1 to 1.1)	.99[b]
Time to reintubation, median (IQR), h	19 (12 to 28)	15 (9 to 31)	−4 (−54 to 46)	.66[f]
ICU length of stay, median (IQR), d	6 (2 to 8)	6 (2 to 9)	0 (−10 to 24)	.29[f]
Hospital length of stay, median (IQR), d	11 (6 to 15)	12 (6 to 16)	4 (−28 to 32)	.76[f]
ICU mortality	3 (1.1)	3 (1.1)	0 (−2.3 to 2.3)	.99[a]
Hospital mortality	10 (3.8)	13 (5)	1.2 (−2.5 to 4.9)	.94[a]
Adverse events, nasal mucosa and skin trauma	0	NA	NA	NA

Abbreviations: ICU, intensive care unit; IQR, interquartile range; NA, not applicable.

[a] Cochran-Mantel-Haenszel χ^2 test stratified according to recruiting hospital.

[b] Fisher exact test or χ^2.

[c] Respiratory acidosis: pH less than 7.35 with $Paco_2$ greater than 45 mm Hg; hypoxia: Spo_2 less than 90% or Pao_2 less than 60 mm Hg at Fio_2 greater than 0.4.

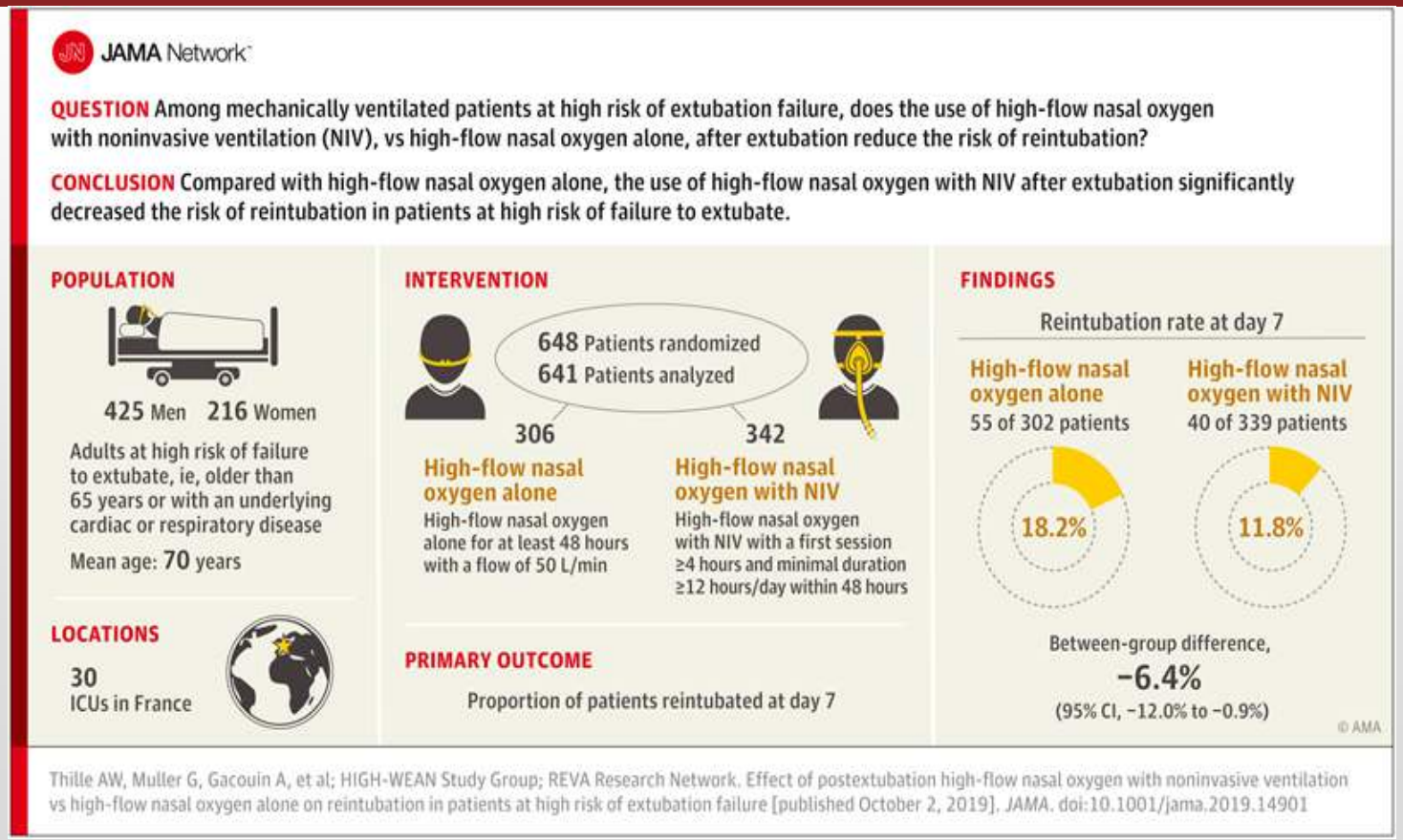
[d] Heart rate less than 50/min with loss of alertness, or severe hemodynamic instability (systolic blood pressure <90 mm Hg for >30 min) unresponsive to fluids and vasoactive drugs.

[e] Criteria for reintubation secondary to low level of consciousness: decrease in Glasgow Coma Scale score more than 2 points or score less than 9 points with $Paco_2$ less than 45 mm Hg.

[f] Mann-Whitney *U*.

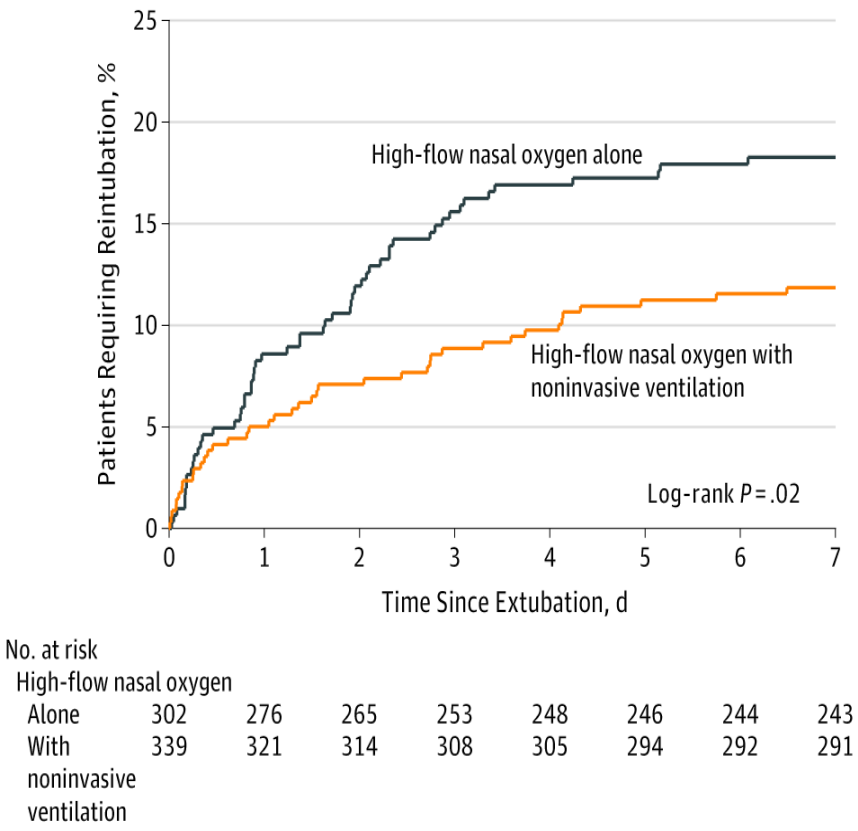
Hernández et al. *JAMA*.2016;315(13):1354–1361. doi:10.1001/jama.2016.2711

Evidence



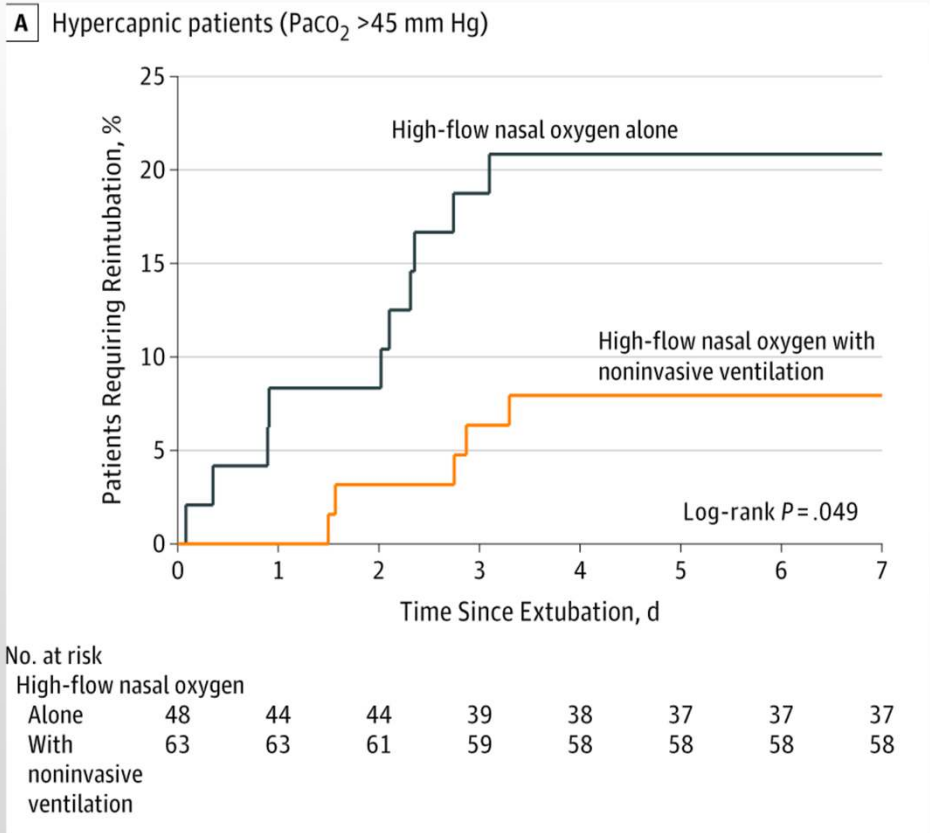
Thille et al. *JAMA*. 2019;322(15):1465–1475. doi:10.1001/jama.2019.14901

Evidence



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



No. at risk

High-flow nasal oxygen								
Alone	48	44	44	39	38	37	37	37
With noninvasive ventilation	63	63	61	59	58	58	58	58

Evidence

Meta-Analysis > Intensive Care Med. 2022 Feb;48(2):137-147.
doi: 10.1007/s00134-021-06581-1. Epub 2021 Nov 25.

Noninvasive respiratory support following extubation in critically ill adults: a systematic review and network meta-analysis

Shannon M Fernando [1 2], Alexandre Tran [3 4 5], Behnam Sadeghirad [6 7], Karen E A Burns [7 8 9], Eddy Fan [8 10 11 12], Daniel Brodie [13 14], Laveena Munshi [8 10 11], Ewan C Goligher [8 10 11 12], Deborah J Cook [7 15], Robert A Fowler [8 10 16], Margaret S Herridge [8 10 11 12], Pierre Cardinal [3], Samir Jaber [17 18], Morten Hylander Møller [19], Arnaud W Thille [20 21], Niall D Ferguson [8 10 11 12], Arthur S Slutsky [8 9], Laurent J Brochard [8 9], Andrew J E Seely [# 3 4 5 22], Bram Rochwerg [# 7 15]

Affiliations + expand

PMID: 34825256 DOI: 10.1007/s00134-021-06581-1

Fernando et. Intensive Care Med. 2022 Feb;48(2):137-147. doi: 10.1007/s00134-021-06581-1. Epub 2021 Nov 25. PMID: 34825256.

Evidence

Table 2 Network and absolute estimates evaluating the efficacy of the interventions for prevention of reintubation in critically ill adults

Comparison	Network odds ratio (95% CI)	Absolute risk difference (95% CI)	Number needed to treat	GRADE
NIPPV vs conventional oxygen	0.65 (0.52–0.82)	– 5.18 (– 8.09 to – 2.26)	20 (13 to 45)	Moderate[a]
HFNC vs conventional oxygen	0.63 (0.45–0.87)	– 3.84 (– 6.7 to – 0.98)	26 (15 to 102)	Moderate[a]
NIPPV vs HFNC	1.04 (0.78–1.38)	– 1.34 (– 4.4 to 1.72)	N/A	Low[a,b]
HFNC + NIPPV vs conventional oxygen	0.38 (0.19–0.74)	– 10.25 (– 18.49 to – 2.01)	10 (6 to 50)	Moderate[a]
HFNC + NIPPV vs NIPPV	0.58 (0.3–1.11)	– 5.07 (– 13.38 to 3.24)	N/A	Low[a,b]
HFNC + NIPPV vs HFNC	0.6 (0.33–1.08)	– 6.41 (– 14.13 to 1.31)	N/A	Low[a,b]

NIPPV noninvasive positive pressure ventilation, *HFNC* high-flow nasal cannula, *GRADE* grading of recommendations assessment, development, and evaluation, *OR* odds ratio, *CI* confidence interval

[a] Lowered for risk of bias

[b] Lowered one level for imprecision as CIs don't exclude harm

Evidence

Table 3 Network estimates evaluating the efficacy of the interventions for prevention of short-term all-cause mortality in critically ill adults

Comparison	Network odds ratio (95% CI)	Absolute risk difference (95% CI)	GRADE
NIPPV vs conventional oxygen	0.8 (0.61–1.04)	– 1.65 (– 3.81 to 0.5)	Moderate[b]
HFNC vs conventional oxygen	0.9 (0.66–1.24)	– 0.29 (– 1.58 to 1.01)	Low[a]
NIPPV vs HFNC	0.89 (0.69–1.13)	– 1.37 (– 3.47 to 0.72)	Moderate[b]
HFNC + NIPPV vs conventional oxygen	0.95 (0.56–1.62)	0.41 (– 5.36 to 6.18)	Low[a]
HFNC + NIPPV vs NIPPV	1.19 (0.73–1.95)	2.07 (– 3.93 to 8.07)	Low[a]
HFNC + NIPPV vs HFNC	1.05 (0.69–1.62)	0.7 (– 4.93 to 6.33)	Low[a]

NIPPV noninvasive positive pressure ventilation, *HFNC* high-flow nasal cannula, *GRADE* grading of recommendations assessment, development, and evaluation, *OR* odds ratio, *CI* confidence interval

Imprecision only incorporated at network level not at direct or indirect

[a] Lowered two levels for imprecision as wide CIs don't exclude important harm

[b] Lowered one level for imprecision as CIs don't exclude harm

Question

Which of the following is true?

1. Extubation to HFNC will reduce rate of reintubation as compared to standard O2 therapy.

2. Extubation to HFNC will reduce time to reintubation

3. Extubation to HFNC will not reduce rate of intubation as compared to standard O2 therapy

4. Extubation to HFNC will reduce rate of intubation but does not reduce time to reintubation.

Case 6

72 y/o female with COPD, HTN, CHF with EF 40% intubated for acute hypoxic respiratory failure secondary to CHF exacerbation. On Day 3 patient passes SBT.

Which of the following would you choose as an extubation strategy?

1. Extubation to NIV + HFNC
2. Extubation to NIV alone
3. Extubation to HFNC
4. Extubation to 6L NC

Key Points - Conclusion

1. HFNC vs NIV → equally efficacious in post extubation period to prevent reintubation compared to conventional oxygen therapy

2. Use NIV prophylactically post extubation as compared to at the time of extubation failure as it is associated with increased mortality

3. Use NIV + HFNC versus HFNC to prevent reintubation in high risk patients

4. Always take into account the accessible resources you have as some of the above interventions may be limited based on the availability of resources

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Questions?

