What to Know About High Flow

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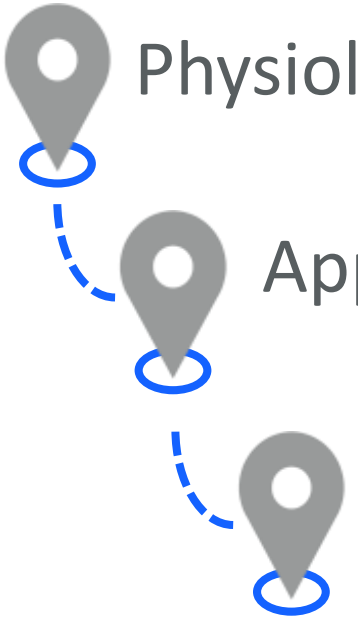
Roadmap for today



Physiologic effects of high flow nasal cannula

Approach to high flow initiation

When and how to wean high flow support

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Meet Mr. S. He presented with an acute viral pneumonia and is now receiving 3L by nasal cannula.

Estimate his delivered FiO_2?

A. 24%
B. 28%
C. 32%
D. 36%

~FiO_2 = 20% + 4% for every L

- 1 L/min = 24%
- [illegible]/min = [illegible]%
- 3 L[illegible]2%
- 4 L/[illegible]36%
- 5 [illegible]in [illegible]%
- [illegible]L/min = 4[illegible]%

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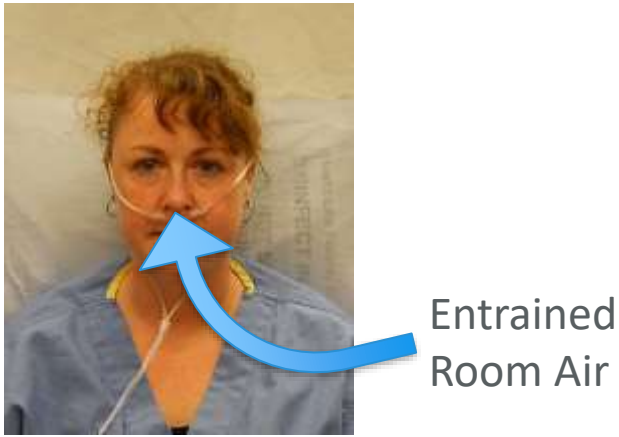
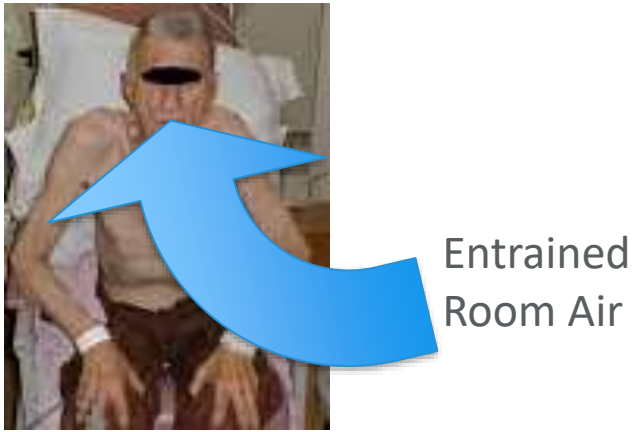
FiO_2 Delivery Varies Based on the Amount of Entrained Room Air

Inspiratory flow at rest
~25-40 L/min

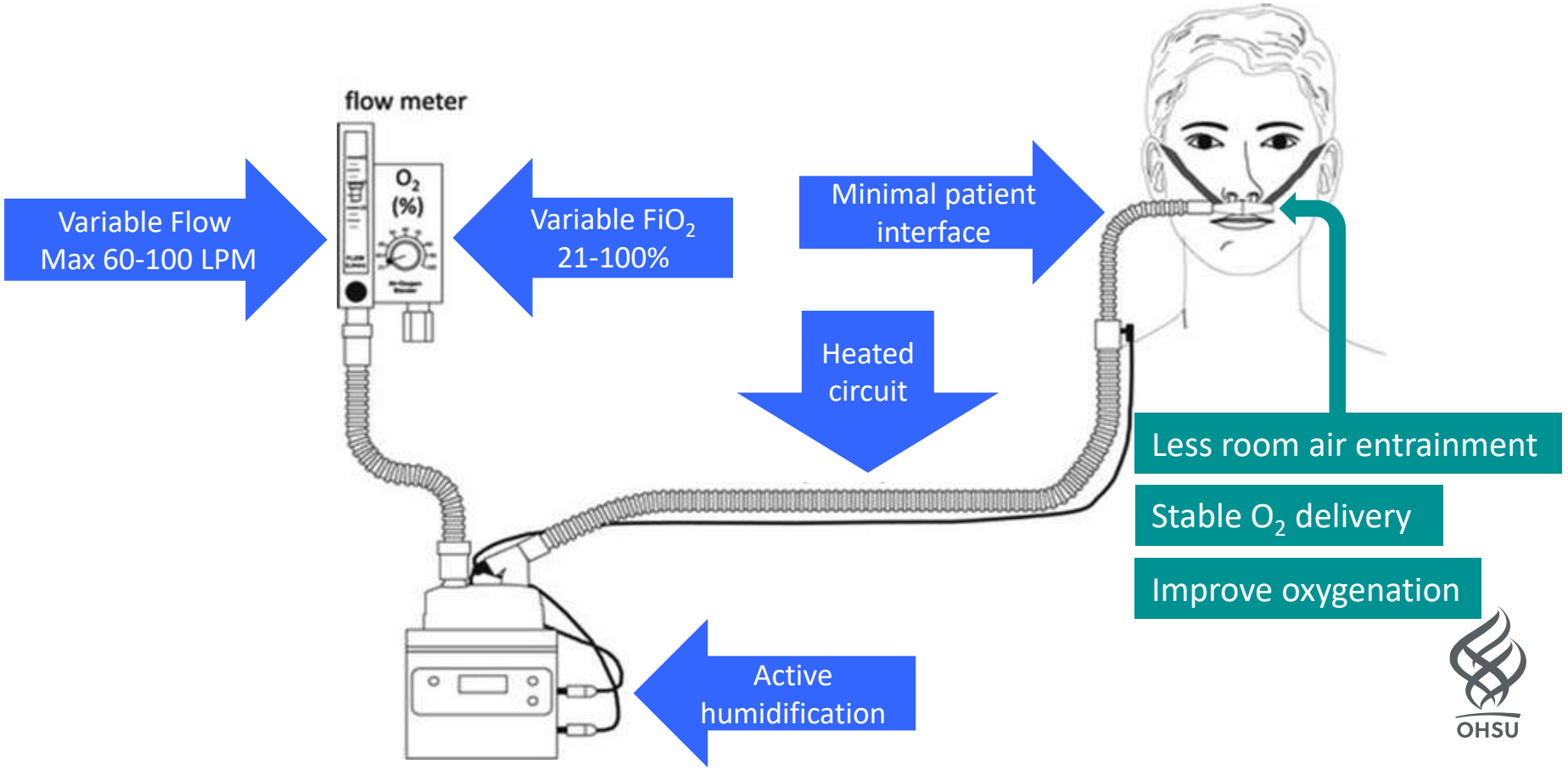


Inspiratory flow during respiratory distress
~ 60-100 L/min



Delivered FiO_2 DECREASES during respiratory distress due to increased room air entrainment

Features of High Flow Nasal Cannula



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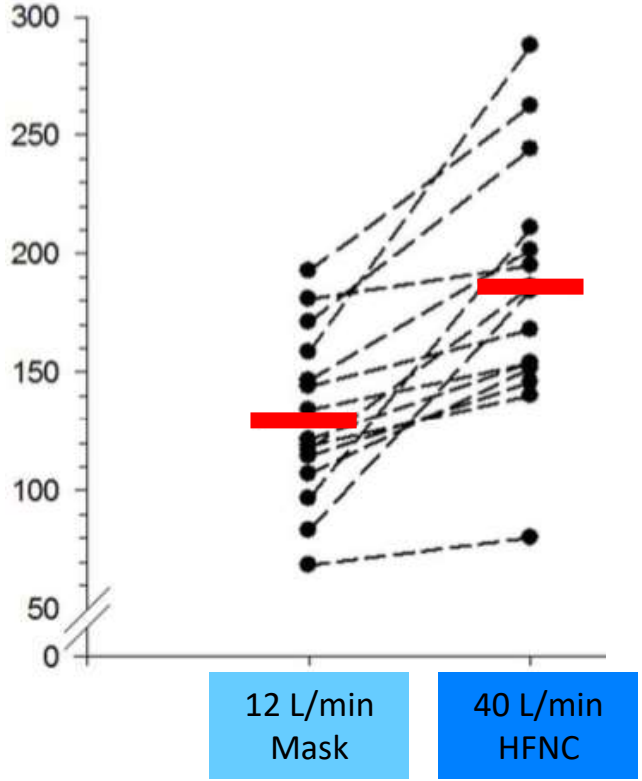
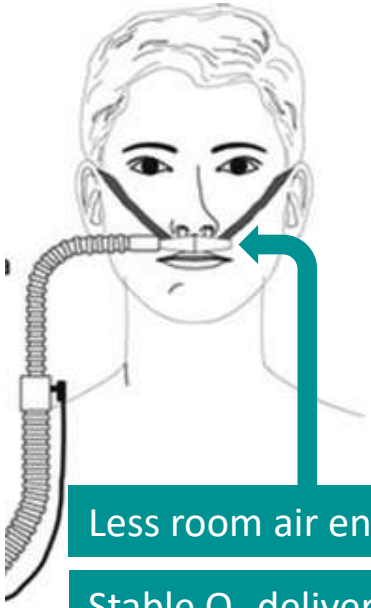
Features of High Flow Nasal Cannula

PaO_2 / FiO_2 (mmHg)





- Less room air entrainment
- Stable O_2 delivery
- Improve oxygenation

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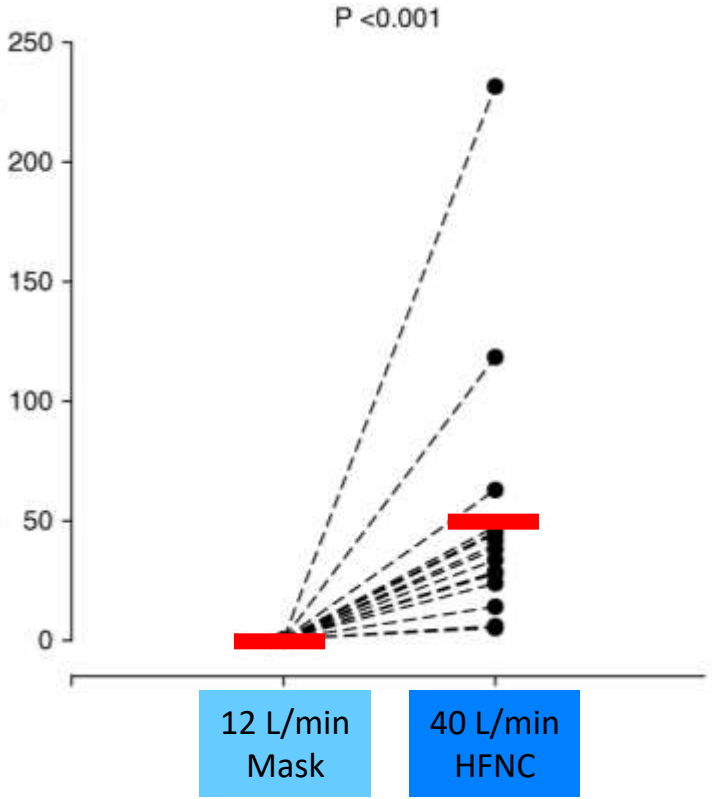
High Flow Produces Alveolar Recruitment

Lung Volume
(end-expiration; % baseline Vt)



Mauri et al. AJRCCM. 2017.1;195(9):1207-1215.

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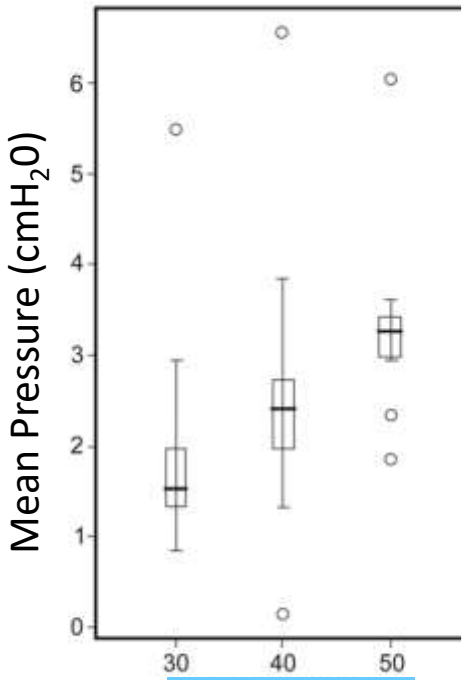
High Flow Generates Positive Nasopharyngeal Pressure

Nasopharyngeal Pressure



Mouth Closed

Mouth Open

Parke, et al. The effects of flow on airway pressure during nasal high-flow oxygen therapy. Respir Care, 2011.

Tracheal Pressure Monitoring with High Flow

Chanques et al. Comparison of three high flow oxygen therapy delivery devices: a clinical physiological cross-over study. Minerva Anestesiol 2013;

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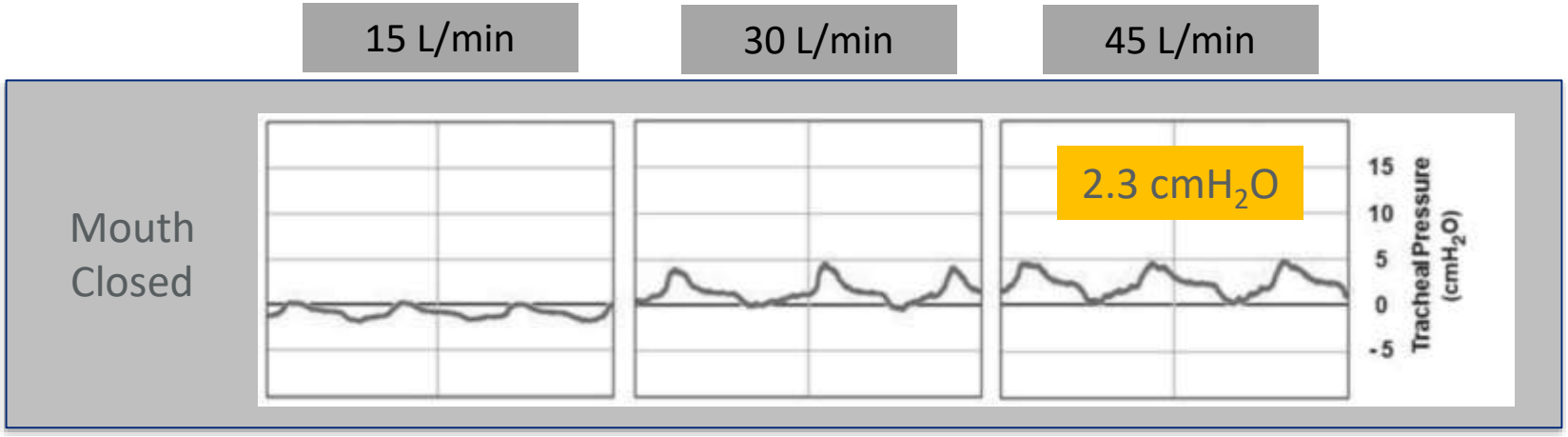
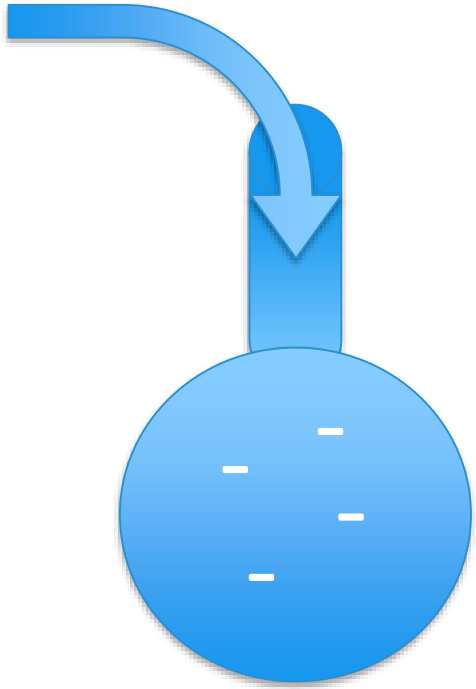
High flow produces low levels of positive pressure in the trachea…



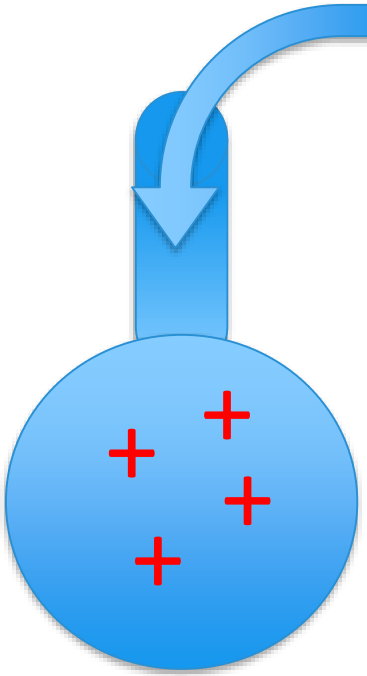
Potential for Reduced Barotrauma vs NIV

High Flow



Alveolus
Negative Pressure Breath

Non-Invasive
Ventilation



Barotrauma
Volutrauma
Inflammation

Alveolus
Positive Pressure Breath

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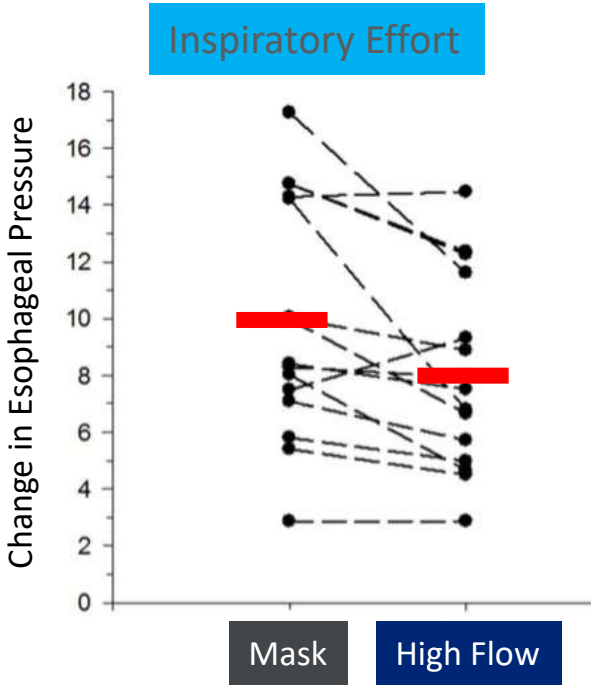
High Flow Improves Work of Breathing



Mauri et al. Physiologic effects of high flow nasal cannula in acute hypoxemic respiratory failure. AJRCCM 2017.

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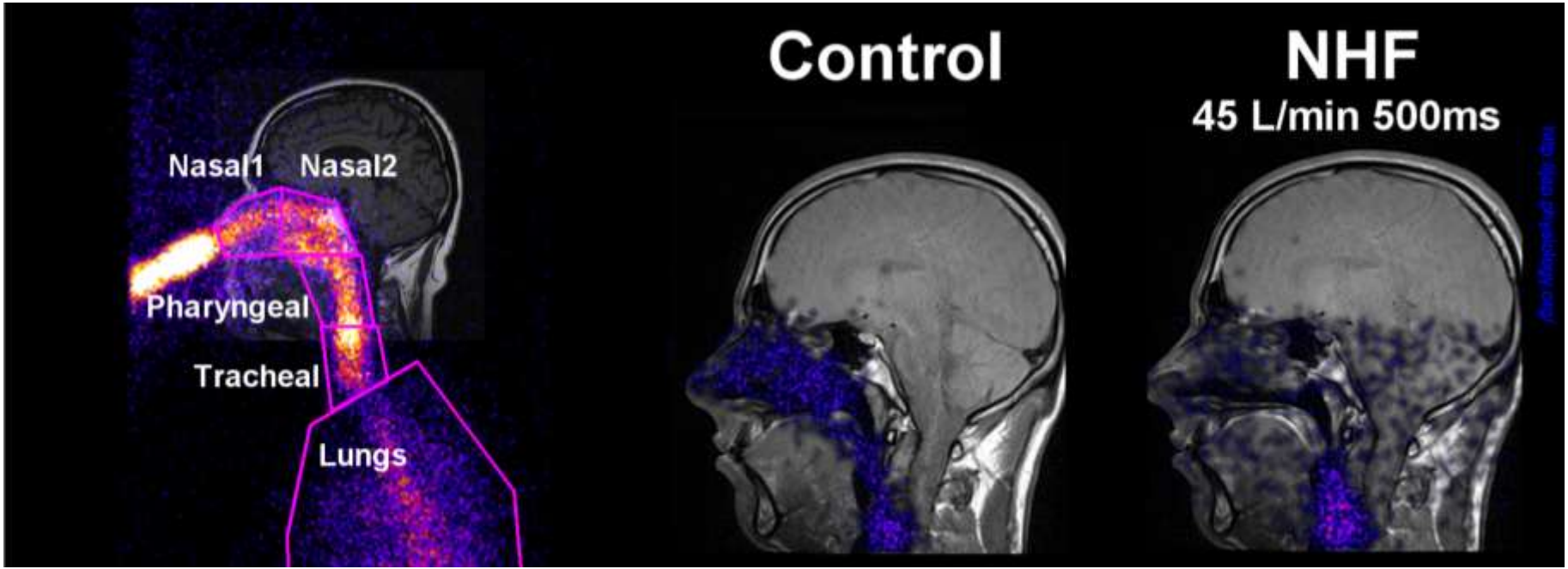
High Flow Reduces Anatomic Dead Space



Krypton gas washout in simulated airway

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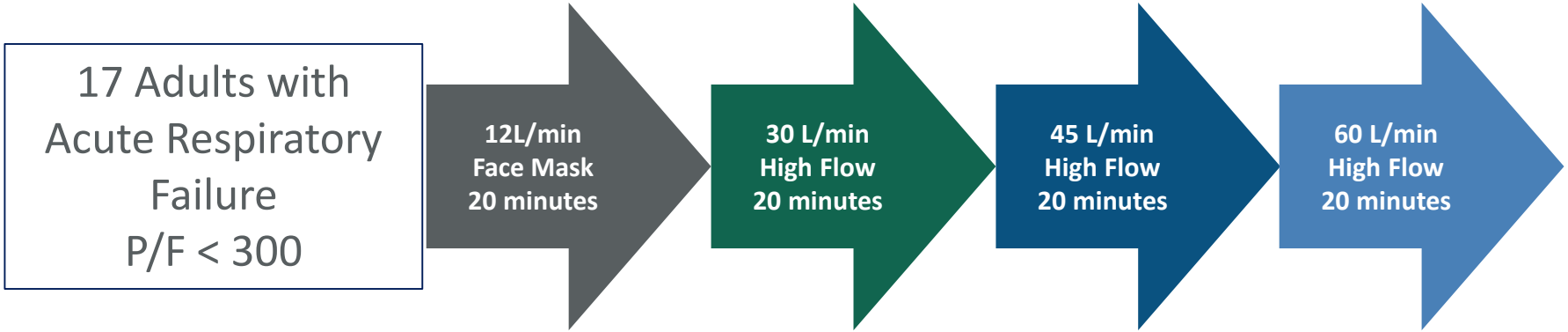
Mauri et al. Physiologic effects of high flow nasal cannula in acute hypoxemic respiratory failure. AJRCCM 2017.

Testing Effects of Flow on Work of Breathing



Mauri et al. Optimum support by high-flow nasal cannula in acute hypoxemic respiratory failure: effects of increasing flow rate. Int Care Med 2017.

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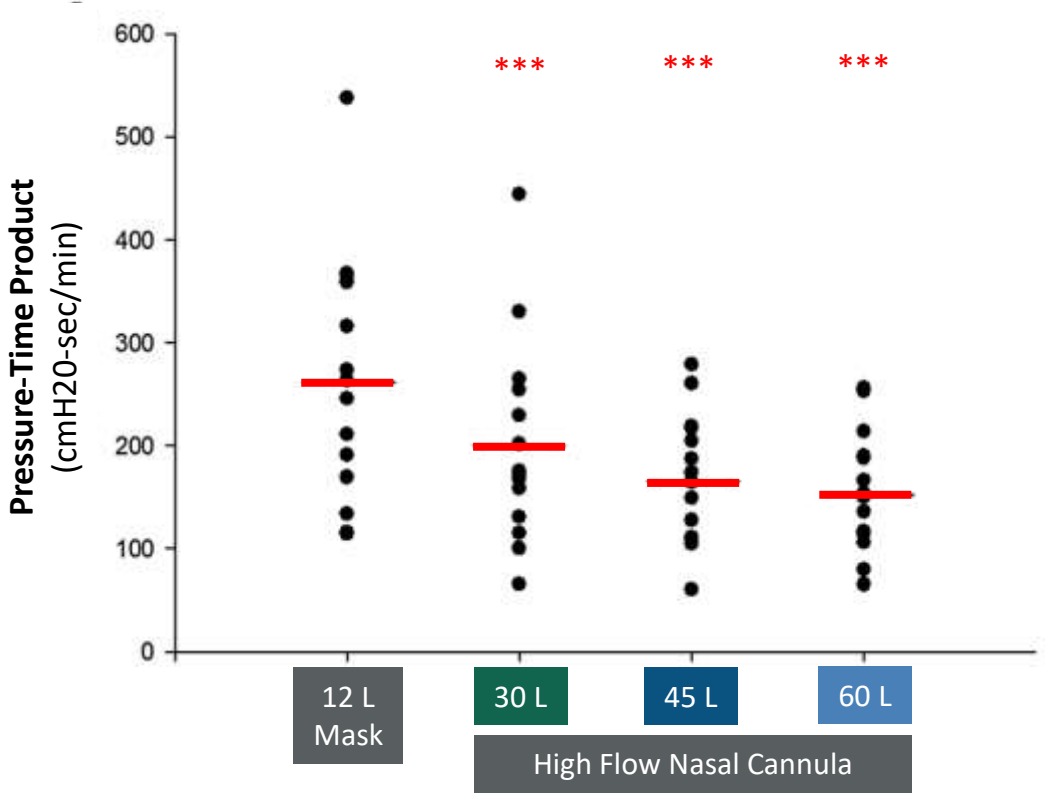
High Flow Reduces Metabolic Demands of Breathing

Metabolic Demands of Breathing



Mauri et al. Optimum support by high-flow nasal cannula in acute hypoxemic respiratory failure: effects of increasing flow rate. Int Care Med 2017.

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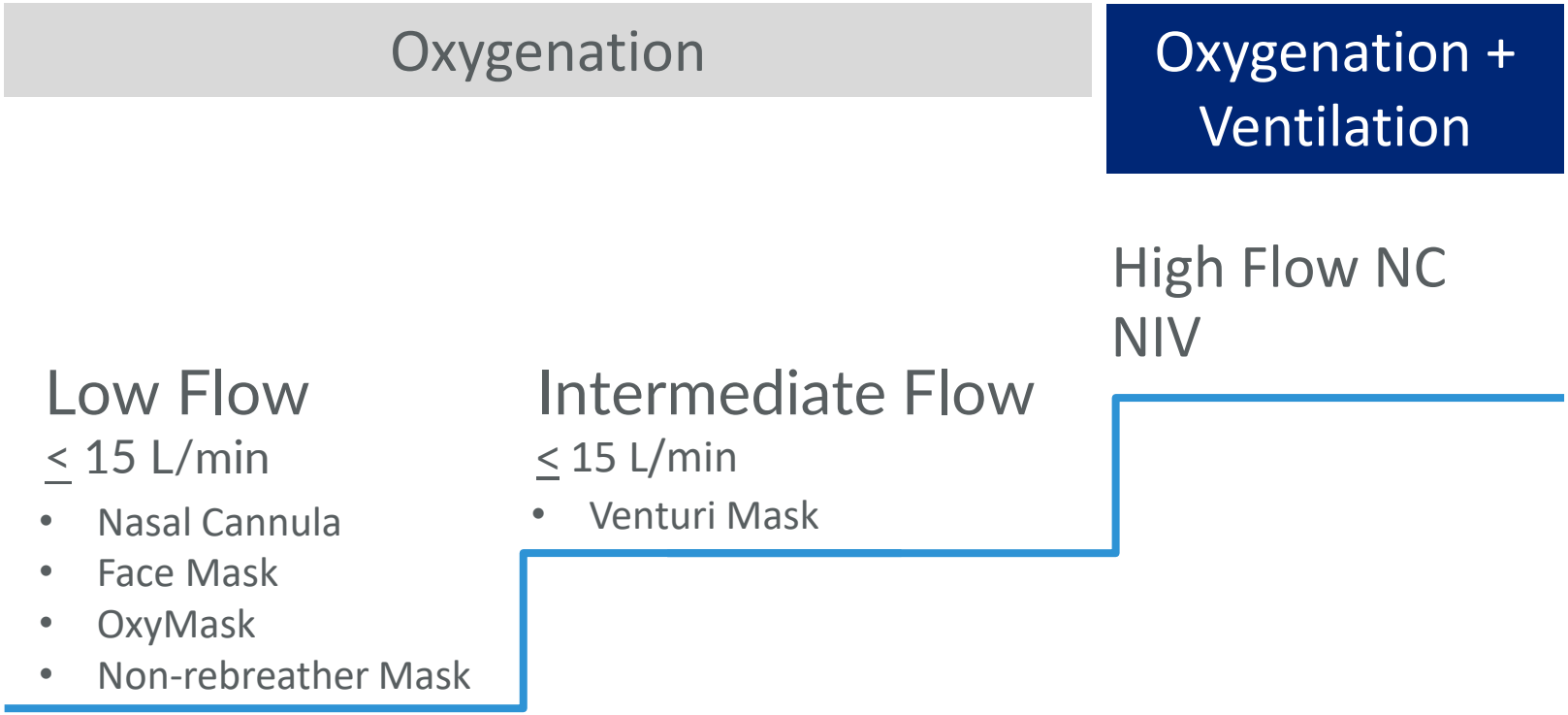
Levels of Respiratory Support



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Ms. C. is a 62 year old with COVID19 who initially required 4L of oxygen. You are called to her bedside for respiratory distress and initiate high flow.

Assuming each setting is sufficient to achieve an SpO_2 > 90%, what initial high flow settings would you choose?

A) 25L @ 100% FiO_2
B) 35L @ 70% FiO_2
C) 45L @ 55% FiO_2
D) 55L @ 35% FiO_2

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My Approach to High Flow Initiation and Titration in Hypoxemic Patients

High work of breathing?
At risk for intubation?

↓

Support both ventilation and oxygenation

Maximize flow (>30 L/min)

Titrate FiO_2 to sat goal

Low work of breathing?

↓

Support oxygenation

Maximize FiO_2

Titrate flow to sat goal

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High Flow Nasal Cannula Indications

- Acute Hypoxemic Respiratory Failure
- Reducing Reintubation Risk
- Pre-oxygenation for Intubation
- Procedural Oxygenation
- Acute Exacerbation of COPD

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FLORALI Trial

313 Patients with Acute Resp Failure

- RR>25
- $PaCO_2$ < 45
- P/F < 300
- 10+ liters for 15+ minutes

106 // High Flow NC

50 L/min
100% FiO_2
FiO_2 Titrated for 92% Sat
48 Hours

96 // Standard Oxygen

10 + L/min NRBM
100% FiO_2
Flow Rate Titrated for 92% Sat
Until Intubation/Recovery

111 // NIV

IPAP for 7-10 ml/kg
PEEP/$FiO_{2\ for}$ 92% Sat
48 Hours
At Least 8 Hrs/Day
High Flow When Off Mask

FRAT J ET AL. N ENGL J MED 2015;372:2185-2196.

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FLORALI Trial

313 Patients with Acute Resp Failure

- RR>25
- $PaCO_2$ < 45
- P/F < 300
- 10+ liters for 15+ minutes

106 // High Flow NC

~48 L/min
~82% FiO_2

96 // Standard Oxygen

13 L/min

111 // NIV

IPAP 8.3 cm/H_20
Vt ~ 9
EPAP 5 cm/H_20
FiO_2 67%
~8 Hrs per day

FRAT J ET AL. N ENGL J MED 2015;372:2185-2196.

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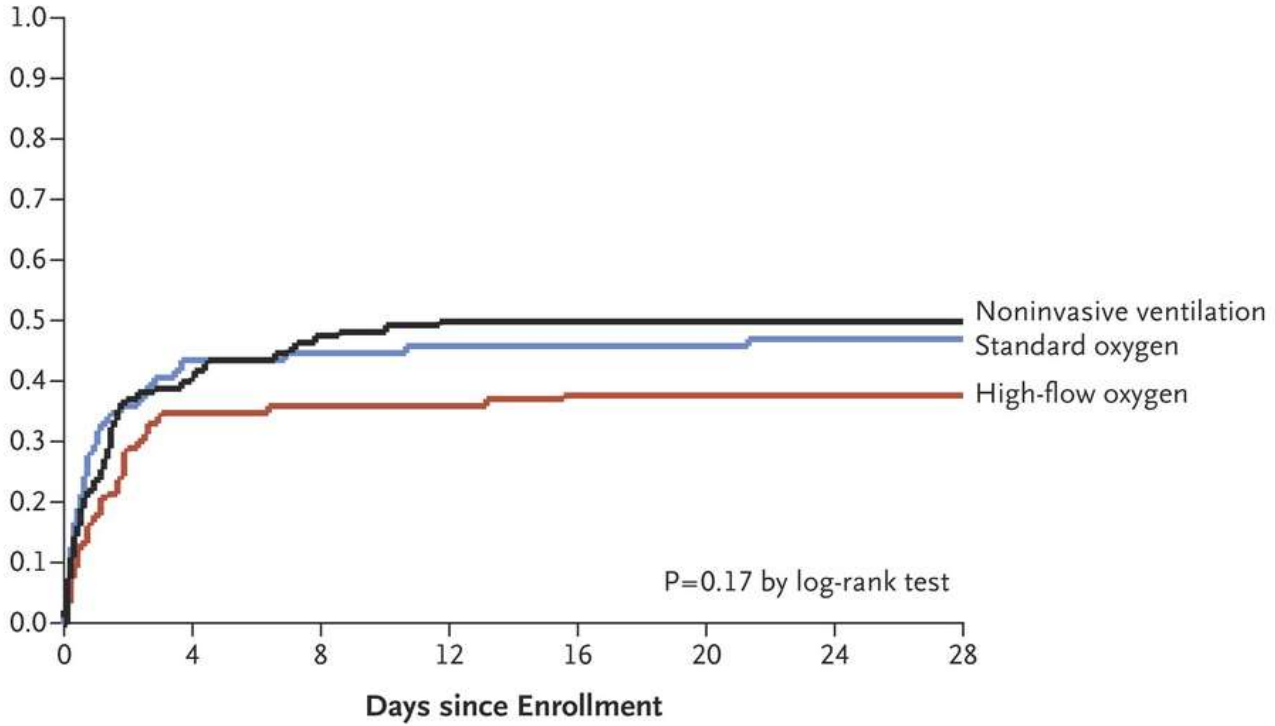
Fewer Intubations in HFNC Group

*Did Not Meet Statistical Significance

Incidence of Intubation



FRAT J ET AL. N ENGL J MED 2015;372:2185-2196.

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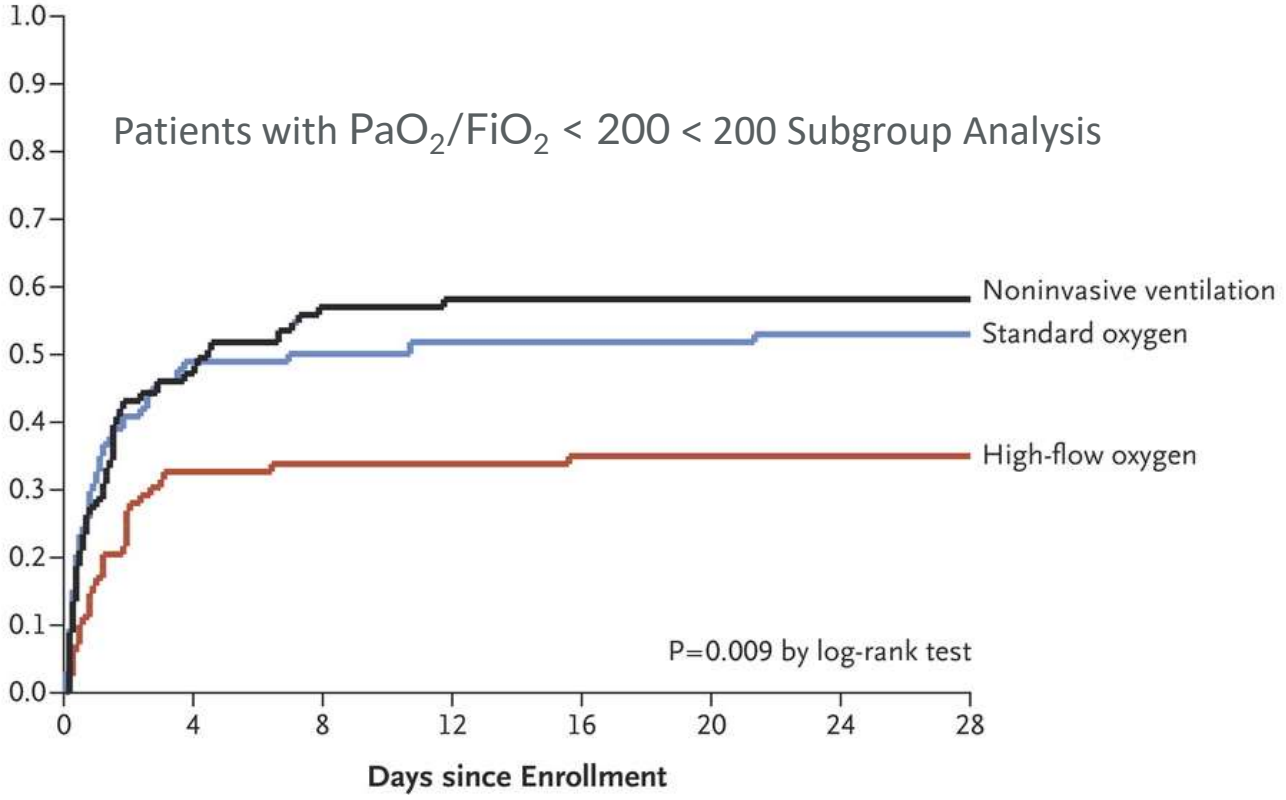
Fewer Intubations with HFNC Use in Patients with More Severe Lung Disease

Incidence of Intubation



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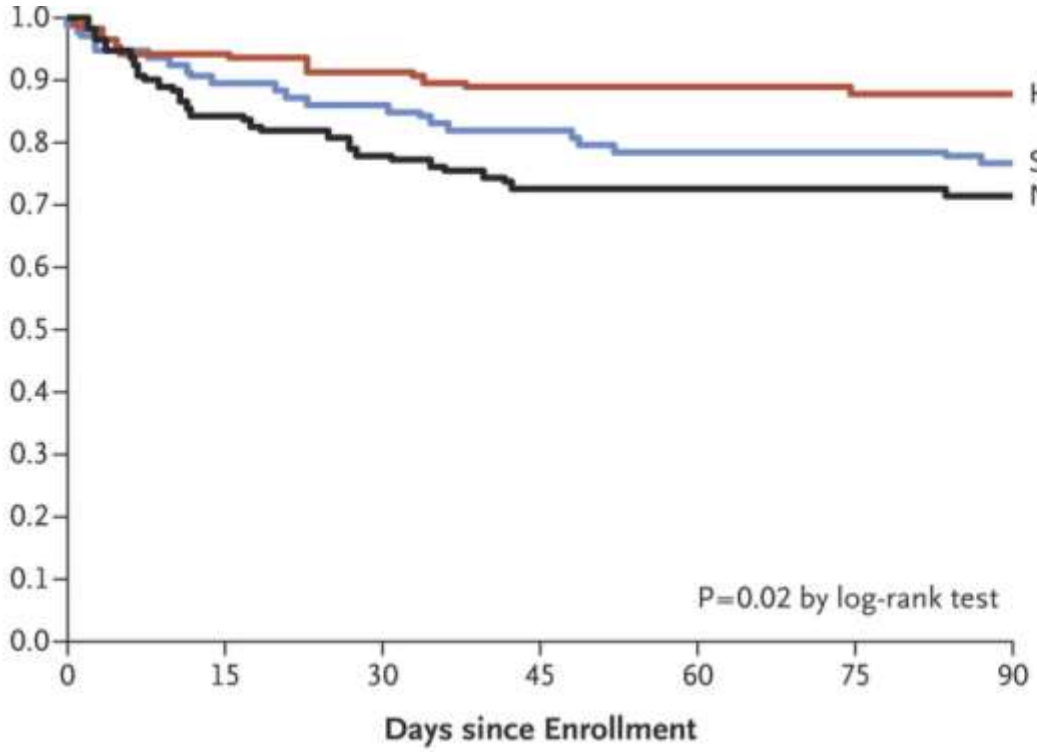
Higher Overall Survival in High Flow Group

Overall Survival



(46%)

(55%)

(58%)

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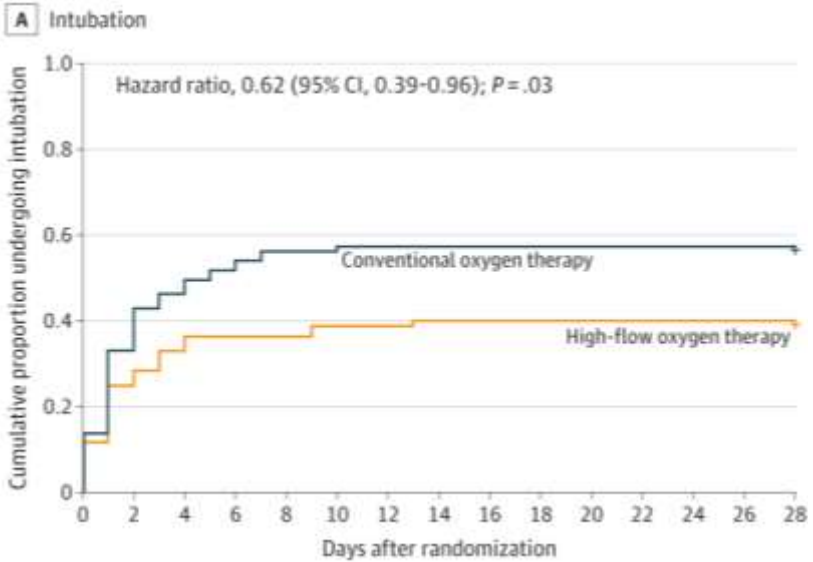
High Flow Use Reduces Intubations, Improves Clinical Recovery in COVID-19



Ospina-Tascon, et al. JAMA. 2021;326(21):2161-2171.

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High Flow Nasal Cannula

Approach to Weaning

1. Is my patient ready to wean?
2. Should I wean flow or FiO_2 first, or both together?

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Your patient is receiving 40 LPM @ 50% FiO_2 and appears comfortable. Her SpO_2 is 95%.

Which of the following would you do next?

A. I would wean flow first
B. I would wean FiO_2 first
C. I would wean both FiO_2 and flow simultaneously

Is my patient ready to wean from High Flow?

- Underlying condition necessitating HFNC use is improving
- SpO_2 greater than 88%
- Respiratory rate ≤ 24
- Low work of breathing
  - able to speak in full sentences
  - absence of accessory muscle use

≤ 40 L/min
≤ 60% FiO_2

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Is my patient ready to wean from High Flow?

Is High Flow Supporting…

- Both ventilation and oxygenation
- Only oxygenation

M.L. is a 43 year-old male with acute hypoxemic respiratory failure secondary to aspiration pneumonitis after a surgery.

Initial HFNC settings: 40 L/min @ 100% FiO_2.

Over several days, his work of breathing improved and his settings were reduced to 25 L/min and 50% FiO_2.

Further flow weaning was limited due to desaturations to less than 88%.

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Initiating a “Low Flow Breathing Trial (LBT)”

Return to starting High Flow settings

Decrease flow by 10 L/min
Increase FiO_2 as needed to achieve target saturation

Reassess vital signs and work of breathing in 10-20 minutes

Decrease flow by 10 L/min
Increase FiO_2 as needed to achieve target saturation

Reassess vital signs and work of breathing in 10-20 minutes

Once flow $\leq$ 20 L/min, trial of low flow cannula or face mask

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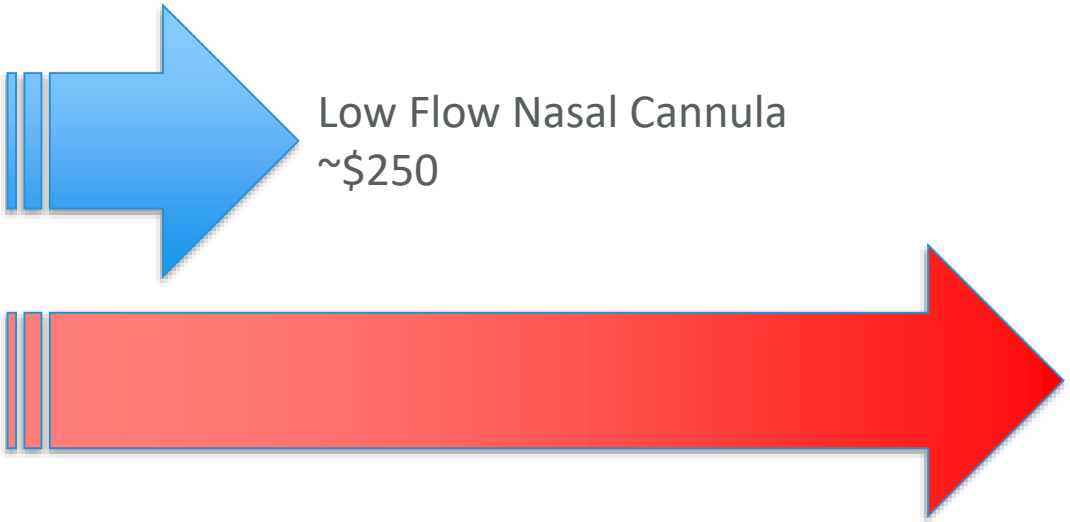
Cost of High Flow Nasal Cannula



Low Flow Nasal Cannula
~$250

High Flow Nasal Cannula
~$2500

Delay in advancement of care
Unnecessary resource utilization (equipment, beds and personnel)

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Thank You