Respiratory Support in COVID-19 for Unfamiliar Doctors

POWH Anaesthesia for COVID-19
Training Team

Learning Objectives

- Assess the severity of COVID-19 respiratory failure
- Describe the different forms of oxygen therapy
  - Standard oxygen therapy
  - High Flow Nasal Oxygen
- Understand the role of non-invasive ventilation
- Appreciate the role of prone positioning
- Identify the patient requiring escalation to ICU

Moderate Severity Therapies

	Moderate Requires any oxygen	**Moderate** Requires oxygen by $HiFO_2$ or mask up to FiO_2 0.4
Target SpO_2	Up to 4L/min O_2 by nasal prongs or FiO_2 0.35 by venturi mask required	Up to FiO_2 0.4 (4-6L/min) required

Standard Oxygen Therapies

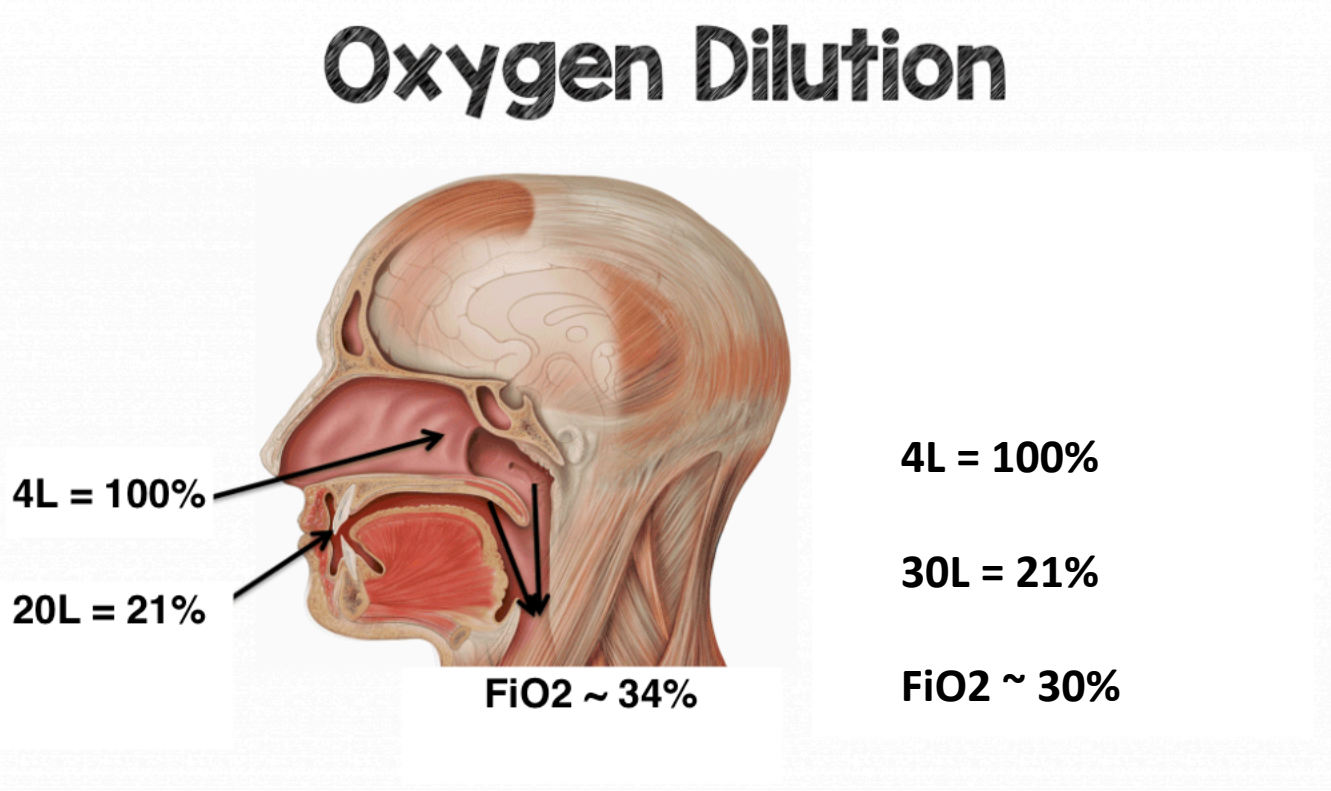
Table 1. Estimated inspired oxygen concentration

Nasal cannulae		Face mask	
Flow rate (L/min)	Estimated FIO_2 (%)	Flow rate (L/min)	Estimated FIO_2 (%)
1	24%	5	30%
2	28%	6	35%
3	32%	7	40%
4	36%	8	45%
5	40%	9	50%
6	44%	10	55%

FIO_2 = fraction of inspired oxygen.

Variable FiO2 Delivery

- Dependent on patient's inspiratory flow rate
- Function of Minute Volume (TV x RR)



Standard Oxygen Therapies

- Venturi Mask

  Set a fixed FiO2

- Non-Rebreather Mask

  >10L/min → FiO2 >60%

Moderate-Severe Severity Therapies

	Moderate Requires oxygen by HiFO$_2$ or mask up to FiO$_2$ 0.4	**Severe** Requires CPAP 10cm (12cm if BMI>30)
Target SpO$_2$	Up to FiO$_2$ 0.4 (4-6L/ min) required	Up to FiO$_2$ 0.6 (8-10L/ min O2) required
ABG	– consider ABG. PaO2:FiO$_2$<300mmHg	ABG recommended. PaO$_2$:FiO$_2$<300mmHg
Prone	Min >3hrs/24 (aim for at least 8hr)	Min >3hrs/24 (aim for at least 8hr)

Advanced Therapies

- Prone Positioning
- High Flow Nasal Oxygen (HFNP/HFOT)
  - When unable to maintain saO2 > 92% despite O2 at <5L/min or FiO2 = 0.4
  - Persistent RR > 30bpm or increased work of breathing
- Non-Invasive Ventilation (NIV)
  - Continuous Positive Airway Pressure (CPAP)
  - Bilevel Positive Airway Pressure (BiPAP)

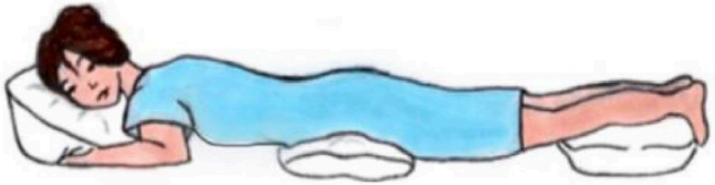
Prone Positioning

- Improves Ventilation/Perfusion Mismatch
- Improves oxygenation
- Encouraged to self-prone for at least 3 hours/ day, ideally >8 hours/day

Awake Proning in COVID-19

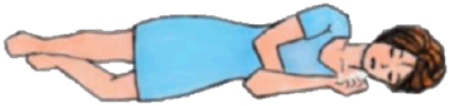
You have been asked by your medical team to participate in proning (tummy lying)
This will help to get more air into all areas of your lungs and will help with your recovery
Please do not stay in any position that causes discomfort/pain – readjust your position as you need to and use pillows to help

Aim to spend 8 hours a day on your tummy in blocks of up to 2 hours



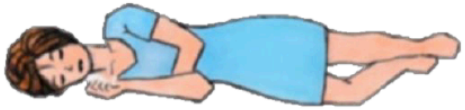
PRONE

After 2 hours if you need a break from prone please choose one of the below positions for 30 minutes



LEFT SIDE-LYING

UPRIGHT



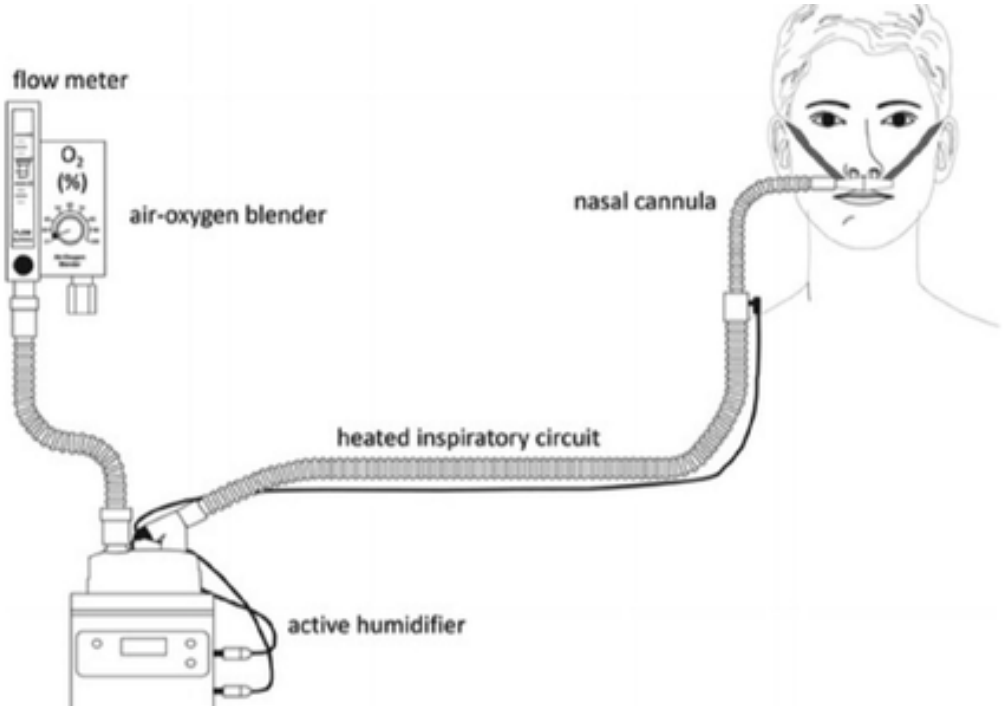
RIGHT SIDE-LYING

When you feel ready you can return back to the prone position to repeat the cycle

Please aim to *avoid* time lying in a reclined position on your back

Humidified High Flow Nasal Oxygen

- Blend of O2 and air at a flow rate exceeding patient's own peak physiological flow rate (Usually 25-35L/min)
- Heated to body temperature
- Humidified to 100% relative humidity



- Can generate Fi02 to 100%
- Positive End Expiratory Pressure (PEEP/CPAP) of up to 5cmH20 (variable)

Advantages

Humidification

- Preserves the nasal mucosa
- Enhances mucocilliary function

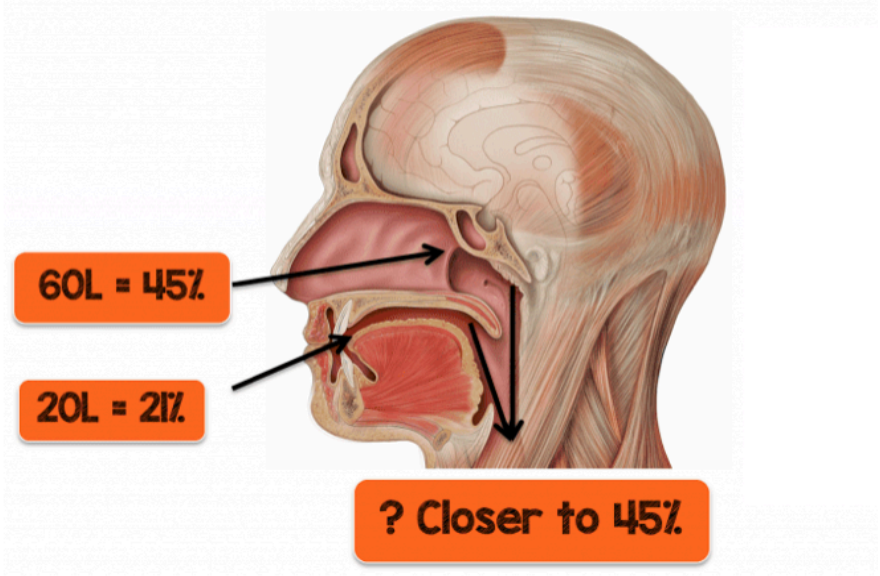
Flushes nasopharyngeal dead space

- Decreases dead space
- Decreases C02 rebreathing

Airway splinting effect

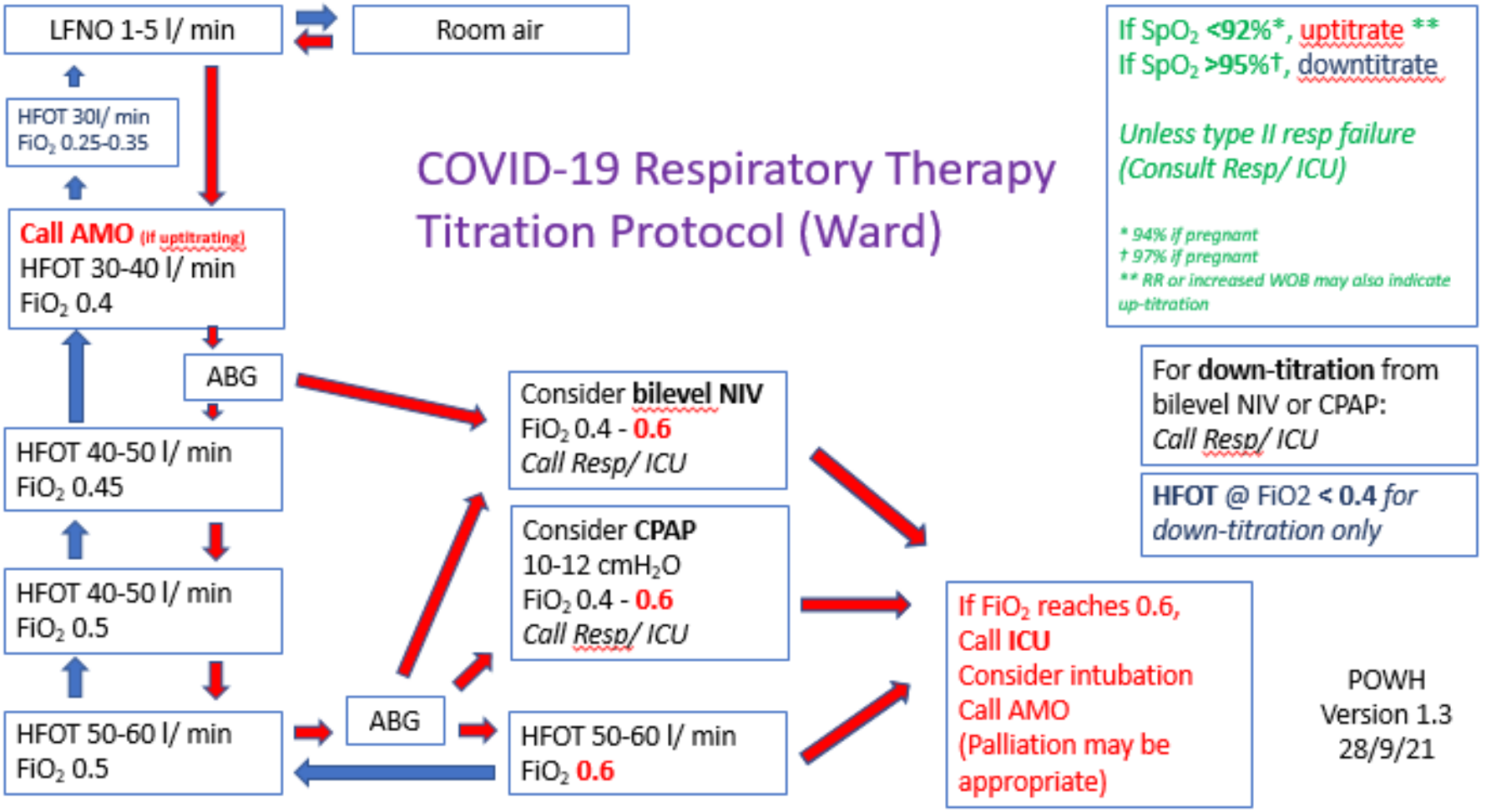
- Prevents supraglottic collapse
- Decreases nasopharyngeal resistance
- Decreases work of breathing

Less Oxygen Dilution Effect

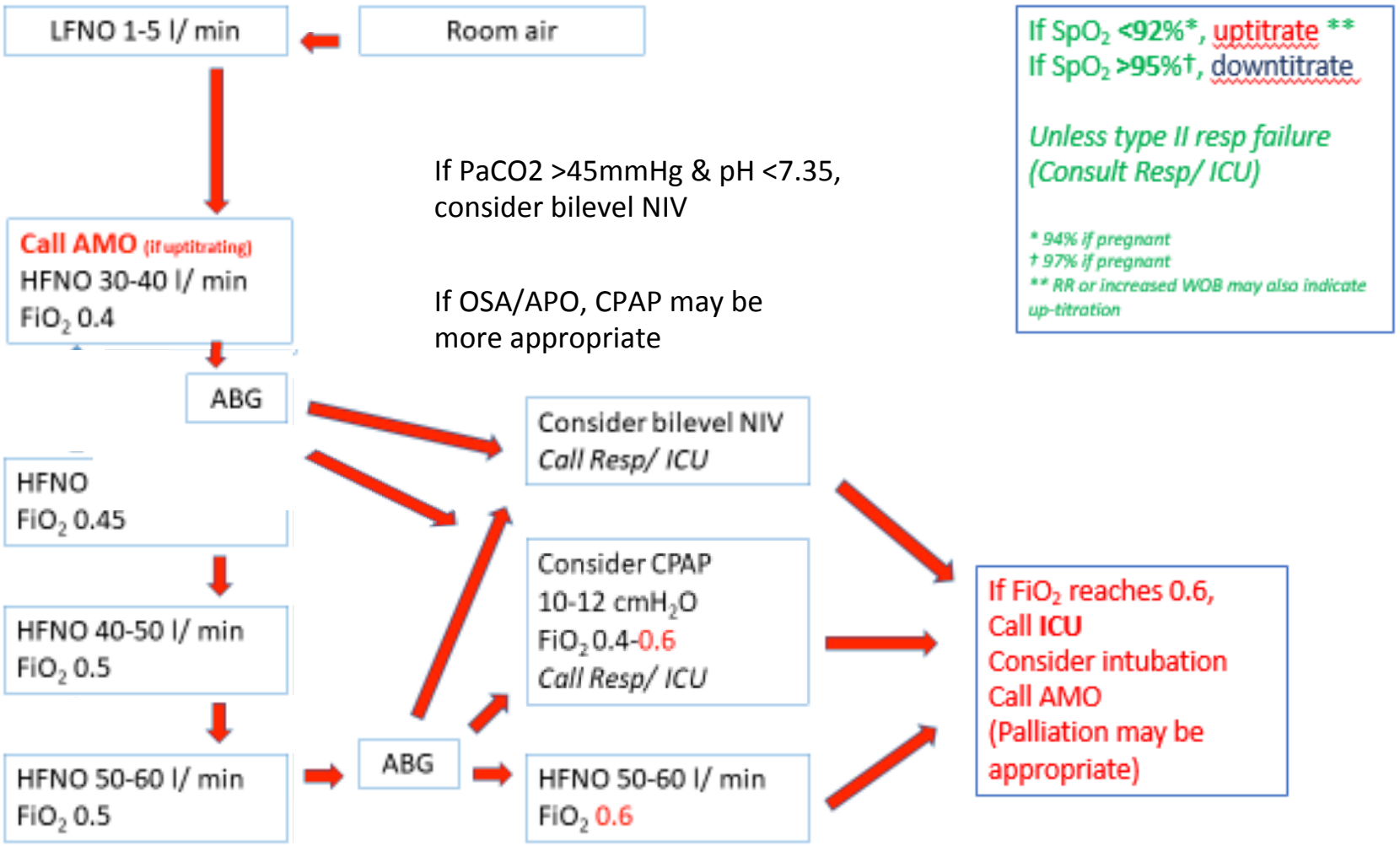


FiO2 ~ 39%

POWH Flowchart



HFNO Uptitration



Holes Punched as per AS2828.1: 2012

BINDING MARGIN - NO WRITING

SES110065

S0808 260516

NSW Health
South Eastern Sydney Local Health District

Facility:

HIGH FLOW OXYGEN THERAPY (HFOT) CHART

FAMILY NAME | MRN

GIVEN NAME | ☐ MALE ☐ FEMALE

D.O.B. ____/____/____ | M.O.

ADDRESS

LOCATION / WARD

COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

DIAGNOSIS

Underlying Lung Function: ☐ Obstructive ☐ Restrictive ☐ Not Known

Interface:

☐ Nasal Prongs ☐ Tracheostomy Hood Size: ____________

Date HFOT set up: ____________

Date circuit change required: ____________

ABG's	Date	Time	pH	O_2	CO_2	HC03	Base Excess	F_iO_2
Baseline								
Follow Up								

PRESCRIBERS ORDERS (Recommended to rechart every 24hrs or at the prescriber's discretion)

Date	Time	O_2 Flow rate L/Min	Airflow rate L/Min	Total gas flow L/Min	F_iO_2	Goal SaO_2	Weaning	Prescriber's instructions	MO Sign/ or delegate

MACHINE OBSERVATIONS | PATIENT OBSERVATIONS

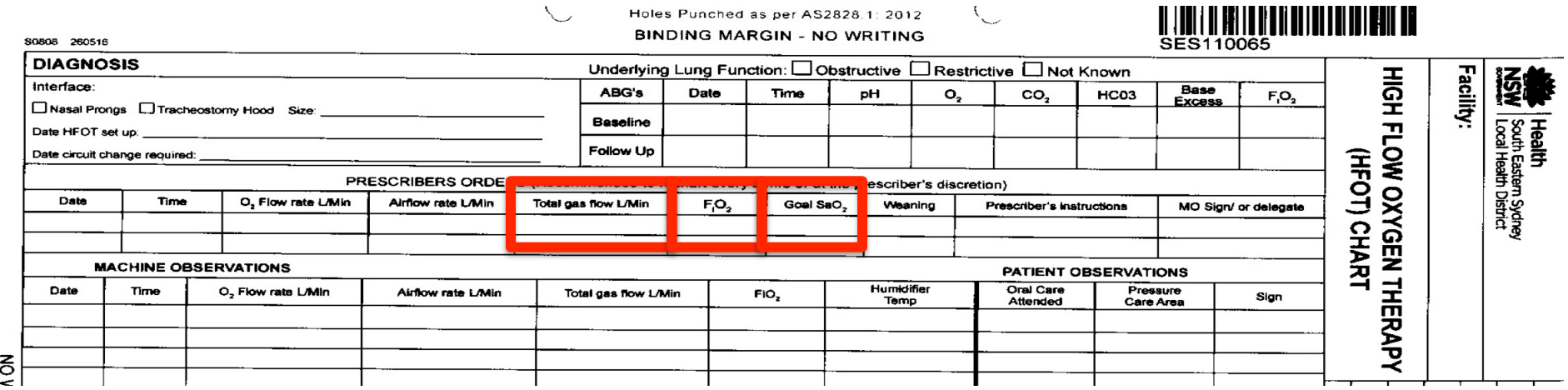
Date	Time	O_2 Flow rate L/Min	Airflow rate L/Min	Total gas flow L/Min	FiO_2	Humidifier Temp	Oral Care Attended	Pressure Care Area	Sign

NO WRITING

HIGH FLOW OXYGEN THERAPY (HFOT) CHART SES110.065

HFNP Settings

- Set Total gas flow L/Min (30-60 L/Min)
- Set FiO2 (40% - 60%)
- Set Goal SaO2 (92-96% , 88-92% in COPD, 94-97% if pregnant)



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HIGH FLOW OXYGEN THERAPY (HFOT) CHART

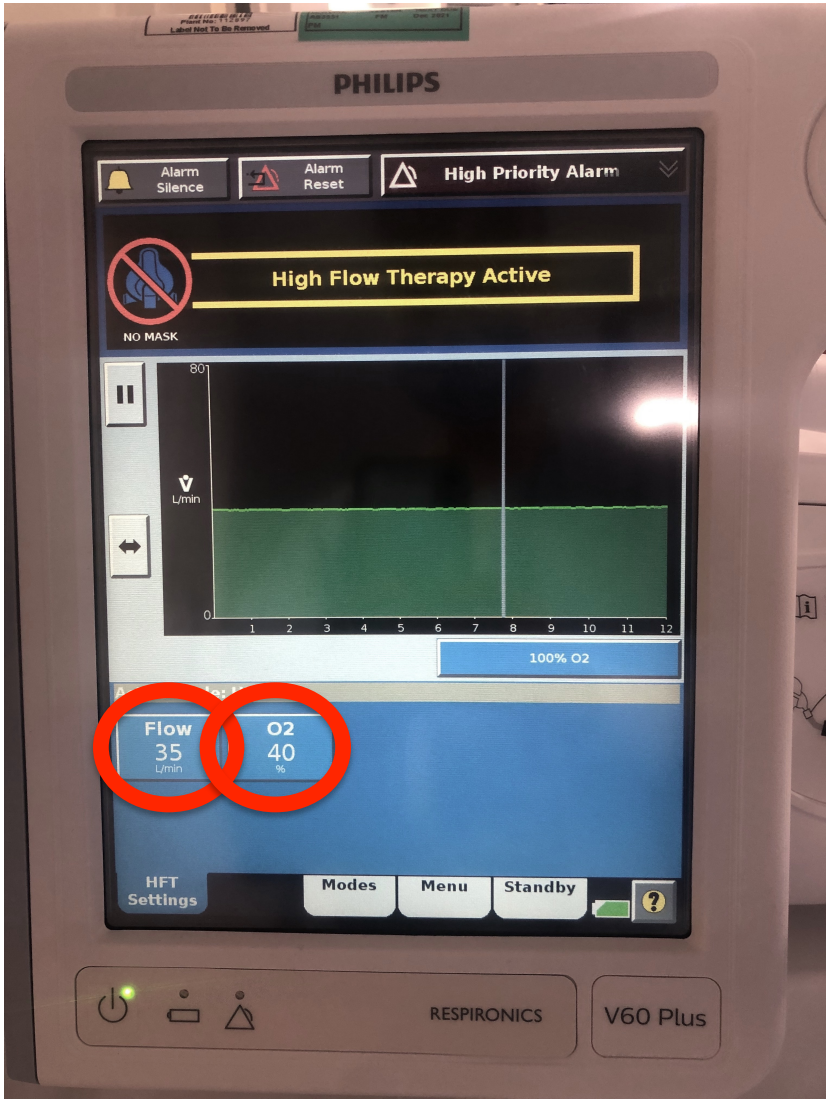
Facility:

NSW Health South Eastern Sydney Local Health District

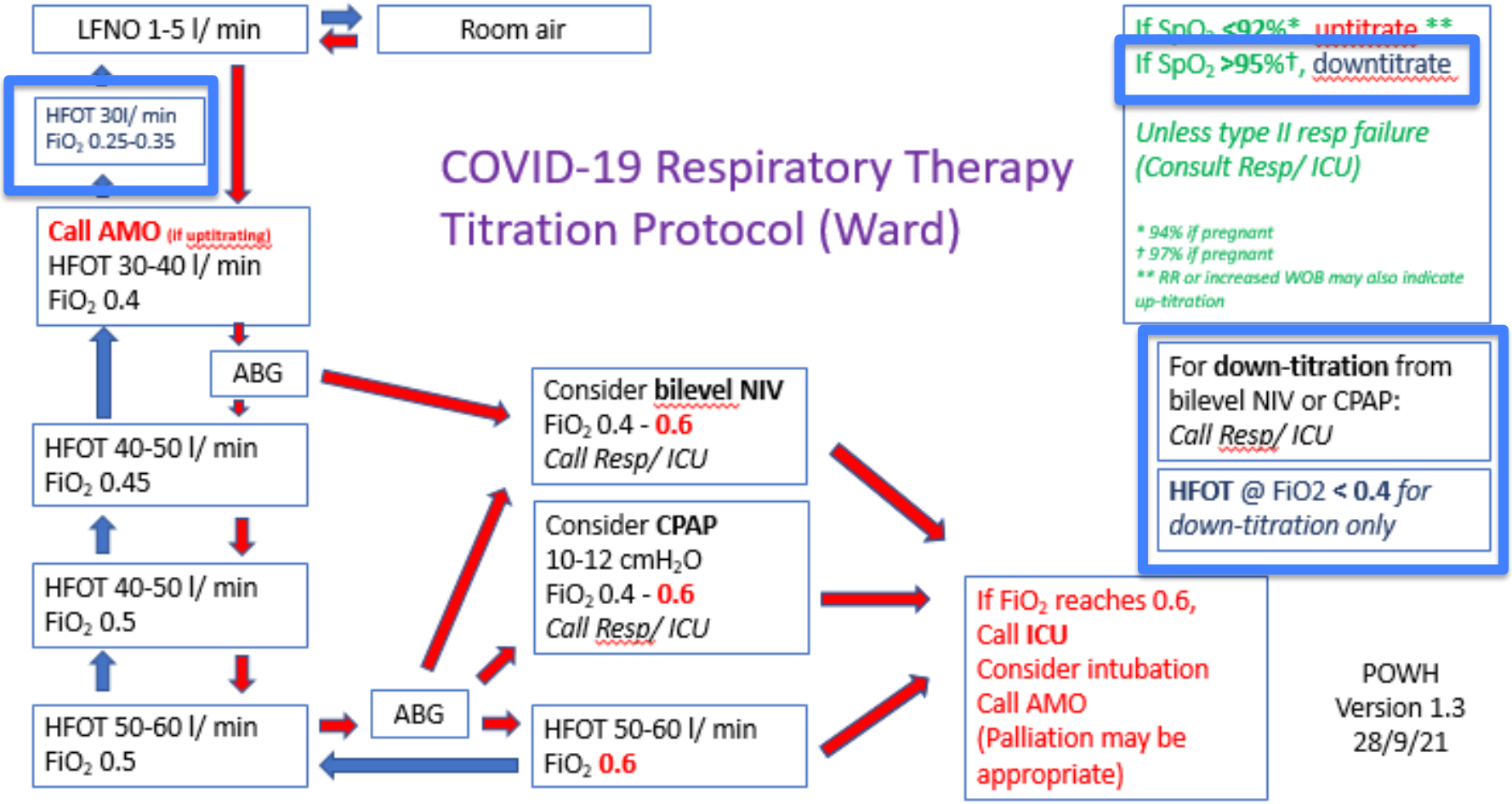
NOV

- Review Patient q8h for first 24hrs then q12h

HFNP


PHILIPS
Alarm Silence
Alarm Reset
High Priority Alarm
High Flow Therapy Active
NO MASK
80
0
L/min
1 2 3 4 5 6 7 8 9 10 11 12
100% O2
Flow
35
L/min
O2
40
%
HFT Settings
Modes
Menu
Standby
RESPIRONICS
V60 Plus

HFNO Downtitration



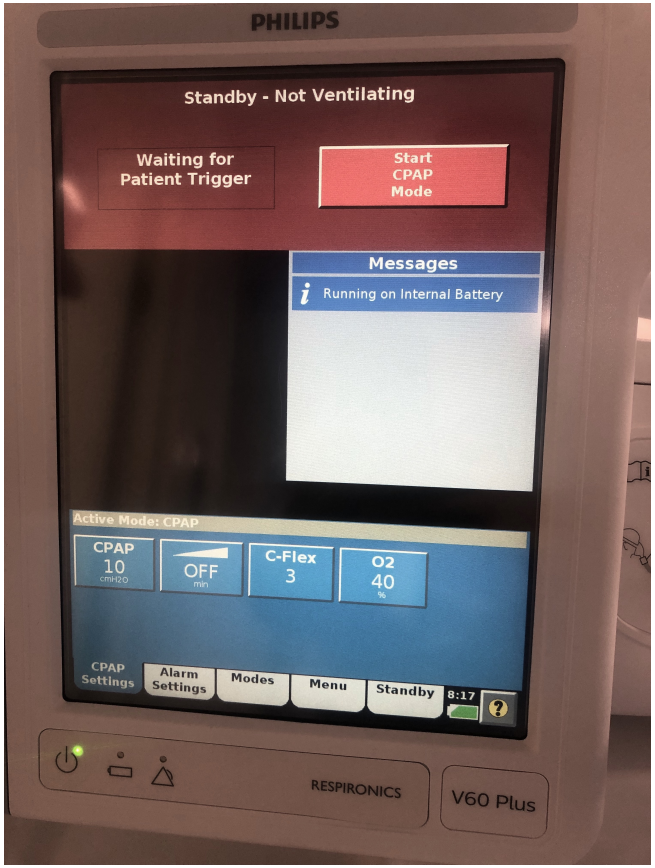
Non Invasive Ventilation (NIV)

- Continuous Positive Airway Pressure (CPAP)
- Bilevel Positive Airway Pressure (BiPAP)

Benefits

- Reduced work of breathing
- Redistribution of fluid from alveolar space into capillaries
- Improved ventilation to perfusion mismatch through recruitment of collapsed alveoli
- Ability to deliver an increased FiO2
- Reduces the need for intubation and its associated risks (ie. Ventilator associated pneumonia)

NIV Equipment



- Tight Fitting Mask (Straps)
- No Expiratory Vents on mask
- Viral filter for expired gases

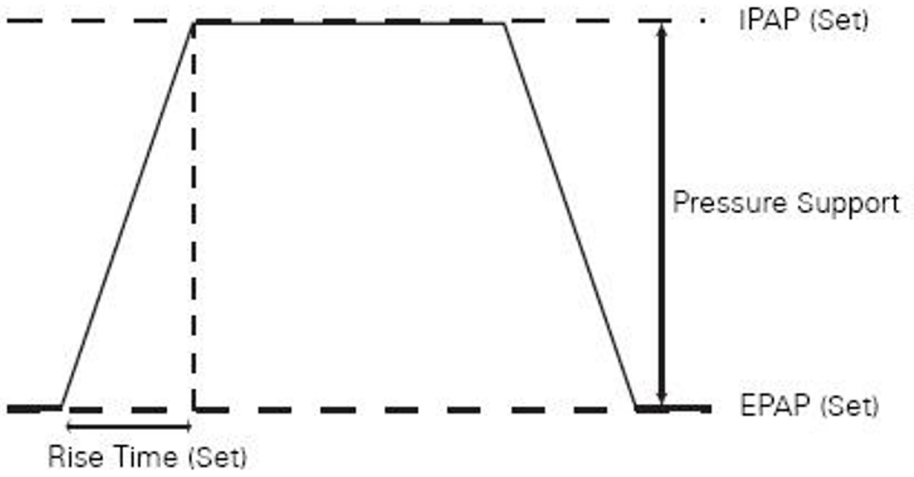
Continuous Positive Airway Pressure (CPAP)

- Delivers a constant positive pressure throughout the entire respiratory cycle

USED FOR	SET	RESULTS IN
Acute Pulmonary Oedema Hypoxic respiratory failure Obstructive sleep apnoea	PEEP/EPAP Fi02	Keeping alveoli open

Bilevel Positive Airway Pressure (BiPAP)

Constant positive pressure throughout the entire respiratory cycle with a higher pressure during inspiration



USED FOR

Asthmatics
Neuromuscular disorders
Chronic Obstructive Pulmonary Disease (COPD)
Hypercapnic Respiratory Failure

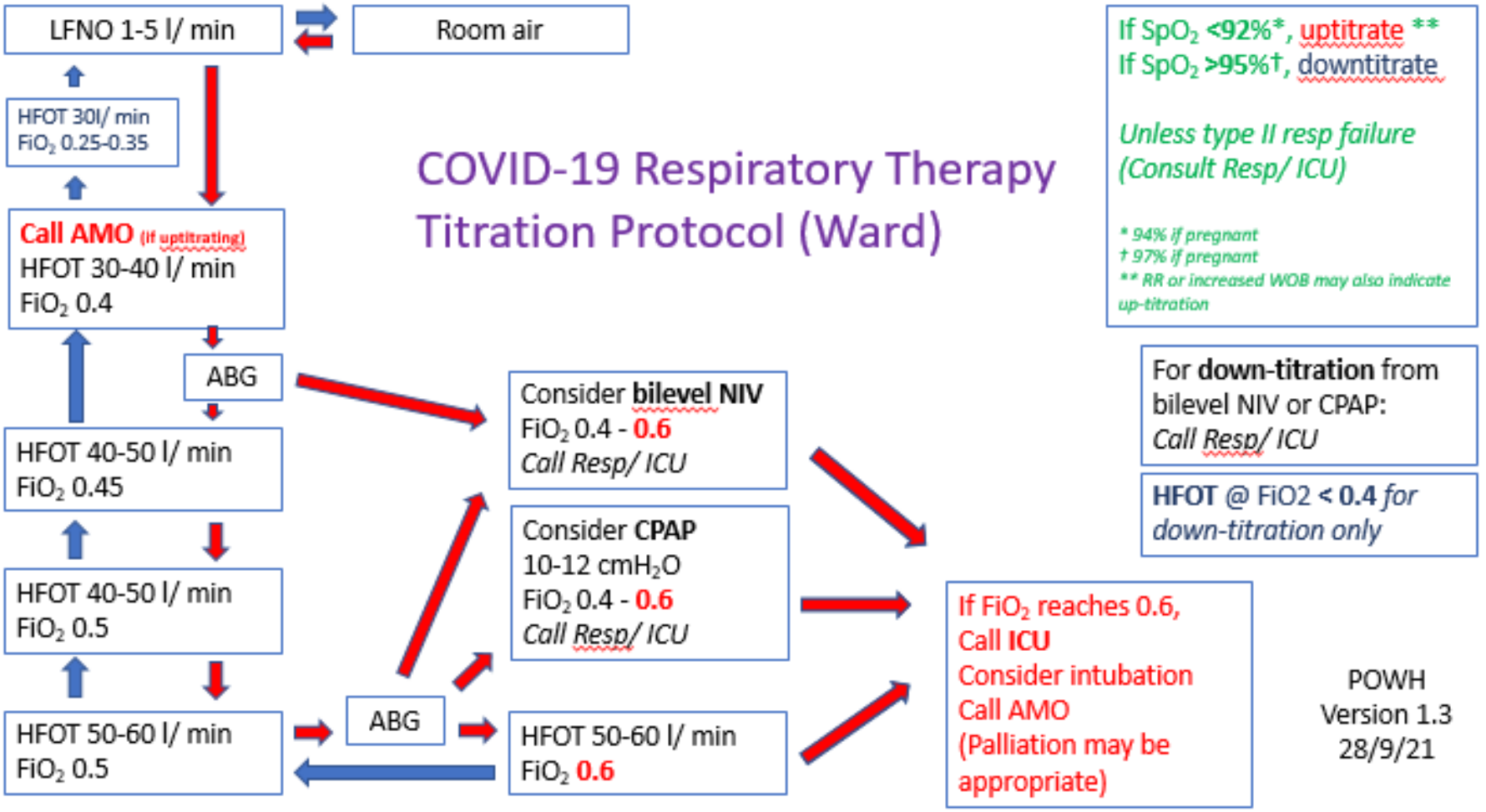
SET

PEEP/EPAP
PS/IPAP
Fi02

RESULTS IN

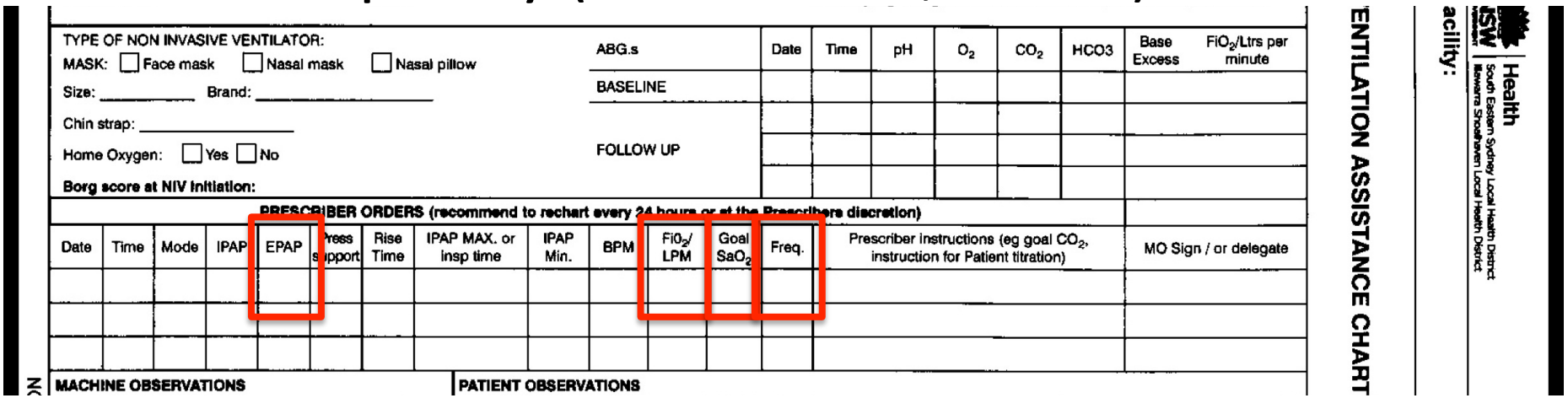
Keeping alveoli open
?Alveoli recruitment
Increased Tidal Volumes

POWH Flowchart



NIV (CPAP) Settings

- Set FiO2 (40% - 60%)
- Set Goal SaO2 (92-96% , 88-92% in COPD, 94-97% if pregnant)
- Set EPAP (CPAP) (10cmH2O, up to 12cmH2O)
- Set Frequency (Continuous, Hours)



TYPE OF NON INVASIVE VENTILATOR:
MASK: ☐ Face mask ☐ Nasal mask ☐ Nasal pillow
Size: _____ Brand: _____
Chin strap: _____
Home Oxygen: ☐ Yes ☐ No
Borg score at NIV initiation:

ABG.s	Date	Time	pH	O_2	CO_2	HCO3	Base Excess	FiO_2/Ltrs per minute
BASELINE								
FOLLOW UP								

PRESCRIBER ORDERS (recommend to rechart every 24 hours or at the Prescribers discretion)

Date	Time	Mode	IPAP	EPAP	Press support	Rise Time	IPAP MAX. or insp time	IPAP Min.	BPM	FiO_2/ LPM	Goal SaO_2	Freq.	Prescriber instructions (eg goal CO_2, instruction for Patient titration)	MO Sign / or delegate

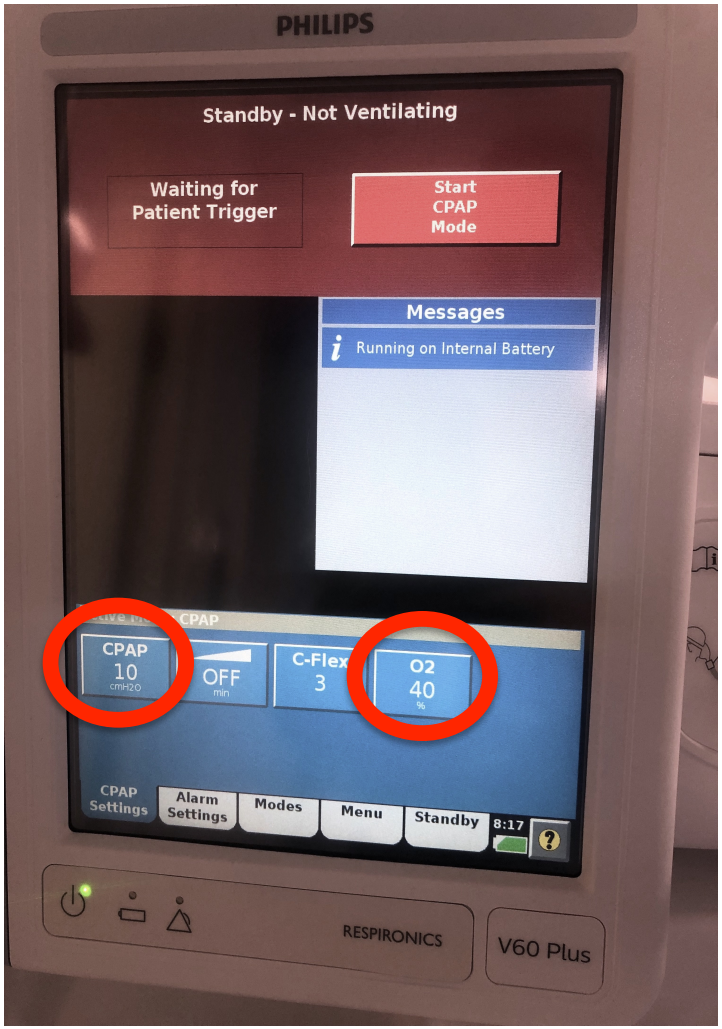
MACHINE OBSERVATIONS | PATIENT OBSERVATIONS

ENTILATION ASSISTANCE CHART

acility:

Health
South Eastern Sydney Local Health District
Illawarra Shoalhaven Local Health District

NIV (CPAP) Settings



Complications

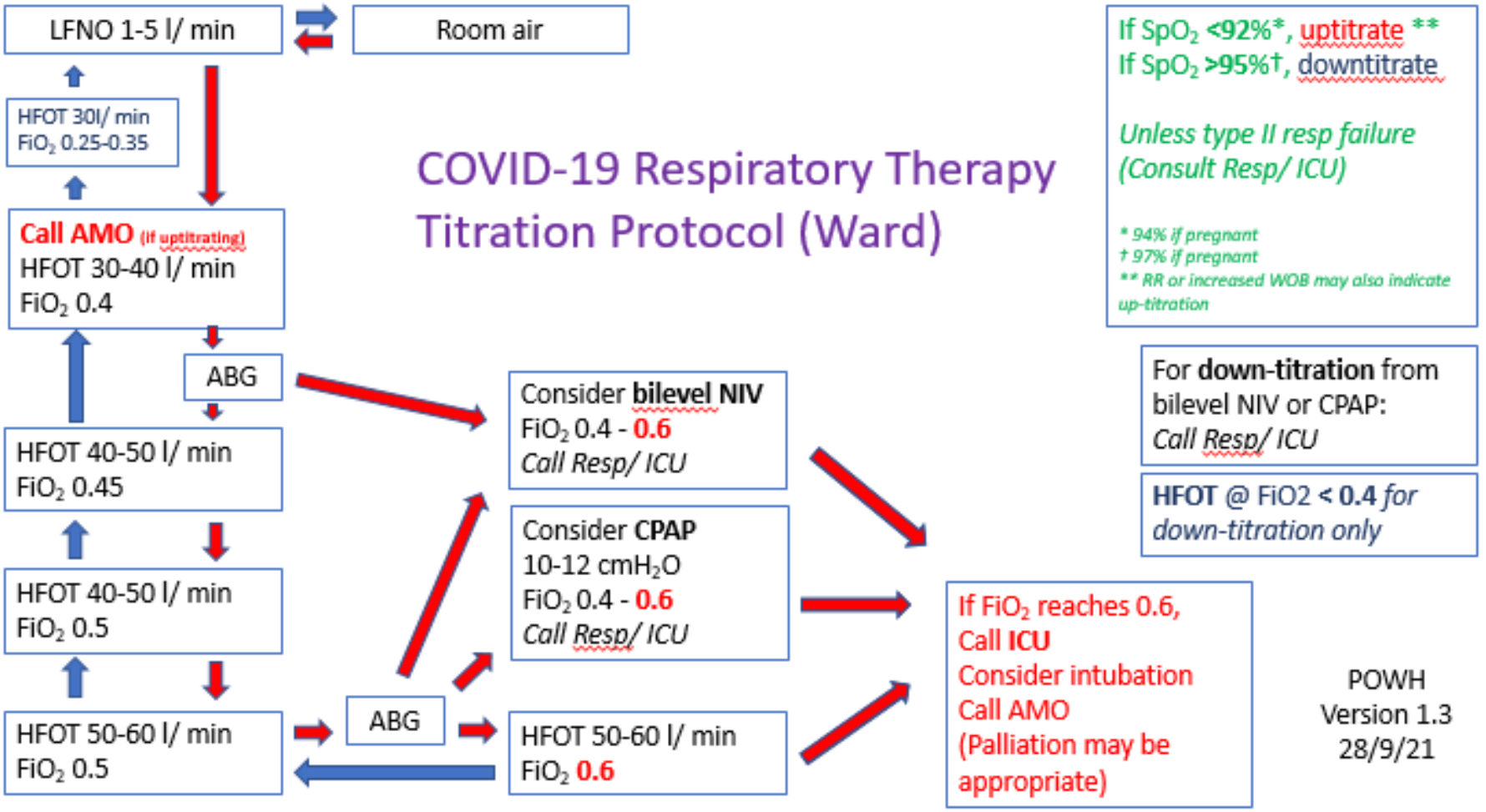
- Facial Pressure Injuries
- Aspiration
- Mucous plugging
- Expanding Pneumothorax

Contraindications (HFOT + NIV)

- Patients requiring immediate escalation of care ie. requiring intubation
- Untreated pneumothorax
- Facial-maxillary trauma
- Anterior base of skull fracture

- Patients with decreased level of consciousness (GCS <8) unless for palliative approach
- For NIV : Cardiovascular instability

POWH Flowchart



Deterioration

	Severe Requires CPAP 10cm (12cm if BMI>30)	**Critical** Requires referral to intensive care fo invasive mechanic ventilation
Target SpO_2	Up to FiO_2 0.6 (8-10L/ min O2) required	Unable to maintain SpO_2. Continue CPAP plus O_2 at 10L/min, transfer to ICU
ABG	ABG recommended. PaO_2:FiO_2<300mmHg	ABG required. PaO_2:FiO_2<200mmHg or acute hypercapnoea
Prone	Min >3hrs/24 (aim for at least 8hr)	Min >3hrs/24 (aim for at least 8hr)
Setting	Specialist respiratory ward or ICU	ICU

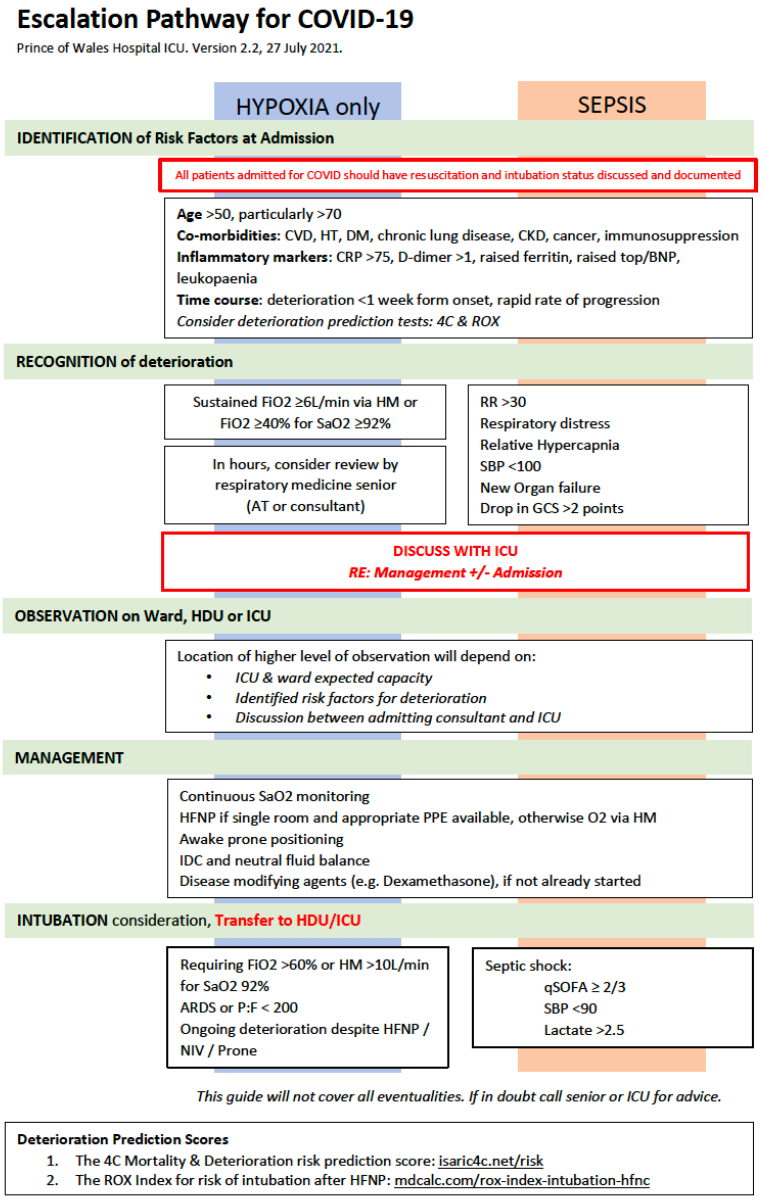
Maximal Ward Therapy

	Flow / Pressure	Maximum FiO2	Trigger for ICU review
HFOT settings	30-60L	60%	SpO2<92% and/or increased WOB
CPAP settings	10cmH2O (12cmH2O if BMI >30)	60%	SpO2<92% and/or increased WOB
Palliative settings	Any	Any	N/A

Guidelines for the Management of COVID-19 in the Intensive Care Unit

Prince of Wales Hospital

Version 3.2, 27 July 2021



Escalation Pathway for COVID-19

Prince of Wales Hospital ICU. Version 2.2, 27 July 2021.

HYPOXIA only | SEPSIS

IDENTIFICATION of Risk Factors at Admission

All patients admitted for COVID should have resuscitation and intubation status discussed and documented

Age >50, particularly >70
Co-morbidities: CVD, HT, DM, chronic lung disease, CKD, cancer, immunosuppression
Inflammatory markers: CRP >75, D-dimer >1, raised ferritin, raised top/BNP, leukopaenia
Time course: deterioration <1 week form onset, rapid rate of progression
Consider deterioration prediction tests: 4C & ROX

RECOGNITION of deterioration

Sustained FiO2 ≥6L/min via HM or FiO2 ≥40% for SaO2 ≥92%

In hours, consider review by respiratory medicine senior (AT or consultant)

RR >30
Respiratory distress
Relative Hypercapnia
SBP <100
New Organ failure
Drop in GCS >2 points

DISCUSS WITH ICU
RE: Management +/- Admission

OBSERVATION on Ward, HDU or ICU

Location of higher level of observation will depend on:
- *ICU & ward expected capacity*
- *Identified risk factors for deterioration*
- *Discussion between admitting consultant and ICU*

MANAGEMENT

Continuous SaO2 monitoring
HFNP if single room and appropriate PPE available, otherwise O2 via HM
Awake prone positioning
IDC and neutral fluid balance
Disease modifying agents (e.g. Dexamethasone), if not already started

INTUBATION consideration, **Transfer to HDU/ICU**

Requiring FiO2 >60% or HM >10L/min for SaO2 92%
ARDS or P:F < 200
Ongoing deterioration despite HFNP / NIV / Prone

Septic shock:
qSOFA ≥ 2/3
SBP <90
Lactate >2.5

This guide will not cover all eventualities. If in doubt call senior or ICU for advice.

Deterioration Prediction Scores

1. The 4C Mortality & Deterioration risk prediction score: isaric4c.net/risk
2. The ROX Index for risk of intubation after HFNP: mdcalc.com/rox-index-intubation-hfnc

HYPOXIA only

SEPSIS

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This guide will not cover all eventualities. If in doubt call senior or ICU for advice.

Escalation to ICU

- Consider ceilings of care

- Intubation **IS LIKELY** for COVID-19 when:
  - FiO2 >60% or 10L/min via HM for SaO2 92%
  - ARDS or P:F <200
  - Ongoing deterioration despite HFNP/NIV/Prone position
  - Shock

- Intubation for **non-COVID indications** in COVID-19 patients, such as coma or airway concerns, remains unchanged

Case 1:

46 yo male previously well. Admitted 2days ago from home (HITH) with SpO2 90%, HD stable, T39C.

COVID Hx: **Day 10 of COVID Sx**
Day 9 since +swab

Sx: **Fatigue, SOB, occ. cough**
Unvaccinated

Risk Factors: **obesity 120kg**
smokes 10cig/day
(no HT/DM/immunosuppression/vascular dx/ renal dx/known lung dx)

Inflammatory markers: **Elevated:** **LDH**
Ferritin
CRP
D-dimer

Decreased: **lymphocyte count**

CXR: bilateral infiltrates

Progress:

Initially:

- 1-2L NP O2 for SpO2 93-94% rr24
- Able to take NP off to go to toilet
- Non-compliant with proning

Today

Requiring 3-4L NP O2 this morning for SpO2 92-93%

- Now desaturates when returning from toilet:
  SpO2 89% rr32 T 38.8C

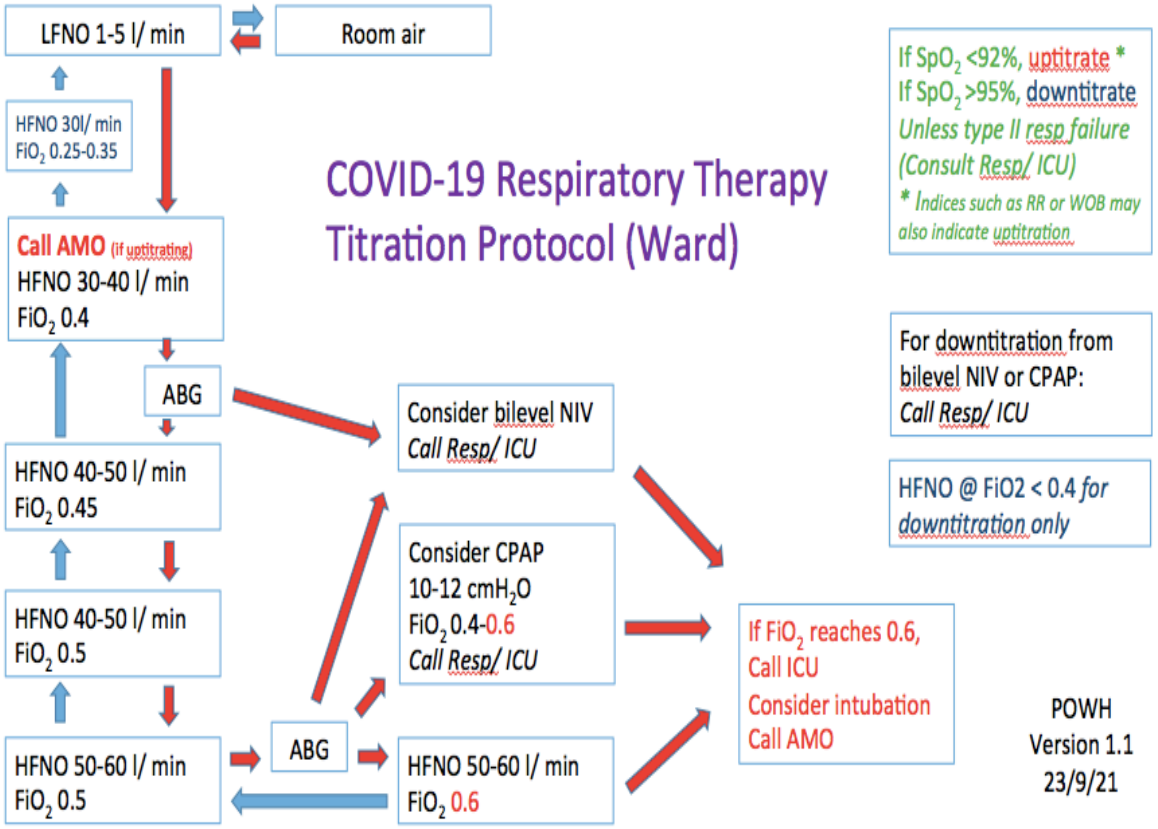
The nurse asks you to review him.

You optimise conservative management:

- reapply O2 at 4L/min *continuously*
- put him in the *prone position* (with pillows under chest/ hips/feet)
- Start regular *paracetamol*
- *d/w registrar*- starting dexamethasone…

He improves:

SpO2 89 -> 94%
Rr 32 -> 26
T 38.5 -> 37.7



Next day: Day 11 of COVID illness

Reasonably stable o/n 3-4L NP O2 SpO2 93%

Inflammatory markers have risen o/n

That morning you are asked to review the patient :

He is in the prone position

Breathless and speaking short sentences

SpO2 88-90% on 4L NP RR 38 T 38.8

What will you do?

You:

- Assess the patient- Sx/signs of inc WOB
- Call AMO
- Start HFNO 40Lmin^{-1}/40%

He improves SpO2 94% rr28

When he moves in the bed his SpO2 drops to 88% but quickly comes up at rest (this indicates he has little reserve)

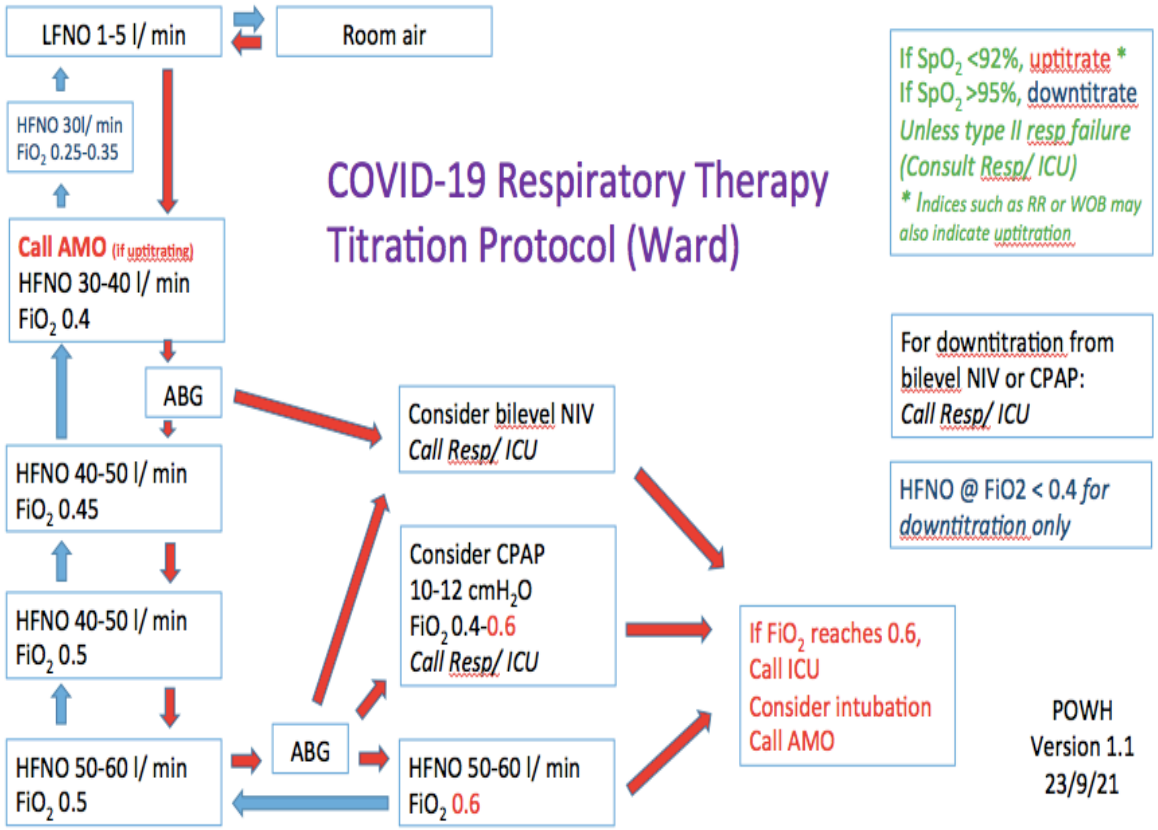
45min later you are called again:

Pt is on 40L/40% HFNO and prone

SpO2 90%

RR 34

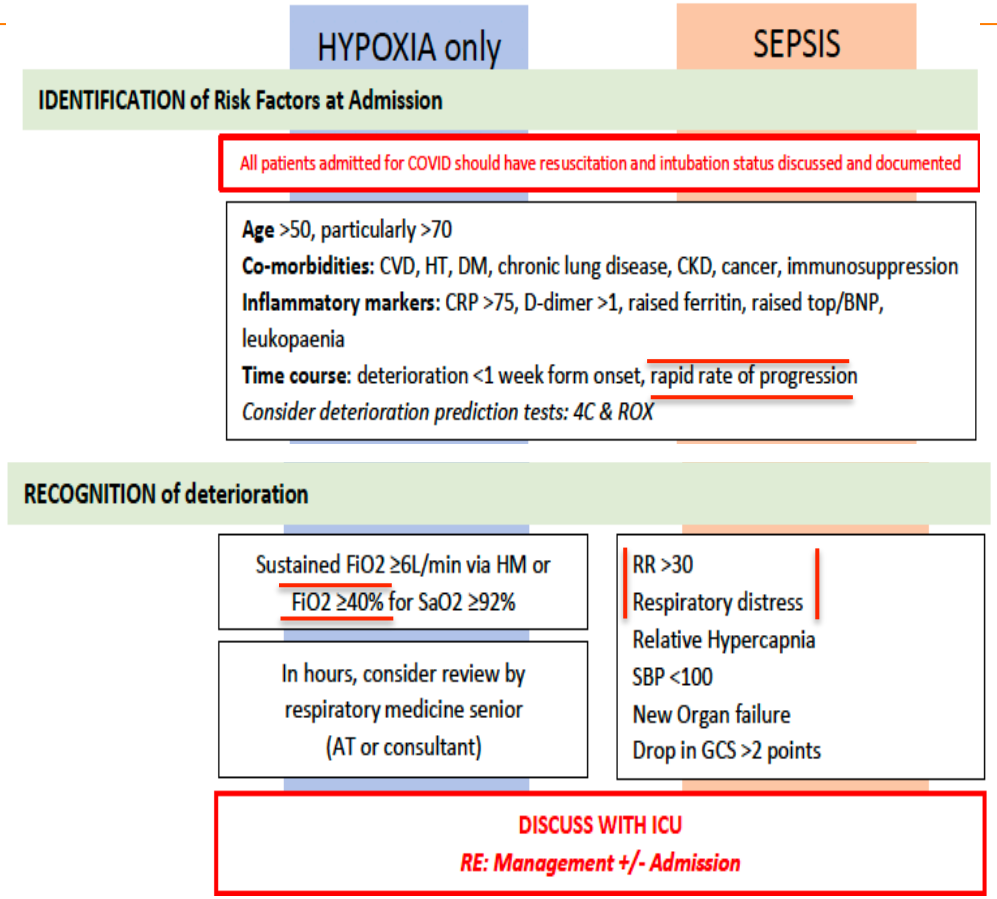
Still feels breathless. Speaking in short sentences.



You:

- Do an ABG
- Turn HFNO up to 50L/45%
- Discuss the need for possible CPAP/BiPAP with respiratory registrar +/- ICU

The patient settles on 50L /45%: SpO2 94% rr28



NB.
This patient is deteriorating and potentially needs ICU review and plan for possible admission made.

Case 2:

64 yo male. Admitted yesterday from home (HITH) with SpO2 85%, HD stable, T38C.

COVID Hx: **Day 5 of COVID Sx**
Day 3 since +swab

Sx: **Fatigue, SOB, productive cough**
Vaccinated- 2wks ago dose AZ 1wk ago

Risk Factors: **COPD – recent admission 2/12 ago**
SpO2 usually approx.92-94%
T2DM on OHG
RCC- currently taking immunomodulators
HT

Inflammatory markers: **Elevated:** **LDH**
Ferritin
CRP
D-dimer

Decreased: **lymphocyte count**

CXR: bilateral infiltrates

Overnight: SpO2 90- 92% on 4L NP O2 rr26

This morning:

SpO2 85-87% rr34 on 4L NP BP 105/62 HR 90bpm Temp 38.3

Transitioned to HFNO 40/40 aiming SpO2 88-92

Respiratory registrar requested ABG

1hr later:

ABG results show -

pH 7.3

pO2 55

pCO2 60

BIC 28

Lactate 3.0

What will you do?

References

- **Care of adult patients with COVID-19 in acute inpatient wards https://www.health.nsw.gov.au/Infectious/covid-19/communities-of-practice/Documents/care-adults-acute-inpatient-wards.pdf**
- National COVID-19 Clinical Evidence Taskforce. Australian guidelines for the clinical care of people with COVID-19. 2021 {version 42.1}. Available from: https://covid19evidence.net.au/
- **Guidelines for the Management of COVID-19 in the Intensive Care Unit** Prince of Wales Hospital Version 3.2, 27 July 2021