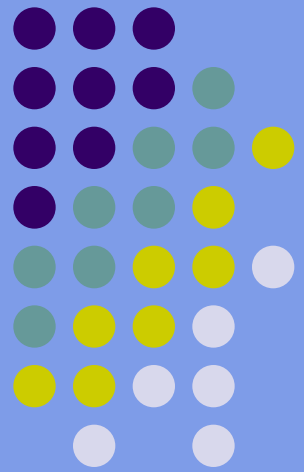
High Humidity
High Flow
Oxygen Delivery

Sue Jones RRT

Quality Improvement Coach

Sponsored by

Fisher&Paykel

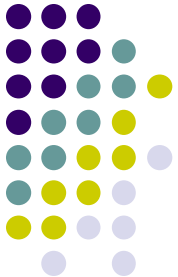


Below is a figure from the book, showing a woman inhaling oxygen from a device that stored enough

O2 for intermittent use in 1887

FIG. 4.—THE INHALING FLASK, AND METHOD OF USING.

Oxygen compound(therapy) – It's origin and development, by Drs. Starkey and Palen, 1888



PRICE OF OFFICE TREATMENT

- **The fee for this Treatment is $30.00 per month, payable in advance. This calls for thirty treatments, whether in as many consecutive days or otherwise.**

1881 Oxygen therapy

PRICE OF HOME TREATMENT

- **The HOME TREATMENT is sent by Express, at the cost of the person ordering it, on the receipt of the price, which is $15.00. It contains two months' supply of "Compound Oxygen," with inhaling apparatus, and full and explicit directions for use. If sent C.O.D.the cost of collection will be added to the Express charges**

- **NO EXTRA CHARGE FOR ADVICE OR CONSULTATION**

THE PRINCIPLES AND PRACTICE OF MEDICINE, by William Osler, M.D.(1892)

PNEUMONIA -- Treatment

- **OXYGEN GAS -- It is doubtful whether the inhalation of oxygen in pneumonia is really beneficial. Personally, when called in consultation to a case, if I see the oxygen cylinder at the bedside I feel the prognosis to be extremely grave. It does sometimes seem to give transitory relief and to diminish the cyanosis. It is harmless, its exhibition is very simple, and the process need not be at all disturbing to the patient. The gas may be allowed to flow gently from the nozzle directly under the nostrils of the patient, or it may be administered every alternate 15 minutes through a mask.**

Case Study

57 year old man

- Past medical hx hypogammaglobulinemia for about 30 years characterized by recurrent pneumonias
- In Feb 2012 presents with
  - 48 hr hx of ↓oral intake
  - Cough, clear to green
  - Upper clavicular chest pain
  - Posterior back pain
  - SOB mild to moderate
  - Small amount of vomiting and loose stool

Patient History

- Recurrent lobar pneumonia
- Has had one UTI
- Non-smoker, minimal alcohol usage
- Jehovah’s witness

Arrives in ER Vital signs include:

- T 36.5
- HR 123
- BP 79/45
- Mild to moderate SOB, able to speak in half sentences
- Labs Hgb 125, White count 21.6, platets 226, bands 4.34, INR 1.5, PTT 45, Na 141, K 502, anion gap 14 urea 13, creatinine 266, CK 339 and Trop 0.01

- Chest x-ray results
  - L lower lobe consolidation
  - Lingular air space disease
  - Loss of L hemidiaphragm
  - R lower lobe infilitrates
  - R upper air space disease
- Comparison to Dec. 2011 the L lower and the R upper air space disease is new

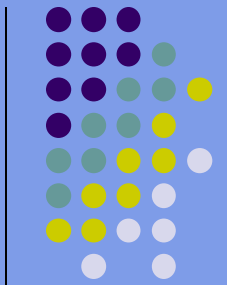
- Assessment and issues
  - Hx of hypogammaglobulinemia
  - Recurrent pneumonia with new pulmonary infiltrates
  - Hypotension
  - Worsening renal function
  - Decrease perfusion to tissues
- Plan to follow in ICU
  - Patient may require ventilation

- Treatment recommended by Intensivist
  - 5 liters of fluid in ER while waiting for ICU bed
  - Levo
  - Azithromycin, Tazocin and Vancomycin
  - Manage respiratory status with appropriate oxygen therapy

- High humidity High flow therapy initiated at 50% oxygen and flows of 40lpm
- ABG after 2.5 hrs
  - pH 7.22, PaCO2 45, PaO2 115, HCO3 18, sat 98%

Over next 72 hours patient tried off HHHF therapy after 24 hours respiratory status worsened returned to HHHF for another 48 hours and then weaned down to low volume neb and face mask

Nasal High Flow



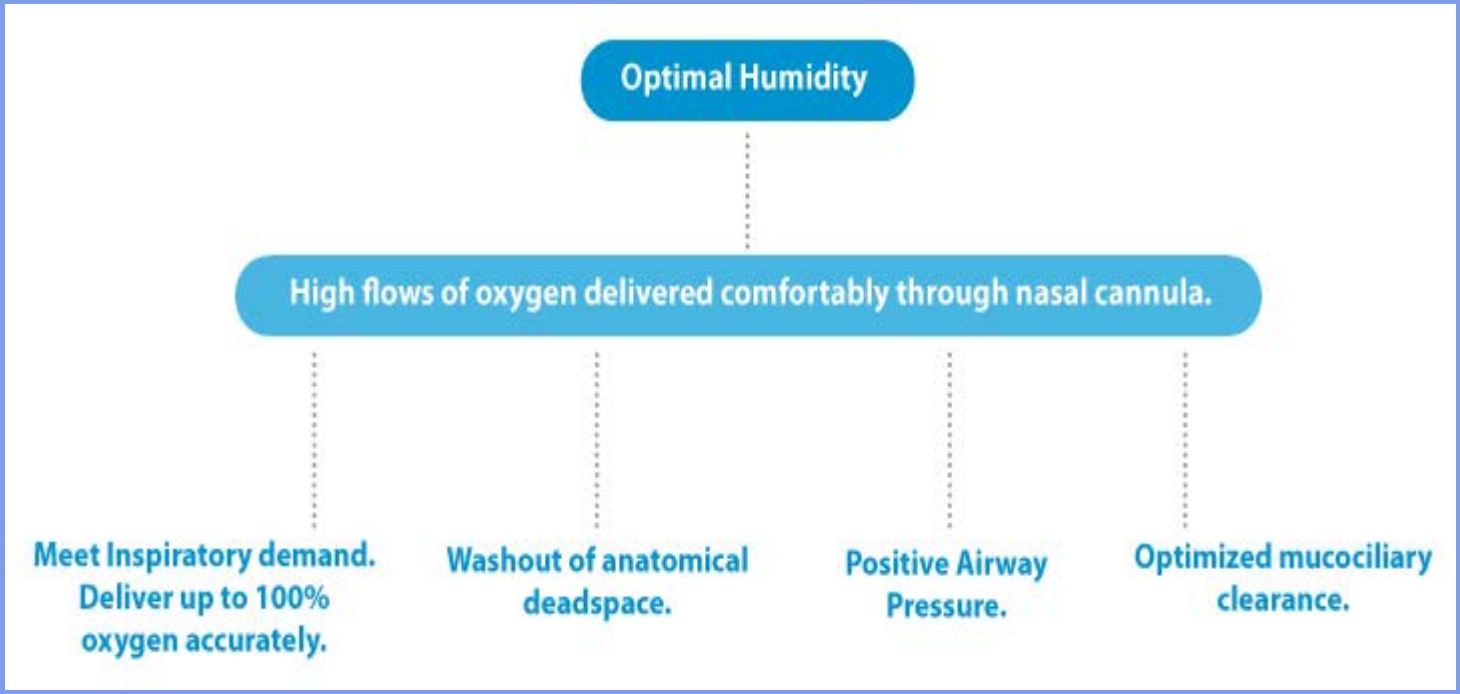
- Comfortable, Effective Oxygen Delivery

Objectives

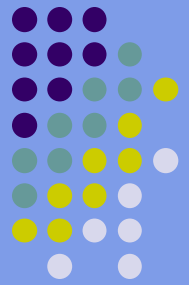
- What is Nasal High Flow?
- Key benefits of Nasal High Flow
- Which Patients?
- Delivering NHF

Nasal High Flow

Nasal High Flow allows you to **comfortably** and **effectively** deliver oxygen to your hypoxemic patients with mild to moderate respiratory distress.

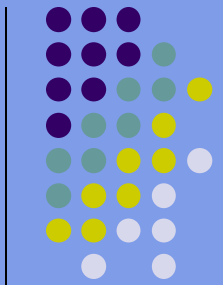


High Humidity High Flow Oxygen Therapy



- Key benefits of Nasal High Flow

Optimized Mucociliary Clearance

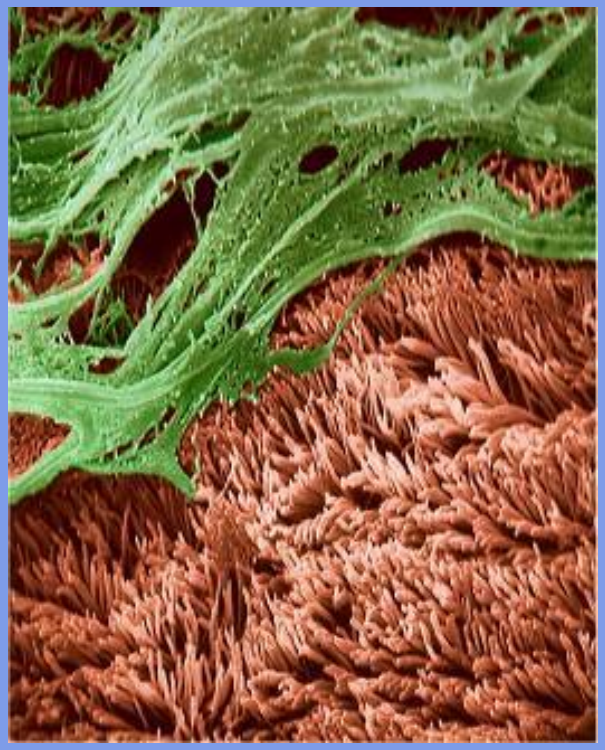


- High humidity high flow systems provide humidification technology which emulates the bodies natural balance of temperature and humidity in healthy human lungs.
- The air/oxygen blend delivered with a High Flow High Humidity device is conditioned to provide optimal humidity.
- The optimal level of humidity is shown to be 37 °C, 44 mg/L
- This conditioning makes the delivery of Nasal High Flow possible

Optimized Mucociliary Clearance

Delivering Optimal Humidity, 37 °C, 44 mg/L, optimizes mucociliary clearance[6,7,8]

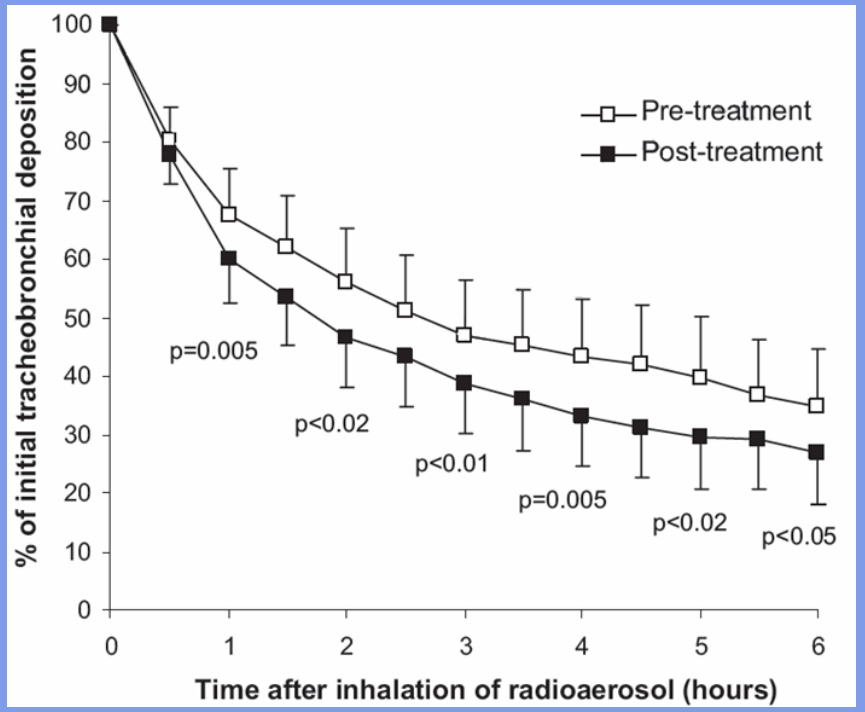
- Improved secretion quality
- Maintenance of the mucosal function
- Secretions remain mobile for transport out of the airway



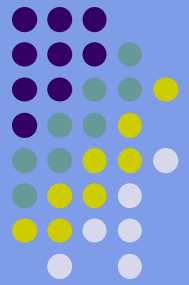
Mechanism Study

Hasani *et al*., 2008 used a radio-aerosol technique to measure mucociliary clearance before and after 7 days of domiciliary nasal high flow with humidification

- Delivered optimally humidified flow of 20 to 25 L/min through nasal cannula for 3 hrs each night
- Following humidification, mucociliary clearance significantly improved



Four Key Benefits of Using HHHF

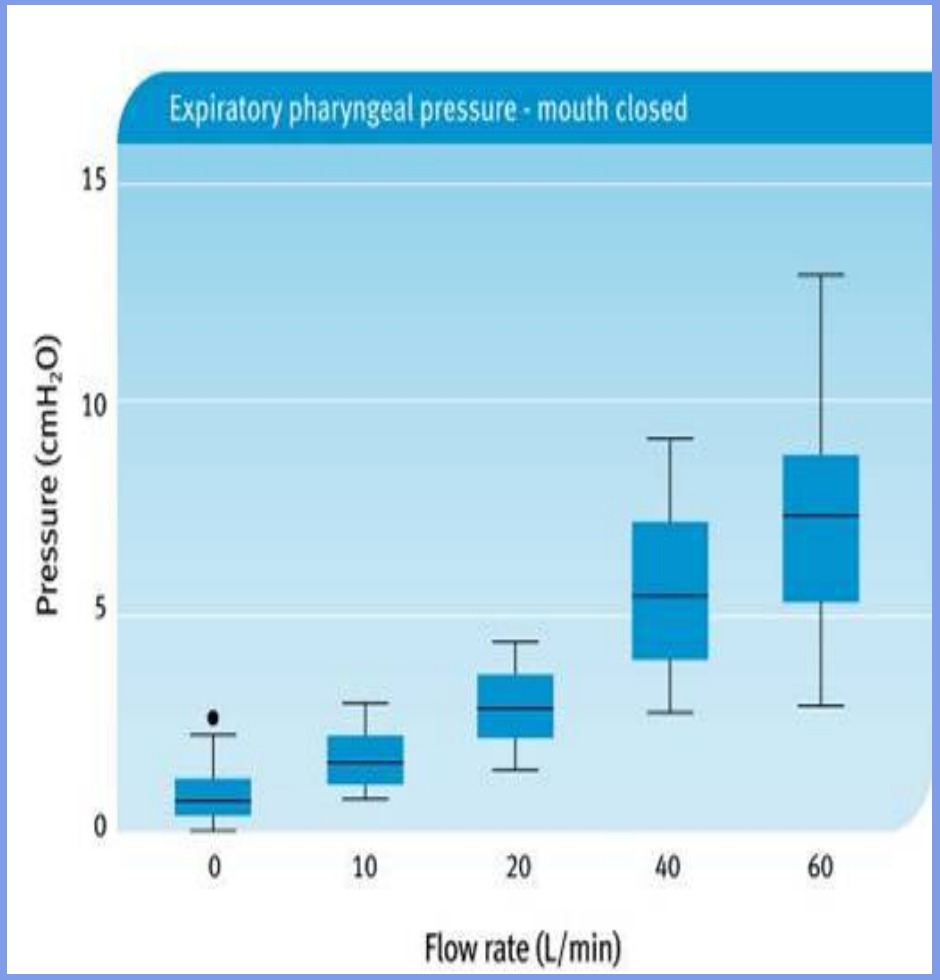


- Optimized mucociliary clearance
- **Positive airway pressure during the Respiratory cycle**
- Effective oxygen delivery
- Washout of anatomical dead space

Positive Airway Pressure during the Respiratory Cycle

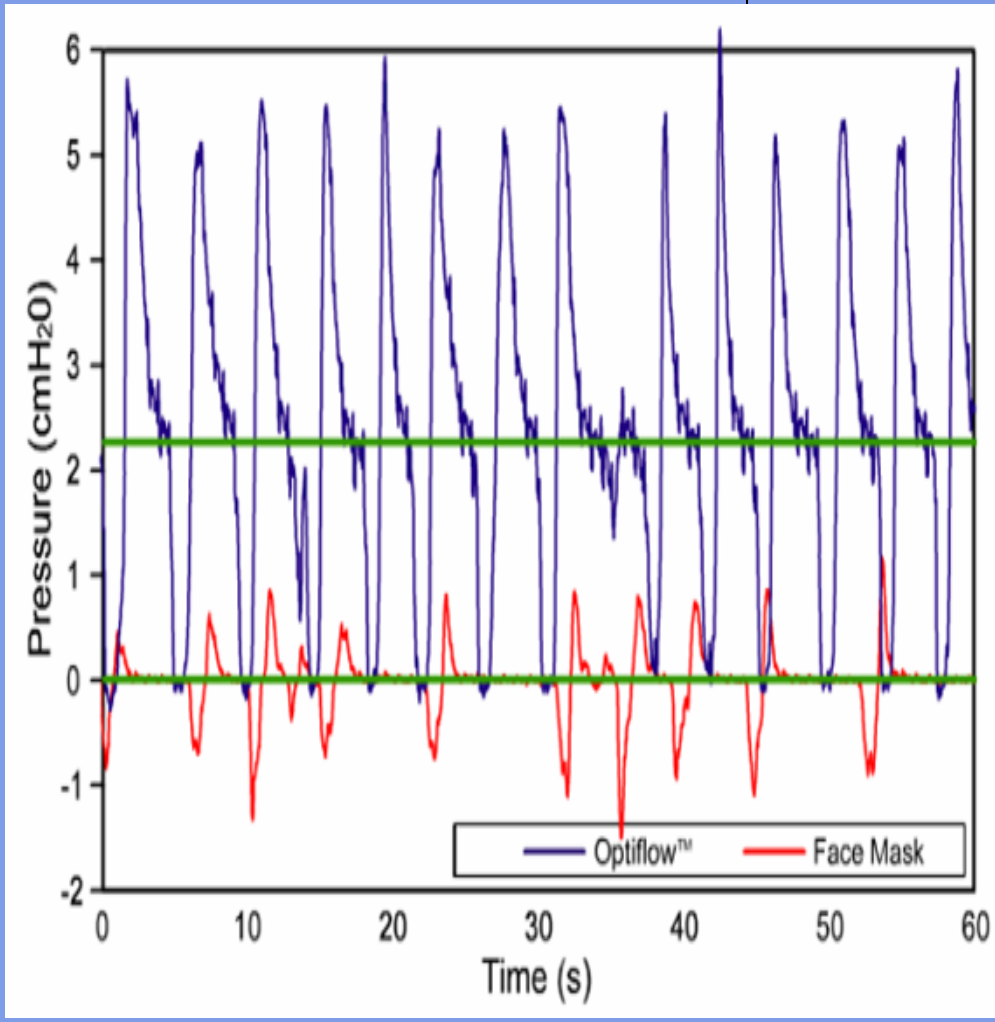
- Research has indicated that **low levels** of positive airway pressure are generated with Nasal High Flow.

- The amount of pressure is dependent on a number of variables including:
  - Flow rate (10-60l/min)
  - Upper airway anatomy
  - Size of cannula relative to the nares
  - Mouth position (closed or open)

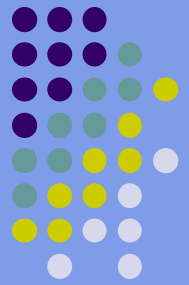


Positive Airway Pressure during the Respiratory Cycle

- Parke *et al*., 2008 compared nasopharyngeal airway pressures with Nasal High Flow and face mask oxygen therapy with mouth open and mouth closed

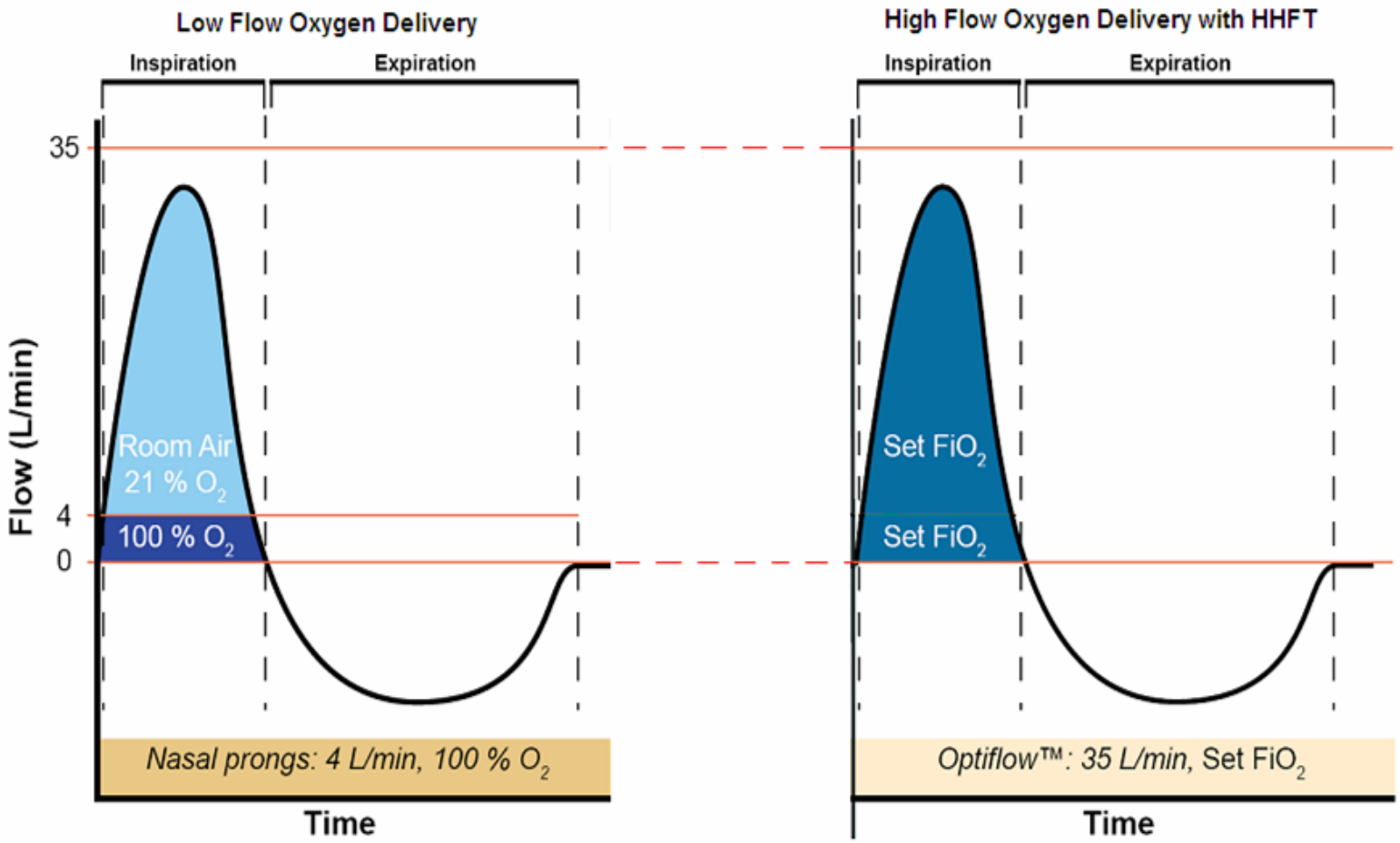


Four Key Benefits of Using HHHF



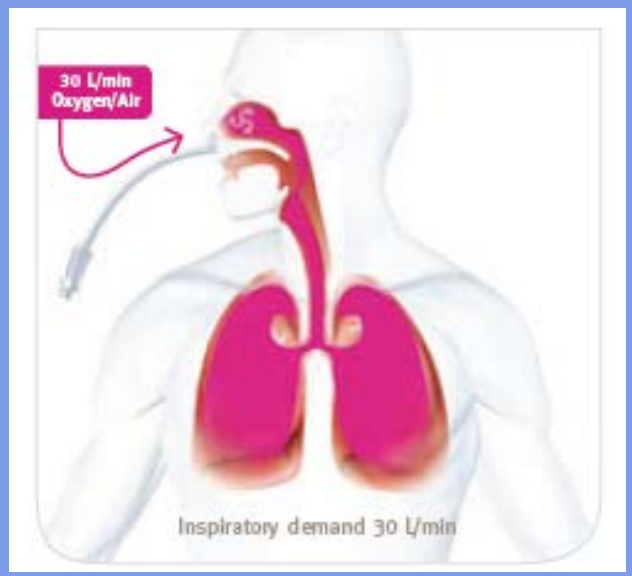
- Optimized mucociliary clearance
- Positive airway pressure during the Respiratory cycle
- **Effective oxygen delivery**
- Washout of anatomical dead space

Provides prescribed/set FiO_2

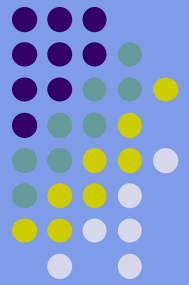


Effective Oxygen delivery

- The flow delivered using High Humidity High Flow aims to meet or exceed the patient's inspiratory demand:
  - Room air entrainment is minimized
  - Dilution of prescribed oxygen and humidity is reduced



Four Key Benefits of Using HHHF



- Optimized mucociliary clearance
- Positive airway pressure during the Respiratory cycle
- Effective oxygen delivery
- **Washout of anatomical dead space**

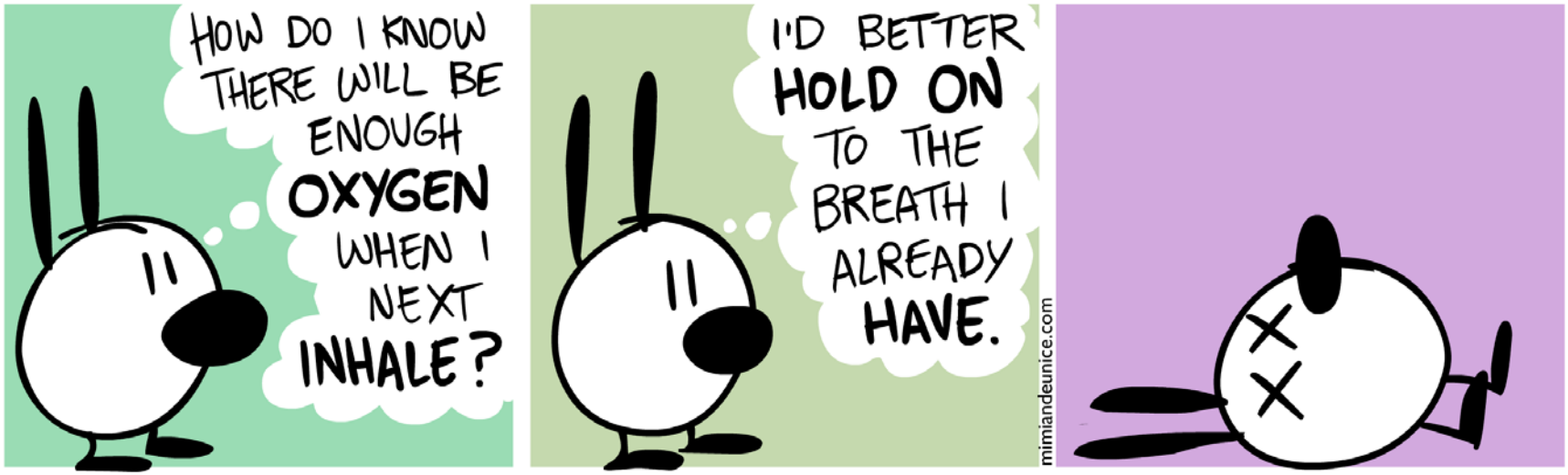
Washout of Anatomical Dead Space

- There is a continuous washout of the upper airway (anatomical dead space) caused by the continuous delivery of high flows.

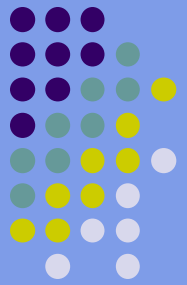
- Two key benefits of this flushing effect:
  - Reduces re-breathing of expired CO_2
  - Provides a reservoir of fresh gas in the upper airway for each and every breath
- This may assist in more efficient gas exchange in the patient.

Which Patients could benefit from HHHF?

- Comfortable, effective oxygen delivery


HOW DO I KNOW THERE WILL BE ENOUGH OXYGEN WHEN I NEXT INHALE?
I'D BETTER HOLD ON TO THE BREATH I ALREADY HAVE.
mimiandeunice.com

Case Study

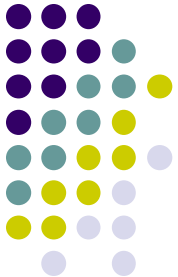


- 60 year old man who is morbidly obese with end stage COPD, on home oxygen, developed atrial fib, hx of CAD and chronic lymphocytic leukemia and newly diagnosed diabetes

- Admitted with acute exacerbation of COPD, BIPAP initiated and admitted to ICU
- Temp 39.6
- 12 hours after BIPAP initiated it was removed and patient tried on oxymask at 8 lpm resulted in acute respiratory distress with oxygen saturation dropping to 80% and increase WOB

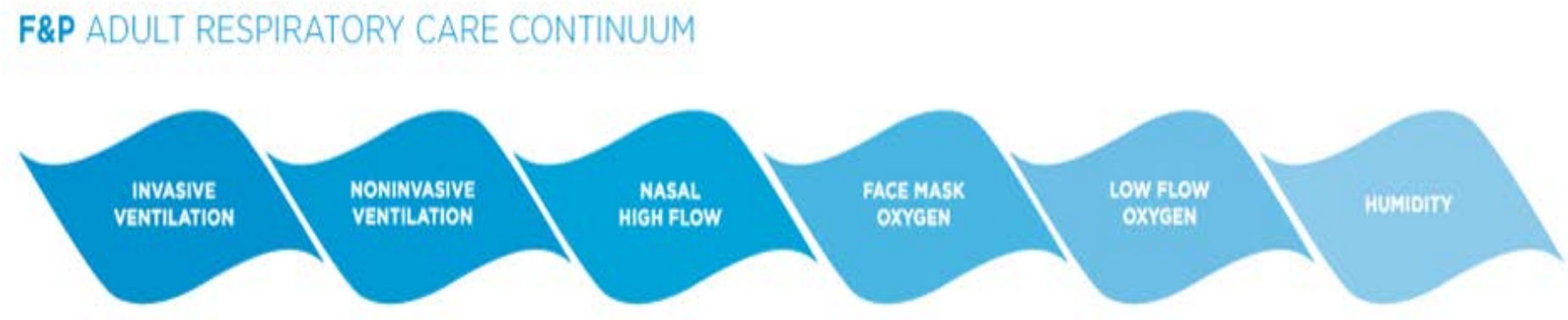
- Patient placed on HHHF as the BIPAP was limiting mobility
- Discussions with family members as to patients health conditions and resuscitation wishes, DNR initiated
- Patient remained on HHHF until his death 3 days later

Which Patients Could Benefit from NHF?

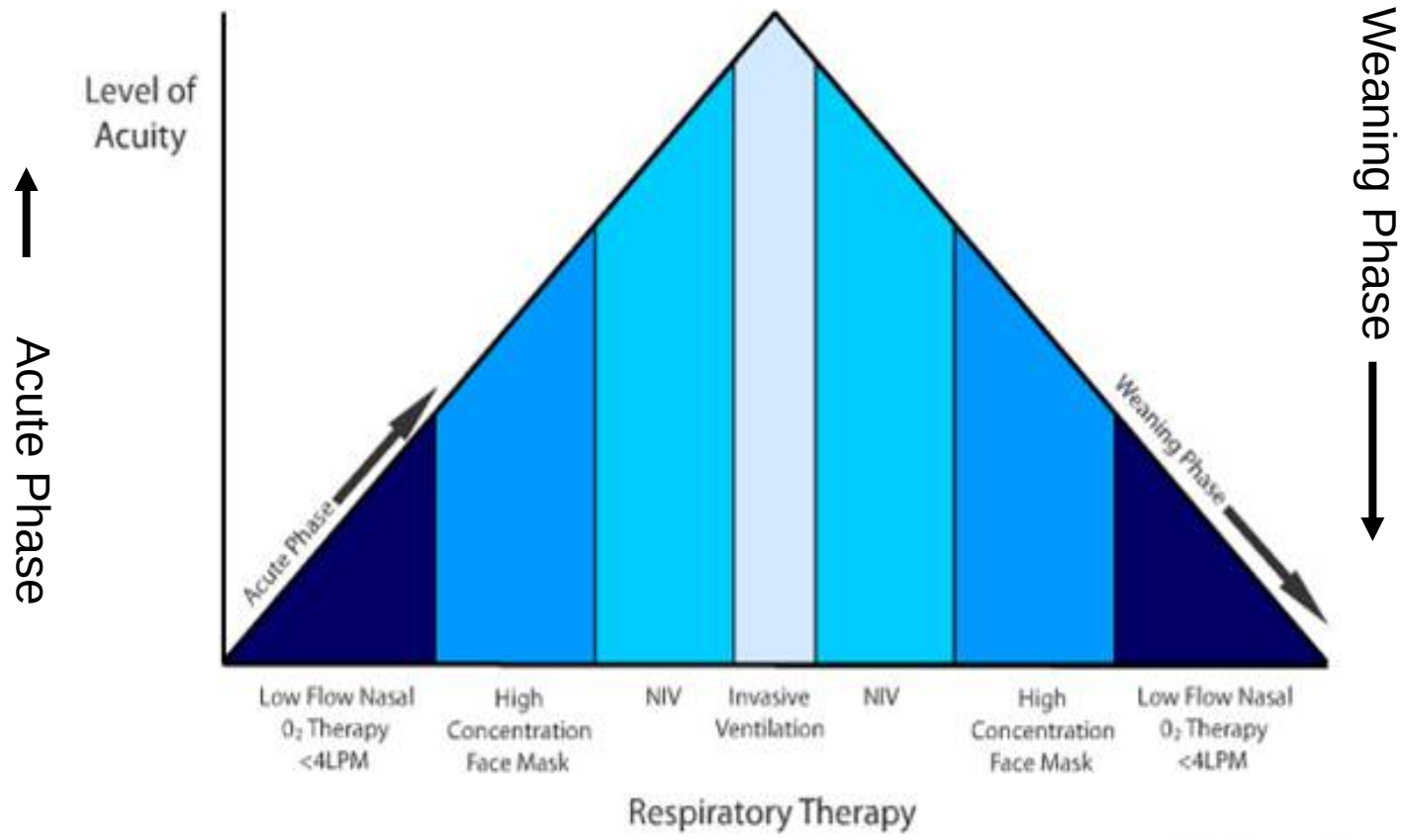


Patient Group	Examples	Clinical Issues	Gas Exchange Issues
Obstructive Pulmonary Disease	Asthma Emphysema Lung Cancer	Abnormal Secretions Blocked Airways (structural or secretions)	Mild – moderate hypoxemia
Restrictive Lung Disease	Pulmonary Fibrosis Pneumoconiosis	Loss of FRC Loss of Gas Exchange Units	Mild – moderate hypoxemia
Pneumonia	Flu Complication secondary to ……	Airway Obstruction due to secretions Lung Consolidations	Mild – moderate hypoxemia
Atelectasis	Post-Op patient Chest Trauma	V/Q Mismatch	Mild – moderate hypoxemia

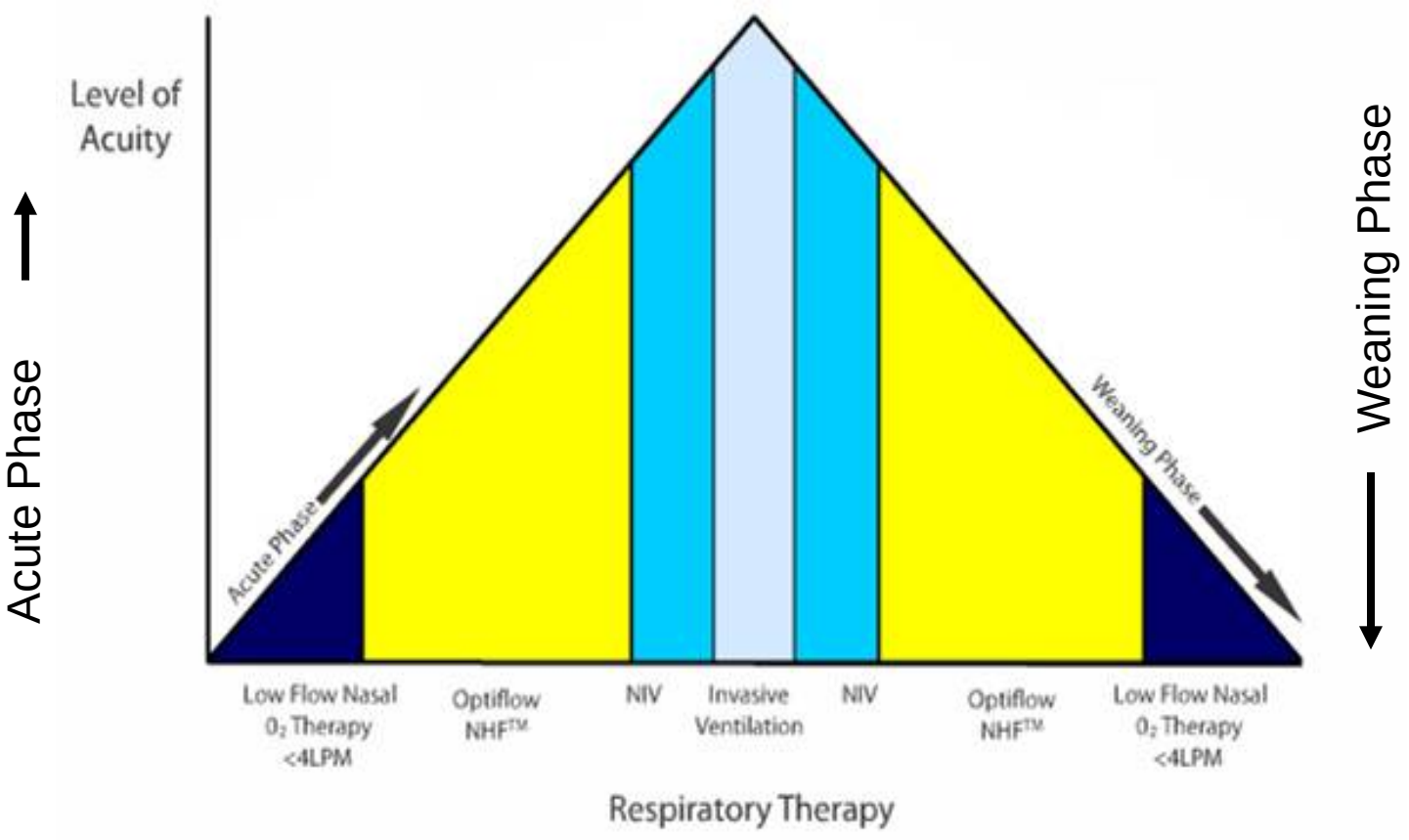
Where does HHHF fit in the continuum of care?



Nasal High Flow



Nasal High Flow



Case Study

- Elderly lady of 86 years
- Post op knee surgery, day 2
- Develops
  - Vomiting
  - SOB worsens overnight
  - O2 sat on RA 67% in am

- Critical Care rapid response team called
- Patient assessed
  - patient now on non-rebreather mask at 15 lpm O2 sats now 86-88%
  - Hx of angina
  - Hypotension
  - High cholesterol on meds well controlled

- Treatment
  - Patient started on HHHF
    - 50 lpm
    - 95% oxygen
  - Sent to CT for scan (used NRB for transport)
  - Patient moved to surgical step down for observation
  - Heparin started once CT confirmed PE diagnosis

- Results
  - Patient remained on HHHF for 26 hours, weaned oxygen levels and discontinued to nasal prongs with a O2 saturation of 93%

High Flow
High Humidity
Oxygen Therapy

- Delivering High Flow Therapy

Delivering Nasal High Flow

A combination of:

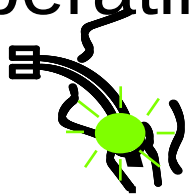
- **Heated Humidifier**
  - Delivery circuit that preserves humidity
- **Air/Oxygen Blender**
  - **Maxventuri blender (10-60l/min)**
  - Standard blender with high flow flowmeter
  - Manual method with air and O_2 source
  - Some ventilators with O_2 therapy mode
- **Nasal Cannula Interface**

Optiflow Setup Pictures

Blender

Air/O_2
Flow Meters

Mode Button

- Choice between two operating modes
- 
- invasive

non-invasive

Benefits

- Patients rate as more comfortable
- Compliance increases
  (reduces claustrophobia)
- Allows patients to eat & drink
- Maintain dignity

Take home messages

- Provides prescribed FiO_2
- Optimal Humidity Ensures Comfort and Compliance
- Delivers low level positive airway pressure
- Helps improve mucociliary clearance

High Humidity High Flow

Thanks to Fisher and Paykel

Questions?

Comfortable effective oxygen delivery