Models of care COVID-19
Acute hypoxaemic respiratory failure

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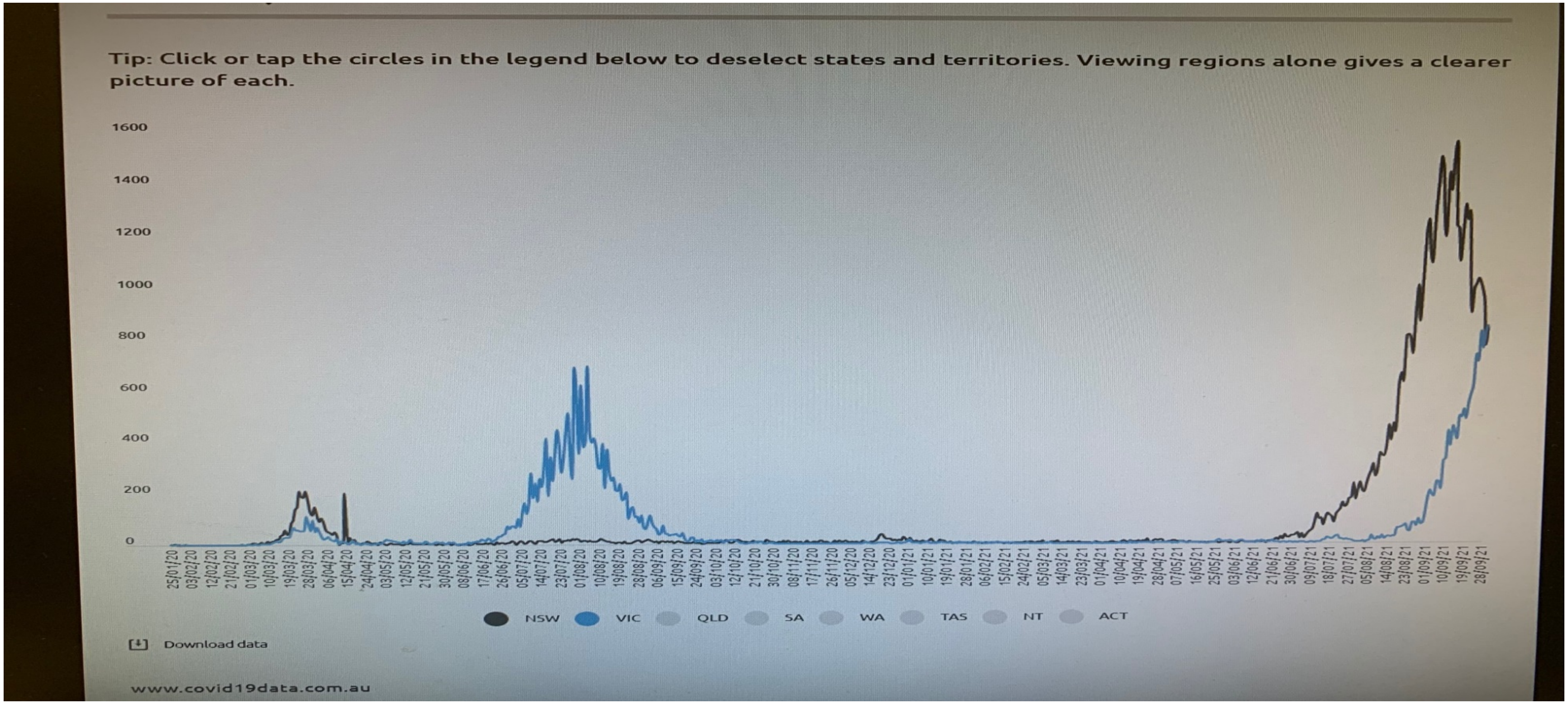
A tale of two cities

	Cases	Hospital	ICU	1st dose	2nd dose
NSW	866	1082	212 (108)	86%	62%
VIC	950	371	81 (55)	79%	48%



CPAP (EPAP) improves gas exchange and ↓ WOB

Lung effects

- Recruits underventilated alveoli
  - Improves gas exchange (hypoxia)
- Increases (end expiratory) lung volume
  - Improves gas exchange (hypoxia)
- Counters intrinsic PEEP
  - Decreases WOB COPD
- Bronchodilates

- Increase in lung volumes and improvements in ventilation in low V/Q units

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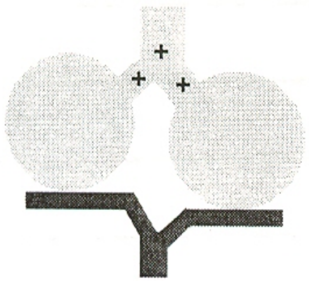
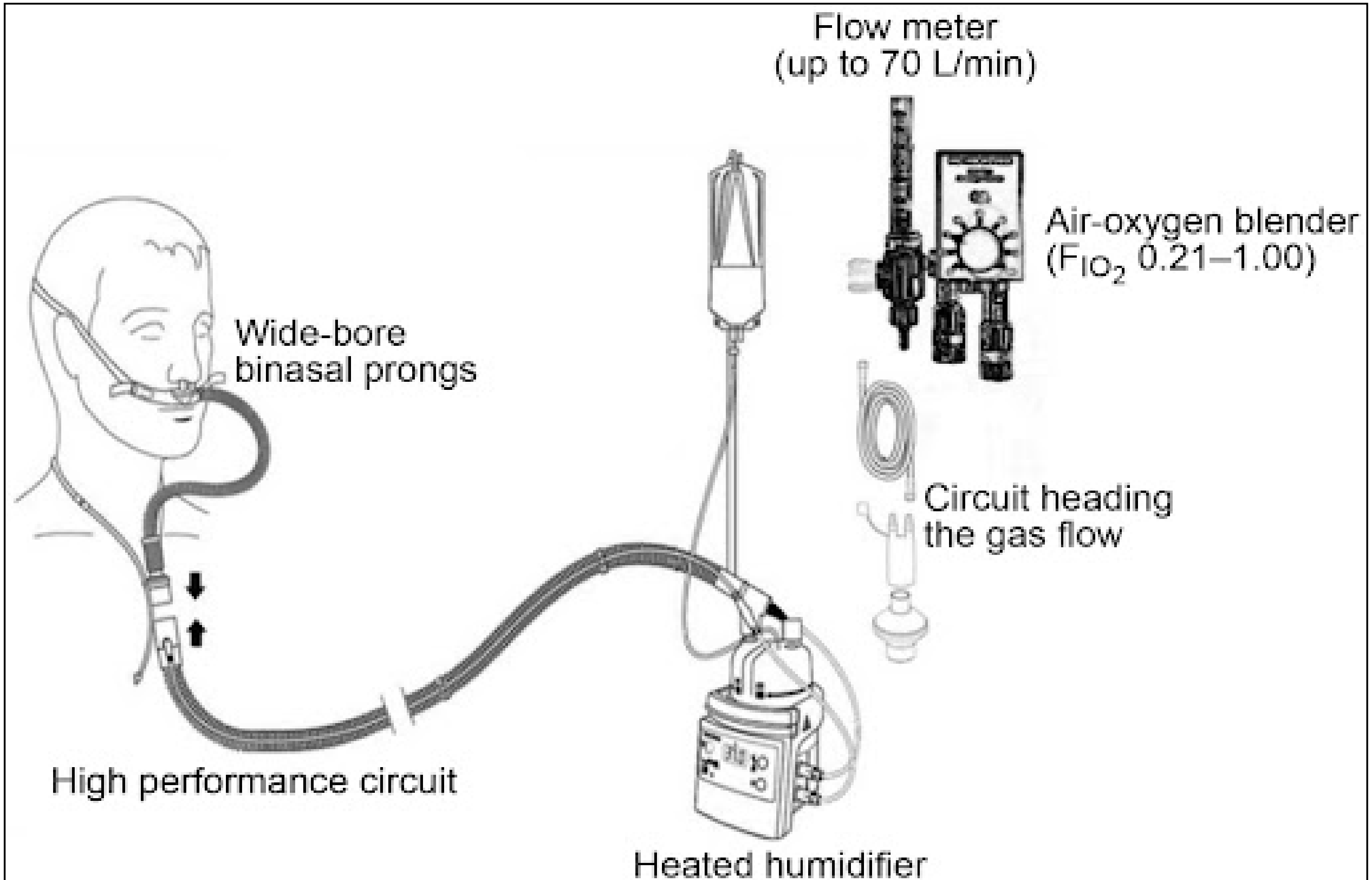


HFNO



Flow meter
(up to 70 L/min)
Air-oxygen blender
(F_{IO_2} 0.21–1.00)
Wide-bore
binasal prongs
Circuit heading
the gas flow
High performance circuit
Heated humidifier

Definitions hypoxaemia

- PaO_2: FiO_2< 400 (PaO_2 < 84 on RA)- Mild
- PaO_2: FiO_2< 300 (PaO_2 < 63 on RA)- Moderate
- PaO_2: FiO_2< 200 (PaO_2 < 42 on RA)- Severe

Classifications	PaO_2 (
Normal	80-100 mm Hg
Mild hypoxemia	60-80 mm Hg
Moderate hypoxemia	40-60 mm Hg
Severe hypoxemia	<40 mm Hg

ARDS Severity	PaO2/FiO2	Mortality
Mild	200 – 300	27%
Moderate	100 – 200	32%
Severe	< 100	45%

Australian guidelines for the clinical care of people with COVID-19

NATIONAL COVID-19 CLINICAL EVIDENCE TASKFORCE

Conditional recommendation

Consider using NIV therapy for patients with hypoxaemia associated with COVID-19, ensuring it is used with caution and strict attention is paid to staff safety including the use of appropriate personal protective equipment (PPE). If NIV is being used, ideally this should be in a negative pressure room. If none is available, other alternatives are single rooms, or shared ward spaces with cohorting of confirmed COVID-19 patients only.

Conditional recommendation

Consider using HFNO therapy for patients with hypoxaemia associated with COVID-19, ensuring it is used with caution and strict attention is paid to staff safety including the use of appropriate personal protective equipment (PPE). If HFNO is being used, ideally this should be in a negative pressure room. If none is available, other alternatives are single rooms, or shared ward spaces with cohorting of confirmed COVID-19 patients only.

Use the lowest flow necessary to maintain oxygen saturation ≥ 92%.

Benefits and harms

Small net benefit, or little difference between alternatives

NIV can improve oxygenation in patients with hypoxaemia but may be associated with a high failure rate and delayed intubation. Evidence from non-COVID patients with acute hypoxaemic respiratory failure shows uncertainty for all-cause mortality and endotracheal intubation. NIV is a known aerosol-generating procedure, with possible increased risk of aerosolisation with poor mask fit *[18]*. Since there is a potential risk of transmission to healthcare workers, the procedure should be used with caution and follow strict attention to staff safety.

Association of Noninvasive Oxygenation Strategies With All-Cause Mortality in Adults With Acute Hypoxemic Respiratory Failure

A Systematic Review and Meta-analysis

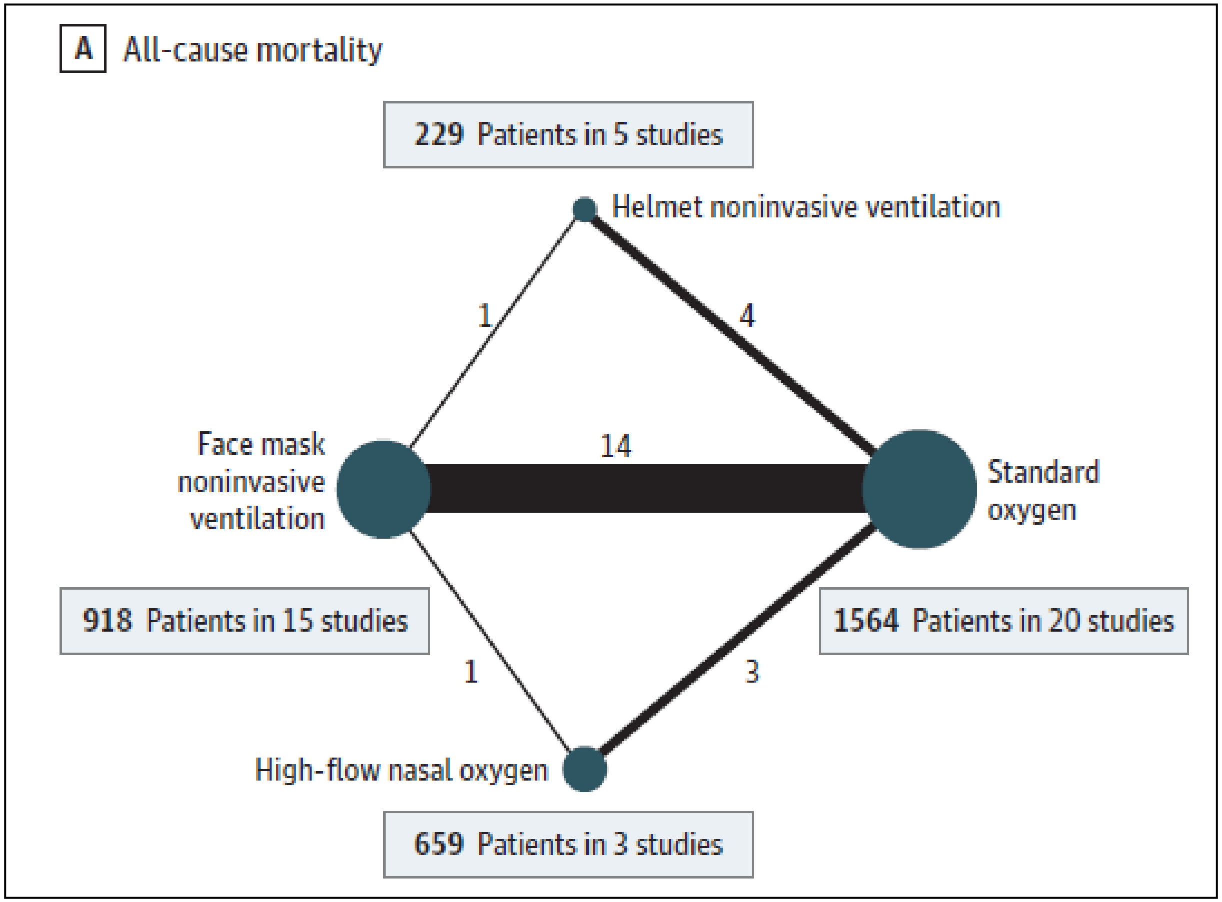


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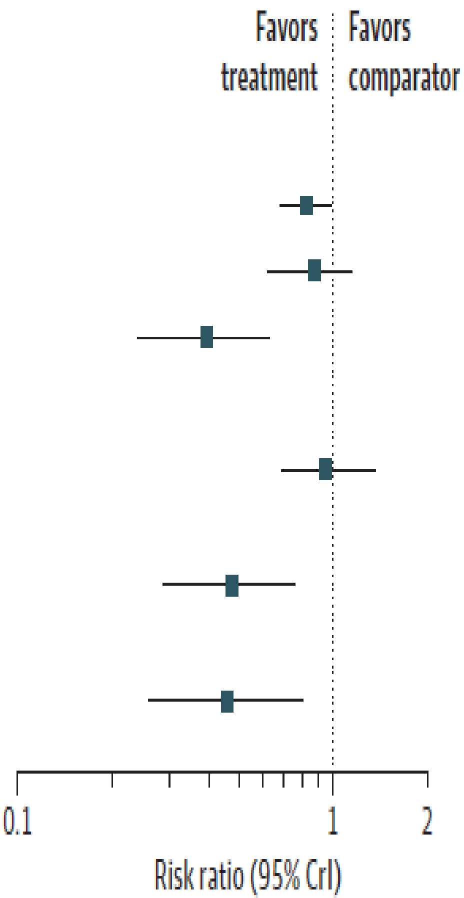
Table. Main Characteristics of Included Studies

Source	Funding	Total No. of patients	Main reason for hypoxemic respiratory failure (main baseline risk factor)	Age, mean, y	Pa_{O_2}:F_{IO_2} ratio	Respiratory rate, /min	Main exposure	Comparator	Outcomes of interest assessed	Timing of measurement for study outcomes
Antonelli et al,[6] 2000	Undisclosed	40	Mixed ARF (immunocompromised [100%])	45	129	38	Face mask noninvasive ventilation (n = 20)	Standard oxygen (n = 20)	Death, intubation	ICU discharge, hospital discharge
Azevedo et al,[33] 2015	Undisclosed	30	CAP (CHF [43%])	67	NA	NA	High-flow nasal oxygen (n = 14)	Face mask noninvasive ventilation (n = 16)	Intubation	ICU discharge
Azoulay et al,[34] 2018	French Ministry of Health	776	CAP (immunocompromised [100%])	64[a]	132	33	High-flow nasal oxygen (n = 388)	Standard oxygen (n = 388)	Death, intubation	ICU discharge, hospital discharge, 28 days
Bell et al,[35] 2015	Fisher & Paykel	100	Mixed ARF	73	NA	33	High-flow nasal oxygen (n = 48)	Standard oxygen (n = 52)	Intubation	Emergency department, ICU discharge
Brambilla et al,[9] 2014	IRCCS Fondazione Ca'Granda, Ospedale Maggiore Policlinico, Milan	81	CAP (immunocompromised [32%])	67	141	34	Helmet noninvasive ventilation (n = 40)	Standard oxygen (n = 41)	Death, intubation	Hospital discharge
Confalonieri et al,[36] 1999	Undisclosed	56	CAP	64	175	37	Face mask noninvasive ventilation (n = 28)	Standard oxygen (n = 28)	Death, intubation	ICU discharge, 60 days
Cosentini et al,[37] 2010[b]	Undisclosed	47	CAP	69	248	27	Helmet noninvasive ventilation (n = 20)	Standard oxygen (n = 27)	Death, intubation	Emergency department
Delclaux et al,[38] 2000	Vital Signs Inc	123	CAP	58[a]	144	33	Face mask noninvasive ventilation (n = 62)	Standard oxygen (n = 61)	Death, intubation	ICU discharge, hospital discharge
Doshi et al,[10] 2018	Vapotherm	204	Mixed ARF (acute exacerbation COPD [26%])	63	NA	30	High-flow nasal oxygen (n = 104)	Face mask noninvasive ventilation (n = 100)	Intubation	72 hours
Ferrer et al,[39] 2003	Red GIRA, Red Respira, and Carburos Metalicos SA	105	CAP (immunocompromised [20%]; CHF [28%])	62	103	37	Face mask noninvasive ventilation (n = 51)	Standard oxygen (n = 54)	Death, intubation	ICU discharge
Frat et al,[7] 2015	French Ministry of Health	310	CAP (immunocompromised [26.5%])	60	155	33	High-flow nasal oxygen (n = 106)	Face mask noninvasive ventilation (n = 110); standard oxygen (n = 94)	Death, intubation	ICU discharge, 90 days
Hernandez et al,[40] 2010	Consejería de Sanidad de Castilla	50	Chest trauma	43	109	NA	Face mask noninvasive ventilation (n = 25)	Standard oxygen (n = 25)	Death, intubation	ICU discharge, hospital discharge
He et al,[41] 2019	National Natural Science Foundation of China	200	CAP	55	231	25	Face mask noninvasive ventilation (n = 102)	Standard oxygen (n = 98)	Death, intubation	ICU discharge, hospital discharge
Hilbert et al,[42] 2001	Undisclosed	52	CAP (immunocompromised [100%])	49	139	36	Face mask noninvasive ventilation (n = 26)	Standard oxygen (n = 26)	Death, intubation	ICU discharge, hospital discharge

Figure 3. Forest Plots for the Association of Noninvasive Oxygenation Strategies With Study Outcomes

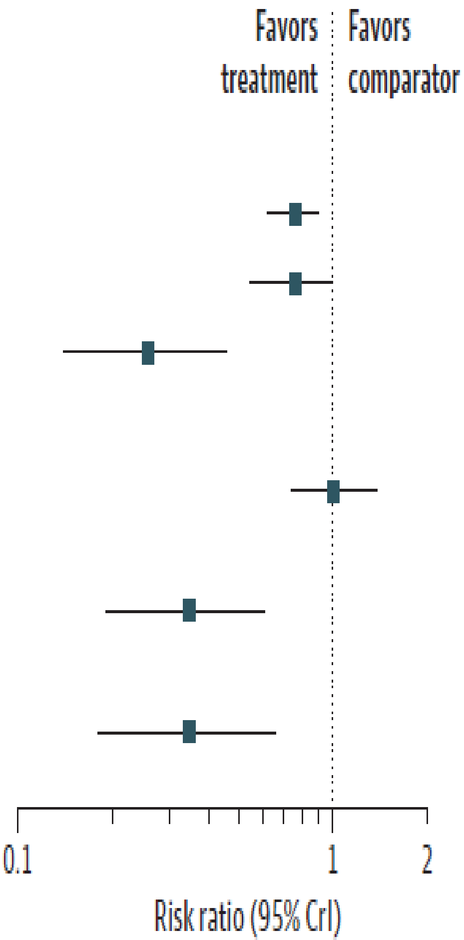
A All-cause mortality

	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)



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)



High-flow nasal cannula for acute hypoxemic respiratory failure in patients with COVID-19: systematic reviews of effectiveness and its risks of aerosolization, dispersion, and infection transmission

Study or Subgroup	HFNC Events	HFNC Total	Standard O2 Events	Standard O2 Total	Weight	Risk Ratio IV, Random, 95% CI
Azoulay 2018	138	388	140	388	51.8%	0.99 [0.82, 1.19]
Frat 2015	13	106	22	94	19.3%	0.52 [0.28, 0.98]
Jones 2016	35	165	24	138	27.8%	1.22 [0.76, 1.95]
Makdee 2017	1	63	0	65	1.1%	3.09 [0.13, 74.55]
Total (95% CI)		722		685	100.0%	0.94 [0.67, 1.31]
Total events	187		186			

15 June 2020

Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 5.17$, df = 3 ($P = 0.16$); $I^2 = 42\%$

Test for overall effect: $Z = 0.38$ ($P = 0.70$)

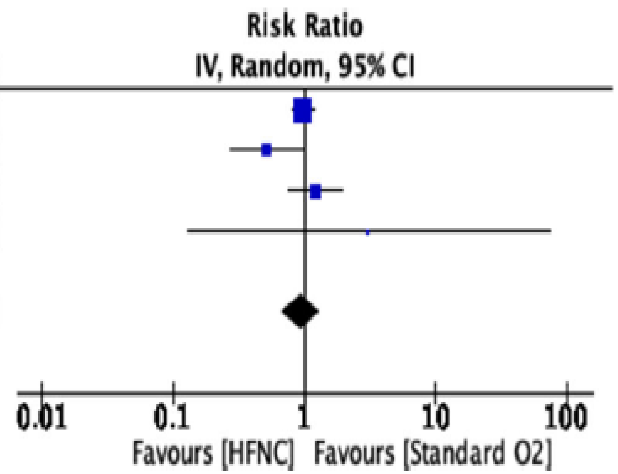
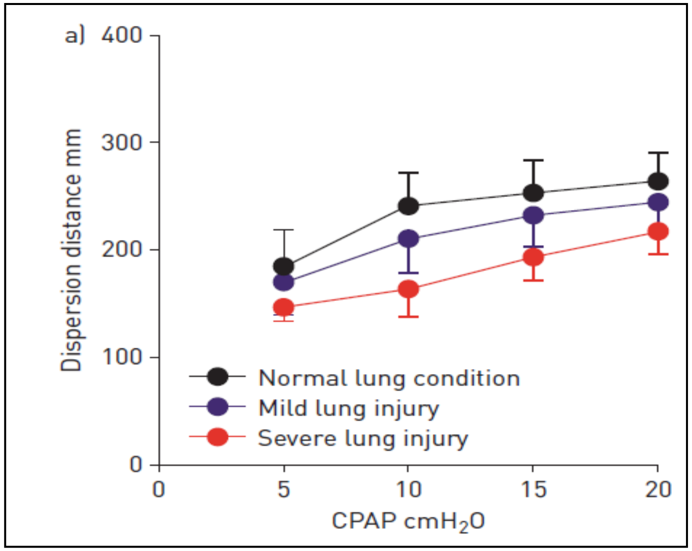


Fig. 4 Mortality forest plot for review on HFNC for acute hypoxemic respiratory failure. CI = confidence interval; HFNC = high-flow nasal cannula

Exhaled air dispersion during high-flow nasal cannula therapy *versus* CPAP *via* different masks

Scenario	Lung condition/injury	Flow rate $L \cdot min^{-1}$	Exhaled air dispersion distance mm
1	Normal	60	172±33
2	Mild	60	72±18
3	Severe	60	48±16
4	Normal	30	130±11
5	Mild	30	61±17
6	Severe	30	37±12
7	Normal	10	65±15
8	Mild	10	43±10
9	Severe	10	30±8



Cite this article as: Hui DS, Chow BK, Lo T, *et al.* Exhaled air dispersion during high-flow nasal cannula therapy *versus* CPAP *via* different masks. *Eur Respir J* 2019; 53: 1802339 [https://doi.org/10.1183/13993003.02339-2018].

An adaptive randomized controlled trial of non-invasive respiratory strategies in acute respiratory failure patients with COVID-19

Characteristic	Conventional Oxygen Therapy	CPAP	HFNO	P value
Mean age ± SD - years	57.6 ± 12.7	56.7 ± 12.5	57.6 ± 13.0	0.515*
Sex – no. (%)				0.589 #
Male	312 (65.7)	260 (68.4)	272 (65.2)	
Female	163 (34.3)	120 (31.6)	145 (34.8)	

CPAP set-up PEEP			
No. of patients	-	312	-
Mean ± SD (cm$H_2$0)	-	9.5 (8.4)	-
HFNO set-up flow			
No. of patients	-	-	336
Mean ± SD (L/min)	-	-	50.8 (12.6)

medRxiv preprint doi: https://doi.org/10.1101/2021.08.02.21261379

Characteristic	Conventional Oxygen Therapy	CPAP	HFNO	P value
Respiratory rate				
No. of patients	472	377	414	
Mean ± SD – (breaths per minute)	25.0 ± 6.8	26.4 ± 7.5	25.4 ± 7.0	0.017 *
FiO_2				
No. of patients	458	362	404	
Mean ± SD	0.61 ± 0.24	0.62 ± 0.24	0.60 ± 0.24	0.633 *
SpO_2				
No. of patients	471	377	409	
Mean ± SD – (%)	93.1 ± 3.8	92.9 ± 3.7	92.5 ± 4.3	0.076 *
SpO_2 to FiO_2 ratio				
No. of patients	457	361	400	
Mean ± SD – (%)	186.4 ± 99.1	182.8 ± 94.7	186.3 ±97.5	0.841 *
PaO_2				
No. of patients	315	238	284	
Test not available	140	122	108	
Mean ± SD (mmHg)	73.3 ± 24.2	71.0 ± 17.8	70.0 ± 20.1	0.150 *
PaO_2 to FiO_2 ratio				
No. of patients	305	228	281	
Test not available	140	122	108	
Mean ± SD	134.9 ± 82.8	131.8 ± 67.8	138.5 ±87.6	0.643 *

Outcome	Pairwise Treatment Comparisons				Odds Ratio†/Hazard Odds‡/Mean Difference§ (95% CI)			
	CPAP versus Conventional Oxygen Therapy¶		HFNO versus Conventional Oxygen Therapy‖		CPAP versus Conventional Oxygen Therapy¶		HFNO versus Conventional Oxygen Therapy‖	
					Unadjusted	Adjusted	Unadjusted	Adjusted
	CPAP	Conventional Oxygen Therapy	HFNO	Conventional Oxygen Therapy				
Tracheal Intubation or mortality within 30 days – no./total (%)†	137/377 (36.3)	158/356 (44.4)	184/414 (44.4)	166/368 (45.1)	0.72 (0.53- 0.96)	0.67 (0.48- 0.94)	0.97 (0.73 -1.29)	0.95 (0.69- 1.30)
Intubation within 30 days – no./total (%)†	126/377 (33.4)	147/356 (41.3)	170/414 (41.1)	153/368 (41.6)	0.71 (0.53- 0.96)	0.66 (0.47- 0.93)	0.98 (0.74- 1.30)	0.96 (0.70 - 1.31)
Mortality at 30 days – no./total (%)†	63/378 (16.7)	69/359 (19.2)	78/415 (18.8)	74/370 (20.0)	0.84 (0.58 -1.23)	0.91 (0.59 -1.39)	0.93 (0.65 -1.32)	0.96 (0.64 - 1.45)
Secondary outcomes #								
Tracheal Intubation rate in the study period – no./total (%)†, *	126/377 (33.4)	147/356 (41.3)	169/414 (40.8)	154/368 (41.8)	0.71 (0.53- 0.96)	0.66 (0.47- 0.93)	0.96 (0.72- 1.28)	0.93 (0.68- 1.28)
Admission to critical care – no./total (%)†	205/379 (54.1)	219/356 (61.5)	253/416 (60.8)	214/368 (58.2)	0.74 (0.55- 0.99)	0.69 (0.49- 0.96)	1.12 (0.84- 1.49)	1.06 (0.76-1.47)

CPAP reduced intubation rate compared to COT, NNT 12

AHRF COVID-19

- What are the roles of high flow nasal oxygen and NIV (bilevel, CPAP)?
- Who should manage hypoxaemic patients and where?
- How can our systems adapt to the rapidly changing environment?

AUSTRALASIAN sleep ASSOCIATION

VIRTUAL

Sleep DownUnder 2021

10 October – 13 October