NIV for Acute Respiratory Failure

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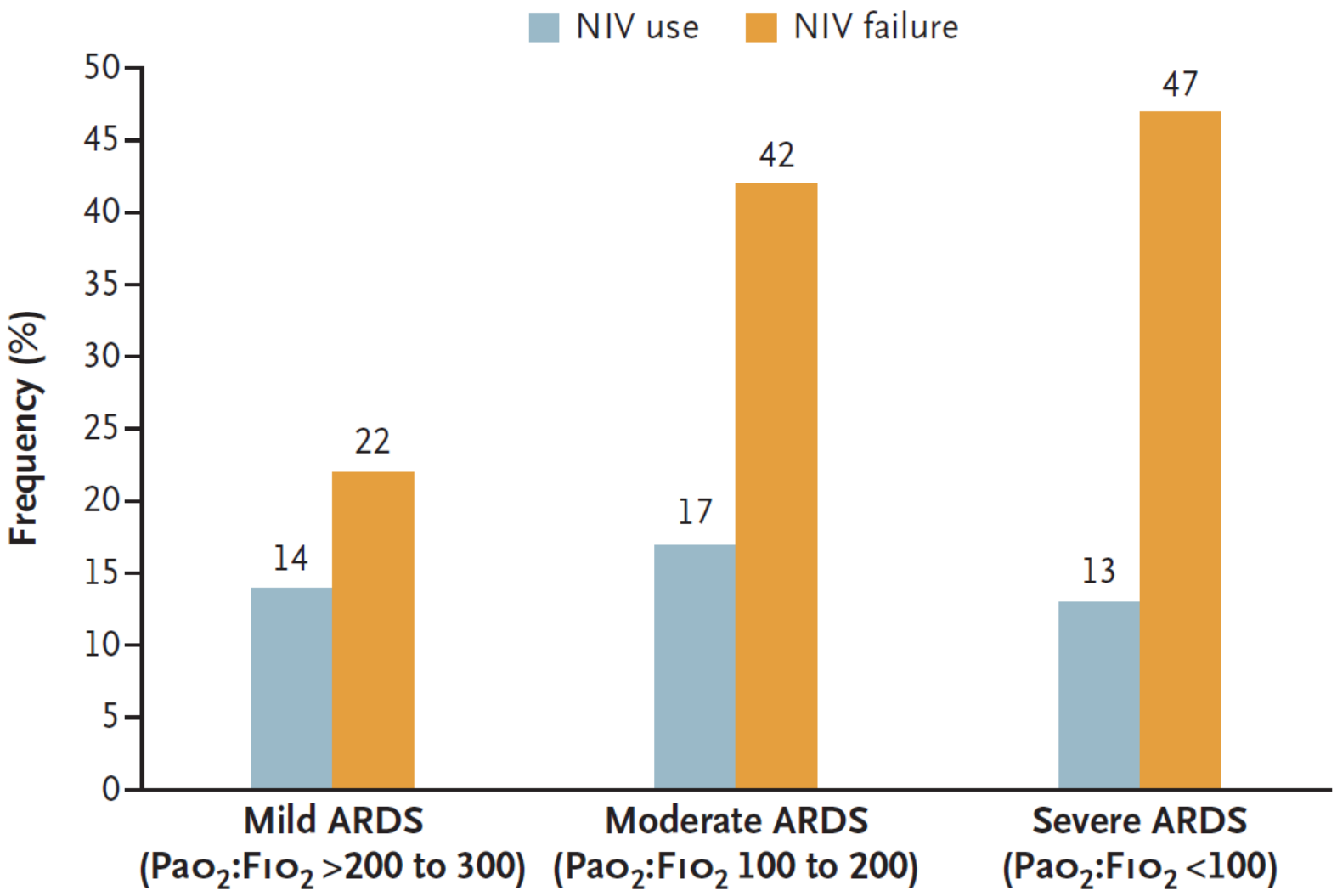
Evidence for NIV across acute care condition

Clinical indication[#]	Certainty of evidence[¶]	Recommendation
Prevention of hypercapnia in COPD exacerbation	⊕⊕	Conditional recommendation against
Hypercapnia with COPD exacerbation	⊕⊕⊕⊕	Strong recommendation for
Cardiogenic pulmonary oedema	⊕⊕⊕	Strong recommendation for
Acute asthma exacerbation		No recommendation made
Immunocompromised	⊕⊕⊕	Conditional recommendation for
***De novo* respiratory failure**		No recommendation made
Post-operative patients	⊕⊕⊕	Conditional recommendation for
Palliative care	⊕⊕⊕	Conditional recommendation for
Trauma	⊕⊕⊕	Conditional recommendation for
Pandemic viral illness		No recommendation made
Post-extubation in high-risk patients (prophylaxis)	⊕⊕	Conditional recommendation for
Post-extubation respiratory failure	⊕⊕	Conditional recommendation against
Weaning in hypercapnic patients	⊕⊕⊕	Conditional recommendation for

[#]: all in the setting of acute respiratory failure; [¶]: certainty of effect estimates: ⊕⊕⊕⊕, high; ⊕⊕⊕, moderate; ⊕⊕, low; ⊕, very low.

Eur Respir J 2017;50:1602426

Frequency of use and failure face-mask NIV for Lung SAFE study

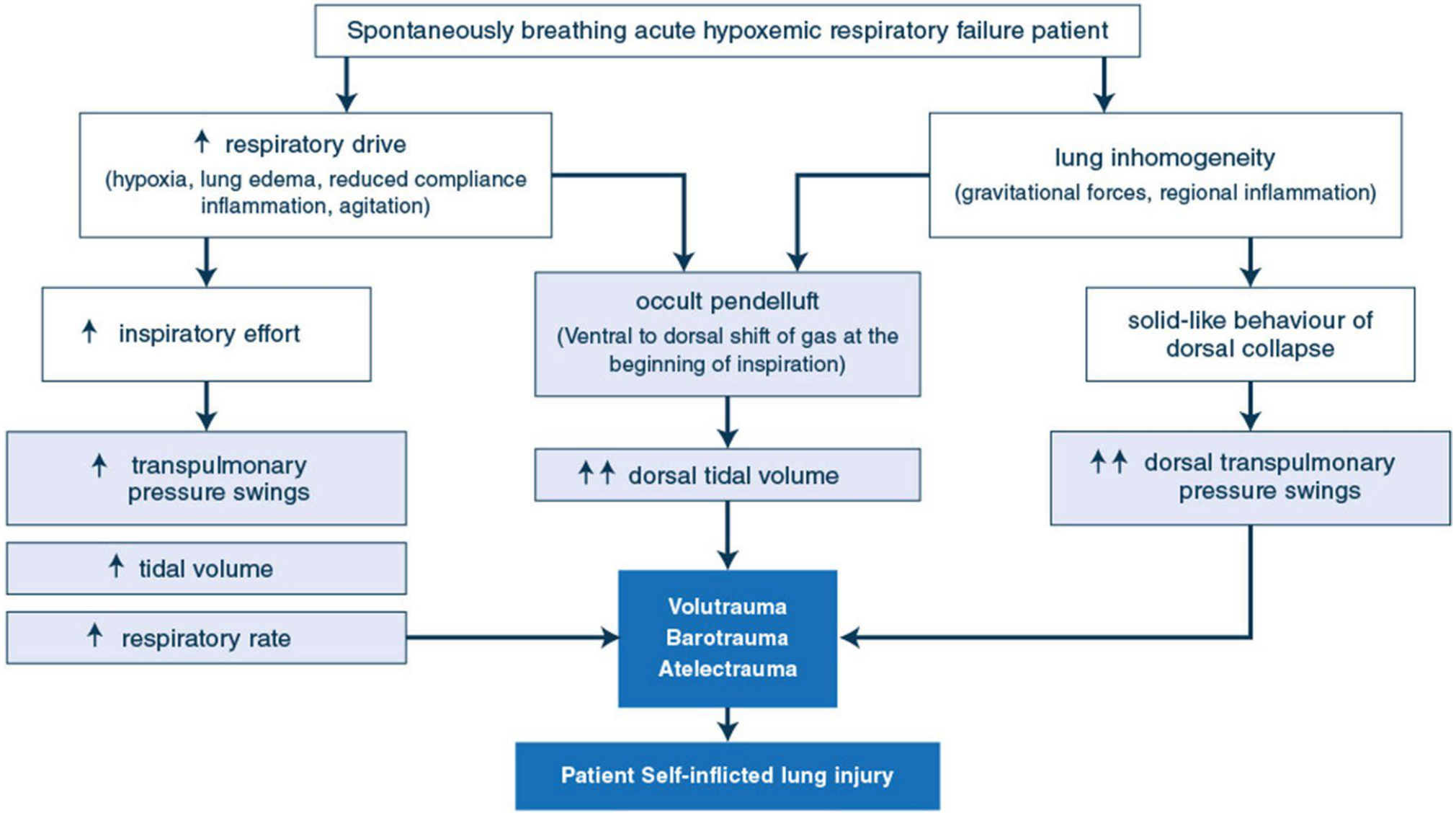


NEJM 2022;387:1688-98

NIV of patients with ARDS, insight from the LUNG SAFE study

	ARDS-NIV (without Treatment Limitations)		
	Success	Failure	*P* Value
Patients, n (%)			0.001
All	218 (62.5)	131 (37.5)	
Mild ARDS	77 (77.8)	22 (22.2)	
Moderate ARDS	105 (57.7)	77 (42.3)	
Severe ARDS	36 (52.9)	32 (47.1)	
Male, n (%)	129 (59.2)	80 (61.1)	0.727
Age, median (IQR)	66.5 (52 to 78)	63.0 (53 to 74)	0.081
ICU mortality, n (%)			
All	23 (10.6)	56 (42.7)	<0.001
Patients with $Pa_{O_2}/F_{I_{O_2}}$ ratio <150 mm Hg	13 (14.6)	36 (45.0)	<0.001
Patients with $Pa_{O_2}/F_{I_{O_2}}$ ratio ⩾150 mm Hg	10 (7.8)	20 (39.2)	<0.001
Hospital mortality, n (%)	35 (16.1)	59 (45.4)	<0.001
Parameters at day of ARDS onset, mean ± SD			
Pa_{O_2}, mm Hg	88.6 ± 31.6	83.1 ± 30.5	0.097
$F_{I_{O_2}}$	0.58 ± 0.22	0.63 ± 0.21	0.007
$Pa_{O_2}/F_{I_{O_2}}$ ratio, mm Hg	171 ± 65	145 ± 60	<0.001
pH	7.38 ± 0.09	7.38 ± 0.09	0.967
Pa_{CO_2}, mm Hg	48 ± 17	44 ± 17	0.009
Base excess, mmol/L	1.91 ± 6.73	−0.02 ± 6.83	0.002
PEEP, cm H_2O	7 ± 2	7 ± 2	0.478
Total respiratory rate, breaths/min	25 ± 6	27 ± 8	0.012
Minute ventilation, L/min	12.71 ± 5.07	14.03 ± 6.25	0.107
Tidal volume, ml/kg PBW	8.38 ± 2.60	8.65 ± 3.11	0.795
Nonpulmonary SOFA score adjusted	2 ± 3	3 ± 3	0.019
Patients under pressors agents, n (%)	23 (11.7)	18 (15.1)	0.376
Use of CPAP, n (%)	59 (27.1)	35 (26.7)	0.907

AJRCCM 195(1),66-77,2016



Intensive Care Medicine 2021;47,851-866

Predictor of intubation in patients with AHRF

Multivariate logistic regression of factors ass. with intubation

Risk Factors		OR (95% CI)	*p*
In patients treated with conventional O_2 therapy by nonrebreathing mask[a]	**50 vs 44**		
Respiratory rate ≥ 30 breaths/min at H1		2.76 (1.13–6.75)	0.03
In patients treated with high-flow nasal cannula oxygen therapy[a]	**66 vs 40**		
Heart rate at H1 (per beat/min)		1.03 (1.01–1.06)	< 0.01
In patients treated with noninvasive ventilation[ab]	**55 vs 55**		
Tidal volume > 9 mL/kg of predicted body weight at H1		3.14 (1.22–8.06)	0.02
Pao_2/Fio_2 ≤ 200 mm Hg at H1		4.26 (1.62–11.16)	0.003

CCM 2018;46:208-215

- **Oronasal Mask NIV vs Standard Oxygen Therapy**

  High Flow Oxygenation

- **Helmet NIV vs Standard Oxygen Therapy**

  Oronasal NIV

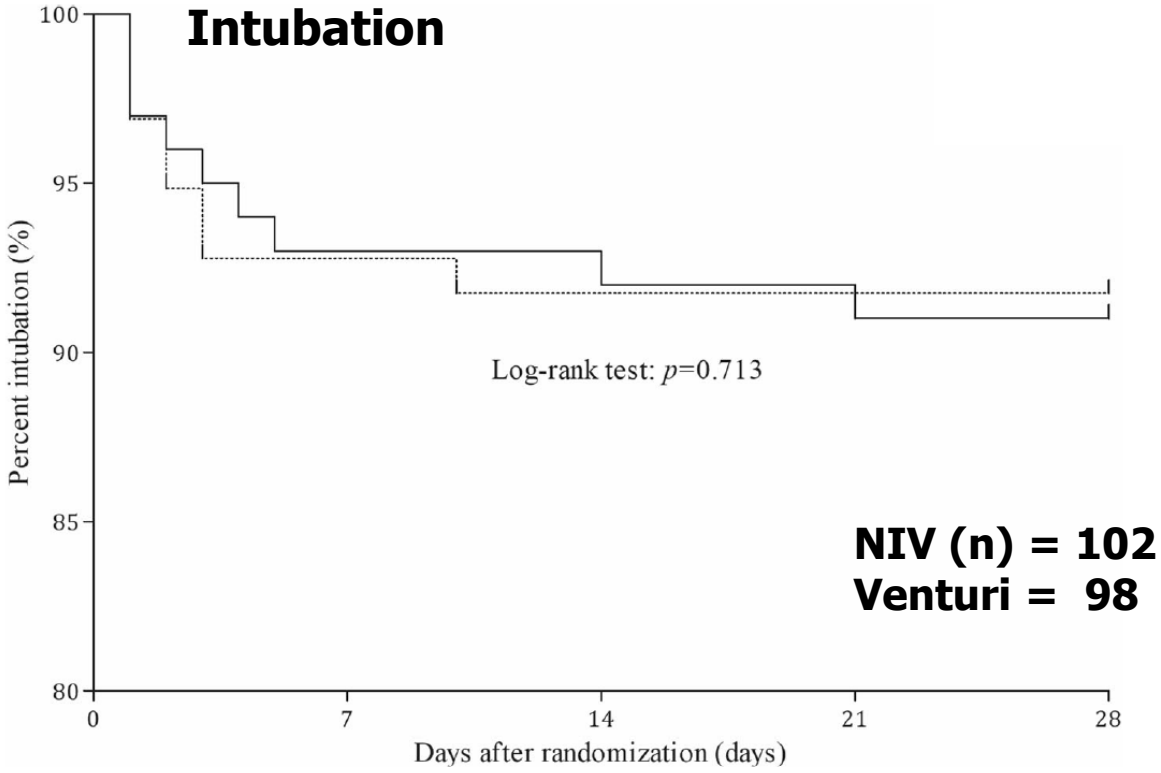
  High Flow Oxygenation

A multicenter RCT of NIV in pneumonia-induced early mild ARDS

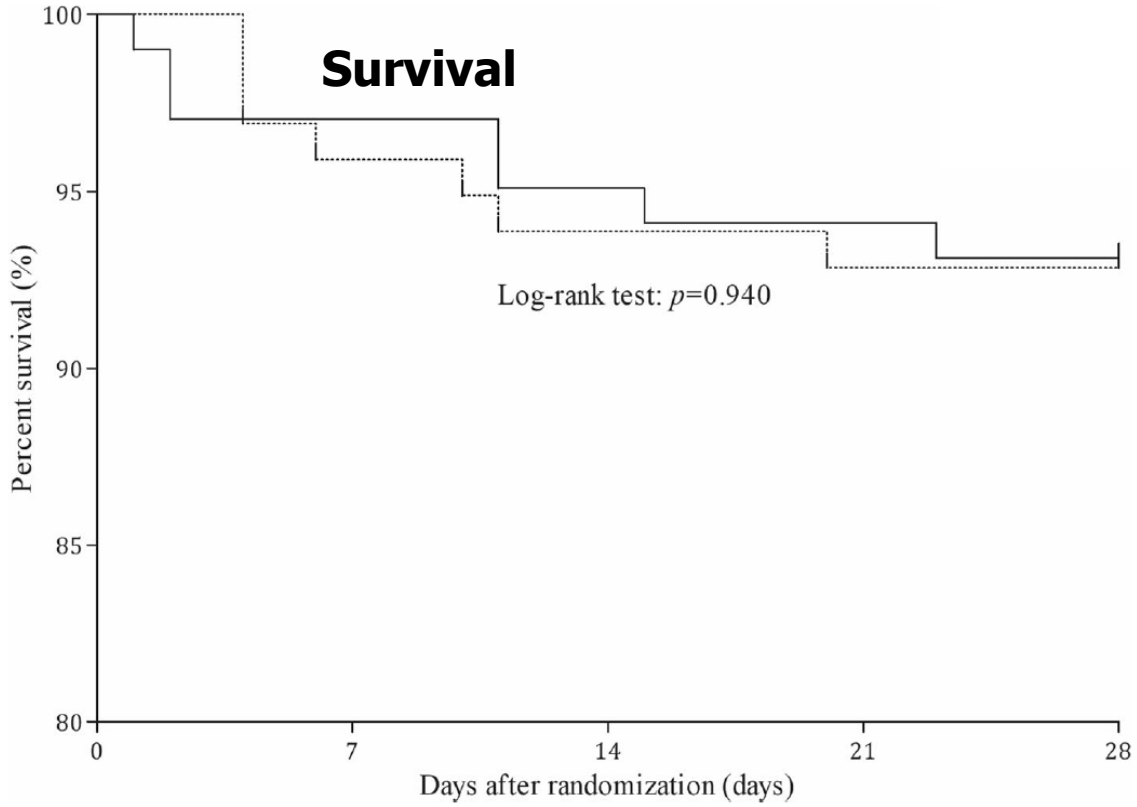
(Oronasal mask vs Venturi mask)

(PF ratio 200-300)

IPAP 14 / EPAP 6



NIV (n) = 102
Venturi = 98



Critical Care (2019) 23:300

Acute Respiratory Failure in Patients with Severe CAP

(Oronasal mask vs O_2)

Inclusion

- **RR > 35**
- **Accessary muscles**
- **PaO_2 < 68 on FiO_2 ≥ 0.4**
- **PF ratio < 250 on FiO_2 ≥ 0.5**
- **$PaCO_2$ > 50 with pH < 7.33**
- **50% in size of infiltration**
- **SBP ≤ 90 or DBP ≤ 60**
- **Vasopressor > 4h**
- **UO < 80 cc in 4h**

	Patients with COPD			Patients without COPD		
	Noninvasive Ventilation	Standard Treatment	p Value	Noninvasive Ventilation	Standard Treatment	p Value
Number	12	11		16	17	
Age	68.4 ± 4.8	73.0 ± 5.1	0.52	64.2 ± 4.2	53.3 ± 4.1	0.07
pH	7.28 ± 0.04	7.27 ± 0.06	0.13	7.39 ± 0.1	7.37 ± 0.1	0.57
Pa_{O_2}:FI_{O_2}	194 ± 31	170 ± 42	0.64	165 ± 30	164 ± 52	0.94
Pa_{CO_2}	73 ± 7	68 ± 9	0.15	32 ± 7	34 ± 5	0.35
APACHE II score	20.1 ± 1.5	21.4 ± 1.5	0.55	19.9 ± 1.3	16.3 ± 1.2	0.05
Met intubation criteria	0 (0.0%)	6 (54.6%)	0.005	6 (37.5%)	8 (47.1%)	0.73
Avoided intubation	12 (100%)	5 (45.5%)	0.005	10 (62.5%)	9 (52.9%)	0.73
Nurse workload						
Day 1	7.3 ± 0.5	8.7 ± 0.5	0.06	8.5 ± 0.5	6.4 ± 0.5	0.005
Days 1–3	6.1 ± 0.6	8.1 ± 0.7	0.04	7.1 ± 0.7	5.5 ± 0.6	0.08
Duration of intubation, d	0	12.3 ± 3.9	0.00	6.8 ± 4.2	8.0 ± 3.4	0.41
Duration of use of MV, h	69 ± 36	220 ± 281	0.07	119 ± 105	195 ± 282	0.31
Duration of ICU stay, d	0.25 ± 2.1	7.6 ± 2.2	0.02	2.9 ± 1.8	4.8 ± 1.7	0.44
Duration of hospital stay, d	14.9 ± 3.4	22.5 ± 3.5	0.13	17.9 ± 2.9	15.1 ± 2.8	0.48
Hospital mortality	1 (8.3%)	2 (18.2%)	0.59	6 (37.5%)	4 (23.5%)	0.47
2-mo mortality	1/9 (11.1%)	5/8 (62.5%)	0.05	6/14 (42.9%)	5/15 (33.3%)	0.71

AJRCCM 1999;160:1585-1591

Effect of NIV vs Oxygen therapy on Mortality Among immunocompromised Patients with ARF (Oronasal mask vs O_2)

Inclusion

- **RR > 35**
- **PaO_2 < 60 on RA**
- **Respiratory distress**
- **Hematologic or solid tumor (Active or remission < 5 yrs)**
- **Solid organ transplantation**
- **Immunosuppressants**

	Oxygen Alone (n = 183)	Noninvasive Ventilation (n = 191)	Absolute Difference (95% CI)	*P* Value
Primary End Point				
All cause 28-d mortality, No. (%)	50 (27.3)	46 (24.1)	−3.2 (−12.1 to 5.6)	.47
Secondary End Points				
Need for invasive mechanical ventilation, No. (%)	82 (44.8)	73 (38.2)	−6.6 (−16.6 to 3.4)	.20
SOFA on day 3, median (IQR)	4 (2-6)	4 (2-5)	−0.5 (−1.2 to 0.3)	.17
ICU-acquired infection, No. (%)	46 (25.1)	48 (25.1)	0 (−8.8 to 8.8)	.99
Length of ICU stay, median (IQR), d	7 (3-16)	6 (3-16)	−0.3 (−3.2 to 2.6)	.55
Duration of mechanical ventilation, median (IQR), d	14 (6-33)	17 (6-38)	0.3 (−5.7 to 6.3)	.70
Length of hospital stay, median (IQR), d	22 (14-42)	24 (12-43)	0.3 (−5 to 5.5)	.99
Mortality at 6 mo, No. (%)[a]	82/181 (45.3)	72/182 (39.6)	−5.7 (−16.4 to 3.9)	.23
Good performance status in 6-mo survivors, No. (%)[b]	70/75 (93.3)	85/91 (93.4)	−0.1 (−7.7 to 7.5)	.98

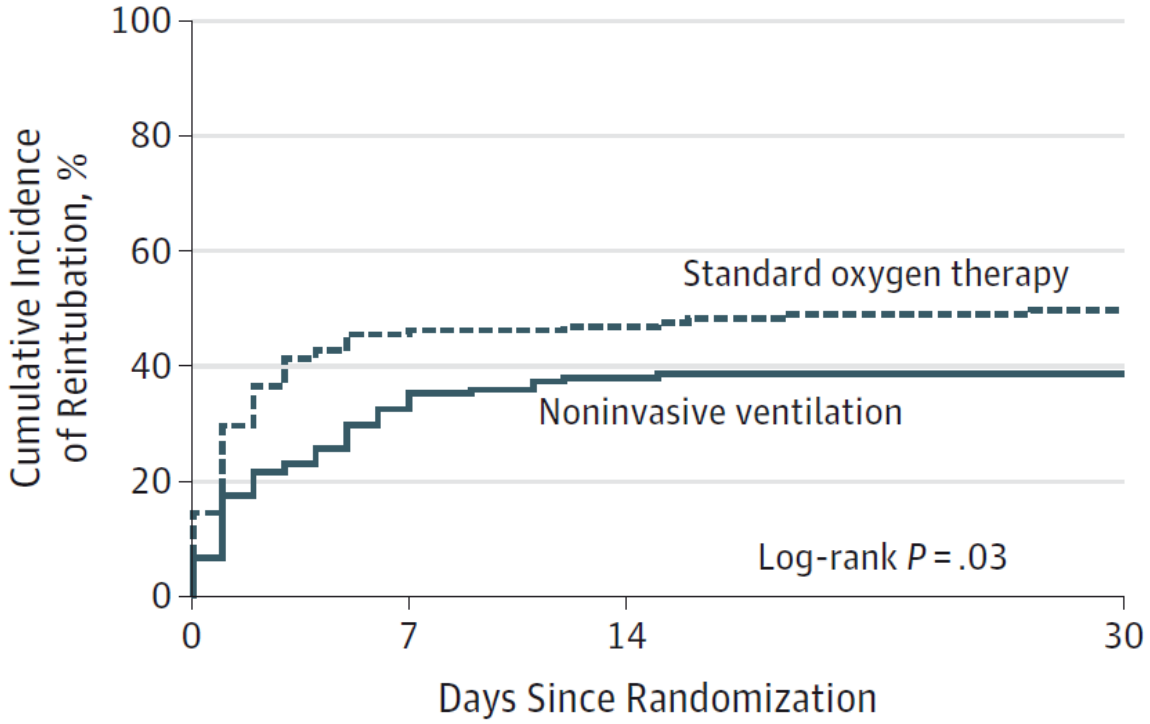
Exclusion: $PaCO_2$ >50

JAMA 2015;314(16):1711-1719

Effect of NIV on Tracheal Reintubation Among Patients with Hypoxemic Respiratory Failure Following Abdominal Surgery (Oronasal mask vs O_2)

Inclusion

- elective or non-elective under GA
- PaO_2 < 60 on RA or
  PaO_2 < 80 on 15 LPM
  over 30min after surgery
- RR > 30
- Respiratory distress



No. at risk				
Standard oxygen therapy	145	79	76	71
Noninvasive ventilation	148	99	90	87

JAMA 2016;315(13):1345-1353

Effect of NIV on Tracheal Reintubation Among Patients with Hypoxemic Respiratory Failure Following Abdominal Surgery (Oronasal mask)

Acute respiratory failure		
Respiratory rate, mean (SD), /min	29 (7)	28 (8)
Time from end of surgery to acute respiratory failure, mean (SD), d	2.6 (1.7)	2.4 (1.6)
Time from extubation to acute respiratory failure, mean (SD), d	1.9 (1.6)	2.0 (1.6)
Time from acute respiratory failure to inclusion in study, median (IQR), h	3.1 (1.0-8.7)	2.8 (1.0-7.3)
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)
Arterial blood gas at randomization, mean (SD)		
pH	7.41 (0.07)	7.42 (0.07)
Pao_2:Fio_2 ratio, mm Hg	188 (71)	201 (69)
$Paco_2$, mm Hg	37 (7)	39 (7)
HCO_3, mmol/L	24 (4)	25 (4)

JAMA 2016;315(13):1345-1353

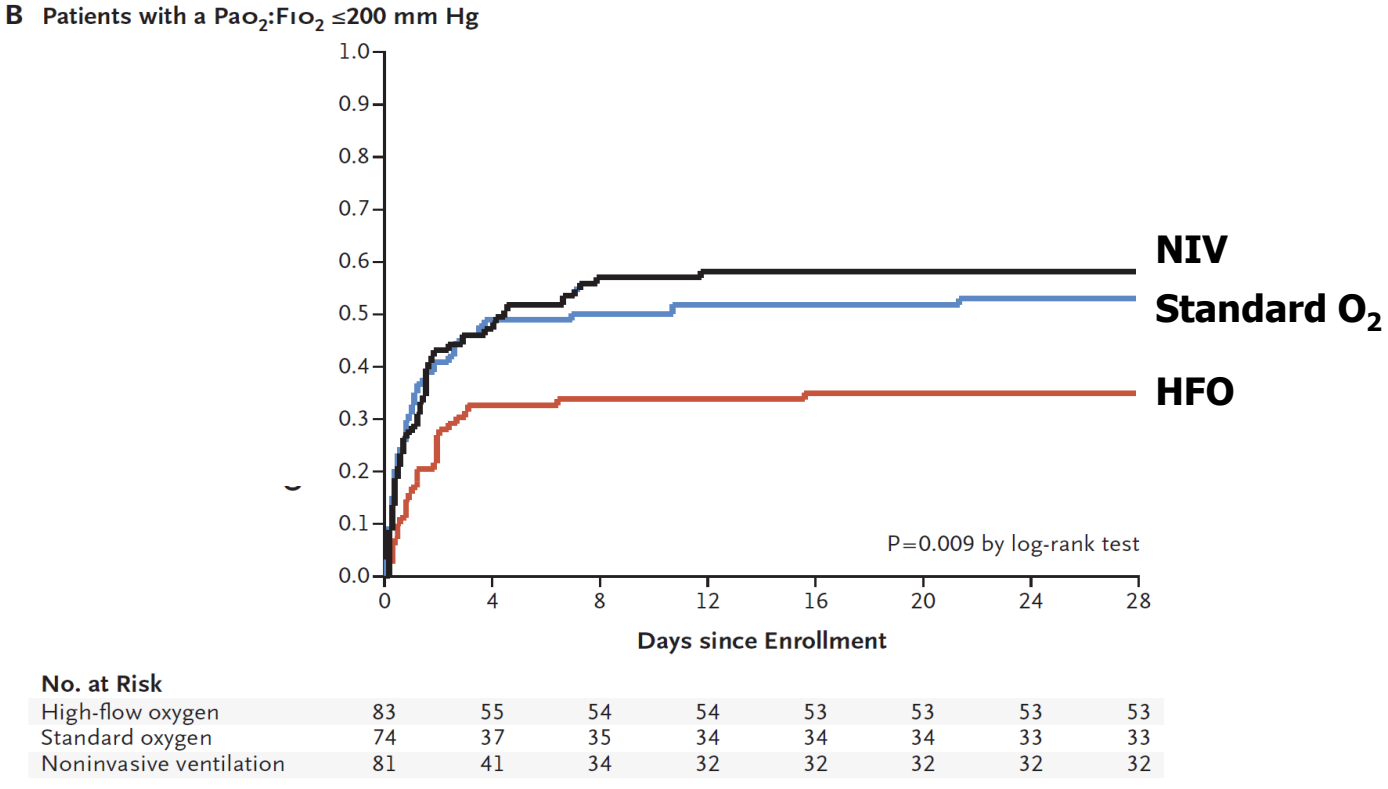
HFNC in AHRF (HFO vs Oronasal mask)

NIV IPAP 8 / EPAP 6

Standard O_2 > 10L

HFO: 50 LPM

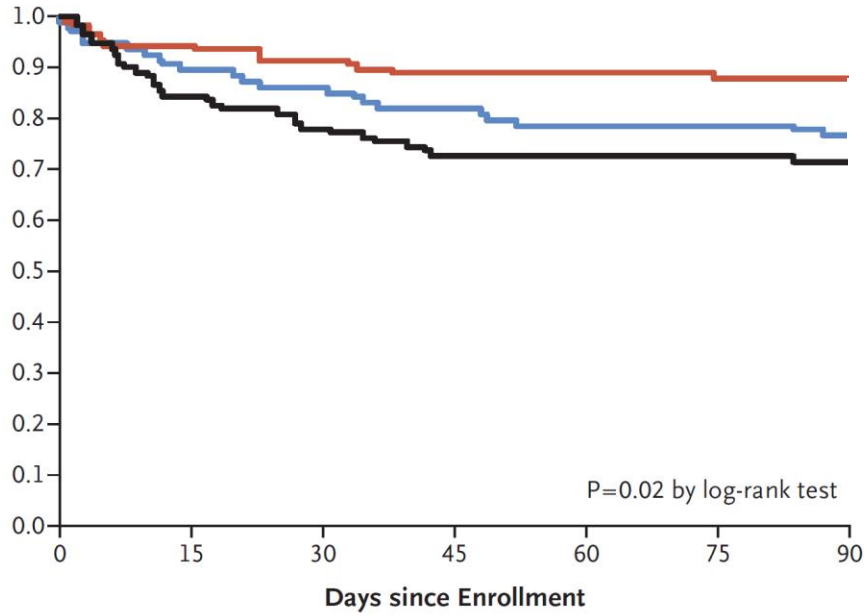
Cumulative incidence of Intubation : PF ≤ 200



No. at Risk

High-flow oxygen	83	55	54	54	53	53	53	53
Standard oxygen	74	37	35	34	34	34	33	33
Noninvasive ventilation	81	41	34	32	32	32	32	32

Cumulative Probability of Survival



	106	100	97	94	94	93	93
	94	84	81	77	74	73	72
	110	93	86	80	79	78	77

NEJM 2015;372:2185-21963

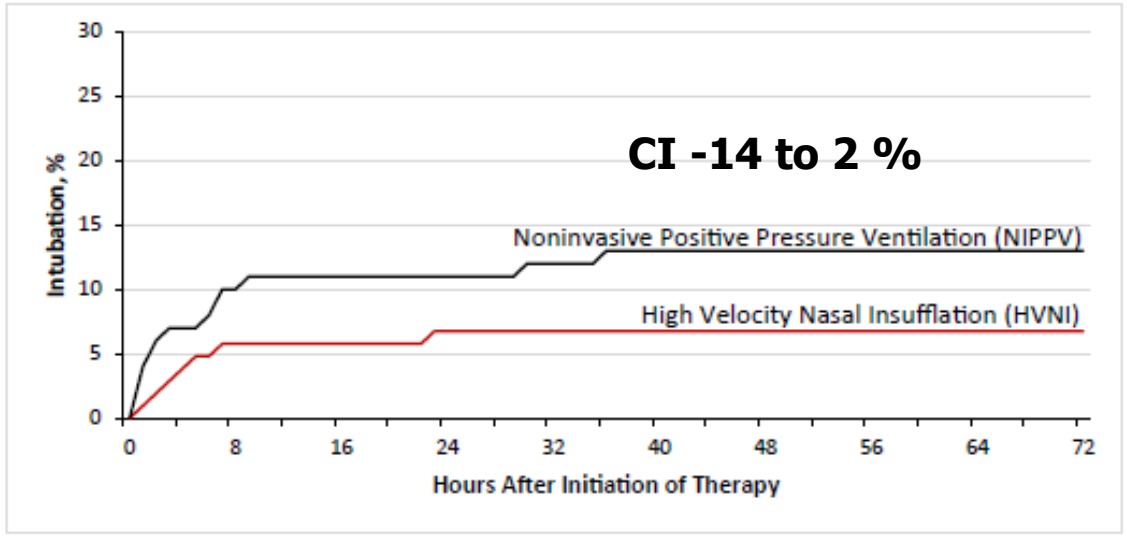
High-velocity Nasal insufflation in treatment of RF at ED

(HFO vs Oronasal mask)

Baseline characteristics

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)
Presenting condition, No. (%)		
Asthma	8 (8)	6 (6)
Congestive heart failure	19 (18)	14 (14)
Chronic renal failure	2 (2)	2 (2)
COPD	38 (37)	41 (41)
General dyspnea	37 (36)	37 (37)
Discharge diagnosis, No. (%)		
Asthma	4 (4)	3 (3)
Acute decompensated heart failure	22 (21)	20 (20)
Acute COPD exacerbation	29 (28)	24 (24)
Acute hypercapnic respiratory failure	5 (5)	7 (7)
Acute hypoxic respiratory failure	13 (13)	13 (13)
Acute hypercapnic and hypoxic respiratory failure	16 (15)	13 (13)
Pneumonia/sepsis	15 (14)	20 (20)
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)

IPAP 10 / EPAP 5



No. at Risk										
HVNI	104	98	98	97	97	97	97	97	97	97
NIPPV	100	90	89	89	88	87	87	87	87	87

HFNC is noninferior to NIPPV at 15% margin for intubation

Ann Emerg Med. 2018;72:723-83

Benefits & risks of NIV in COVID-19 (COVID-ICU)

Standard O_2 : 6 L/min

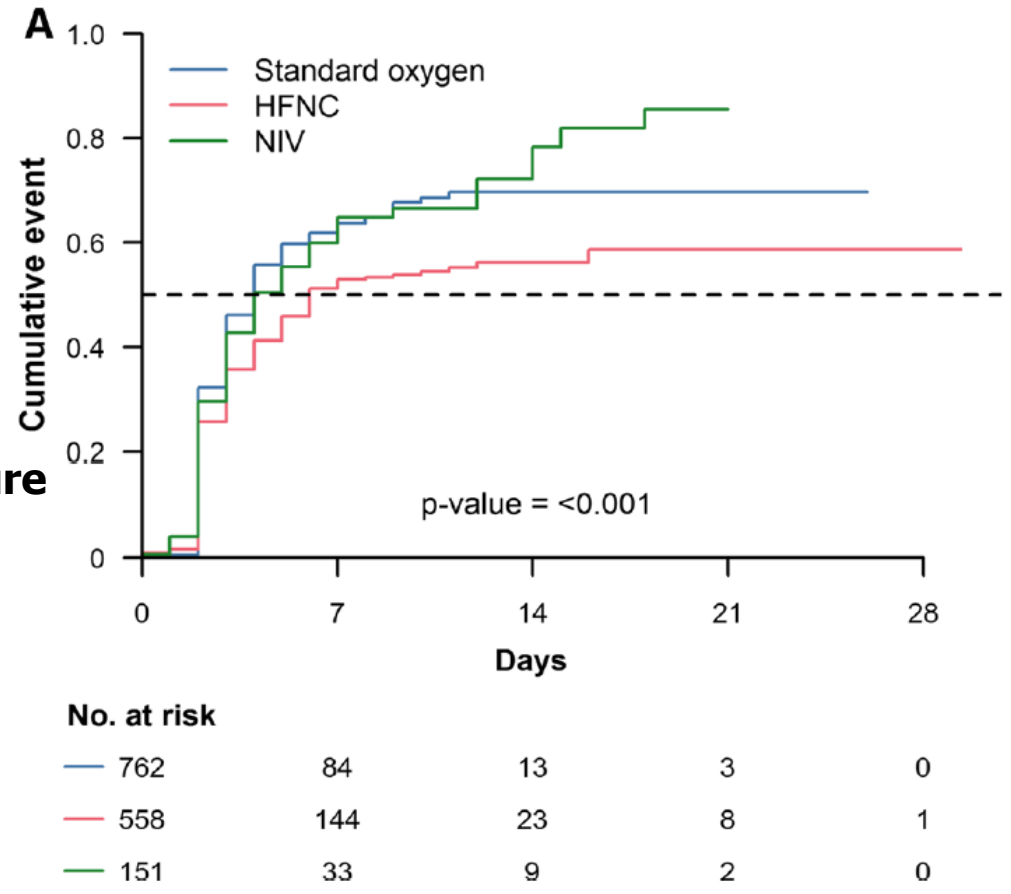
NIV: PS 8 PEEP 7

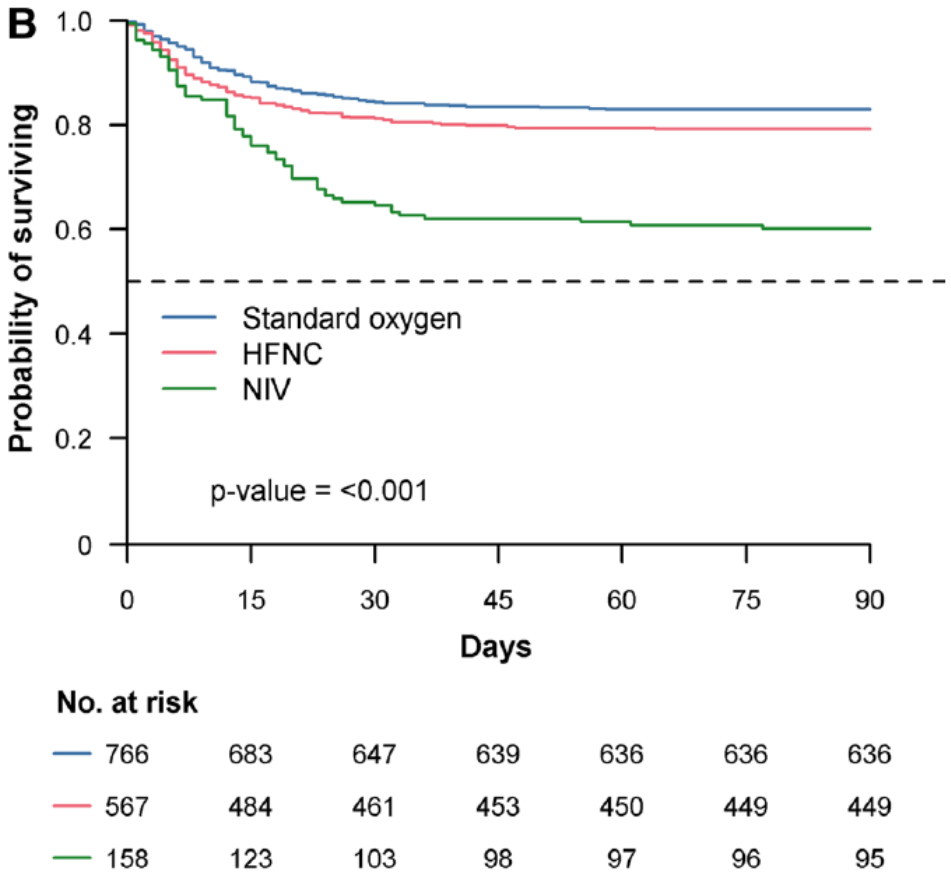
HFNC : 50 LPM

Prospective cohort study admitted in ICU by COVID-19 / Oronasal mask vs HFO

Oxygen failure

Intubation + DNR





DNR rate

Standard O_2 : 8 % / HFNC : 10% / NIV 23%

Critical care 2021; 25:421

- **Oronasal Mask NIV = Standard Oxygen Therapy**

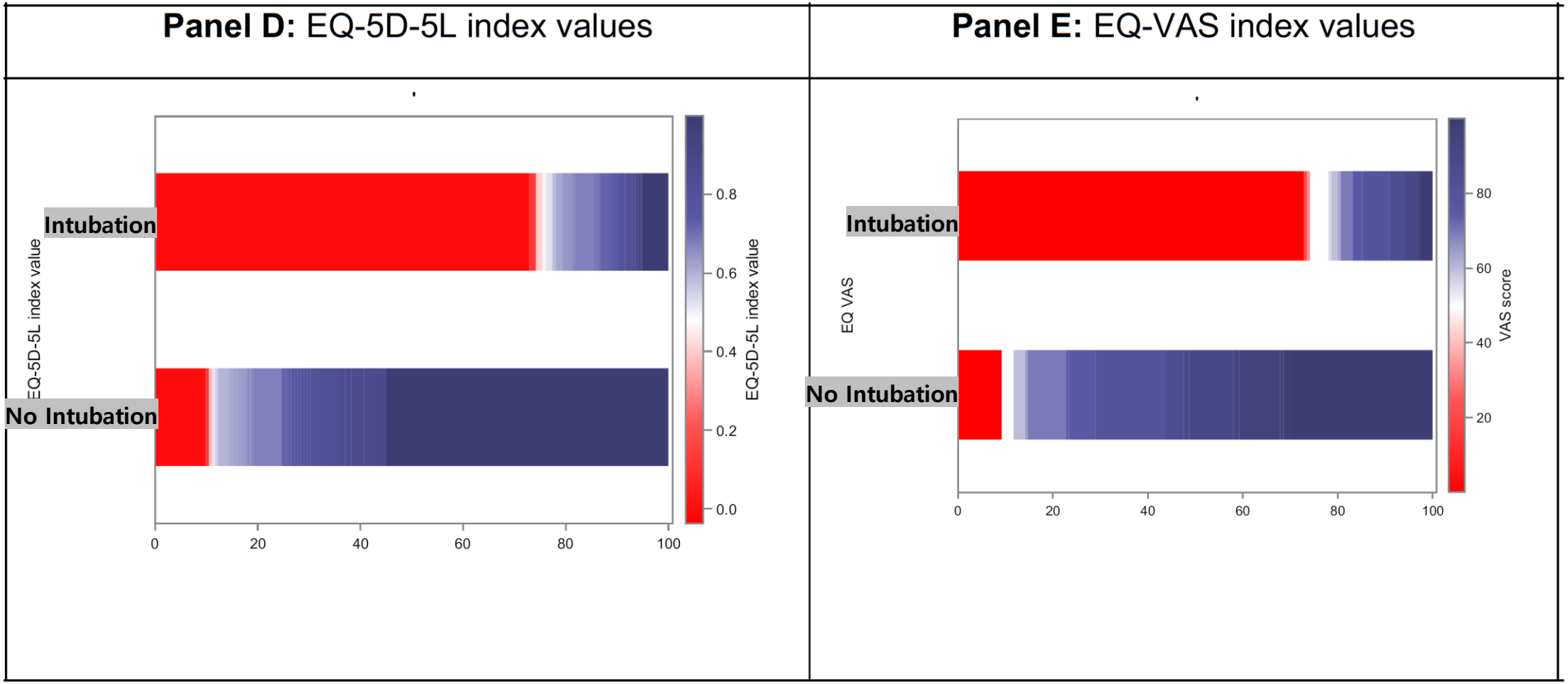
  ≤ *High Flow Oxygenation*

- **Helmet NIV vs Standard Oxygen Therapy**

  Oronasal NIV

  High Flow Oxygenation

180-day outcomes of COVID-19 treated with helmet NIV or usual respiratory support



ICM 2023 ;23:1-11

Break normal physiology of upper airway

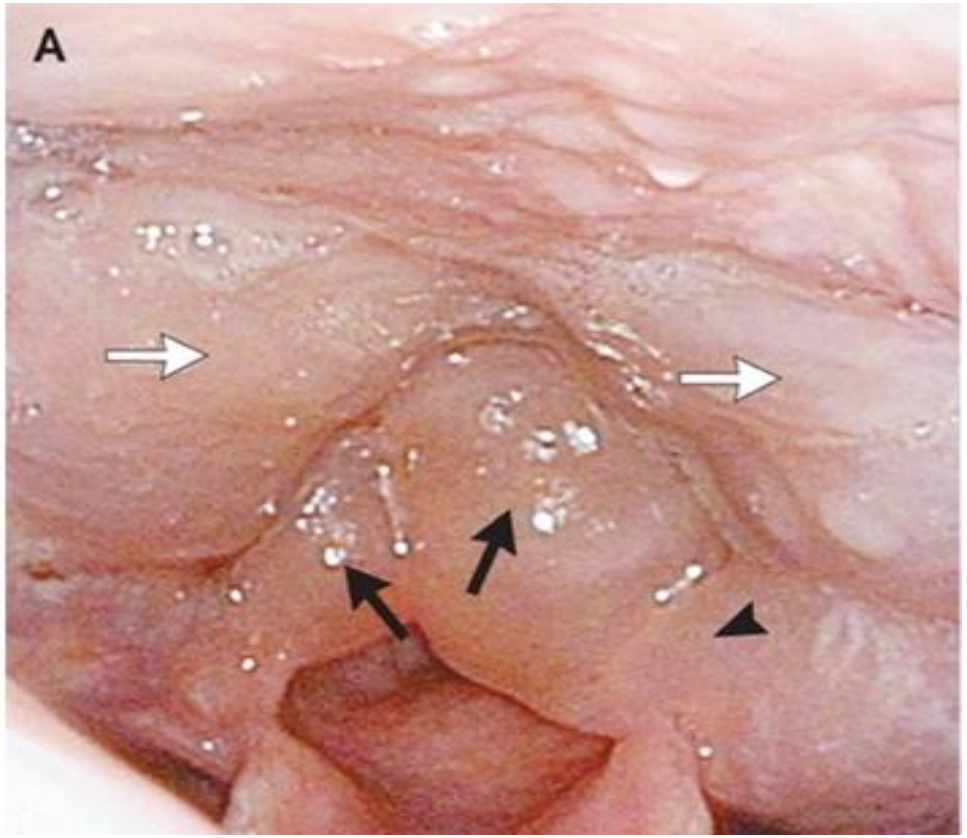
VAP

Heavy sedation

Muscle weakness

Alertness

delirium



Physiological Effects

- **Tight neck sealing**

  → High PEEP (10-12 cmH_2O)

  → Less air leak

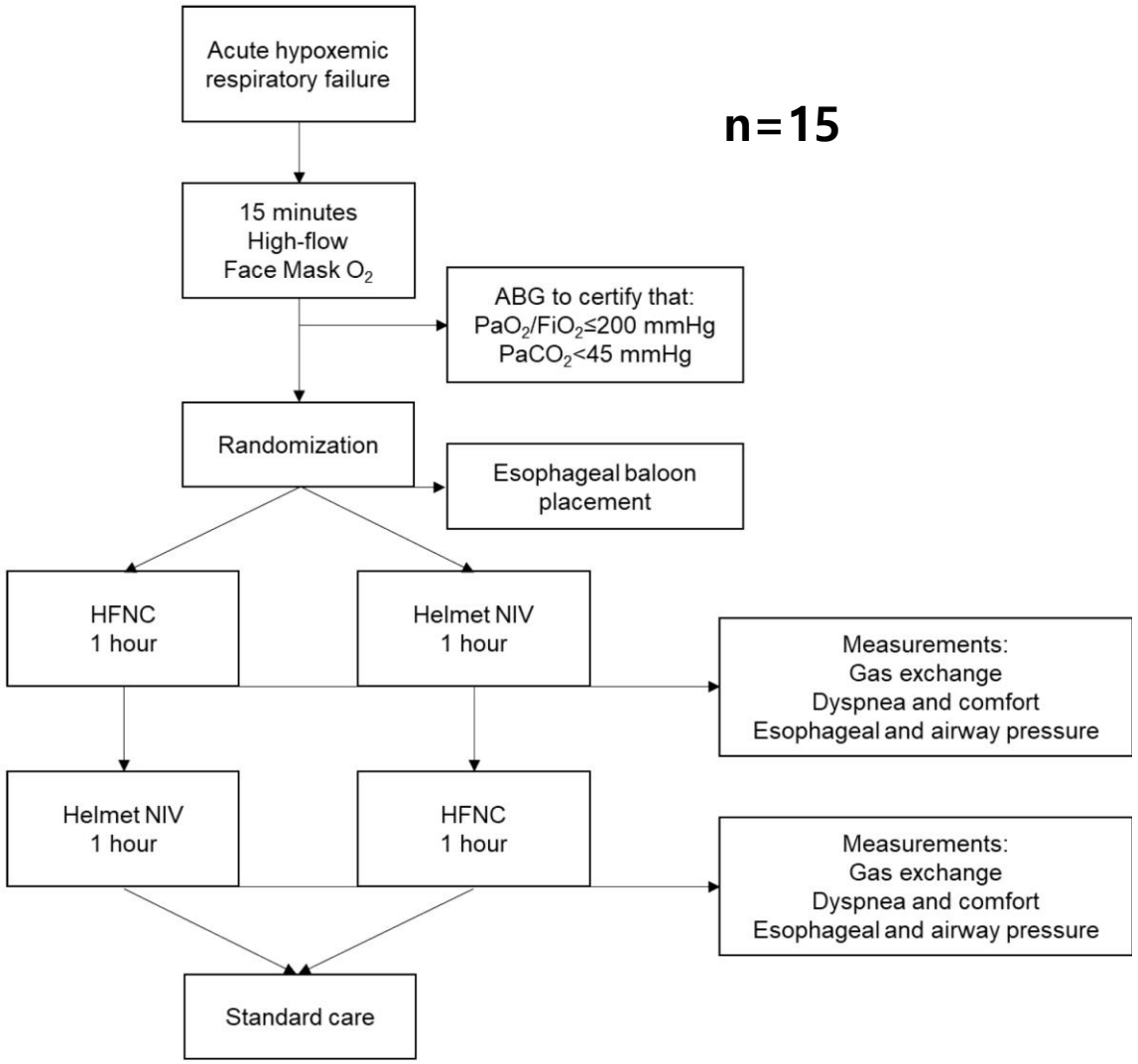
- **Better tolerability**

  → Uninterrupted treatment

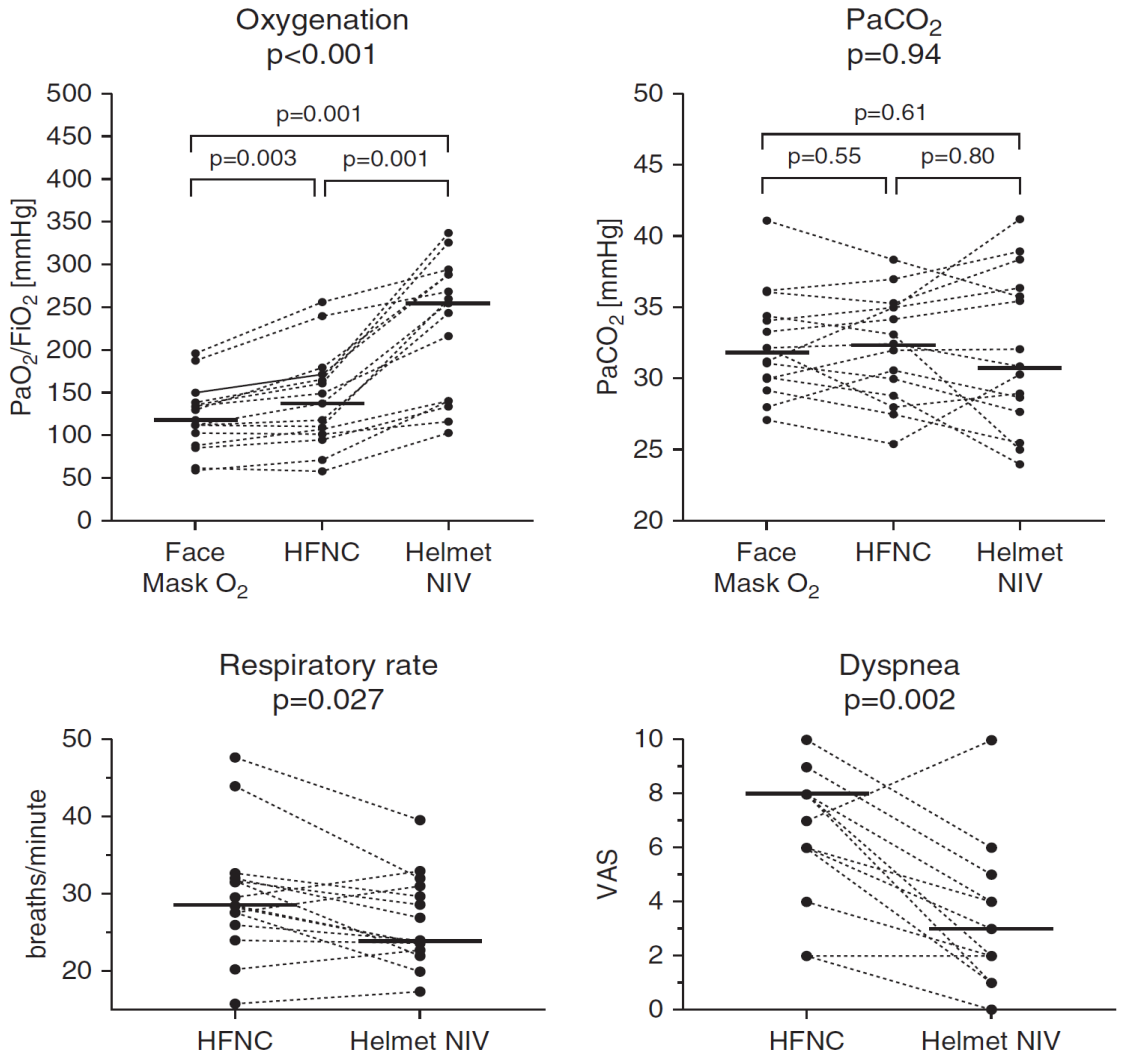
Physiological Effects of higher PEEP

- Alveolar recruitment and enhanced ventilator homogeneity
- Reduced work of breathing (+ inspiratory support)
- Providing mechanical stent of the upper airway (OSA, OHS)
- In case of left ventricular dysfunction
  - Decreasing preload and afterload

Physiologic comparison of HFNC & Helmet NIV in AHRF



n=15



AJRCCM 2020;201;303

Helmet CPAP vs O_2 therapy to improve oxygenation in CAP

CAP

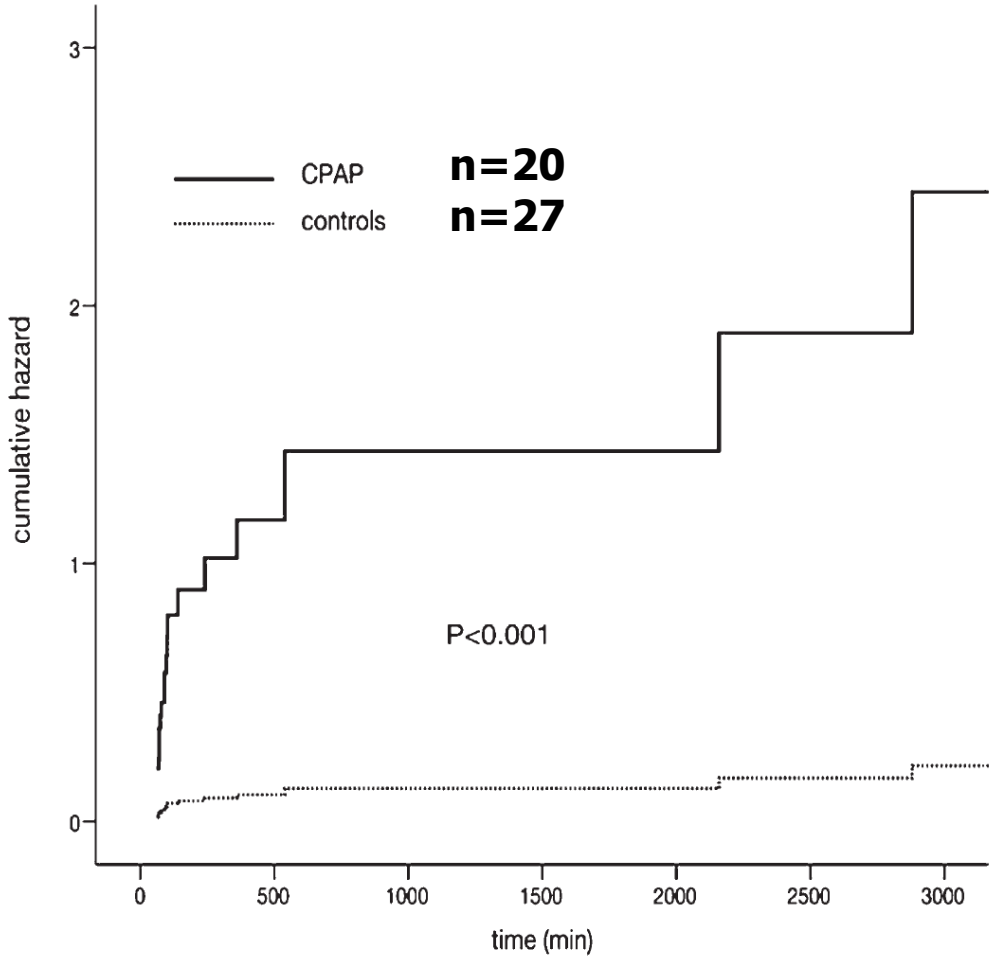
- **RR ≤ 35**
- **300 ≥ PF ratio ≥ 200, venturi 15 L**

→ CPAP 10 vs Venturi mask

→ PF ratio ≥ 315 on CPAP group

switched to Venturi mask

Relative rapidity PF ratio ≥ 315



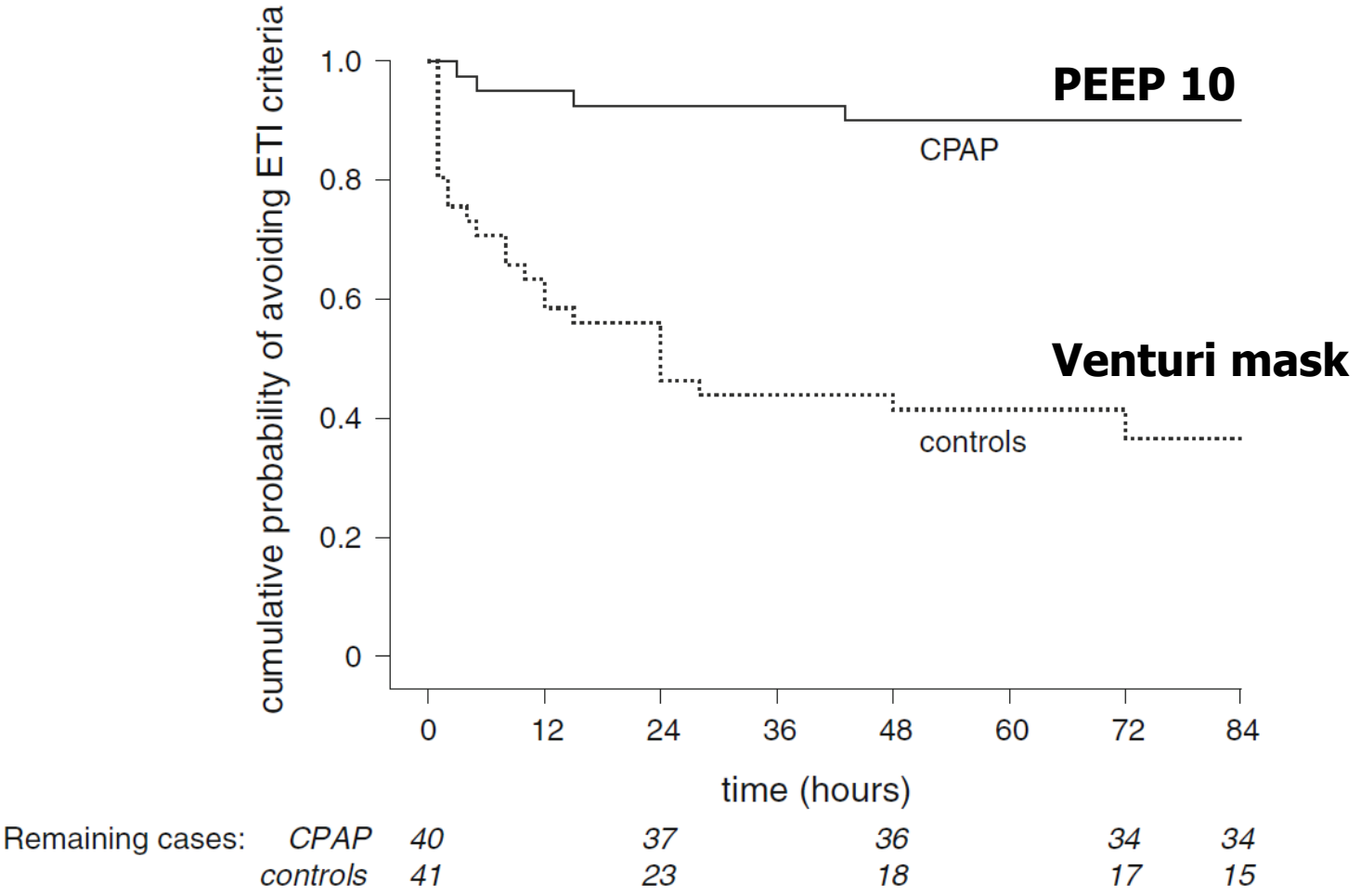
Chest 2010; 138(1):114-120

Helmet CPAP vs O_2 in severe hypoxemic RF due to pneumonia

Severe Hypoxemic RF

- PF ratio <250 with O_2 15L
- RR > 30
- Respiratory distress

	CPAP	Venturi
PF ratio	134	148



ICM (2014) 40:942-949

CPAP for treatment of postoperative hypoxemia

Inclusion

Abdominal surgery over 1.5 h

After extubated,

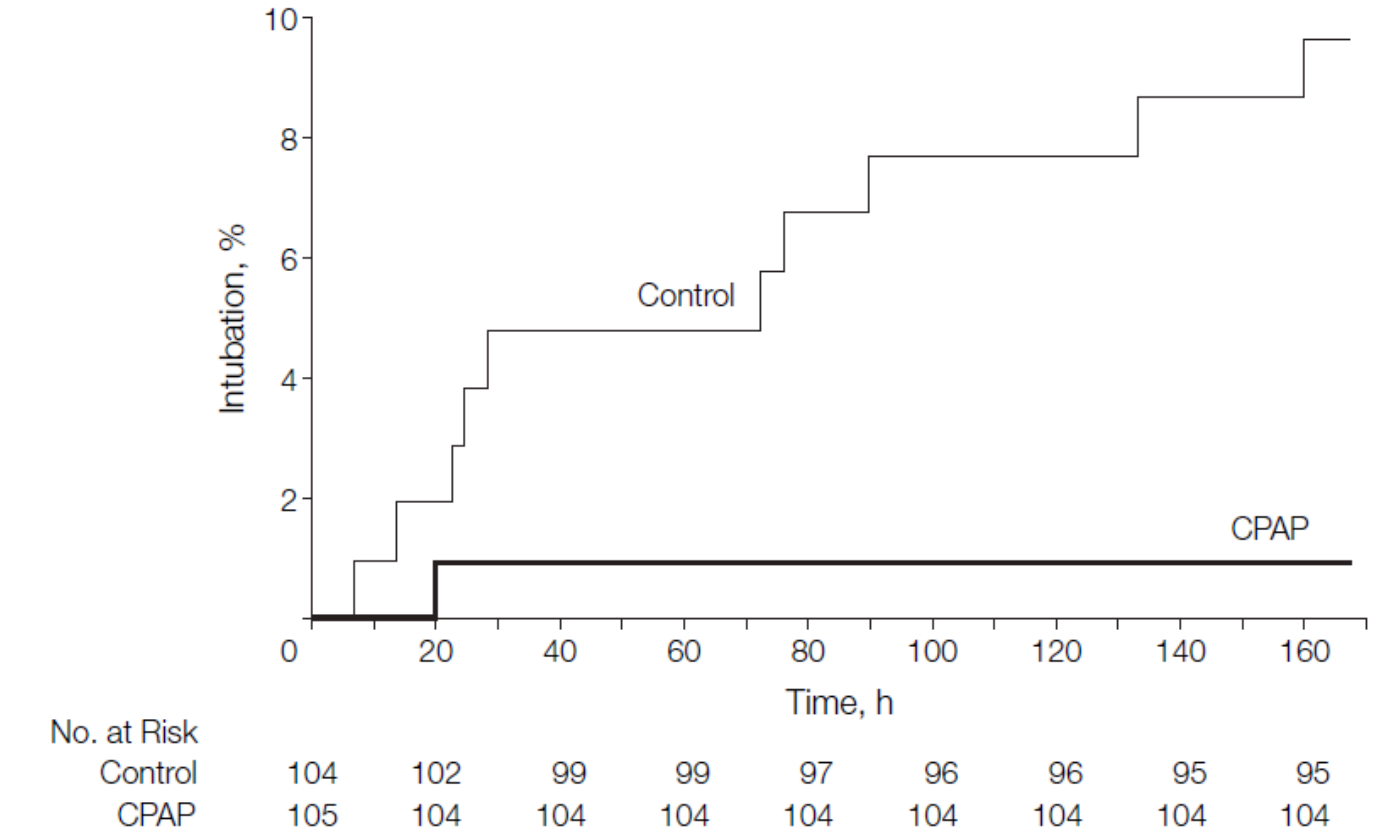
PF ratio < 300 with venturi 0.3

Exclusion

Chronic heart disease and

Respiratory disease excluded

PEEP 7.5 on Helmet



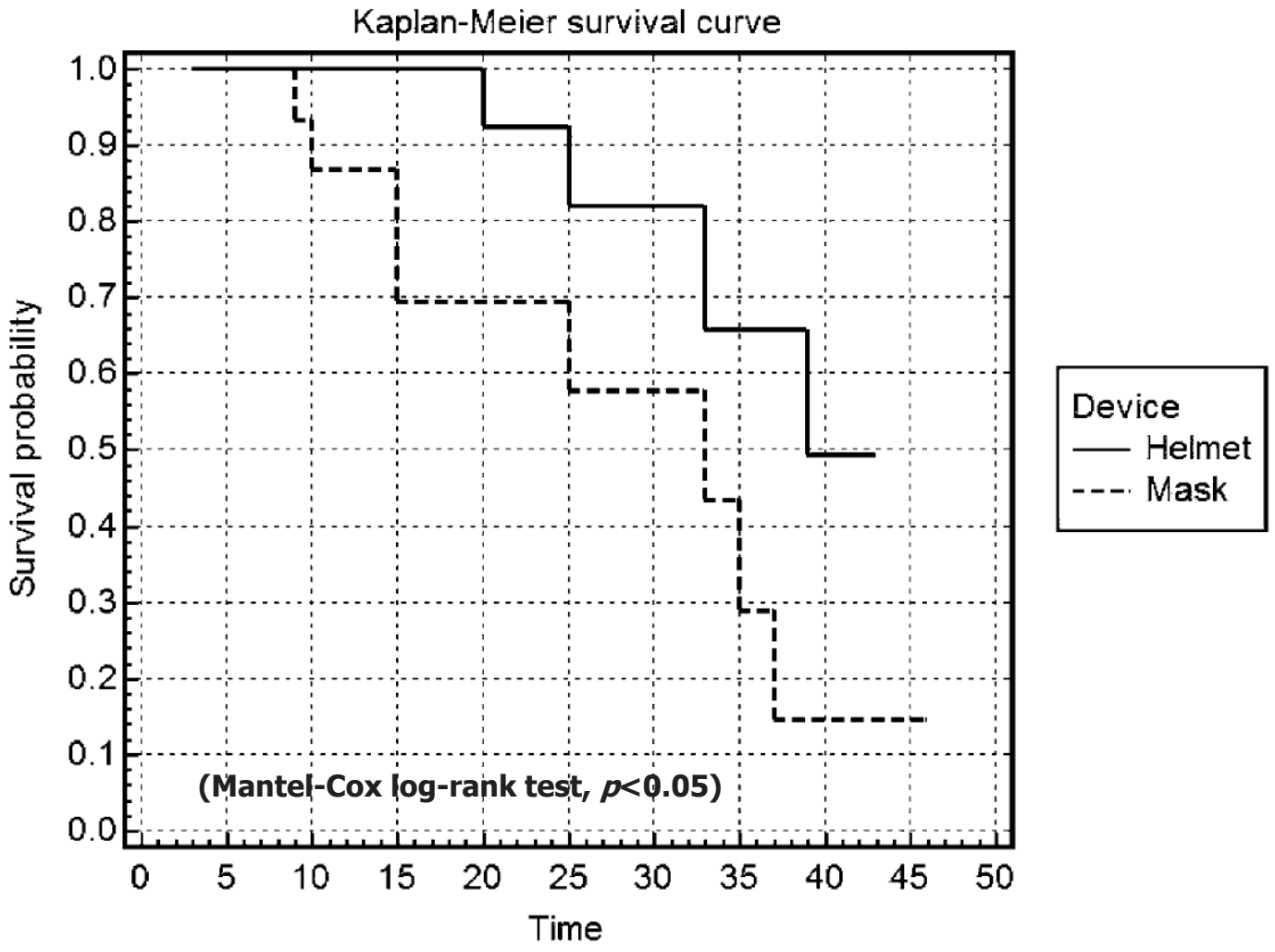
	Venturi	CPAP
PF ratio	255	247

JAMA 2005;293(5):589-595

Noninvasive CPAP by helmet in hematologic malignancy patients with hypoxic ARF

	Helmet	Mask
N	**17**	**17**
PEEP	**8**	**8**
Duration	**28.4 hs**	**7.5 hs**
Intubation	**0**	**7**

Uninterrupted Treatment !!



ICM 2004;30:147-150

Helmet vs Face mask on the rate of endotracheal intubation in ARDS

Baseline characteristics

Characteristic	No. (%) of Patients Receiving Noninvasive Ventilation	
	Face Mask (n = 39)	Helmet (n = 44)
Respiratory and Hemodynamic Parameter, Median (IQR)		
Duration of NIV before randomization, median, h	13 (8-19.7)	10.3 (8.3-13.4)
Inspiratory positive airway pressure, cm H_2O	10 (10-15)	12 (10-14.5)
Expiratory positive airway pressure, cm H_2O	5 (5-8)	5 (5-8)
Spo_2, %	95 (91-99)	97 (95-99)
Fio_2, %	60 (50-80)	60 (40-90)
Pao_2:Fio_2	144 (90-223)	118 (93-170)
Shock, No. (%)	12 (31)	9 (20)

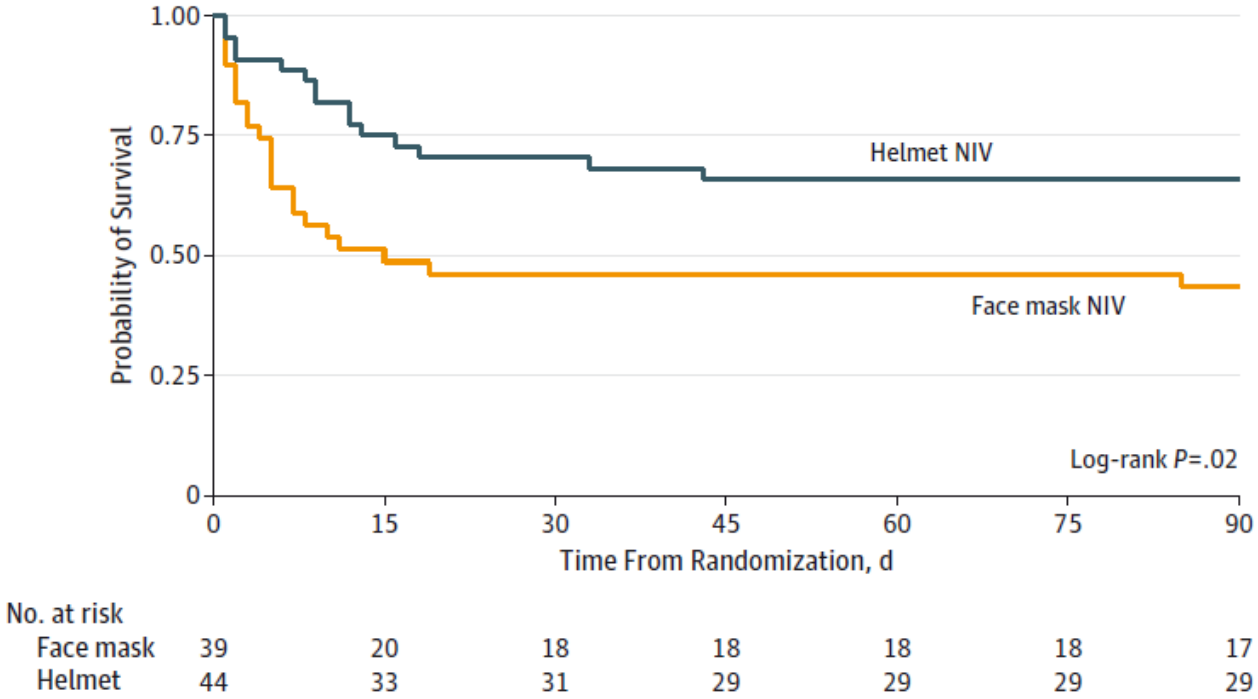
Level of Respiratory support during NIV

	Noninvasive Ventilation, Median (IQR)		
	Face Mask (n = 39)	Helmet (n = 44)	*P* Value
Respiratory support with NIV[a]			
Duration of NIV, h	26.4 (7.0-60.0)	19.8 (8.4-45.6)	.68
PEEP, cm H_2O	5.1 (5.0-8.0)	8 (5.0-10.0)	.006
Pressure support, cm H_2O	11.2 (10.0-14.5)	8 (5.6-10.0)	<.001
Fio_2, %	60 (50.0-68.6)	50 (40.0-60.0)	.02
Spo_2, %	95.3 (92.3-96.7)	96.2 (94.8-98.4)	.13
Respiratory rate, breaths/min			
Baseline	28.3 (22.1-34.4)[b]	27.7 (21.5-34.6)[b]	
After randomization	29.1 (22.1-37.6)	24.5 (20.4-30.5)	

JAMA.2016:315(22):2435-2441

Helmet vs Face mask on the rate of endotracheal intubation in ARDS

Probability of Survival from Randomization to Day 90



	Face Mask (n = 39)	Helmet (n = 44)	Absolute Difference (95% CI)
Primary outcome, No. (%)			
Endotracheal intubation	24 (61.5)	8 (18.2)	−43.3 (−62.4 to −24.3)
Reason for intubation			
Respiratory failure	20 (83.3)	3 (37.5)	−45.3 (−82.5 to −9.1)
Circulatory failure	3 (12.5)	0 (0)	−12.5 (−25.7 to 0.7)
Neurologic failure	1 (4.2)	5 (62.5)	58.3 (24.8 to 92.8)
Secondary outcomes, median (IQR), d			
Ventilator-free days	12.5 (0.49-28)	28 (13.7-28)	8.4 (13.4 to 3.4)
ICU length of stay	7.8 (3.9-13.8)	4.7 (2.5-8.7)	−2.76 (−6.07 to 0.54)
Hospital length of stay	15.2 (7.8-19.7)	10.1 (6.5-15.9)	−2.92 (−8.47 to 2.63)
Mortality, No. (%)			
Hospital	19 (48.7)	12 (27.3)	−21.4 (−41.9 to −1.0)
90 d[a]	22 (56.4)	15 (34.1)	−22.3 (−43.3 to −1.4)
Adverse events			
Mask deflation	0 (0)	2 (4.5)	
Skin ulceration	3 (7.6)	3 (6.8)	

Duration of Helmet NIV 19.8 hours

JAMA.2016:315(22):2435-2441

Helmet vs Face mask CPAP in COVID-19 Respiratory failure

Patients

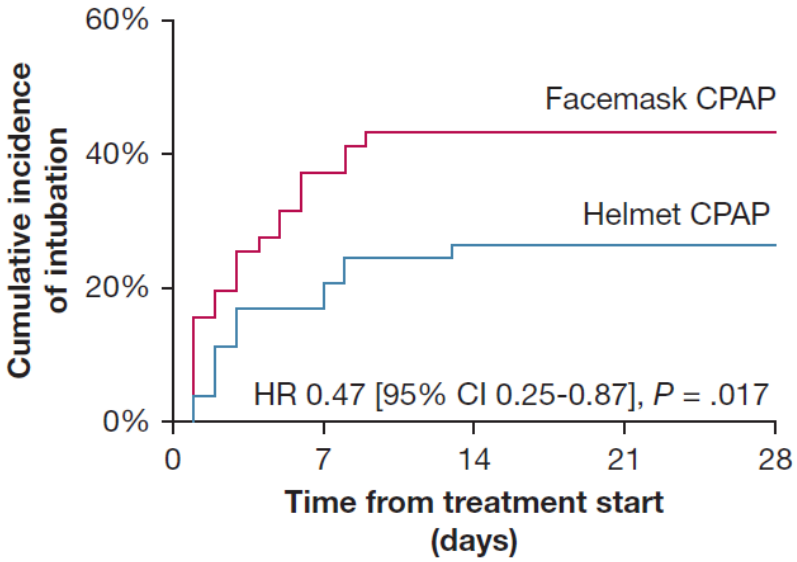
PF ratio ≤ 200 with ≥ 10L O_2

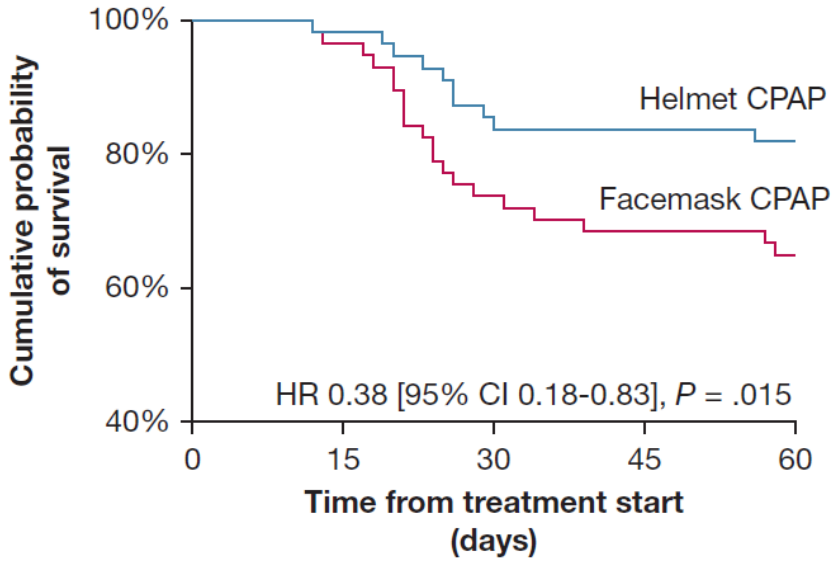
or RR ≥ 25

12 h HFNC at 60 LPM

Non-Responder RR ≥ 30 and
SpO_2 ≤ 94% with FiO_2 ≥ 60%

Helmet CPAP or FaceMask CPAP (n= 55 vs 57)
10-14 cmH_2O





CHEST 2022:163(2);341-344

Effect of Helmet NIV vs Usual respiratory support on Mortality among AHRF due to COVID-19

Variable[a]	No. (%) Helmet noninvasive ventilation (n = 159)	Usual respiratory support (n = 161)
Helmet NIV use during the 28-d study period		
No. of patients	152 (95.6)	4 (2.5)
Total duration of helmet use, median (IQR), h	43 (19.5-70.5)	0 (0-0)
Noninvasive respiratory support in the first 48 h		
Helmet NIV		
No. of patients	151 (95.0)	3 (1.9)
Duration of use, median (IQR), h	34 (15-46)	0 (0-0)
Mask NIV		
No. of patients	43 (27.0)	111 (68.9)
Duration of use, median (IQR), h	0 (0-5)	14 (0-26.5)
Helmet or mask NIV		
No. of patients	154 (96.9)	111 (68.9)
Duration of use, median (IQR), h	40 (24-48)	14.0 (0-27)
High-flow nasal oxygen		
No. of patients	91 (57.2)	122 (75.8)
Duration of use, median (IQR), h	3 (0-15)	23 (4-39)
Standard oxygen		
No. of patients	25 (15.7)	33 (20.5)
Duration of use, median (IQR), h	0 (0-0)	0 (0-0)
Noninvasive ventilation settings (via helmet or mask), day 1		
Highest pressure support level, median (IQR) [No.], cm H_2O	8 (8-10) [152]	8 (0-10) [102]
Highest PEEP, median (IQR) [No.], cm H_2O	10 (10-10) [152]	10 (8-10) [102]

Helmet failure 36.5% (58/159)

- by intolerance

(occurred after 20.5 hours)

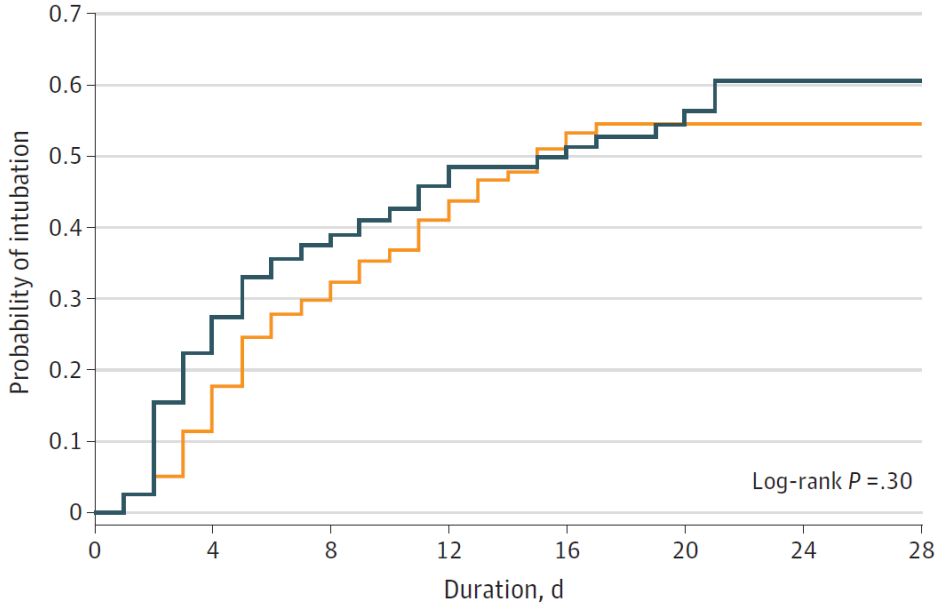
-No PEEP difference between Helmet and Mask

- PF ratio 73 vs 76

JAMA.2022:328(11):1063-1072

Effect of Helmet NIV vs Usual respiratory support on Mortality among AHRF due to COVID-19

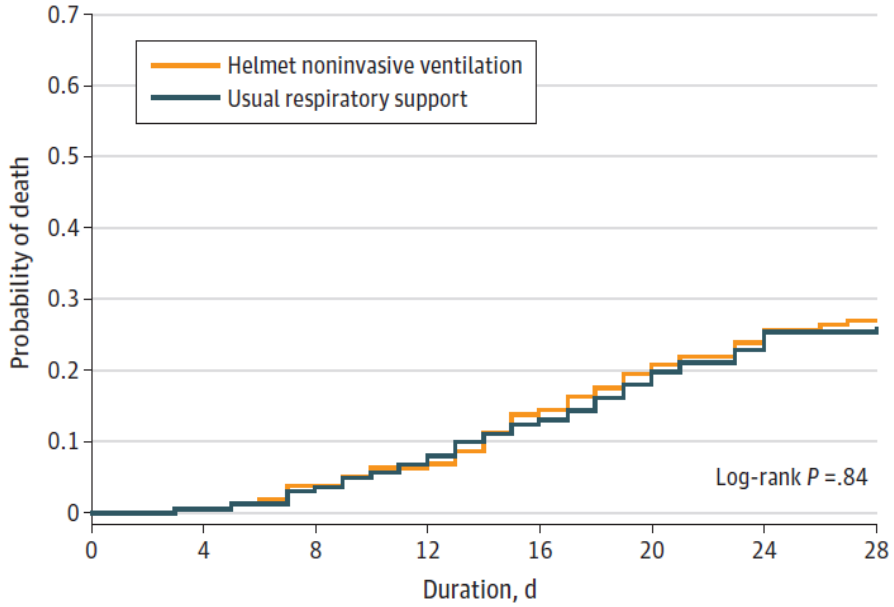
Endotracheal Intubation



No. at risk

Helmet noninvasive ventilation	159	140	107	66	42	24	18	11
Usual respiratory support	161	124	92	60	37	24	12	10

Mortality



No. at risk

Helmet noninvasive ventilation	159	158	153	149	137	128	121	116
Usual respiratory support	161	160	156	150	141	132	124	120

JAMA.2022:328(11):1063-1072

Helmet vs HFNO on days free of respiratory support with COVID-19

Inclusion

- **PF ratio ≤ 200 with Venturi mask**
- **PaCO2 ≤ 45 mmHg**

Intervention

- **Helmet**
  - **48-hour continuous**
  - **PS 10-12 cmH_2O**
  - **PEEP 10-12 cmH_2O**
  - **FiO_2: SaO_2 92-98%**

- **HFNO**
  - **48-hour continuous**
  - **Flow 60 L/min**
  - **FiO_2: SaO_2 92-98%**

Baseline characteristics

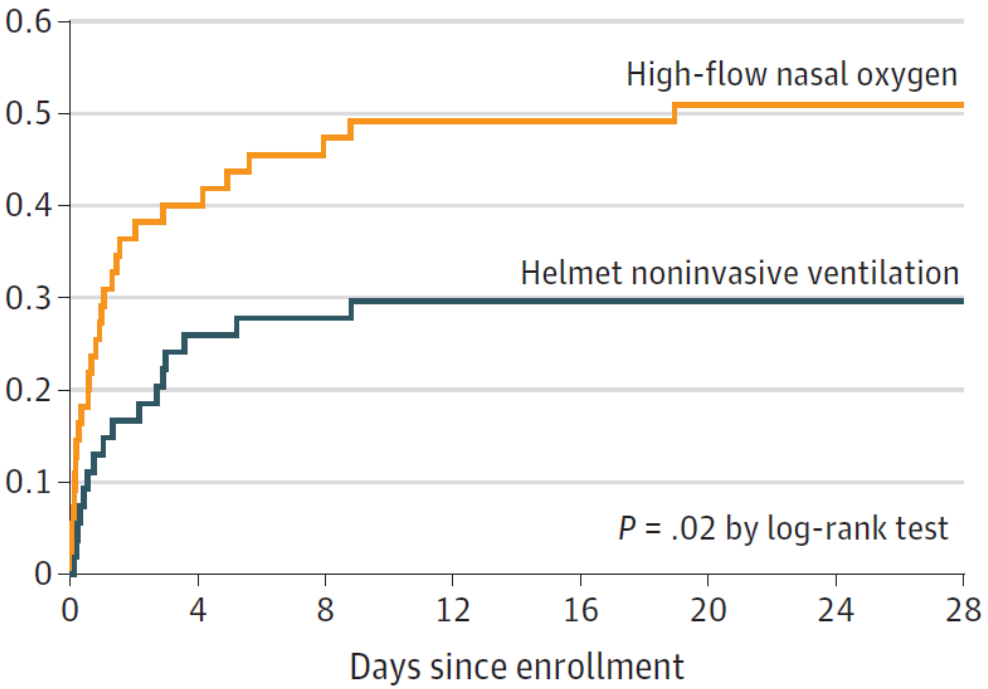
PSV 10 / PEEP 12

Characteristic	No. (%) Helmet noninvasive ventilation (n = 54)	High-flow nasal oxygen (n = 55)
Respiratory rate at enrollment, breaths/min	28 (24-32)	28 (23-32)
Arterial blood gases at enrollment, median (IQR)		
Pao_2/Fio_2 ratio	105 (83-125)	102 (80-124)
pH	7.47 (7.45-7.49)	7.46 (7.45-7.48)
$Paco_2$, mm Hg	34 (31-37)	34 (32-37)
Hypoxemia severity at enrollment		
Pao_2/Fio_2 ratio ≤100	26 (48)	27 (49)
Bilateral infiltrates on enrollment chest x-ray[e]	54 (100)	55 (100)
Concomitant medications		
Dexamethasone	54 (100)	55 (100)
Remdesivir	44 (81)	45 (81)
SAPS II, median (IQR)[f]	32 (27-35)	29 (24-34)
SOFA score at enrollment, median (IQR)[g]	2 (2-3)	2 (2-3)

JAMA 2021:325(17):1731-1743

Helmet vs HFNO on days free of respiratory support with COVID-19

Cumulative incidence of Intubation

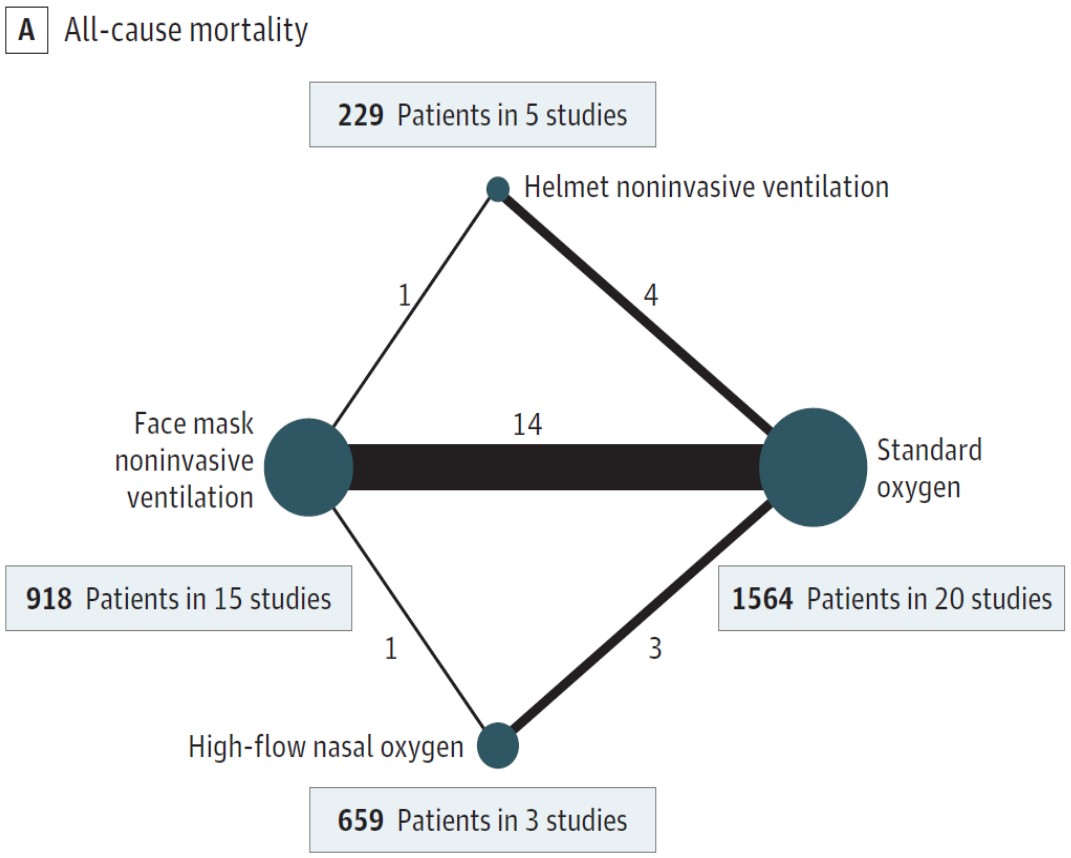


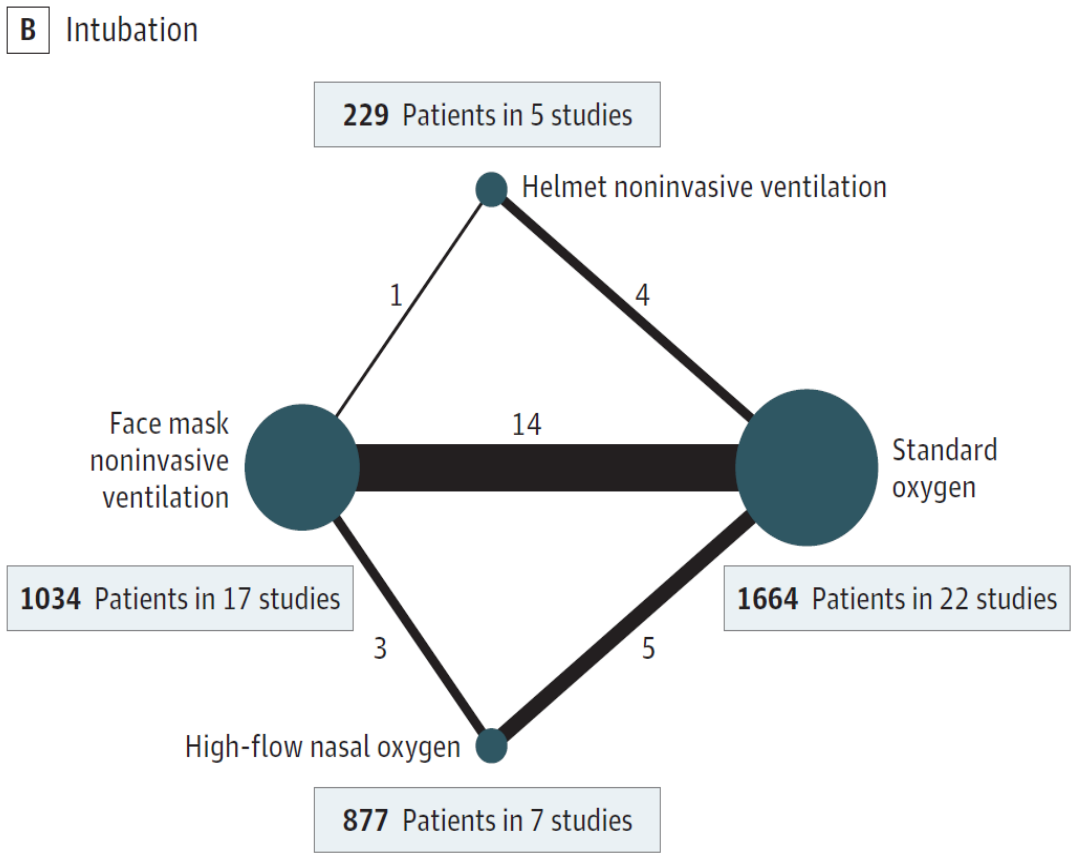
No. at risk

High-flow nasal oxygen	55	34	30	28	28	27	27	27
Helmet noninvasive ventilation	54	41	39	38	38	38	38	38

JAMA 2021:325(17):1731-1743

Ass. of noninvasive O_2 strategies with all–cause mortality with AHRF: Meta-analysis



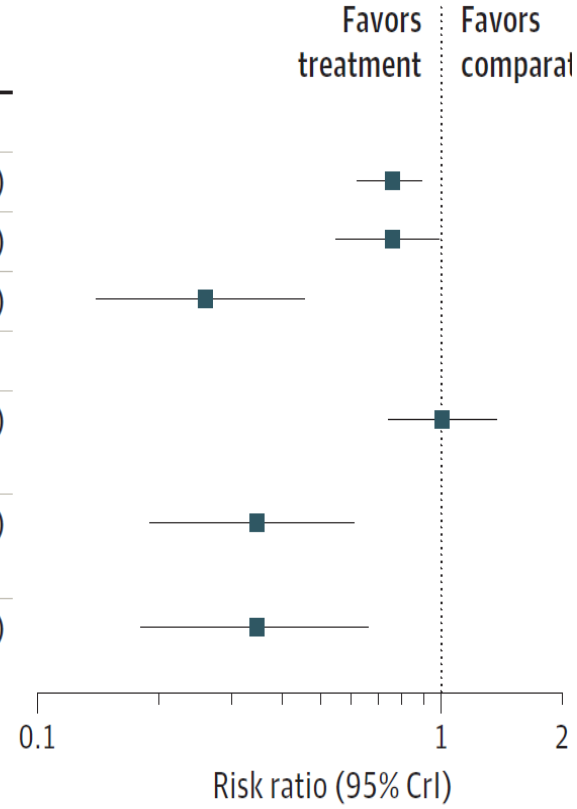


JAMA.2020:324(1):57-67

Ass. of noninvasive O_2 strategies with all–cause mortality with AHRF: Meta-analysis

B Intubation

	No. of patients	No. of trials	Quality	Absolute risk difference (95% CrI)	Network risk ratio (95% CrI)
Compared with standard oxygen					
Face mask noninvasive ventilation	1725	14	Moderate	-0.12 (-0.25 to -0.05)	0.76 (0.62-0.90)
High-flow nasal oxygen	1479	5	Moderate	-0.11 (-0.27 to -0.01)	0.76 (0.55-0.99)
Helmet noninvasive ventilation	330	3	Low	-0.32 (-0.60 to -0.16)	0.26 (0.14-0.46)
Additional comparisons					
Face mask noninvasive ventilation vs high-flow nasal oxygen	450	3	Low	0.00 (-0.13 to 0.10)	1.01 (0.74-1.38)
Helmet noninvasive ventilation vs face mask noninvasive ventilation	83	1	Low	-0.20 (-0.40 to -0.09)	0.35 (0.19-0.61)
Helmet noninvasive ventilation vs high-flow nasal oxygen	0	0	Low	-0.20 (-0.43 to -0.08)	0.35 (0.18-0.66)

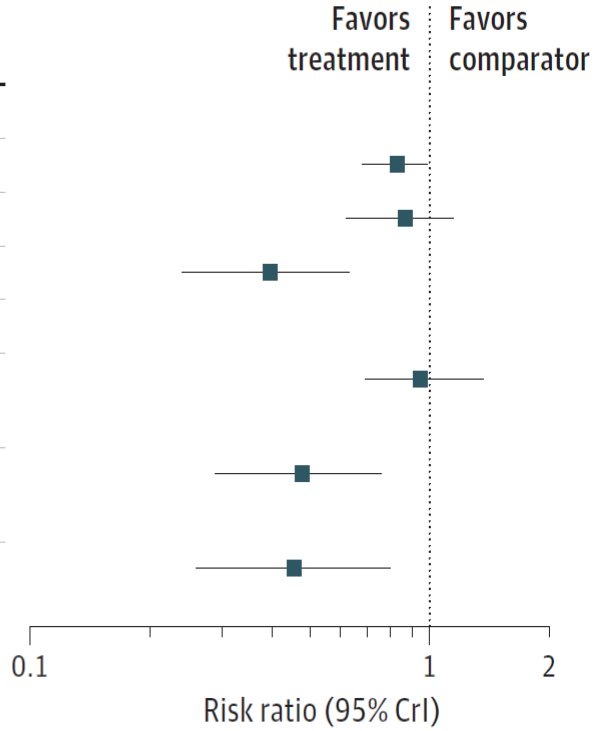


JAMA.2020:324(1):57-67

Ass. of noninvasive O_2 strategies with all–cause mortality with AHRF: Meta-analysis

A All-cause mortality

	No. of patients	No. of trials	Quality	Absolute risk difference (95% CrI)	Network risk ratio (95% CrI)
Compared with standard oxygen					
Face mask noninvasive ventilation	1725	14	Moderate	-0.06 (-0.15 to -0.01)	0.83 (0.68-0.99)
High-flow nasal oxygen	1279	3	Moderate	-0.04 (-0.15 to 0.04)	0.87 (0.62-1.15)
Helmet noninvasive ventilation	330	3	Low	-0.19 (-0.37 to -0.09)	0.40 (0.24-0.63)
Additional comparisons					
Face mask noninvasive ventilation vs high-flow nasal oxygen	216	1	Low	-0.02 (-0.14 to 0.07)	0.95 (0.69-1.37)
Helmet noninvasive ventilation vs face mask noninvasive ventilation	83	1	Low	-0.13 (-0.27 to -0.05)	0.48 (0.29-0.76)
Helmet noninvasive ventilation vs high-flow nasal oxygen	0	0	Low	-0.15 (-0.34 to -0.05)	0.46 (0.26-0.80)



JAMA.2020:324(1):57-67

- Oronasal Mask NIV = Standard Oxygen Therapy

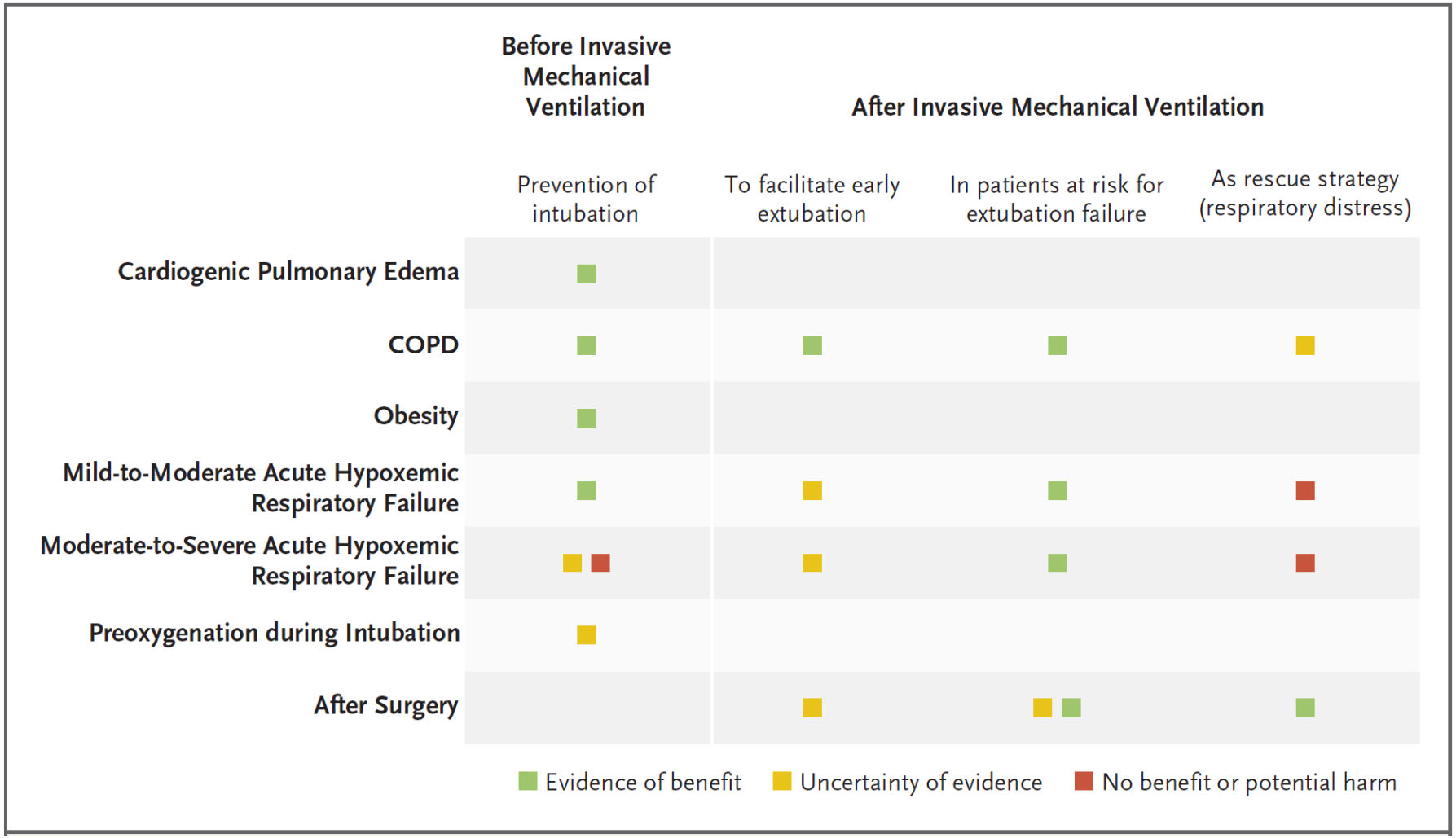
  ≤ *High Flow Oxygenation*

- **Helmet NIV > Standard Oxygen Therapy**

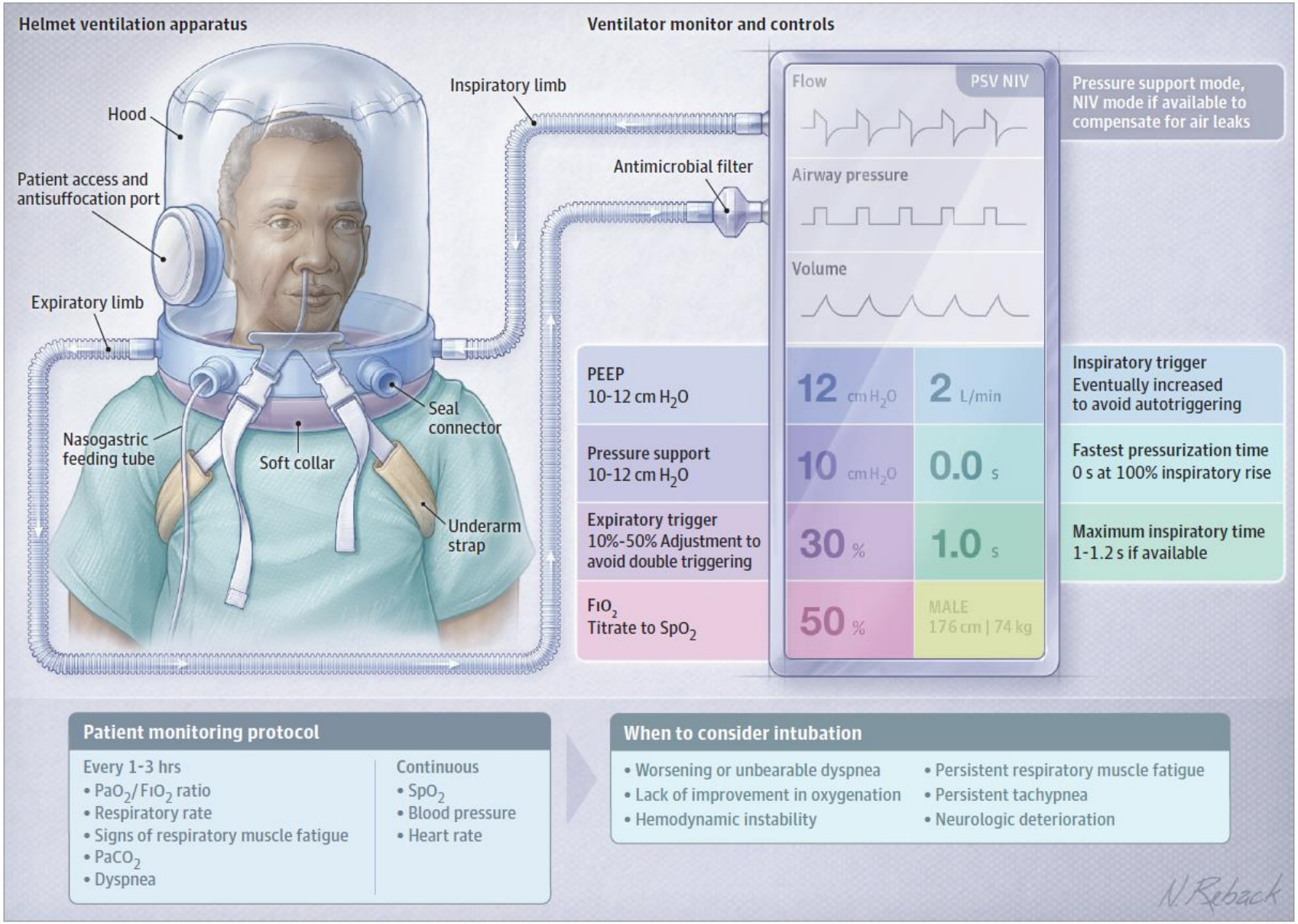
  > Oronasal NIV

  ≥ High Flow Oxygenation

Evidence for NIV across acute care condition



NEJM 2022;387:1688-98



- Volume of Helmet 15-18 L

→ Dead space !!!

→ Desynchronization

(Auto and delayed triggering)

; Inspiratory trigger

; Fastest pressurization

JAMA 2021:325(17):1731-1743

Helmet NIV on COVID-19 in IUH

- **Alert mental status**
- **Bilateral infiltration on CXR**
- **HFNC: FiO_2 0.6 on SaO_2 < 95 %**
- **Respiratory Rate > 30**

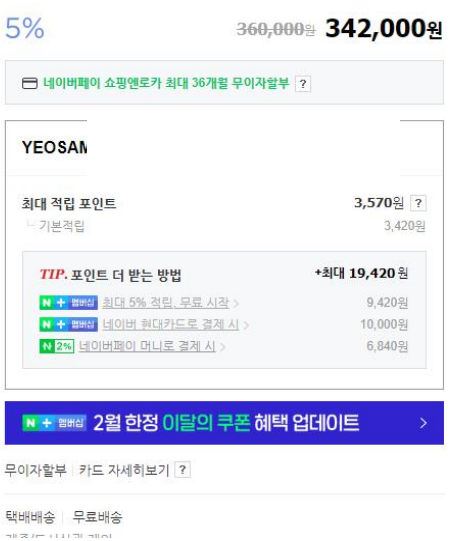
- **NIV Setting**
  - **PEEP 10-12 cmH_2O for $SaO_2 \geq 95$**
  - **PSV 5-10 cmH_2O for RR <30**
  - **FiO2 ≤ 0.6**
  - **Break time only at meal**

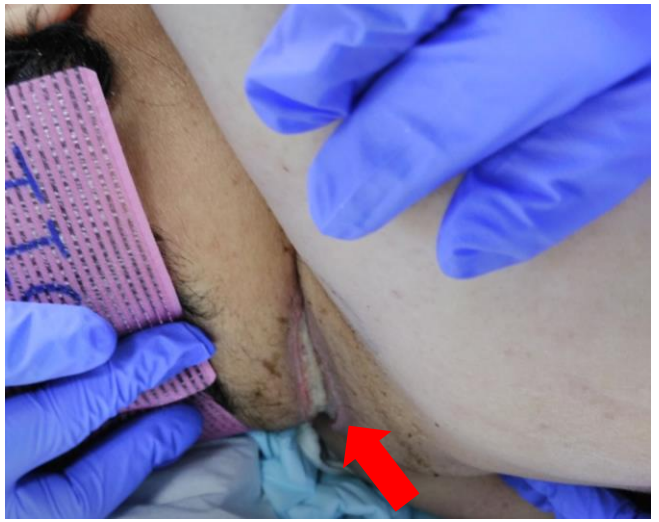
- **NIV Failure**
  - **Intolerance**
  - **SaO_2 < 90 at over FiO_2 0.6**
  - **RR > 35**
  - **Persistent respiratory distress after 6 hour of NIV**

Helmet NIV on COVID-19 in IUH

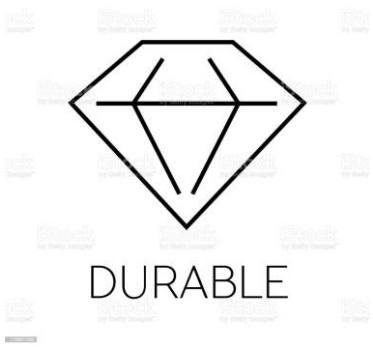
Characteristic		Helmet NIV (N=20)
Age (Years)		63.2
BMI (kg/m2)		24.8
SOFA score (except Respiration)		1.45
Before NIV apply	ROX index	5.86
	pH	7.419
	PaCO2 (mmHg)	40.1
NIV duration (Days)		7.3
NIV failure (%)		9 (45%)
Mortality (%)		6 (30%)

Pitfall of Helmet interface





Skin ulcer



Starmed Helmet :

72 hours

Uncheckable TV

Hypercapnea

Claustrophobia

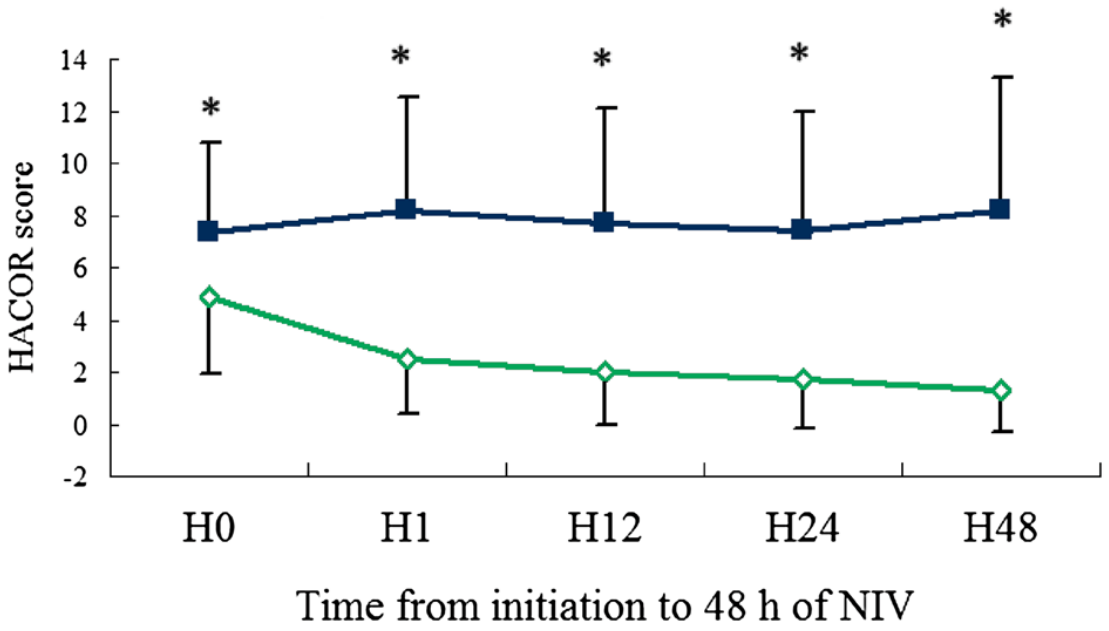
Anxiety

Noise

Monitoring for failure of NIV with AHRF

HACOR with facemask interface

Variable	Value	Score
HR	≤ 120	0
	≥ 121	1
pH	≥ 7.35	0
	7.30-7.34	2
	7.25-7.29	3
	< 7.25	4
Glasgow	15	0
	13-14	2
	11-12	5
	≤ 10	10
PaO_2/FiO_2	>201	0
	176-200	2
	151-175	3
	126-150	4
	101-125	5
	≤ 100	6
RR	≤ 30	0
	31-35	1
	36-40	2
	41-45	3
	≥ 46	4

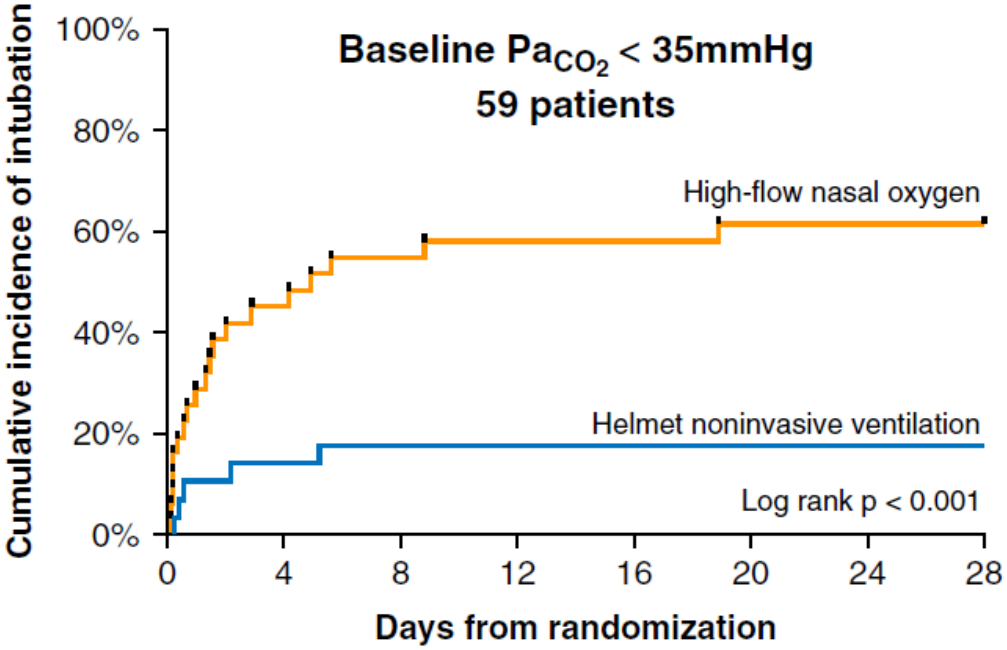


Over 5 points at 1hr after NIV

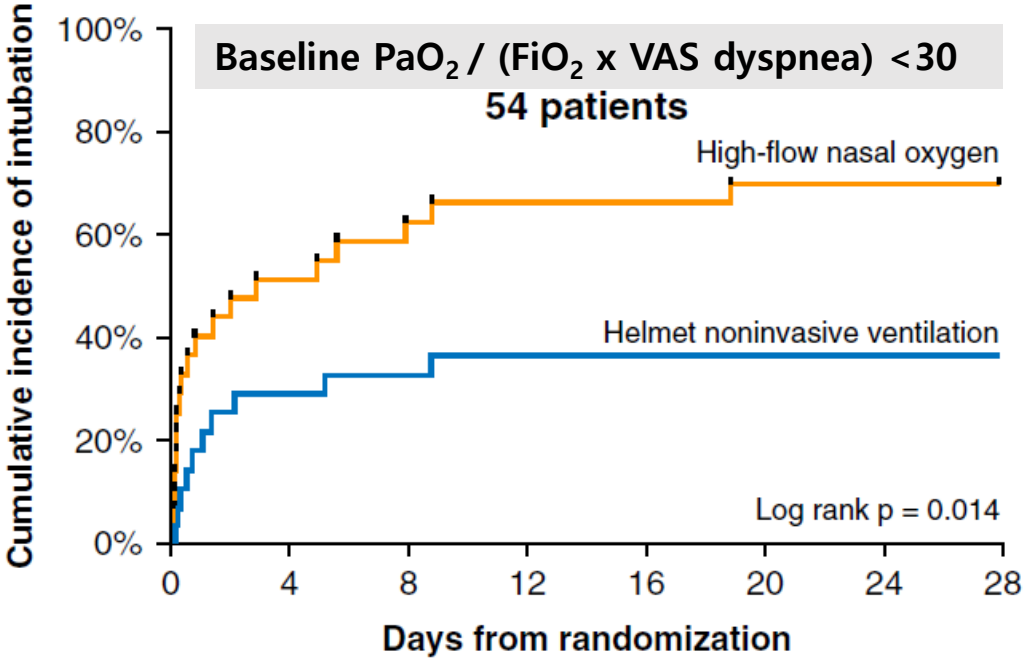
Intensive Care Med (2017) 43:192-199

Monitoring for failure of NIV with AHRF

Helmet interface from HENIVOT



No. At risk								
High-flow oxygen	31	17	14	13	13	12	12	12
Helmet noninvasive ventilation	28	24	23	23	23	23	23	23



No. At risk								
High-flow oxygen	27	14	11	9	9	8	8	8
Helmet noninvasive ventilation	27	20	18	17	17	17	17	17

In ICU Mortality 11% vs 31% (CI, -0.47 to -0.06)

AJRCCM 2022;205:360-364

Take home message

- Helmet NIV can make higher PEEP than any other interfaces

→ Minimize Lung Injury and Improve oxygenation

→ NIV with helmet could be considered in patients with ARDS

- Keep in mind that delayed intubation could lead to higher mortality

- **HACOR score, $PaCO_2$**