the children's hospital at Westmead

NITRIC OXIDE USE IN PICU - CHW

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Inhaled Nitric Oxide (NO) is a potent direct pulmonary vasodilator.
- It is useful in acute management of pulmonary hypertension.
- This document highlights the indications and use of NO in PICU.
- The circuit set-ups for different ventilators incorporating NO are explained.

CHANGE SUMMARY

- The use of Nitric Oxide with Non-invasive Ventilation
- New appendices for Set up using Aeroneb and Non invasive ventilation devices
- Updated PARDS criteria
- Weaning Nitric Oxide
- Use of Nitric in ECLS circuit
- Nursing considerations
- Sample line Disc Filter changes need to be performed every 12 hours
- Pre-use checkout performed by Inhalation therapy to allowing faster commencing of Nitric when required
- Title Updated. Previous title was *Inhaled Nitric Oxide in PICU - CHW*

Approved by:	SCHN Policy, Procedure and Guideline Committee	
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NSW GOVERNMENT

READ ACKNOWLEDGEMENT

- All PICU medical, nursing and allied health staff who care for patients receiving NO should be aware of this document.

TABLE OF CONTENTS

1 Background

- Normal vasomotor tone is largely influenced by the endogenous production of endothelium derived nitric oxide (NO).
- Dysfunction of the pulmonary endothelium secondary to various insults, i.e. hypoxaemia, acidosis, acute lung injury or cardiopulmonary bypass, may result in pulmonary hypertension.
- Temporary supportive therapy with inhaled exogenous nitric oxide has been reported to offer some benefit via its action as a selective pulmonary vasodilator. Although there are no published guidelines with regards to the duration of administration.[1–5]

1.1 Indications to consider NO use

Inhaled Nitric Oxide is indicated in pulmonary hypertension and/or hypoxemia associated with the following conditions: unresponsive to maximal conventional therapy:

- Persistent Pulmonary Hypertension of the Newborn (PPHN)
- Some pulmonary hypoplasia syndromes including post congenital diaphragmatic hernia repair.
- Perioperative cardiac surgical patients with pulmonary hypertension and/or right ventricular dysfunction
- Cavopulmonary anastomosis with high transpulmonary gradient (TPG) and increased pulmonary vascular resistance.
- Acute Respiratory Distress Syndrome (ARDS)
- Nitric oxide has both anticoagulation and potentially anti-inflammatory properties that may be beneficial in patients on extra corporeal life support (ECLS).[6,7] It is indicated in patients at high risk of thrombus formation in the ECLS circuit.

1.2 Delivery

- Nitric oxide is delivered via the INOmax- DSIR Plus nitric oxide delivery system.
- It can be administered via the inhalational route with both invasive (conventional and high frequency oscillatory ventilation) and non-invasive ventilation techniques (face mask, high flow nasal cannula, nasal prongs).
- Administration with non-invasive ventilation techniques has been shown to be safe, feasible, consistent and reliable.[8–10] Potential benefits include avoiding invasive mechanical ventilation and progressing patients to extubation with iNO administered via non-invasive ventilation techniques. *See appendix 6 for Set up in Non-invasive ventilation devices.*
- Nitric Oxide can also be Incorporated into the extra corporeal life support (ECLS/ECMO) gas delivery circuit into the oxygenator.[7,11]

1.3 Cylinder availability:

- Available in 800 ppm NO in nitrogen cylinders.
- Current cost is $70 per hour regardless of dose rate.

1.4 Authorised Prescribers:

- Intensivists

1.5 Place in therapy in relation to alternatives:

- iNO is more specific for pulmonary vasculature than other vasodilators and is thus superior. Sildenafil however has an increasing role and iNO should be substituted with sildenafil at the earliest possible time, particularly as it is substantially cheaper.[12]

2 Guidelines for considering use of iNO therapy

The initiation threshold must consider individual patient characteristics and context and will vary with each patient group. It is important to commence iNO therapy after conventional therapy has been optimized.

2.1 Neonates - PPHN

Maximal conventional therapy (as judged clinically) and an Oxygenation Index (OI) >20

(OI) = MAP × FiO2/PaO_2 × 100

MAP = mean airway pressure

FiO_2 = fractional inspired oxygen concentration

PaO_2 = arterial oxygen tension

2.2 Cardiac

A. Perioperative PHT

Inhaled Nitric oxide should be considered for peri-operative pulmonary hypertension according to the PICU Congenital heart disease perioperative management protocol. Specific patient considerations are summarized below.

Aim	Action
Reduce sympathetic stimulation	Optimize sedation and analgesia (consider fentanyl instead of morphine) Consider neuromuscular blockade Premedicate before noxious stimuli e.g. prior to endotracheal tube suction, manual handling etc. Maintain normothermia
Lower pulmonary vascular resistance	Increase FiO_2 (target PaO_2>100) Optimize ventilation (minimise PEEP to maintain adequate recruitment/ functional residual capacity). Avoid hypo/ hyperinflation. Treat Respiratory /Metabolic acidosis – target pH >7.3 Specific pulmonary vasodilators – iNO, aerosolized iloprost Nonspecific vasodilators – Milrinone, sildenafil, Epoprostenol (prostacyclin)
Other Considerations	Optimize vasoactive support (inotropes – adrenaline, milrinone and pressors – noradrenaline, vasopressin) Optimize fluid status – ensure adequate pre-load/ target optimal CVP as agreed with consultant. Treat severe anaemia (Hb <70mg/dL)

B. High Transpulmonary Gradient (>10-15) and hypoxemia in immediate post-operative period following cavopulmonary anastomosis

- Intensivist to decide.
- Use restricted to trial, consider stopping after 30 minutes if no benefit noted.[1]

2.3 Paediatric acute respiratory distress syndrome (PARDS)

PARDS as defined by the Paediatric Acute Lung Injury Consensus Group, 2023:[13]

Diagnosis of Possible Pediatric Acute Respiratory Distress Syndrome and At-Risk for Pediatric Acute Respiratory Distress Syndrome (Definition Statement 1.5.3, 1.7.2)

Variable	Definition
Age	Exclude patients with perinatal lung disease
Timing	Within 7 d of known clinical insult
Origin of pulmonary edema	Not fully explained by cardiac failure or fluid overload
Chest imaging	New opacities (unilateral or bilateral) consistent with acute pulmonary parenchymal disease and which are not due primarily to atelectasis or effusion[a]
Oxygenation[b] threshold to diagnose possible PARDS for children on nasal respiratory support[c] (definition statement 1.5.1)	
	Nasal continuous positive airway pressure/bilevel positive airway pressure or high-flow nasal cannula (≥ 1.5 L/kg/min or ≥ 30 LPM): $Pao_2/Fio_2 \leq 300$ or $Spo_2/Fio_2 \leq 250$
Oxygenation[b] threshold to diagnose at-risk for PARDS	
	Any interface: Oxygen supplementation[d] to maintain $Spo_2 \geq 88$ but not meeting definition for PARDS or possible PARDS (see above)
Special populations	
Cyanotic heart disease	Above criteria, with acute deterioration in oxygenation not explained by cardiac disease
Chronic lung disease	Above criteria, with acute deterioration in oxygenation from baseline

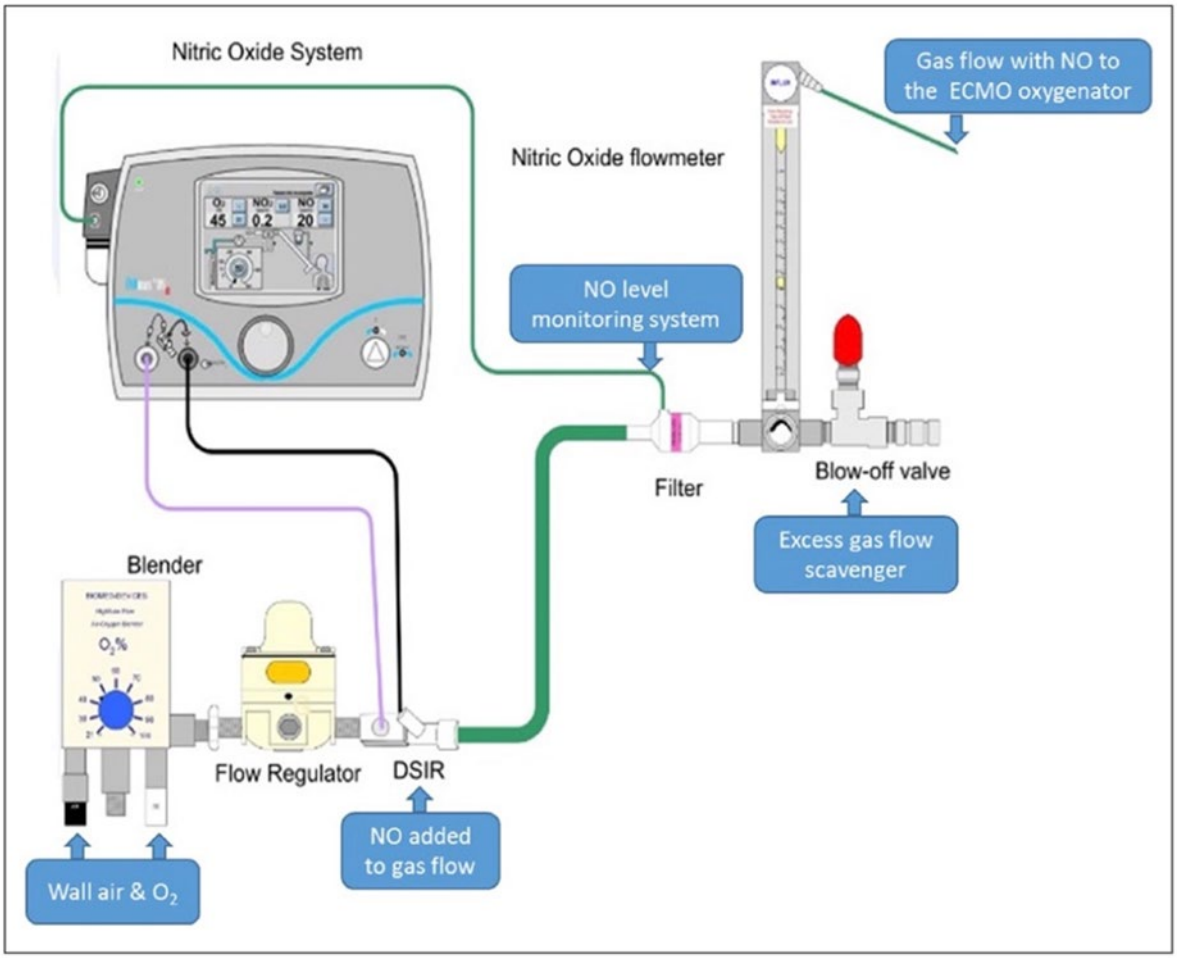
PARDS = pediatric acute respiratory distress syndrome, Spo_2 = oxygen saturation.
[a]Children in resource-limited environments where imaging is not available who otherwise meet possible PARDS criteria are considered to have possible PARDS (definition statement 1.5.2).
[b]Oxygenation should be measured at steady state and not during transient desaturation episodes. When Spo_2 is used, ensure that $Spo_2 \leq 97\%$.
[c]Children on nasal noninvasive ventilation (NIV) or high-flow nasal cannula are not eligible for PARDS but are considered to have possible PARDS when this oxygenation threshold is met.
[d]Oxygen supplementation is defined as $Fio_2 > 21\%$ on invasive mechanical ventilation; or $Fio_2 > 21\%$ on NIV; or "oxygen flow" from a mask or cannula that exceeds these age-specific thresholds: ≥ 2 L/min (age < 1 yr), ≥ 4 L/min (age 1–5 yr), ≥ 6 L/min (age 6–10 yr), or ≥ 8 L/min (age > 10 yr). For children on a mask or cannula, oxygen flow calculated as Fio_2 × flow rate (L/min) (e.g., 6 L/min flow at 0.35 Fio_2 = 2.1 L/min).
Possible PARDS and at-risk for PARDS should not be diagnosed in children with respiratory failure solely from airway obstruction (e.g., critical asthma, virus-induced bronchospasm).

1. The use of iNO in PARDS has been extensively studied. There is evidence that it has favourable short term response towards improvement of hypoxemia, however there is no benefit towards mortality, duration of ICU or hospital stay.
2. iNO is not recommended for routine use in Paediatric ARDS (PARDS). However, its use may be considered in patients with documented pulmonary hypertension or severe right ventricular dysfunction. In addition, it may also be considered in severe cases of PARDS as a rescue from or bridge to extracorporeal life support.[14]
3. When used, assessment of benefit should be undertaken within the first 4 hours and serially to minimize toxicity and to eliminate continued use in the absence of established effect.[14] However, if no benefit has been documented, iNO can be discontinued after a 30 minute trial.[1]
4. The use of iNO in this setting in conjunction with conventional ventilator management has to be discussed with the intensivist prior to initiation.

2.4 Nitric Oxide in Extra Corporeal Life Support (ECLS) Circuits

1. Nitric oxide can be safely added to the extra corporeal circuit via the sweep gas particularly in patients with an increased risk of developing clots in the circuit. A technique for this has been described.[11]
2. The anticoagulation benefit is related to decreased contact activation of platelets. An additional benefit is NO potentially limits the systemic inflammatory response syndrome or ischemia/ reperfusion injury related to the underlying pathology preceding ECMO initiation.
3. The suggested concentration is 20 ppm with an additional 250-300cc per minute added to the sweep gas flow to account for the NO system sampling volume (~250cc/min).

Figure showing the gas flow configuration with NO added.[7]



3 Nitric Oxide exposure guidelines - "Dosages"

- Since inhaled NO is mixed with respiratory gases, a true dosage depends upon respiratory and ventilation parameters i.e. dead space volume, tidal volume, ventilator rate and duration of exposure. Therefore, inhaled NO is ordered as a concentration, in parts per million (ppm).
- Most current research suggests a useful range of exposure between 1-20 ppm.
  Higher range exposure may be more efficacious for short term exposure, but also has a greater potential for toxicity - due to risk of methemoglobinemia and pulmonary injury from elevated nitrogen dioxide (NO2)"

As with most therapeutic agents, the lowest efficacious dose is usually safest.

Suggested administration regime

1. Commence inhaled NO at 20 ppm for 30 minutes to gauge response.
2. If a clinically significant response in PaO_2 or PAP/SAP ratio is seen, maintain 20 ppm for 12-24 hours before commencing iNO weaning depending on individual patient response.
3. If the patient is a persistent non responder at 20 ppm iNO, this should be classed as an iNO treatment failure and iNO should be weaned and stopped.

4 Weaning Inhaled NO

- Inhaled NO should be weaned as soon as possible as dictated by clinical improvement. Markers of improvement include lower FiO2 requirement (<0.6), decreased PEEP requirement from baseline, stable haemodynamics with lower vasoactive requirement, decreased central venous pressure or decreased right ventricular/ pulmonary pressures on assessment by echocardiography.
- Because of the theoretical potential of endogenous NO down regulation and reports of morbidity resulting from rebound pulmonary hypertension following abrupt cessation, inhaled NO should always be weaned slowly however, there is no consensus on weaning duration.
- There is currently no consensus on how to wean inhaled NO but a suggested weaning regimen is in increments of 5ppm every 1-4 hours to 5ppm and thereafter by 1ppm every hour till turned off. A slower rate of withdrawal may be indicated after extended therapy or during periods of instability.[15–17]
- If rebound PHT or hypoxaemia (OI >20) should occur, weaning should promptly be discontinuated to allow for improvement.
- If a clinical deterioration (i.e. decreased SpO2 or MAPs) by $\geq$10% from baseline is noted, increase iNO back to previously administered concentration
- FiO_2 should be maintained at a minimum of 0.4 during weaning and increased by 0.2 for 20 minutes prior to ceasing NO.
- Consider a single enteral dose of 0.4mg/kg of Sildenafil prior to ceasing NO in discussion with the ICU consultant.[12] On a case by case basis higher doses of regular sildenafil may

need to be continued for pulmonary hypertension (decision often made in conjunction with Cardiology).

5 Toxicity

5.1 NO/NO_2 analysis

- High dose inhaled NO (>5000 ppm), well outside the therapeutic range, is known to be toxic.
- Therapeutic doses (<20 ppm) have not been reported to be toxic during short term exposure.
- Even short term exposure to NO_2 may be toxic and published guidelines suggest an upper exposure limit of 3-5 ppm.
- Continuous analysis for NO/NO_2 is mandatory.
- NO2 monitoring alarm should be set at 3ppm.

5.2 Methaemoglobinaemia

- Methaemoglobin percentage (metHb) should be monitored and recorded in all patients. [The methaemoglobin level is available with each arterial blood gas sample].
- If the metHb level reaches 5% and is confirmed on a repeat sample, the inhaled NO should be halved and a repeat metHb collected after a further 30 minutes.
- If this metHb is still >5%, the NO should again be halved until the metHb <5%.
- This is a very unlikely event as all studies reported to date using low dose NO have not reported any significant elevation in metHb. “Methemoglobinemia that does not resolve with dosage reduction or discontinuation of therapy may require intravenous vitamin C, intravenous methylene blue, or blood transfusion, depending on the clinical situation”.

5.3 Pulmonary surveillance

- A chest radiograph should be considered at commencement of iNO and daily whilst continuing to receive inhaled NO.

6 Setup for Servo U with INOmax-DS$_{IR}$ Plus Delivery System

The INOmax- DS$_{IR}$ Plus nitric oxide delivery system is a complete unit which allows the delivery of NO, both at the bed side and during transport.

6.1 Preparation for immediate patient use utilising calibrated machine in CVVH Storeroom.

Nitric should be added to the ventilator circuit by trained nursing staff ONLY

1. Position INOmax- DSIR Plus unit at the patient bed side next to the ventilator.
2. Plug the machine into mains power, the DSIR Plus has 4 hours battery life when fully charged.
3. Connect the white oxygen hose to the wall Oxygen.
4. Turn the machine on.
5. The Pre-use Procedure will commence, press CANCEL.
6. A Low Calibration test continues to run in the background.
7. Perform a cylinder leak test by opening and closing the cylinder valve, watch for the pressure to stabalise
8. Depressurise the grey inlet hose prior to connecting to the back of the machine (refer to appendix 2)
9. Open the cylinder valve.
10. If the patient is unstable, at this point the INO Blender can be used to provide iNO to the patient using an anaesthetic bag. Dial up the required dose and flow on the front prior to disconnecting the patient from the ventilator.
11. Place the injector module on the dry side of the humidifier. The sampling line should be connected on the inspiratory limb approx 15-30cm away from the patient. Use relevant connectors if needed to make components fit into the circuit. Ensure the injector module arrow is positioned in the direction of inspiratory flow (refer to Appendix 3 for set up).
12. If not starting therapy within **10 minutes**, you will need to depressurise the INOmax regulator (grey hose).
13. Connect hand bagging circuit with “green tubing” to the INOBlender port on the front of the unit.
14. Make sure ventilator is switched on and running.
15. Set the initial desired exposure level of NO ppm as per the intensivists order.

Note: LOW Cal calibration procedure will automatically be performed in the background at minimum 12 hourly.

6.2 Ceasing Therapy

- If therapy is no longer required, close all cylinder valves. Depressurize the grey inlet hose.
- The cylinders will display dashes to indicate the cylinder has been closed
- Switch the power off at the back
- Once no longer required, removed the INOmax- DS_{IR} Plus from the patient ventilator circuit and send to inhalation therapy for cleaning
- If the INOmax- DS_{IR} Plus has not been removed from the patient's ventilator circuit and it has been > 24 hours. The pre-use checkout procedure and automated purge must be performed prior to commencement of therapy to ensure any build up of Nitric Dioxide is removed (refer to section 6.3 for Pre-use checkout procedure).
- Prior to commencing the pre-use checkout procedure, ensure iNO circuit is removed from patient ventilator

Note: INOMax DSIR machine needs to be sent to inhalation during business hours to be cleaned.

6.3 Pre-use Checkout

The Pre-use checkout is performed by our Inhalation team each day. A ready to use machine is stored in the CVVH room to be utilised if required. In the event of another machine being needed, please contact the inhalation team afterhours.

When to perform the pre-use checkout procedure

1. The machine has not been in use for more than 24 hours.
2. If the machine has been kept in the patient circuit and not in use for > 24 hours
3. During trouble shooting

Perfoming the Pre-use Checkout (See Appendix 1)

The pre-use assembly tubing and injector module is attached to machine located in the store room. Additional pre use assembly tubing, as well as connectors and adaptors for Servo U neonatal/paediatric or Adult and HFO circuits is available in the nitric spare parts box.

Ensure that oxygen cylinder has 10,000psi to preform test or connect to wall oxygen. This will allow flow through the oxygen blender at the front of the INOmax- DS_{IR} Plus.

Ensure the pre-use assembly tubing and injector module is attached to the machine.

1. Prior to patient use, turn IKARIA INOmax- DSIR Plus machine ON. Switch button located on the back right.
2. Follow onscreen wizard for Pre-Use Procedure and Automated Purge (Do not press cancel).
3. A Low Calibration test continues to run in the background.

   When the Pre-use procedure and automated purge has completed, turn the cylinder valve off (clockwise) and turn OFF machine.

7 Nursing Considerations

7.1 Shift Checks

- Does the set dose match the prescription required?
- Is the set dose and measured dose equal?
    - If not consider changing the disc filter
    - Check all connections are tight
- iNO alarm limits set 5ppm above and below set dose
- NO alarm limit set at 3ppm
- Is the injector module positioned correctly in the ventilator
    - Dry side of humidifier
    - Pointing in the direction of ventilator flow
- Position of the sample tee
    - 15-30 cm from the patient
    - Located on the inspiratory limb

- Change the disc filter on the sample tee every 12 hours
- Check pressure gauge on currently running cylinder is more than 500psi
- Check spare cylinder
    - Unplug grey regulator hose
    - Open and close cylinder – watch for pressure to stabalise
    - Change cylinder is less than 500psi
    - Depressurise hose and leave disconnected until required
- Anaesthetic bag connected to INO Blender

7.2 Transporting patient on iNO

Patients receiving inhaled nitric oxide can be transported on the therapy.

To transport patients:

Connect Nitric machine to a portable oxygen cylinder, mounted on the back of the INOMAx DSIR Machine. This will allow for the INO Blender to be utilised during transport.

Ensure the cylinder is full prior to transport

If fully charged, the INOMax DSIR machine has 4 hours battery life and will continue to display monitored values throughout the transport.

8 Product Manual and Trouble Shooting

For more details please refer to link below:

INOmax- DSIR Plus operation and maintenance manual[18]

https://www.inomax.com/wp-content/uploads/2018/07/20717_ENG_INOmax_DSIR_Plus_OM_Manual.pdf

If unable to troubleshoot please contact 1300 198 565 for technical support

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Appendix 1 Pre-use Checkout

Note: Out of hours when Inhalation Therapy is not available INOmax- DSIR Plus machine is available in the PICU CVVH room.

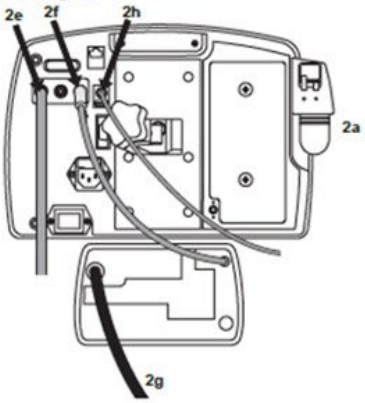
INOmax DS$_{IR}$® INOblender®
Series 3 software

IKARIA® ADVANCING CRITICAL CARE

Pre-Use Checkout

(The following instructions are provided for when the on-screen pre-use wizard is not used.)

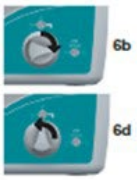
1. Turn device ON, low calibration will begin and complete
2. **Initial Connections:**
   Confirm attachment of the following:
   a. Water separator cartridge, water trap bottle, and patient gas sample line in place
   b. Injector module cable and tubing are connected
   c. Plug in power cord and verify AC power light is ON
   d. Regulator to 800 ppm INOMAX cylinder
   e. Regulator hose to INOmax DS$_{IR}$ inlet
   f. INOblender hose connected and white lock in place
   g. Oxygen source (50 psig) to back of INOblender
   h. IR cable in place



3. Assemble pre-use set-up connectors (diagram on back of card). Do not turn O_2 flowmeter ON yet.
4. **High Pressure Leak Test:**
   Open/close INOMAX 800 ppm cylinder valve
   a. Verify, at least 500 psig cylinder pressure
   b. Verify, no decrease in cylinder pressure for 30 seconds
5. **Manual Purge/Alarm Verification:**
   a. Press CANCEL to exit pre-use wizard.
   b. Verify the INOMAX cylinder valve is closed.
   c. Set the O_2 flowmeter to 10 L/min
   d. Purge INOmax DS$_{IR}$.
      • Set the INOMAX dose to 40 ppm.
      • "Cylinder Valve Closed" alarm will occur.
      • Cylinder gauge pressure should drop to 0 psig.
      • Measured NO_2 will increase and then decrease as NO_2 is purged from the system.
      • "Low Cylinder Pressure" alarm will occur.
   e. Open the INOMAX cylinder valve.
   f. Turn the INOMAX dose to zero. The "Set Dose is Zero, Close Cylinder Valve" indicator will appear. This indicator will display anytime the set dose is returned to zero; however, during this pre-use procedure, leave the cylinder open and touch the screen to reset the indicator.
6. **Integrated Pneumatic Backup Test:**
   a. Verify pre-use assembly flowmeter set to 10 L/min
   b. Turn INOmax DS$_{IR}$ backup switch ON
   c. Verify measured values

NO	14-26 ppm
NO_2	≤ 1.0 ppm

   d. Turn backup switch OFF



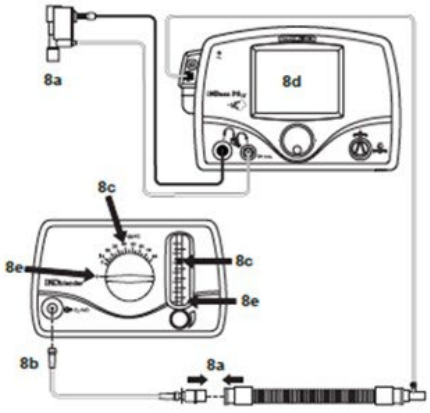
7. **Performance Test:**
   a. Verify O_2 flowmeter is set to 10 L/min
   b. Set INOMAX dose to 40 ppm
   c. Verify monitored values

Acceptable NO Value	35-45 ppm
Acceptable NO_2 Value	<1.5 ppm
FiO_2	95% ± 3%

   d. Set INOMAX dose to 0 ppm
      • "Set Dose is Zero, Please Close Cylinder Valve" reminder will appear- DO NOT close cylinder valve at this time
   e. Turn oxygen flowmeter OFF
8. **INOblender Test:**
   a. Remove injector module from pre-use assembly
   b. Remove O_2 tubing from flowmeter and attach to INOblender outlet
   c. Set INOblender flow to 10 L/min, INOMAX dose to 40 ppm
   d. Confirm acceptable NO value

NO	32-48 ppm

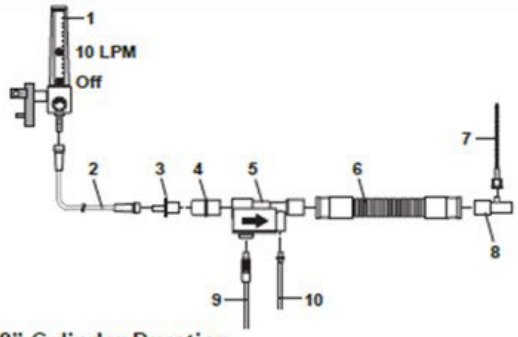
   e. Set INOblender dose and flow to 0



End of Procedure
If device is not used within 10 minutes, depressurize cylinder regulator

⚠ WARNING: This reference card is not a substitute for the INOmax DS$_{IR}$ and INOblender Operation and Maintenance manuals. Refer to these manuals for all applicable cautions and warnings.

Pre-Use Assembly



1. O_2 Flowmeter
2. O_2 Tubing
3. 15M x 4.5 mm Adapter
4. 22M / 15F x 22M / 15F Adapter
5. Injector Module
6. 300 mm of 22 mm hose
7. Patient Gas Sample Line with Nafion
8. Gas Sample Tee
9. Injector Module Electrical Cable
10. NO/N_2 Injector Tube

"88" Cylinder Duration

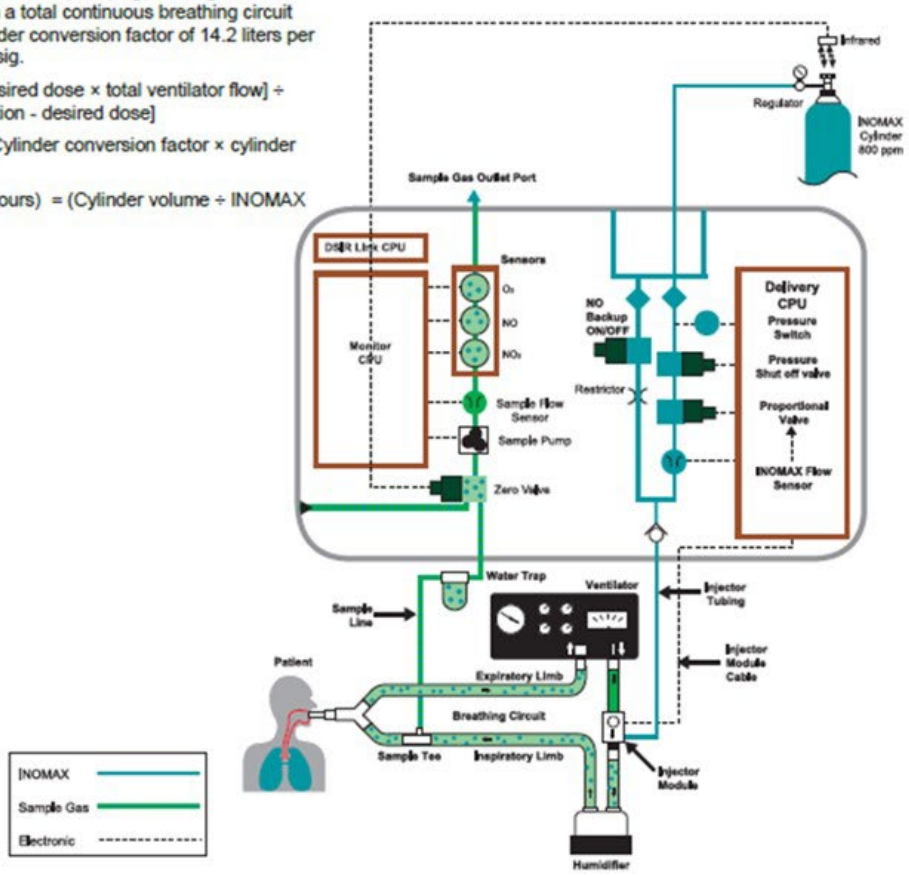
INOMAX Dose (ppm)	FLOW 5 L/min	10 L/min	20 L/min	40 L/min
5	39 Days	19.5 Days	9.8 Days	4.9 Days
10	19.4 Days	9.7 Days	4.8 Days	2.4 Days
20	9.6 Days	4.8 Days	2.4 Days	1.2 Days
40	4.7 Days	2.3 Days	1.2 Days	14 Hours
80	2.2 Days	1.1 Days	13.3 Hours	6.6 Hours

FiO_2 Dilution

INOMAX Dose (ppm)	Set FiO_2 .21	.40	.60	.80	1.00
10	0.21	0.40	0.59	0.79	0.99
20	⚠0.20	0.39	0.59	0.78	0.98
40	⚠0.20	0.38	0.57	0.76	0.95
80	⚠0.19	0.36	0.54	0.72	0.90
	Actual FiO_2				

* All calculations in the table above are based on a full cylinder, 138 bar (2000 psig), 1963 liter "88" cylinder, with a cylinder change at 14 bar (200 psig). The figures are calculated based on a total continuous breathing circuit gas flow and a cylinder conversion factor of 14.2 liters per bar/0.98 liters per psig.

- INOMAX flow = [Desired dose × total ventilator flow] ÷ [Cylinder concentration - desired dose]
- Cylinder volume = Cylinder conversion factor × cylinder pressure (bar/psig)
- Cylinder duration (hours) = (Cylinder volume ÷ INOMAX flow rate) ÷ 60



Appendix 2 Depressurising

Depressurizing or purging the INOmax- DS_{IR} Plus if not in use within 10min

1. If not immediately connecting to a patient (>10min), turn the INOMAX cylinder to OFF.

2. Ensure there is only **one** grey pressure cable that is connected to the back of the machine corresponding to the cylinder that you want to depressurise. Disconnect the gas inlet connector (grey pressure cable).

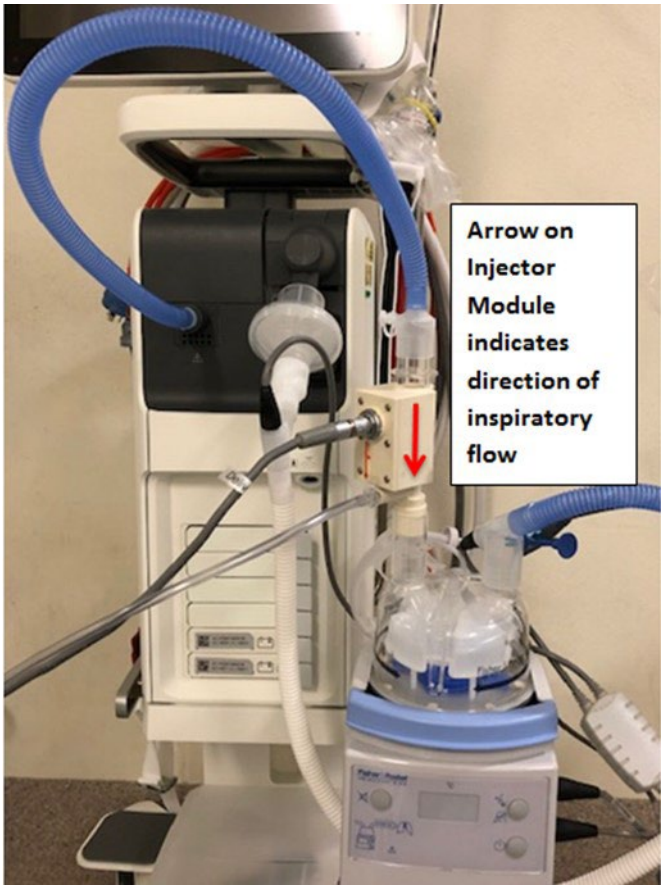
3.Insert cable into purge port on the back of the INOmax- DS_{IR} Plus . Ensure pressure gauge falls to zero.

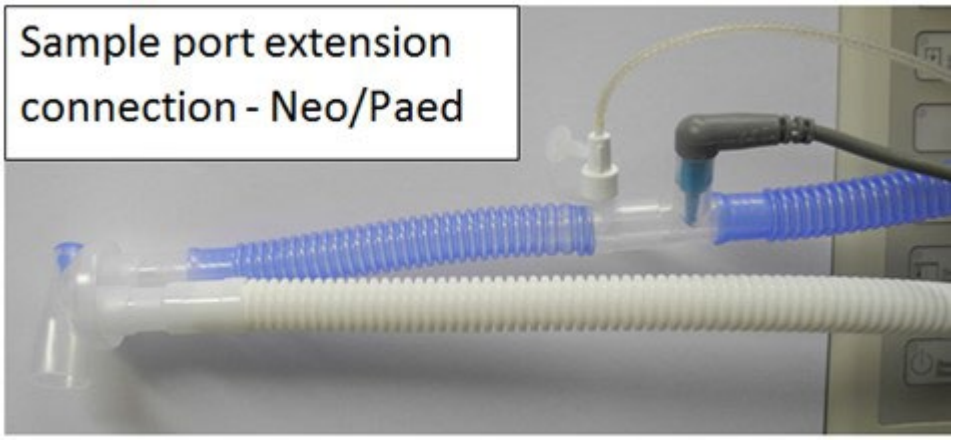
4. Reconnect gas inlet connector back to the original inlet. The machine is ready for use within 24 hours. To commence, turn cylinder on. After 24 hrs repeat pre-use procedure.

If the INOmax DSIR is depressurized and not used within 24 hours, repeat pre-use procedure.

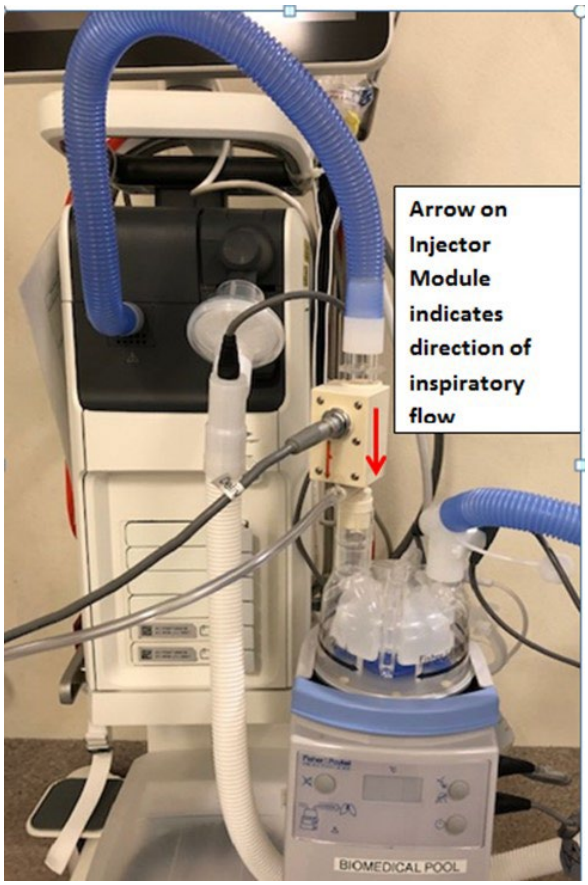
Appendix 3 Circuit set up for Servo U Ventilator

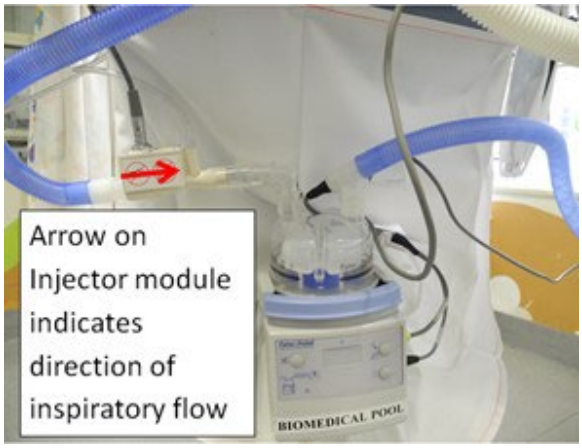
Circuit set up via Servo U Paediatric/Neonatal circuit

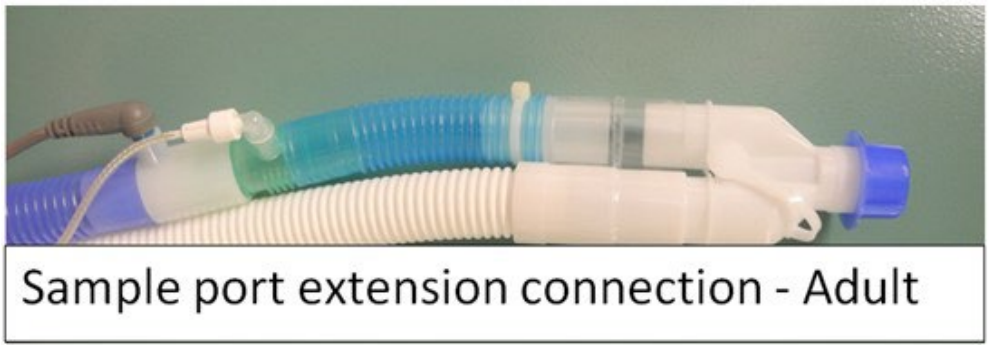




Circuit set up via Servo U Adult circuit







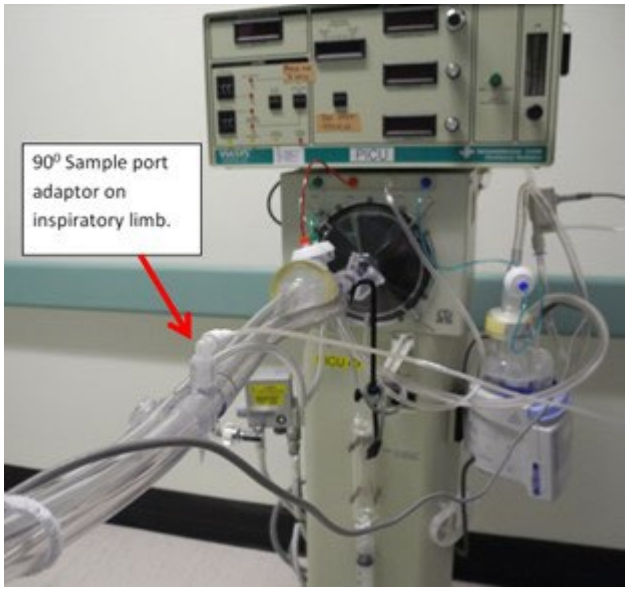
Sample port extension connection - Adult

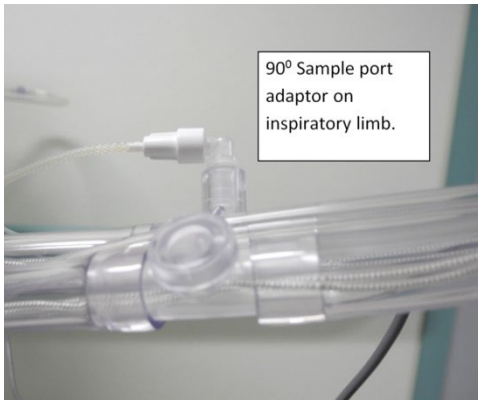
Appendix 4 Sensormedic

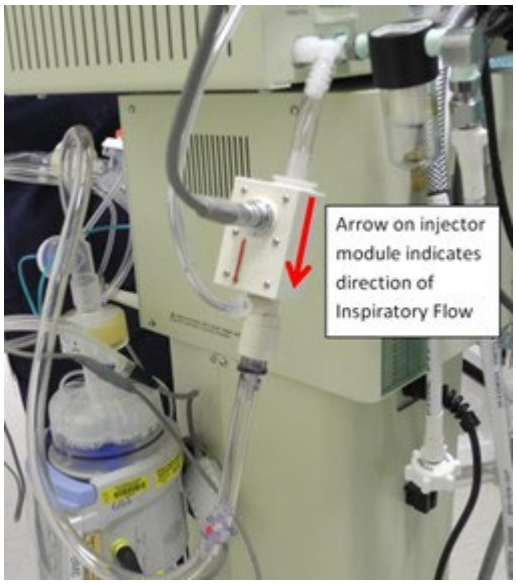
INOmax- DS_{IR} Plus set up with Sensormedic 3100A/B

If INOmax- DS_{IR} Plus is required to be set up with HFVO, than contact Inhalation Therapy.

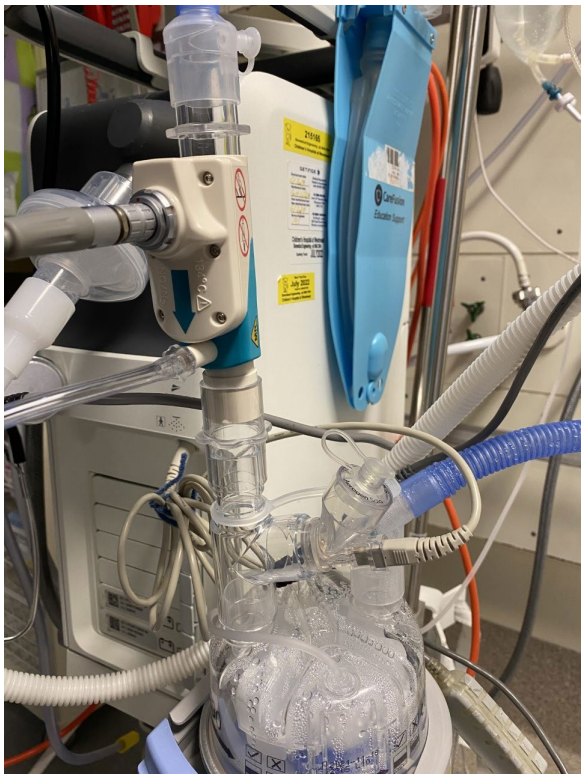
Please use pictures as a reference.







Appendix 5 Aeroneb and Nitric Set up



When utilising Aeroneb and Nitric within the ventilator circuit, ensure the Aeroneb is on the dry side of the humidifier after the injector module.

This will ensure that the nebulisations do not interfere with the injection of Nitric into the circuit or crystallise within the injector module leading to injector module failure.

Appendix 6 Non ventilation and Nitric Oxide Set Ups

Inhaled Nitric Oxide can safely and easily be delivered non-invasively utlising high flow nasal prongs or non-invasive masks. Below are details on setting up non-invasive inhaled nitric in both high flow circuits and the Trilogy evo. Please note that Nitric can be delivered via different devices including non-invasively utilising the Servo U.

Consider these general set up principles with all devices:

i. Injector module on the dry side of the humidifier pointing towards the direction of flow to the patient

ii. The sample line should be located 15-30cm from the patient on the inspiratory limb of the ventilator

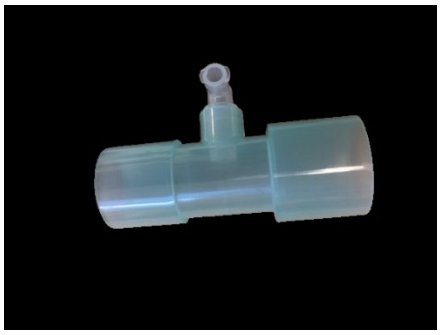
iii. The anaesthetic bag should be connected to the INO Blender

Utlising Nitric Oxide with High Flow Nasal Prongs

Equipment:

- High flow nasal prong circuit appropriate for patient weight
  - < 13 kg Paediatric size
  - > 13 kg Adult size
- Appropriate prongs based on flow rate (refer to HFNPO2 policy)
- INOmax- DS_{IR} Plus Machine
- Ikaria 22mm X 22mm clear Adaptor to connect Injector module to humidifier
- For paediatric use Optiflow adaptor (OPT016)
- For Adult use Green connector with luer lock clear piece obtained from inhalation

Optiflow for Paediatric Circuit



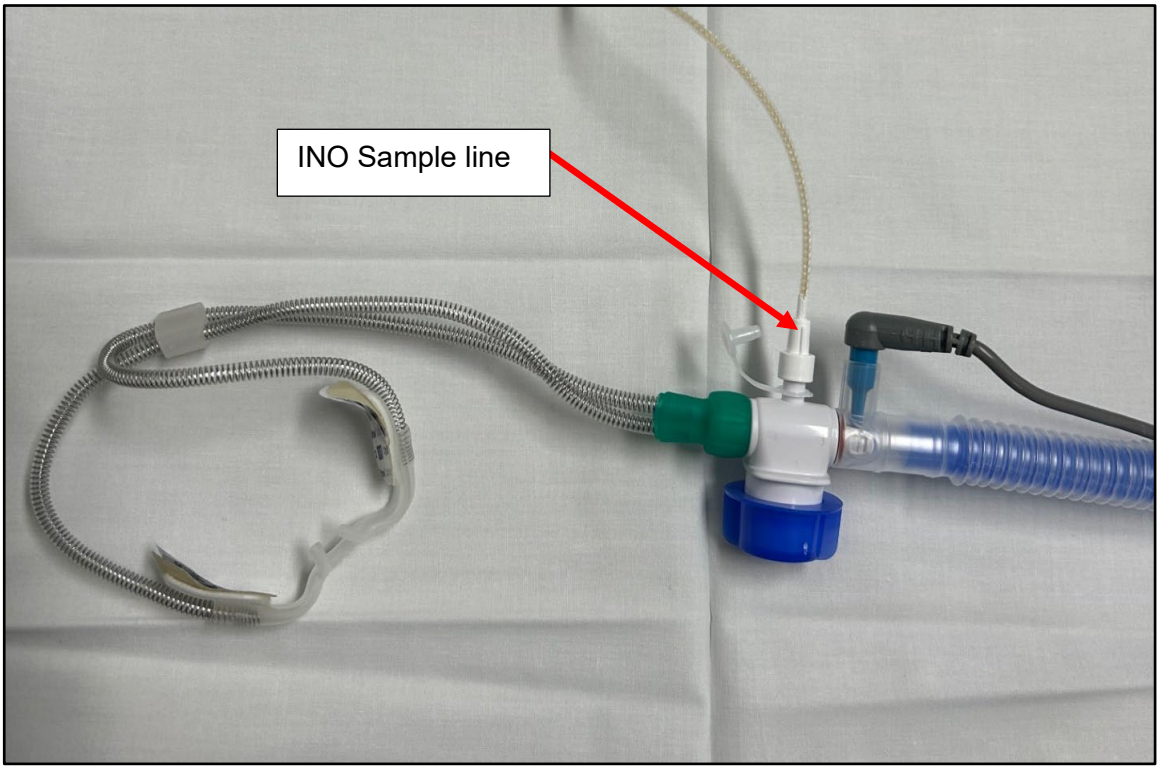
Green Connector for Adult Circuit

Set Up:

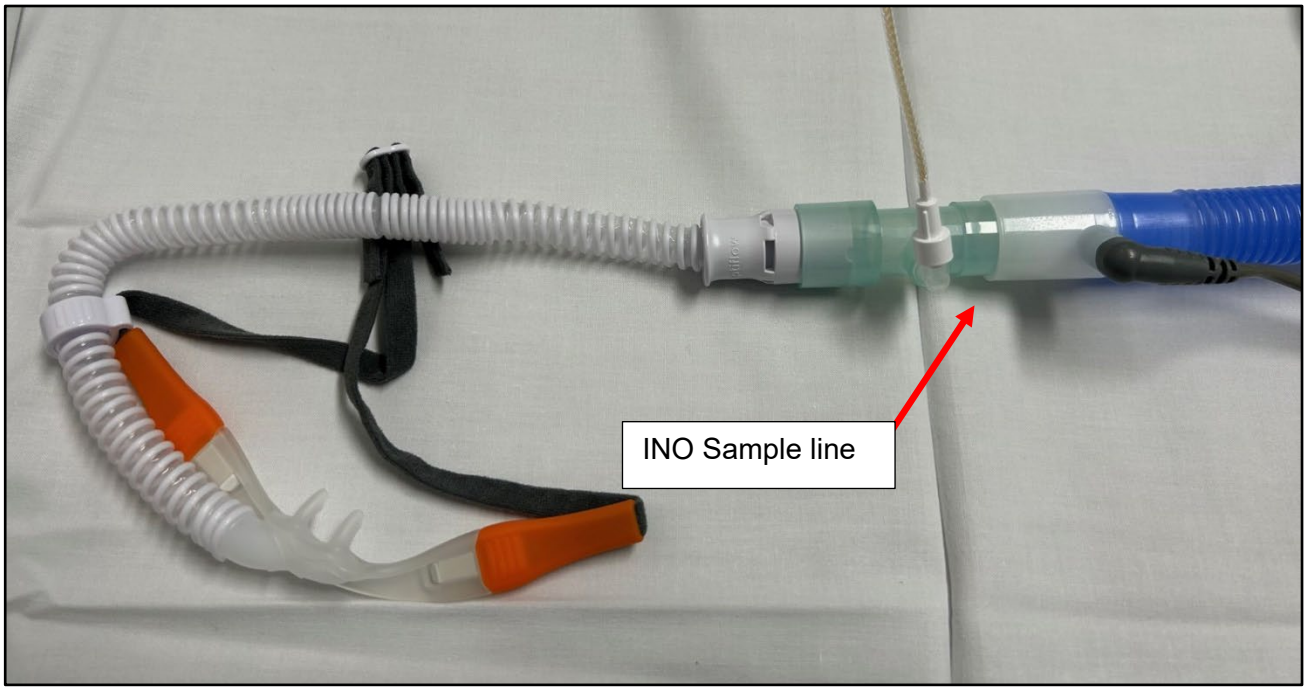
- Connect High flow circuit to wall oxygen and air
- Connect Nasal prongs to adaptor (see pictures below for Adult and Paediatric set up) and then to high flow circuit
- Set up Nitric Machine as per policy

- Connect sample line to Optiflow or green adaptor
- Add injector module to humdifier using Ikaria 22mm X 22mm adaptor
- Dial up dose and commence theraphy

For Paediatric Nasal Cannula



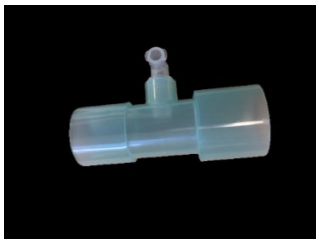
For Adult Nasal Cannula



Utlising Nitric Oxide with Non-invasive Nasal Masks

Pictured below is set up using the Trilogy EVO and Nasal Mask. Please follow the same principles when setting up iNO in another ventilator.

Equipment:



- Non-invasive Mask
- Non- invasive ventilator
- Green adaptor with clear luer lock
- INOMax machine

Set up:

- Connect ventilator to wall O2
- Turn on and perform circuit calibration test
- Set up INOmax- DS_{IR} Plus machine as per policy
- Connect nasal mask, green adaptor and circuit and pictured
- Connect the sample line to the green adaptor
- Place mask onto patients face, and fasten using appropriate head gear.
- Dial up Nitric Dose and commence therapy