Oxygen Therapy

REPUBLIC OF KENYA
MINISTRY OF HEALTH

NEST360°

University of Nairobi

KENYA PAEDIATRIC ASSOCIATION

KEMRI | Wellcome Trust

Keprecon
Kenya Paediatric Research Consortium

Objectives

- Define terms used during oxygen therapy
- Describe the diagnosis and management of hypoxemia
- Outline the role of pulse oximetry
- Describe oxygen delivery methods
- Highlight complications of hyperoxia and hypoxia

Introduction

Definitions

Hypoxemia	Low levels of oxygen in the blood (low oxygen saturation or content)
Hypoxia	Inadequate oxygen in tissues for normal cell and organ function. Results from hypoxemia
SaO_2	Arterial oxygen saturation when measured by gas analysis
SpO_2	Arterial oxygen saturation when measured by a pulse oximeter. Hypoxemia is $SpO_2 < 90\%$

Conditions associated with Hypoxemia in Neonates

- Respiratory Distress Syndrome
- Neonatal pneumonia
- Transient tachypnoea of newborn
- Severe Birth asphyxia
- Sepsis
- Congenital heart defects

Detection of Hypoxemia

How to detect hypoxaemia

Clinical Signs

It is important for health workers to be able to identify clinical signs of hypoxaemia. Combination of clinical signs increases the chances of detecting hypoxaemia

Head nodding, Nasal flaring, Central cyanosis, Grunting with every breath, Severe lower chest wall indrawing, Respiratory rate ≥ 70/min,

WHO 2016: Oxygen therapy for children: a manual for health workers

How to detect hypoxaemia

Blood Gas Analysis

Measures the arterial oxygen saturation (SaO_2). Also measures blood pH and the concentrations of the main electrolytes

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How to detect hypoxaemia

Pulse Oximetry

A pulse oximeter is a computerized unit with a sensor probe.

When attached to the patient, it displays the SpO_2 with an audible signal for each pulse beat and the pulse rate.

SpO_2<90% = Hypoxemia

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Role of Pulse Oximetry

- Most accurate noninvasive method for detecting hypoxaemia
- Measures the percentage of oxygenated hemoglobin in arterial blood (SpO_2)
- Reliable monitor for hypoxemia
- Should be performed on all patients requiring admission and in the outpatient department for babies with fast RR and LCWI - 5th Vital sign

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Role of Pulse Oximetry

- Advantages of using a Pulse Oximeter
  1. Detects 20–30% more babies with hypoxemia than clinical signs alone
  2. Non – invasive and painless unlike blood gas analysis
  3. Easy to use
  4. Inexpensive and widely available

All health facilities should have a pulse oximeter!

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Using a Rad G Pulse oximeter

1**. Patient Cable Connector**: Allows connection to a patient cable (Y-sensor) or data cable.
2. **Power Button:** Powers Rad-G On and Off. See Powering Rad-G ON and OFF on
3. **Display and Touchscreen:** User interface to view parameters and change settings. See Using the Touchscreen and Home Button.
4. **Temperature Window:** Displays temperature and provides the icon that provides the ability to perform the temperature measurement.
5. **Backward Navigation Button:** Navigate back from a selection or exit a menu item
6. **Home Button:** Multipurpose user interface that allows for navigation to the home screen
7. **Main Menu Button:** Access to main menu settings.
8. **Speaker:** The speaker supports audible indicators or instructions.
9. **DC Input Connector:** Connection to an AC power supply for battery charging
WARNING: Only use the AC power supply provided by Masimo. Using a different AC power supply could result in degraded performance and/or patient injury, and cause damage to Rad-G. Check the power cord and plug to ensure that it is intact and undamaged.

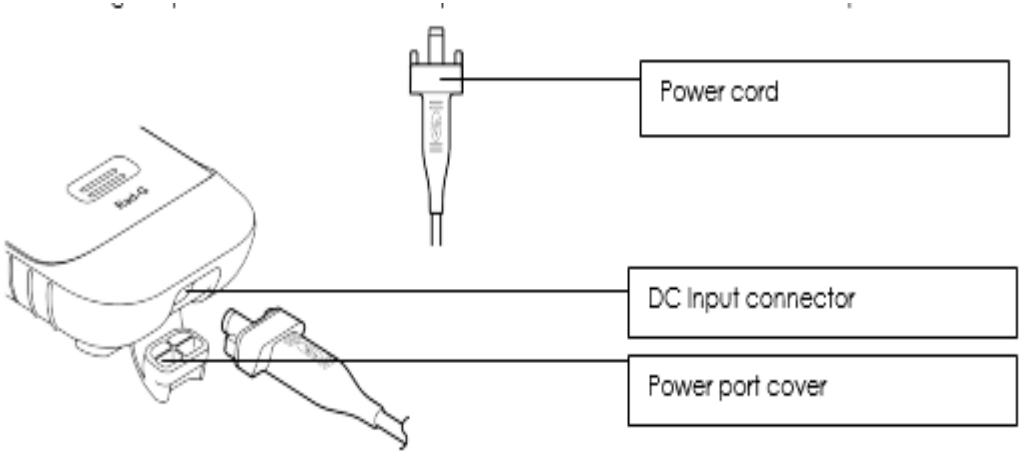
Using a Pulse oximeter

- Pulse oximeters use a light emitter and a light detector at the SpO_2 probe to acquire the oxygen levels in the blood.
- The Light emitter produce two types of light namely:
  1. Infra red light: which is absorbed by oxygenated haemoglobin.
  2. Red light: which is absorbed by deoxygenated haemoglobin.
- The displayed SpO_2 value, is a function of the ratio of the light absorbed detected by the light detector of the probe.

Rad G Pulse oximeter - Parts

Back view

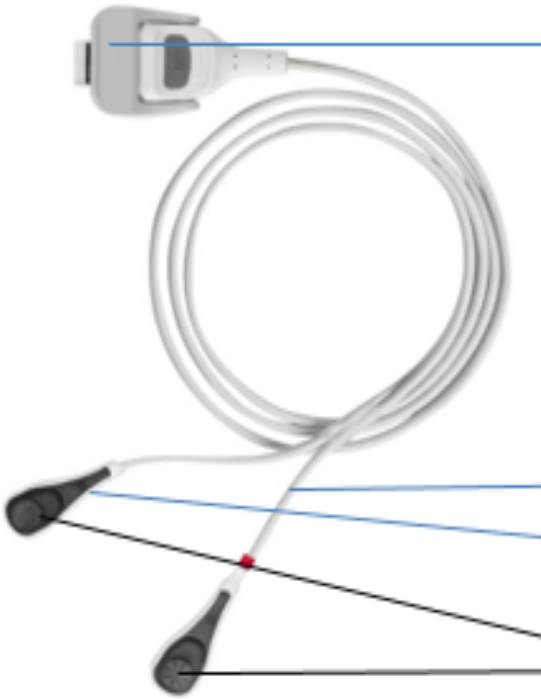
Integrated infrared tem-
perature sensor



Bottom View

Rad G Pulse oximeter Accessory- Parts

Y-sensor



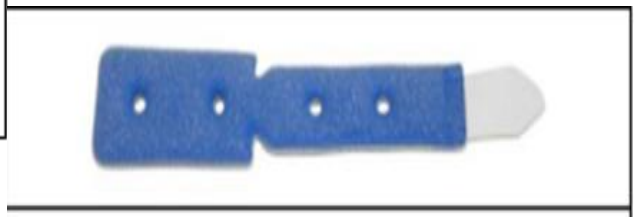
Latch: Secure the connection of the patient cable to Rad-G pulse oximeter

Emitter side of sensor (has a red mark)- light source

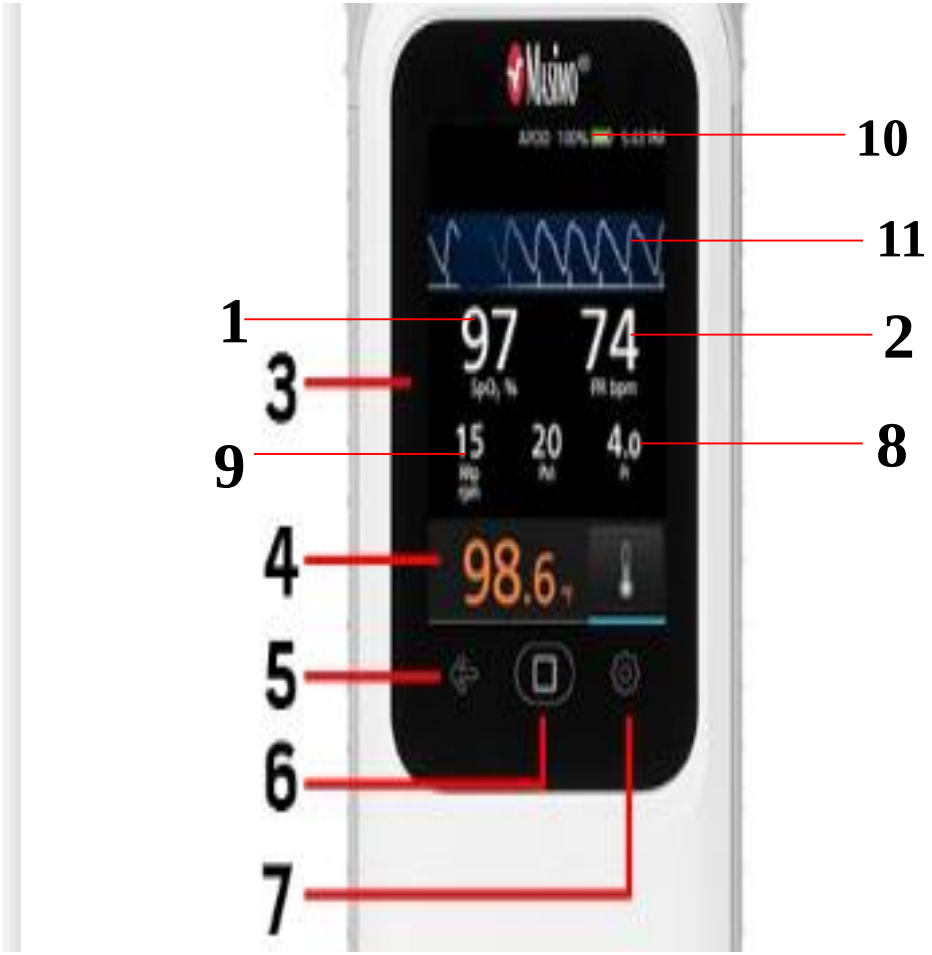
Detector side of sensor – light detector

Sensor button – connects to form wrap

Foam Wrap



Rad G Pulse oximeter - Display



No.	Features
1	SpO2 measured value
2	Pulse rate value
3	Display screen
4	Temperature measured value
5	Backward Navigation Button.
6	Home Button
7	Main Menu Button
8	Perfusion index value
9	Respiratory rate Value
10	Battery icon
11	Plethysmograph

Rad G Pulse oximeter – System Settings

- Ensure date and time are set correctly (Press setting button to go to the main menu, device settings, localization to set time and date)
- Set Temperature into Celsius.(Press setting button, go to parameter settings then to temperature, tap additional settings then slide the button to Celsius.)

Rad G Pulse Oximeter – Parameter Settings

- Press the setting button to go to the main menu, press parameter settings.
- Press each of the vital sign icon this leads you to the corresponding ‘alarm’ icon. Press the alarm icon and ensure correct setting

Alarm limits:

- Oxygen saturation – 85% – 95% (no upper limit of baby off oxygen)
- Heart Rate – 90 – 180 beats/min
- Respiratory rate Max 69/min (no lower limit)
- Temperature 36 – 38.50C – ensure temperature reading is in Celsius

Rad G Pulse Oximeter – Alarms

Physiological Sp02 alarms

Options	Description	Alarm Priority
High Limit	High Limit is the upper threshold that triggers an alarm.	Medium
Low Limit	Low Limit is the lower threshold that triggers an alarm.	High
Rapid Desat	Sets the Rapid Desat limit threshold to the selected amount below the Low Alarm Limit. When an SpO_2 value falls below the Rapid Desat limit the audio and visual alarms are immediately triggered without respect to alarm delay.	NA
Alarm Delay	When an alarm condition is met, this feature delays the audible part of an alarm.	NA

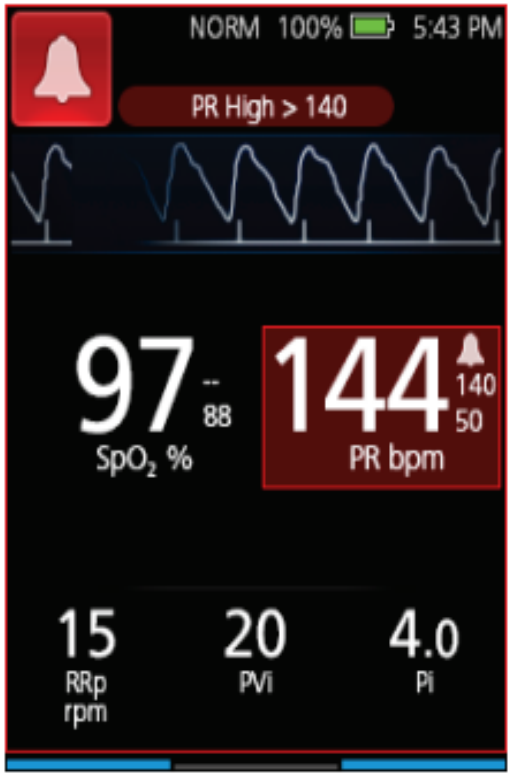
HR and RR alarms

Options	Description	Alarm Priority
High Limit	High Limit is the upper threshold that triggers an alarm.	High
Low Limit	Low Limit is the lower threshold that triggers an alarm.	High

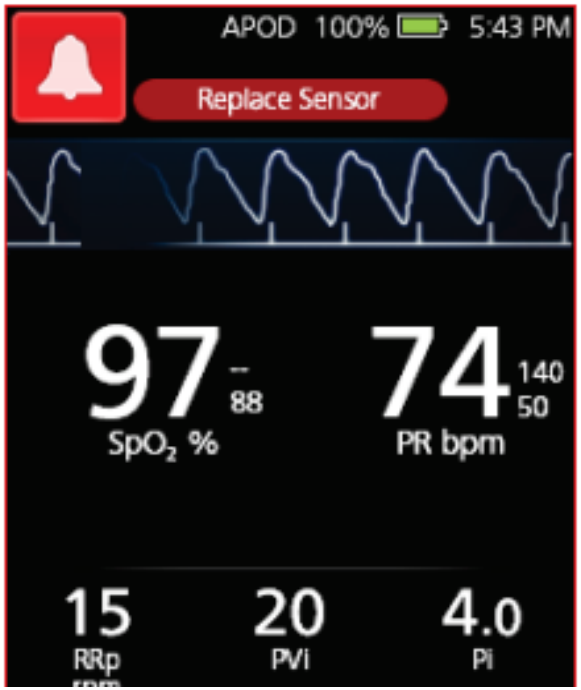
Rad G Pulse Oximeter – Alarms

Message	Potential Causes	Next Steps
No Sensor *No Cable*	• Sensor or cable is not fully inserted into the device. • An incorrect sensor or cable, defective sensor or cable used. • Sensor latch is not fully closed.	• Disconnect and reconnect sensor or cable. • See *Directions for Use* for sensor. • Close sensor latch.
Replace the Sensor	• Sensor is non-functional. • Defective sensor or cable.	Replace sensor.
Sensor Off	Sensor has been removed from patient during monitoring.	Place sensor on patient.
Low Battery	Battery charge is low.	Charge battery by powering the device with AC line power.
System Fault	Internal component failure.	Contact Masimo service. See

Rad G Pulse Oximeter – Alarms

Alarm Source/Example	Explanation
	**Parameter Level:** The example shown here is a PR alarm (PR High) as the reading exceeds the upper alarm limit. Note that the PR parameter as well as the Window are illuminated red, and the explanation of the alarm is shown at the top of the Window (PR High).

Rad G Pulse Oximeter – Alarms

Alarm Source/Example	Explanation
	**System Level:** The example shown here is a "Replace Sensor" alarm. Note that the border of the entire Rad-G display is illuminated, and the explanation of the alarm is shown ir the Status Bar (Replace Sensor).

Rad G Pulse Oximeter – Trouble Shooting

Device does not turn on	• **Battery power is too low, needs to be charged immediately.**
SpO_2 waveforms or values do not displayed on the screen	• Is the red light on the finger sensor flashing? If not, there might be poor contact. • Check the extension cable and the connector. Is the patient's arm under pressure? Never take blood pressure and SpO2 measurements on the same arm. • Is the environmental temperature too low? Never expose the patient's arm to cold air since this can affect readings. • Has all patient nail polish, especially blue or purple, been removed?
SpO_2 values turn on and off during SpO_2 monitoring	• During long term monitoring, patient movement might result in SpO2 interruptions. Keep the patient stabilized.

Rad G Pulse Oximeter – Cleaning

NB: DONT SOAK THE DEVICE

1. Turn off the monitor, disconnect the power cord and the SpO2 sensor probe.
2. Always wipe the pulse oximeter and its probe with 70% alcohol using gauze or cotton swab before first use and between patients.
3. Dry the device naturally in a ventilated cool environment
4. Clean the foam wrap by handwashing with soap and water then air dry.

Using a Pulse oximeter

- Observe hand hygiene
- Disinfect the clean external Y-sensor using 70% alcohol
- Check that you have a fully charged pulse oximeter and a disinfected external Y-sensor and a clean foam wrap.
- To connect the patient cable to the pulse oximeter, ensure that the grooves on the patient cable connector on the pulse oximeter are configured to those of blade of the external Y-sensor
- Connect the Y-sensor to the patient cable connector on the pulse oximeter. Push gently until you hear a click sound.
- Push down the latch on the Y-sensor to ensure this patient cable is securely attached to the patient cable connector.
- Press and hold the power button (for more than 2 seconds) until one audible tone sounds.
- Check for a red light on the emitter side Y-sensor.

Connect patient cable to patient cable connector of Rad-G pulse oximeter

Turn the Oximeter on by long pressing the power button

Check functionality of the device and sensor by red light on the sensor

Inserting the Y-sensor into the form wrap

- **Attach the Y-sensor to the form wrap**: Locate the sensor attachment holes on the wrap. Orient the wrap so that the patient contacting surface (blue) is on the top. Locate the emitter side of the Y-sensor (indicated by red mark on the cable).
- Push the button on the back of the Y-sensor emitter side into the hole on one end of the form wrap (with blue side facing you).
- Push the button on the back of the Y-sensor detector side into a hole on the form wrap. (Approximate the hole to use such that when the wrap is attached to the baby the emitter and the detector are directly opposite (aligned at approximately 180^0)

Using a Pulse oximeter

- Position the baby in a comfortable position on an area that avoids excessive lighting on the pulse oximeter
- Choose an assessment site/extremity which is warm, well perfused and with minimal movements. Usually the foot or the wrist
- Ensure the Y-sensor is attached correctly to the foam wrap depending on the selected assessment site/extremity.
- Clean the site with cotton wool soaked in 70% alcohol and let it dry
- Wrap and snuggly secure the form wrap on the assessment site. Ensure the emitter and the detector line up as shown below

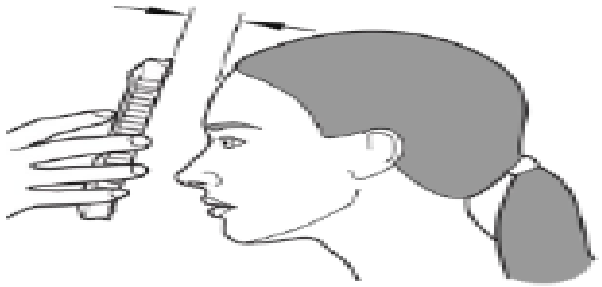
Using a Pulse oximeter

- Allow the baby's trace to establish
- Read the oxygen saturation, wave form, heart rate, respiratory rate, Perfusion Index (PI) (Ensure P.I is above 0.3 for reliable readings **ideally** above 1)
- Confirm that the device is reading accurately by manually assessing the pulse rate and comparing it with what is displayed on the pulse oximeter
- If the oxygen saturation (SpO2) is less than 90%, initiate oxygen therapy
- Ensure the Y Sensor attachment site is changed every 3 hours for skin integrity during continuous monitoring.
- Document all assessments and interventions in the baby's comprehensive newborn monitoring chart.
- Clean the Y sensor with 70% alcohol before attaching it to another patient.

EIAIT
Emergency Triage Assessment and Treatment plus admission

Taking Temperature Measurements

- Select a site at the center of the forehead
- Locate and hold the Rad-G parallel to the skin surface with the temperature sensor aligned with the center of the forehead. Maintain approx. 1.5" to 2" (3.8 to 5 cm/ 2 finger breaths) away from the skin surface.
- Tap the Temperature icon on the display. Hold the Rad-G steady until a beep is heard and the value displays on the screen
- If the temperature is suspected to be incorrect, repeat if still out range use digital thermometer



Limitations a of Pulse Oximeter

1. In CO poisoning it may show high oxygen saturation when this is not the case.
2. Inaccurate readings in low perfusion states:
   - Low cardiac output-shock
   - Vasoconstriction
   - Hypothermia

Management of Hypoxemia

Approach to managing Hypoxaemia

Definitive Treatment

- Supplemental O_2 does not treat the underlying infection.
- Diagnose and treat the underlying condition as a matter of urgency.

Monitor clinical status

- Monitor worsening of clinical status i.e. Work of breathing
- Monitoring oxygen therapy – pulse oximeter

When hypoxemia or significant hypoventilation persists despite interventions, other methods like CPAP are indicated.

Oxygen Therapy

Indications

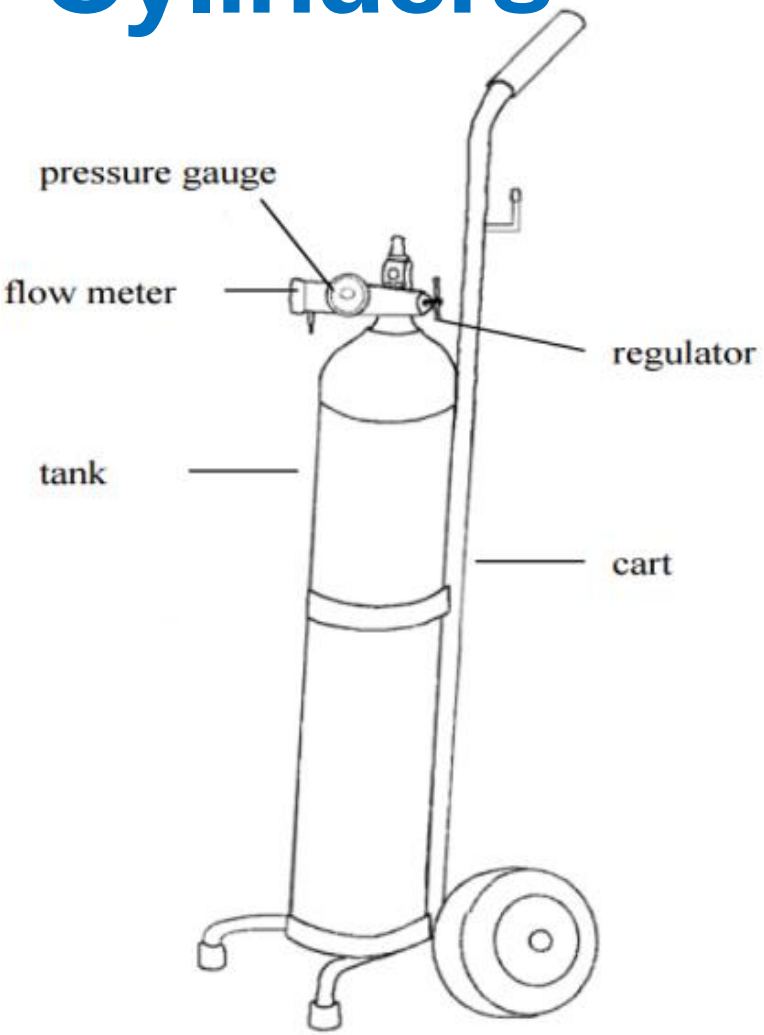
- SpO_2 <90% measured using pulse oximeter
- Clinical signs that may indicate need for oxygen include - severe lower chest wall indrawing, nasal flaring, expiratory grunting, cyanosis, tachycardia, tachypnea

Goals

- Provide O_2 at accurate and safe levels with the lowest possible FiO_2.
- Achieve target adequate oxygenation SpO_2 90-95%

Oxygen Delivery Methods

Oxygen Sources – Oxygen Cylinders



PS:

- Have 2 at all times
- Secure on a trolley
- Keep away from flames

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Sources – Central Piped Oxygen

PS:

- Differentiate piped oxygen and medical air
- Clean the attachment valves daily

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Sources – Oxygen Concentrators

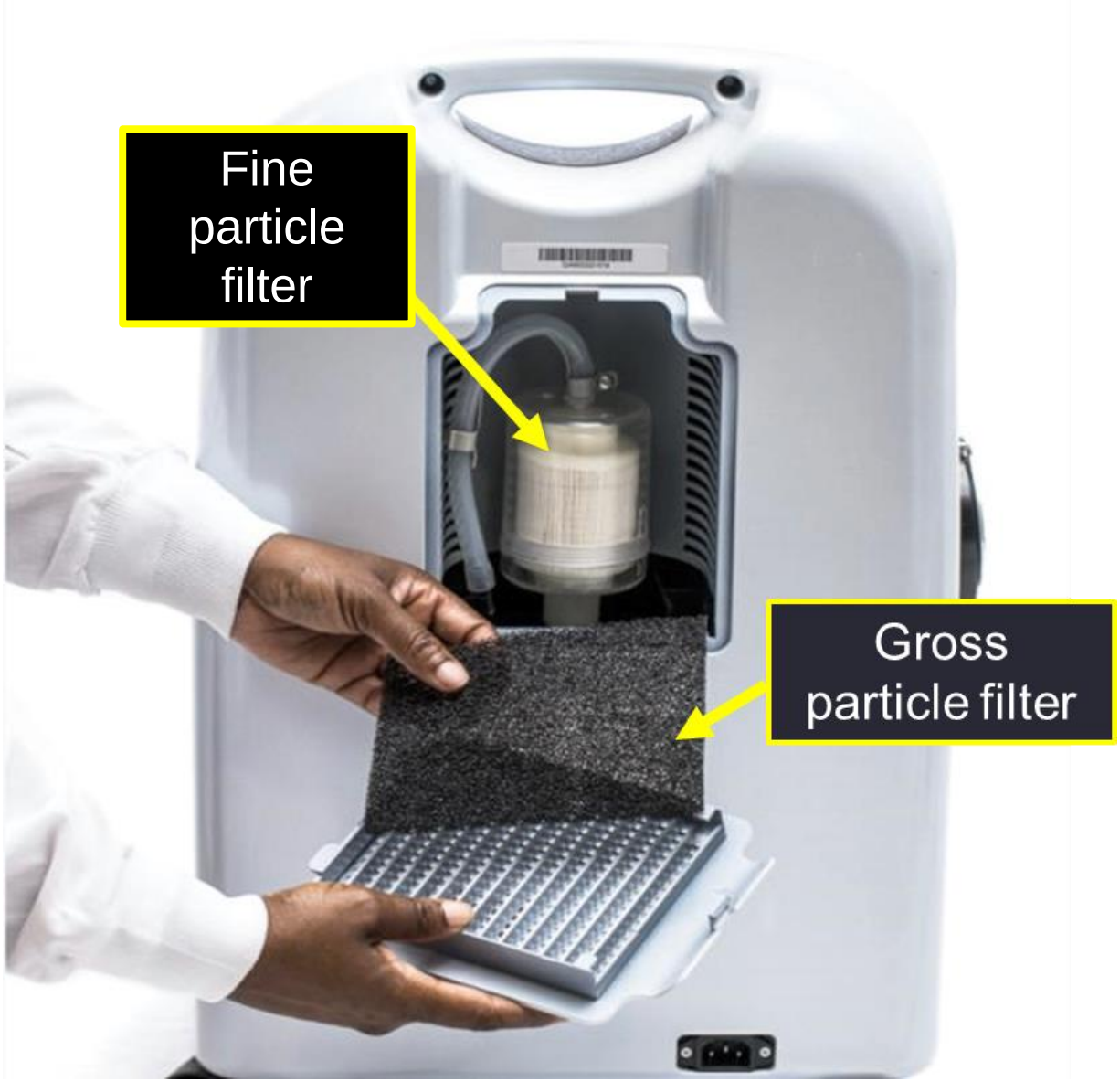
WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Parts the concentrator (Front)

Humidification Bottle

saving children's lives
ETAT+
Emergency Triage Assessement and Treatment plus admission

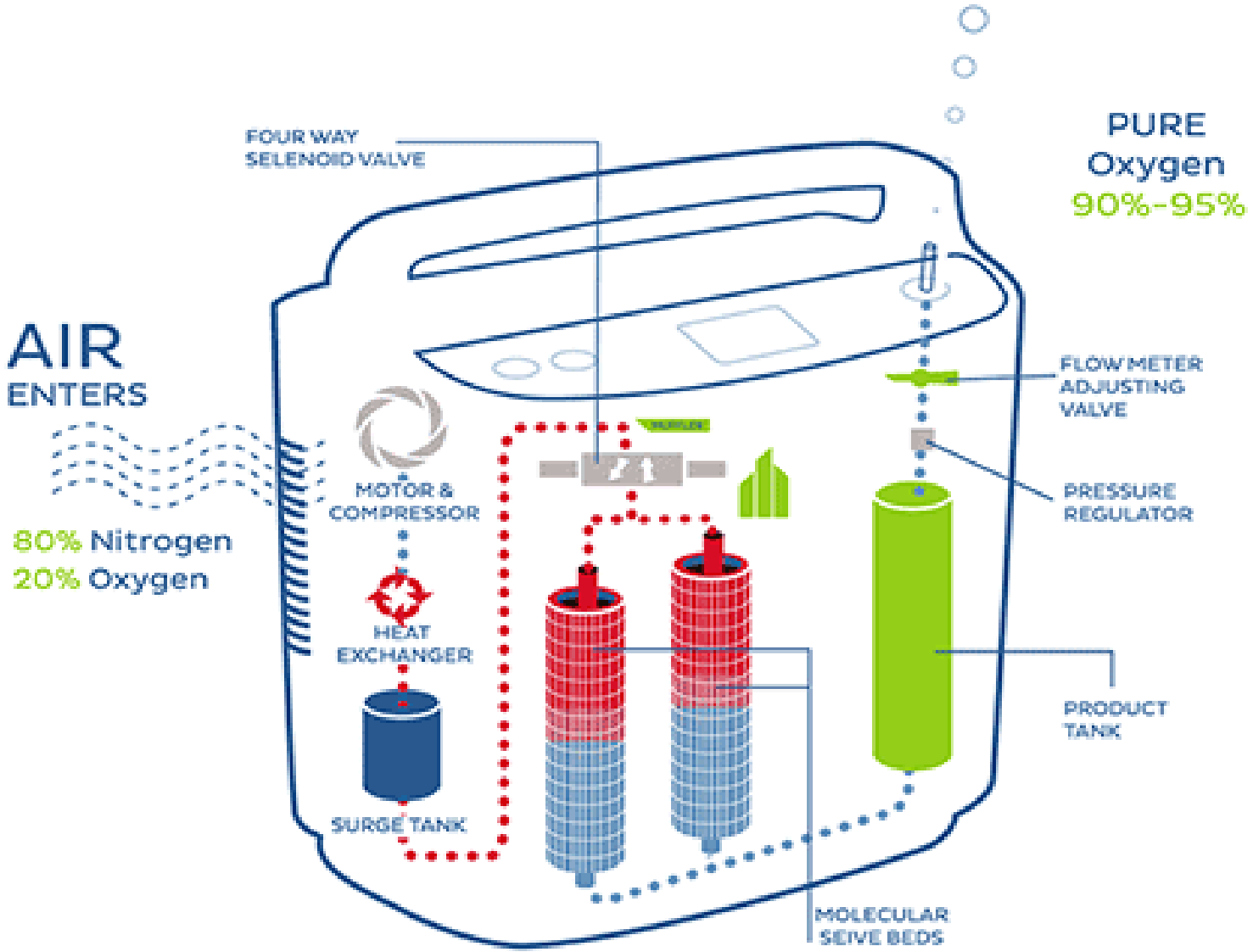
Parts the concentrator (Back)



PS:

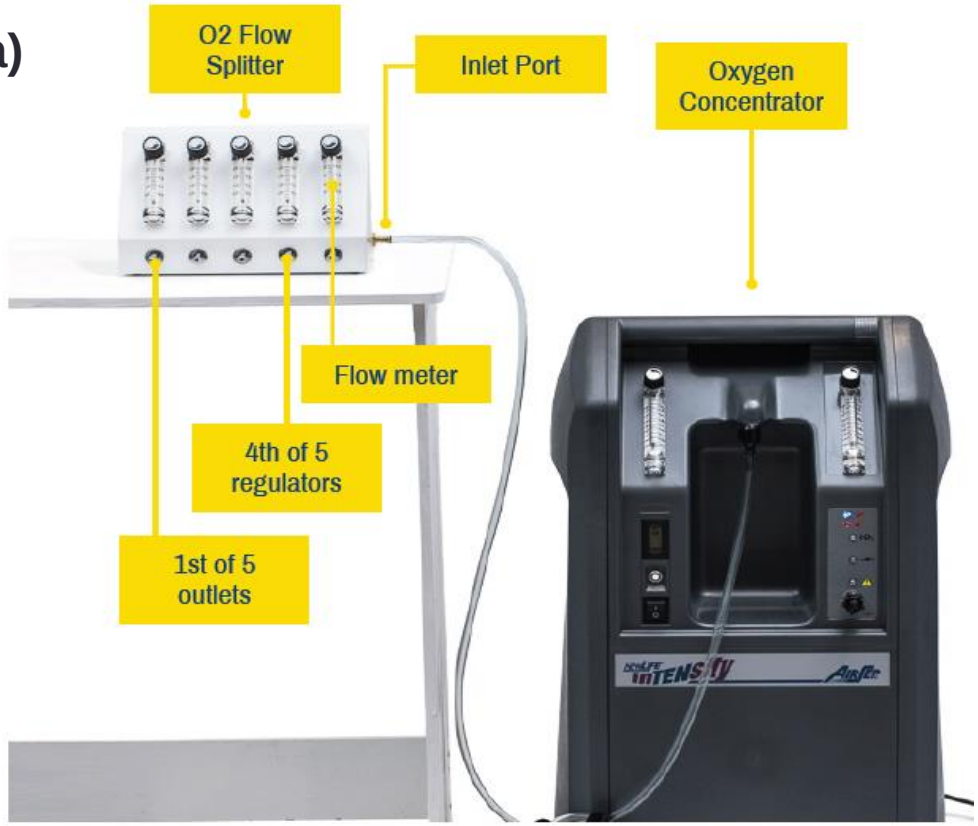
- Clean gross particle filter every week with soap and water
- Change fine particle filter with color changes
- Clean whole machine with 70% alcohol/chlorine base solution
- Analyze oxygen concentration every 3 months or if it breaks down

How the concentrator works



Oxygen Sources – Flow Splitter

a)



b)

c)

PS:

- Used to deliver independently controlled oxygen to multiple patients
- When you alter one valve flow, check that you adjusted the right valve for the intended child and ensure other valves remain as set.
- Read the flowmeter at eye level either above, middle or bottom of the ball based on manufacturer's recommendations

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Preparing the concentrator for use

1. Perform hand hygiene.
2. Place the concentrator at **least 30cm from the wall**
3. Oxygen concentrators should be located near oxygen splitters
4. Plug concentrator into a power source and turn on.
5. Allow to run for **5 minutes** OR until the indicator light shows appropriate concentrations of oxygen are reached.

a)

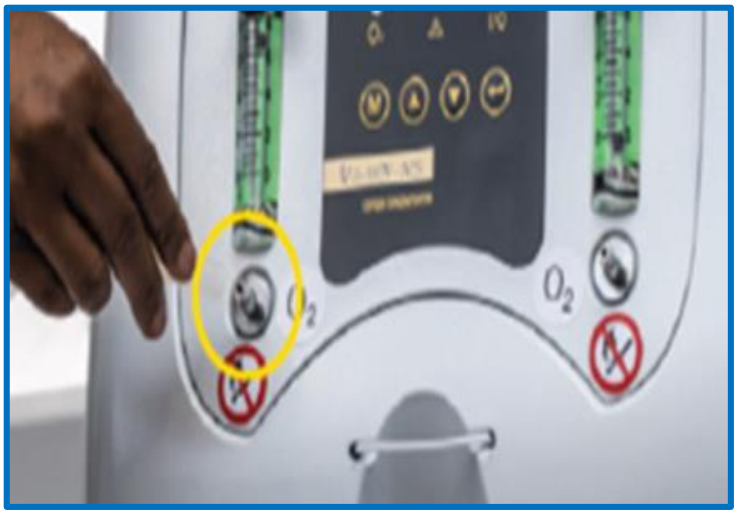
b)

Preparing the concentrator for use

6. Connect the humidifier and its tubings if needed.
7. Connect correctly sized oxygen nasal prongs/catheter or non-rebreather mask to the oxygen port as shown in figure b

a)

b)

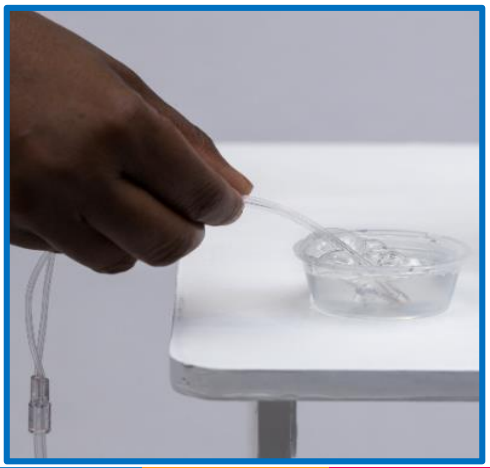


Preparing the concentrator for use

6. Open the oxygen flowmeter in use to the desired flow rate - Read the flow rate in the middle of the ball in the flowmeter as shown in figure a
7. Confirm oxygen is flowing through the method of delivery chosen. For nasal prongs and catheters, place fingers near the openings of nasal prongs/catheter to ensure that oxygen is flowing or bubble through water.

a)

b)



Oxygen Delivery Methods

Nasal Prongs

Proper Use

- Ensure airway is clear – suction if necessary, position (wear N95 mask)
- Instill 2 drops of normal saline into nostrils before inserting the prongs
- Place prongs 2mm from nasal septum
- Secure on both cheeks with transpore adhesive, run the tubing to the back
- Adjust flow rate

Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

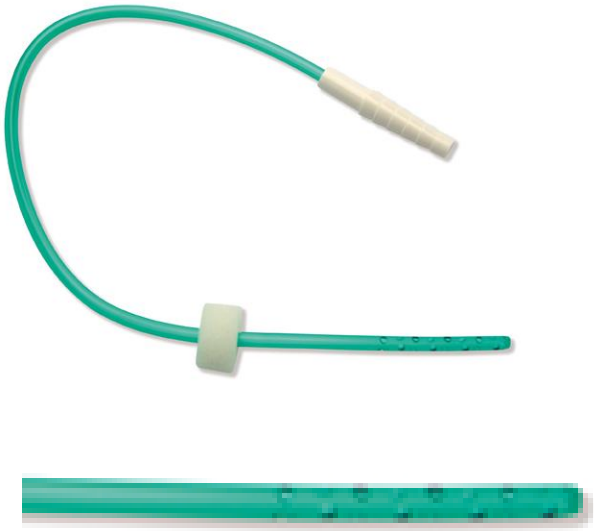
Flow Rates – Nasal Prongs

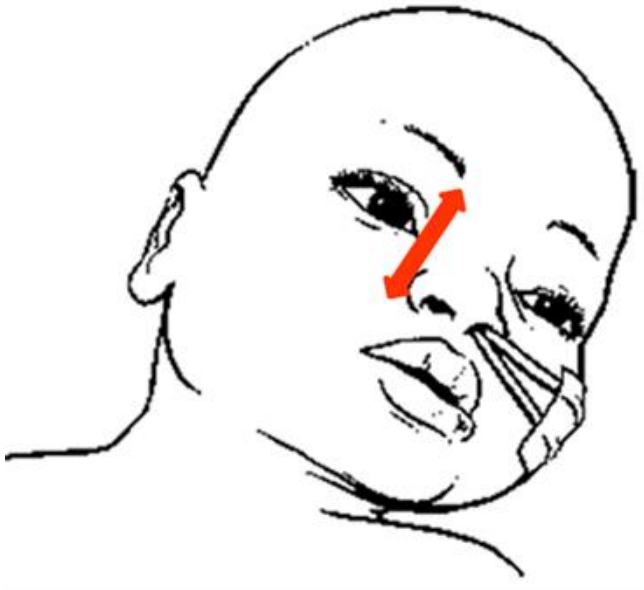
Flow Rate	Age Group	Volume	FIO_2
Standard	Preterm	0.5L/min	30 - 35%
	Term	1L/min	30 -35%
High	Preterm	1L/min	45 - 55%
	Term	2L/min	45 - 55%

Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Delivery Methods

Nasal Catheter



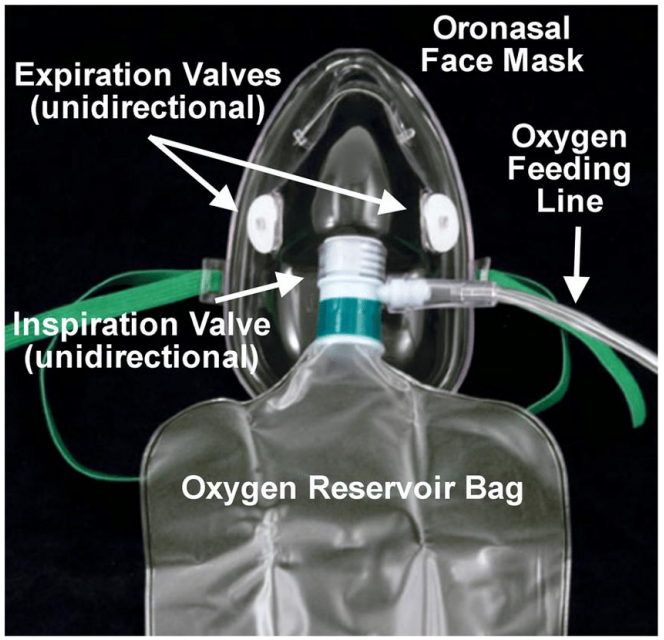


Proper Use

- Ensure airway is clear – suction if necessary, position (wear N95 mask)
- Correct placement sizing – side of the nose to the inner margin of the eyebrow
- Insert appropriately sized nasal gastric (NG) tube if giving high flow rates
- Adjust flow rate as for nasal prongs

Oxygen Delivery Methods

Oxygen Face Mask with a reservoir (Non Rebreather Mask)



Proper Use

- Mostly used post resuscitation
- Ensure airway is clear – suction if necessary, position (wear N95 mask)
- Ensure the reservoir is filled with oxygen before placing mask on the child
- Ensure correct size of mask: covers nose and mouth
- Adjust flow rate to 10 - 15L/min to achieve target SpO_2

Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Humidification

Reduce dryness of O_2 from a source by bubbling it through water.

Indications

- High flow rates of 1L/min with nasal catheters/nasal prongs for preterm babies
- High flow rates of 2L/min with nasal catheters/nasal prongs for term babies
- Use of Non Rebreather Mask (10 – 15L/min)

- Use clear distilled water ONLY
- Change the water daily-Reduces risk of bacterial contamination

WHO oxygen therapy for children 2016 ; https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen blending

- Refers to the combination of pure oxygen with room air to regulate the concentration of oxygen delivered.

- Helps to reduce the risk of complications from exposure to excessive amounts of oxygen

- Even relatively low flow rates of pure oxygen can lead to hyperoxic lung injury among other complications.

Premature babies are especially vulnerable!

Vayu oxygen blender system

Precisely blends air and oxygen to an adjustable concentration.

The system requires an external medical-grade oxygen source with an adjustable flow meter on the outlet.

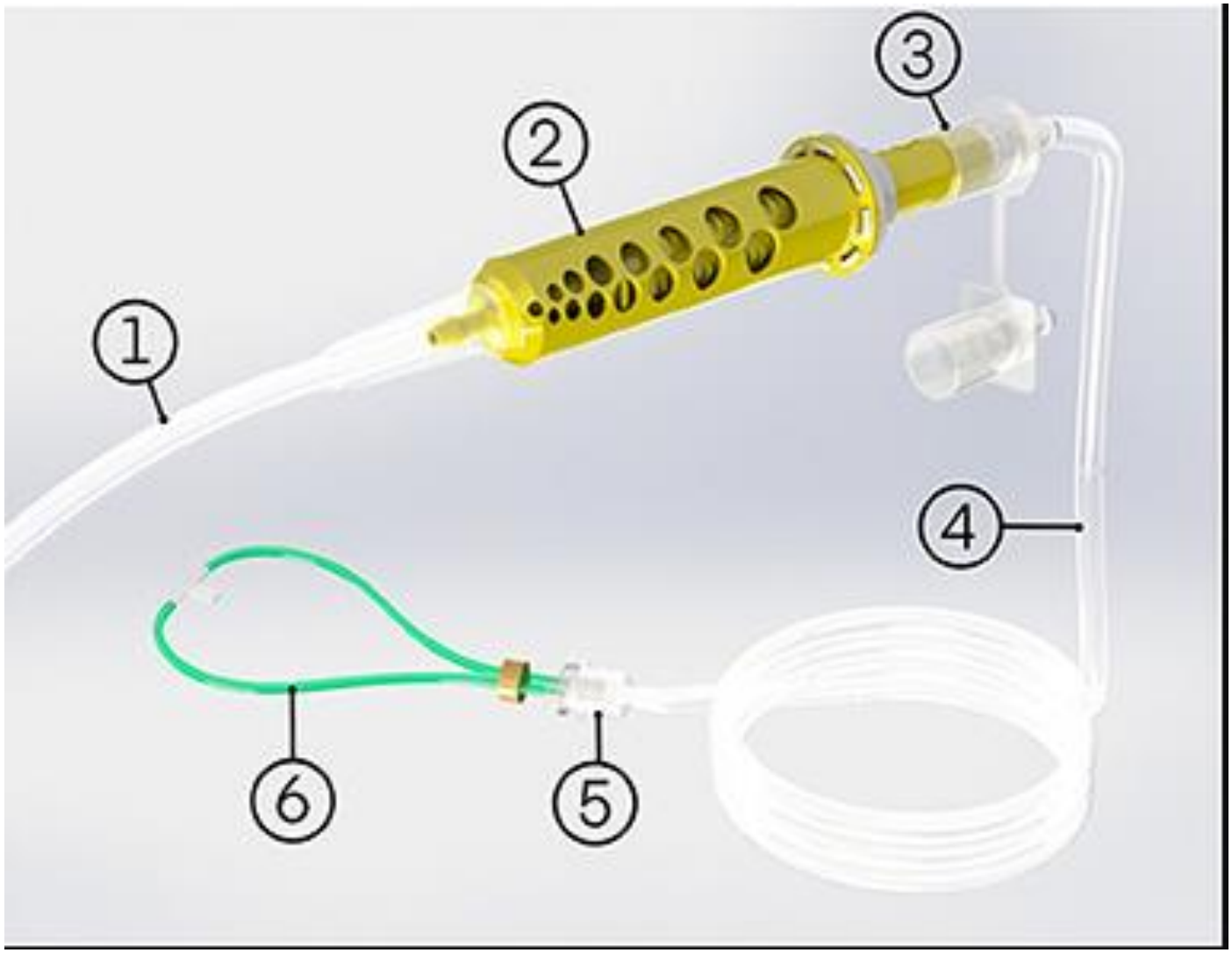
The Vayu oxygen blender system delivers

- Blended air/oxygen flowrate: 0.5 – 4.0 LPM
- Percentage of oxygen offered: 30 – 100 %

Includes multiple nasal prong sizes for patients up to 5 years old.

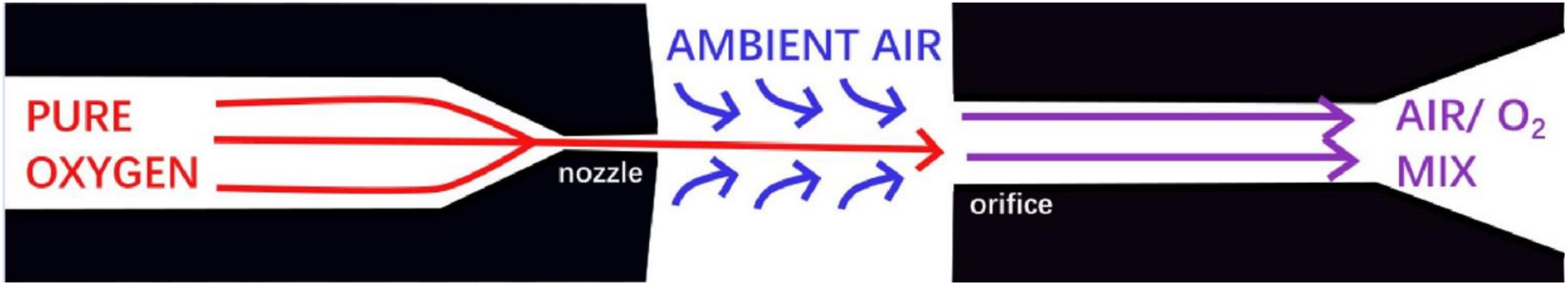
Approved by Kenya PPB.

Vayu oxygen blender system Parts



1. Oxygen tubing
2. Oxygen blender
3. Rotator cuff
4. Patient tubing
5. Cannula adapter
6. Nasal cannula

Device Walkthrough



No electricity? Compressed Air? Why?
Venturi Effect…

- High-speed jet of pure oxygen crosses nozzle
- Pulls in ambient air (21% O_2) due to a pressure differential in chapter
- Provider able to deliver oxygen at an adjustable concentration (30% → 100%)

Circuit setup

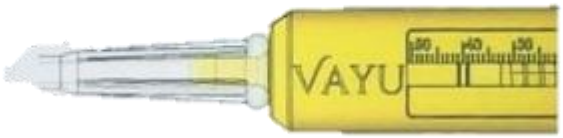
1. 

If your oxygen flow meter has a DISS connection with a humidifier attached to it, unscrew the humidifier and place it aside. Screw on the included oxygen source adapter

2. 

Push the oxygen tubing onto the oxygen source adapter.

If using an oxygen tank, monitor the pressure in the tank and replace it when internal pressure drops below 200 psi

3. 

Connect the other end of the oxygen tubing to the small end of the blender

Circuit setup

4. 

Connect the large end of the rotator to the large end of the blender.

5. 

Connect one end of the patient tubing to the small end of the rotator.

6. 

Connect the other end of the patient tube to the barbed end of the cannula adapter.

Circuit setup

7.

Choose which nasal cannula to use. Note that the green cannula is slightly larger than the white cannula.

Connect the cannula adapter to the chose nasal cannula

Nasal prongs should NOT completely fill the nares. Do not use if the nasal prongs occlude >50% of the nares.

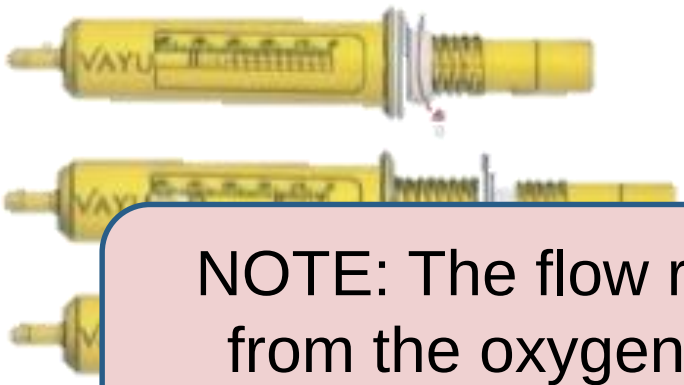
Patient preparation

Hand hygiene
Family centred care

Elevate the head of the bed or place a rolled cotton towel under the patient's neck/ shoulders to align the neck in a sniffing position to maintain an open airway

Ensure the patient has a clear airway by gently suctioning the mouth and the nose as needed.

Patient application



Set the blender and the oxygen flow rate

- Determine what % O2 and flow rate to deliver to the patient
- Consult the chart below to see what number (in mm) to set the blender to

NOTE: The flow rate at the patients nares is different from the oxygen flow rate set at the source. This is because the blender adds ambient air to the oxygen

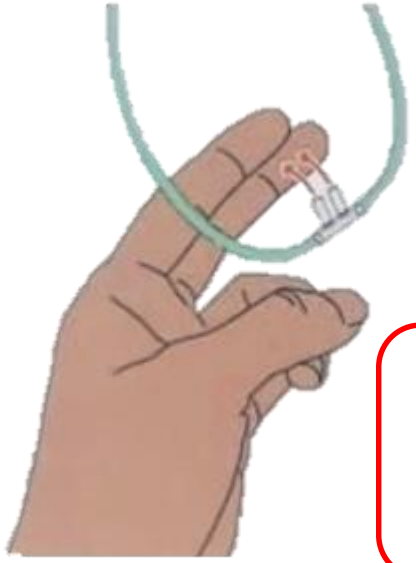
by the chart

Blender setting

Oxygen flow rate

Flow at the patient's nares (LPM)	% Oxygen							
	30%	40%	50%	60%	70%	80%	90%	100%
0.5	0 mm 0.75 LPM	4 mm 0.75 LPM	8 mm 0.75 LPM	15 mm 0.75 LPM	17 mm 0.75 LPM	21 mm 0.75 LPM	28 mm 0.75 LPM	50 mm 0.5 LPM
1	0 mm 1.0 LPM	4 mm 0.75 LPM	8 mm 0.75 LPM	14 mm 0.75 LPM	0.75 LPM	31 mm 1.0 LPM	35 mm 1.0 LPM	50 mm 1.25 LPM
2	0 mm 1.75 LPM	9 mm 1.25 LPM	15 mm 1.25 LPM	27 mm 1.5 LPM	30 mm 1.5 LPM	35 mm 2.0 LPM	39 mm 2.0 LPM	50 mm 2.5 LPM
3	0 mm 2.25 LPM	10 mm 1.75 LPM	16 mm 1.75 LPM	28 mm 2.0 LPM	31 mm 2.25 LPM	36 mm 2.75 LPM	40 mm 3.25 LPM	50 mm 3.75 LPM
4	0 mm 3.0 LPM	11 mm 2.0 LPM	16 mm 2.0 LPM	29 mm 2.5 LPM	32 mm 3.25 LPM	37 mm 3.75 LPM	40 mm 4.5 LPM	50 mm 5.0 LPM

Patient application



Check for airflow from the nasal prongs by wetting a fingertip and placing near the prongs.

Do not touch the nasal prongs when checking for flow to avoid contaminating the prongs!

Using an appropriate skin safe tape, gently press one strip of tape onto each cheek. This is the base layer of tape.

Patient application

Insert prongs into the patients nares so they curve downwards into the nasal passages.

NB: Leave a small gap between patient's septum and base of prongs

Always begin gas flow prior to inserting prongs into patients nares

Using smaller strips of tape, secure the cannula to the patient's cheeks by taping it to the base layer of tape. If the cannula needs to be adjusted, adjust the top layer of tape.

Monitoring

The patient should be closely monitored for the entirety of therapy

- Pulse oximetry to maintain target SPO2 and titrate every 15 to 30 min
- Suction patients nares and mouth as needed
- Check for proper positioning
- Ensure to check for development of nasal trauma due to the prongs.

Troubleshooting

Problem	Possible cause	Solution
When checking for flow before patient application, there is no flow at the nasal cannula	Potential blockage or leak in the circuit	Tighten all connections – including blender lock and tubing connections
		Check tubing and resolve any blockages or kinks
	Problem with oxygen source	Check that your O2 source is compatible with the Vayu oxygen
		Refill tank if out of oxygen
The patient does not settle	Excess secretions	Suction of the patient's nares and mouth
	General discomfort	Try repositioning the patient, checking temperature and time of the last feed

Monitoring Oxygen Therapy

Continuous oxygen monitoring		Intermittent oxygen monitoring
Oxygen saturations are monitored continuously using pulse oximetry	VS	Oxygen saturations are monitored at specific intervals (Eg 4 hourly)

- Current guidelines recommend **continuous monitoring** of oxygen saturation trends, in combination with other vital sign parameters

- Has been shown to predict short-term clinical deterioration as well as long-term outcomes such as BPD

*Kumar, N., Akangire, G., Sullivan, B. et al. Continuous vital sign analysis for predicting and preventing neonatal diseases in the twenty-first century: big data to the forefront. Pediatr Res **87**, 210–220 (2020). https://doi.org/10.1038/s41390-019-0527-0*

Advantages of Continuous Monitoring of Oxygen Therapy

1. Allows continuous assessment of both hypoxemia and hyperoxemia

2. Improves clinician's ability to maintain preterm neonates in a target range (90 – 95%)

3. Early recognition of patient deterioration - has been shown to predict short-term clinical deteriorationas well as long-term outcomes such as BPD

4. Improved patient outcomes
   - ✓ Decreased severity of ROP/BPD
   - ✓ Improved neurological outcomes
   - ✓ Improved growth and development

*Kumar, N., Akangire, G., Sullivan, B. et al. Continuous vital sign analysis for predicting and preventing neonatal diseases in the twenty-first century: big data to the forefront. Pediatr Res **87**, 210–220 (2020). https://doi.org/10.1038/s41390-019-0527-0*

Monitoring Oxygen Therapy

[HOSPITAL NAME]

COMPREHENSIVE NEWBORN MONITORING CHART

Version 2.6

Name	IP NO	Sex M ☐ F ☐	D.O.A / D.O.B
Date today	Diagnosis		
Birth Wt gm	*Interventions: CPAP ☐ Oxygen ☐ Phototherapy ☐ Blood tranfusion ☐ Exchange transfusion ☐ KMC ☐*		

Daily Clinician Feed and Fluid prescription

Day of Life	Current Wt = gm
Total input(feed and fluid) 24hrs =	ml

Feed: BF ☐ EBM ☐ Term Formula ☐ Pre-Term Formula ☐

Route: Cup☐ NGT☐ OGT☐

Volume & Frequency = _____ml 3hrly ☐ 2hrly ☐

Total 24hr Volume = _____ml

IV Fluid & Additives	Vol (ml)	Duration

Other prescribing instructions

Clinician's name Time:

Daily IV Fluid Nursing plan

Start time:

Hourly rate= _____ ml (____ drops/min)

Planned vol = _____ ml in_____ hrs

	Monitoring Freq___hrs | Time												
Vitals	Temp (^{0}C)												
	Pulse (b/min)												
	Resp Rate (b/min)												
	Oxy Sat (%) or Cy^0 Cy$^+$												
Assessment	Resp Distress 0,+,+++												
	CPAP Pressure (cm H_2O)												
	FiO_2 (%)												
	Jaundice 0,+,+++												
	Apnoea Y/N												
	Blood Sugar (mmol/l)												
	Completed by (name)												
Feed	Breastfeeding sufficient Y/N												
	EBM vol given (ml)												
	Formula vol given (ml)												
Fluid	IV volume given												
	IV Line working Y/N												
Output	Vomit Y/N												
	Urine(diapers changed)												
	Stool Y/N												
	Completed by (name)												

Morning shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Deficit_____ m

Afternoon shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Deficit_____ m

Night shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Total feed+fluid in 24hrs_____ ml
Deficit_____ ml

Jaundice 0 none, +mild(face),+++severe(feet)

Tick the category of baby after assessment

Alerts : circle readings outside normal range with red pen and action

Monitoring Oxygen Therapy

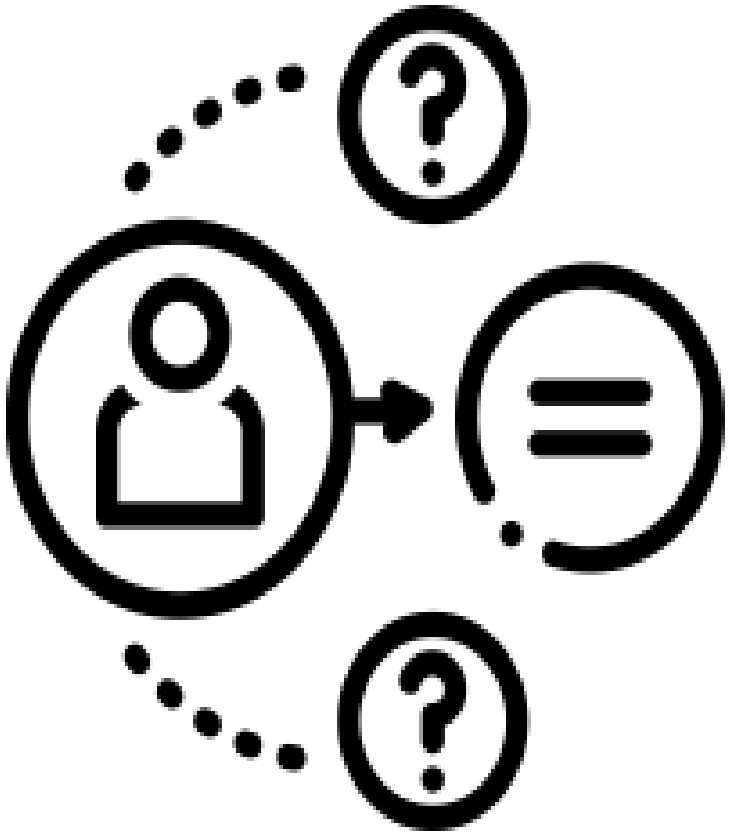
Titrating & Stopping Oxygen

- When Oxygen is started, titrate every 15-30mins by 0.5L/min until SpO_2 is 90-95%
- If baby requires more than the high flow rate oxygen (preterm 1 L/min & term baby 2L/min), consider changing treatment to CPAP
- Stop titrating and begin close monitoring if the baby is clinically stable - no increased work of breathing, SpO_2 between 90 – 95% and no increase in work of breathing

Titrating & Stopping Oxygen

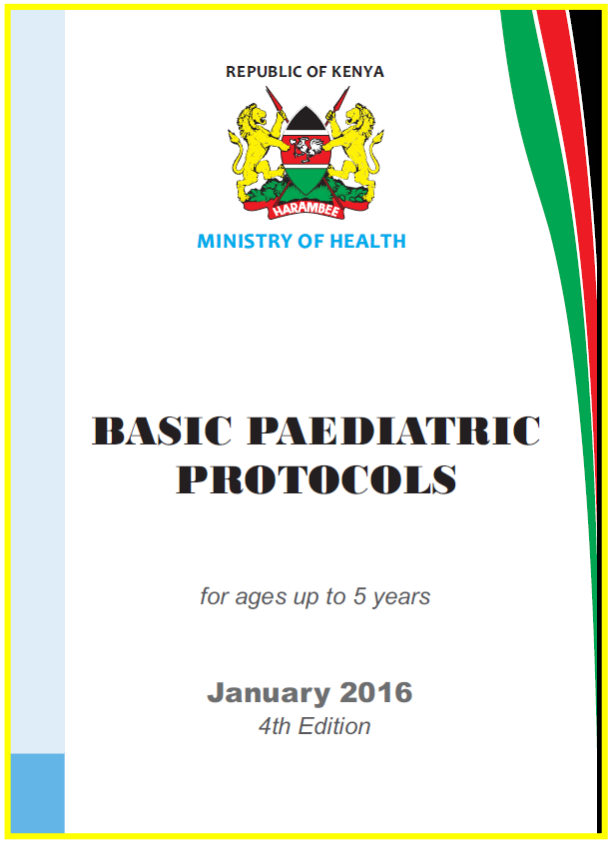
- Wean off oxygen every **15 –30 min** and carefully examine for changes in WoB and SpO_2 to assess whether supplemental oxygen is still required.
- Once oxygen is stopped, recheck SpO_2 after 1h, as late desaturation can sometimes occur.
- Discharge only if newborn has been stable with **SpO_2 ≥ 90% and no increased WoB** on room air for at **least 24hrs**

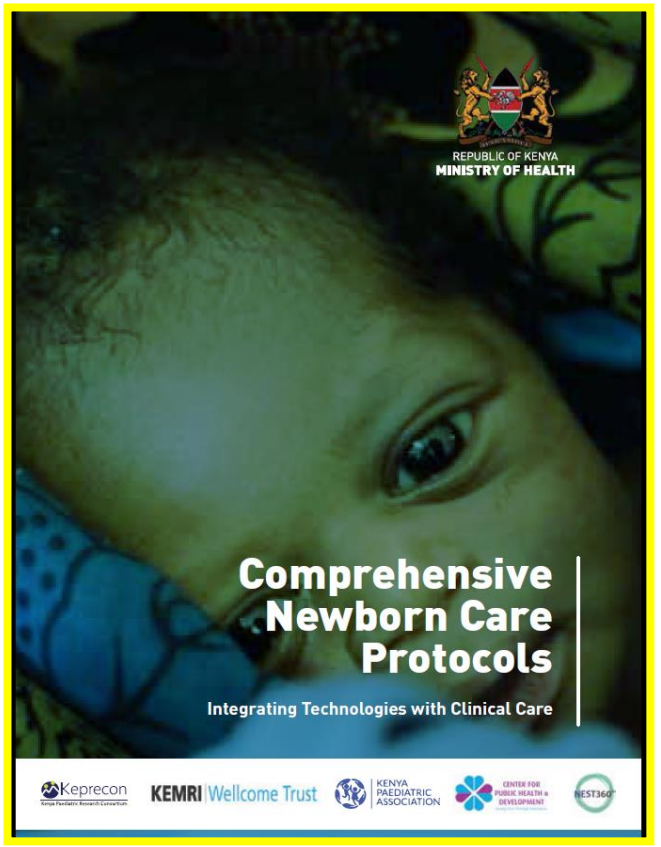
Hypoxemia not responding to Increasing oxygen concentration

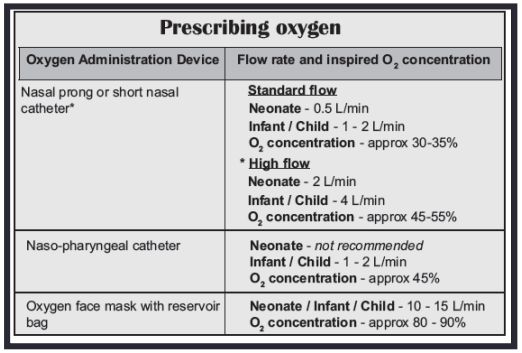


- If respiratory distress persists even after administration of oxygen, it might mean that some of the alveoli are collapsed
- Mechanical ventilation or CPAP may be needed to give pressure to open up the collapsed alveoli

Guidelines

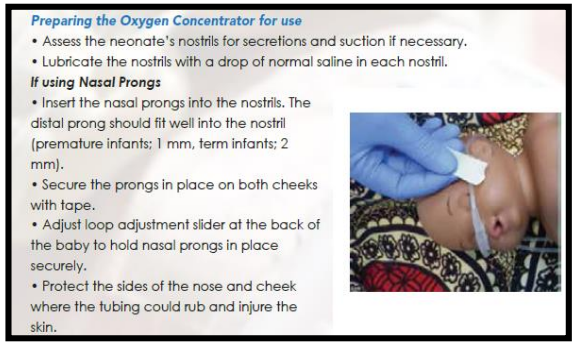






Prescribing oxygen

Oxygen Administration Device	Flow rate and inspired O_2 concentration
Nasal prong or short nasal catheter*	**Standard flow** **Neonate** - 0.5 L/min **Infant / Child** - 1 - 2 L/min **O_2 concentration** - approx 30-35% * **High flow** **Neonate** - 2 L/min **Infant / Child** - 4 L/min **O_2 concentration** - approx 45-55%
Naso-pharyngeal catheter	**Neonate** - *not recommended* **Infant / Child** - 1 - 2 L/min **O_2 concentration** - approx 45%
Oxygen face mask with reservoir bag	**Neonate / Infant / Child** - 10 - 15 L/min **O_2 concentration** - approx 80 - 90%

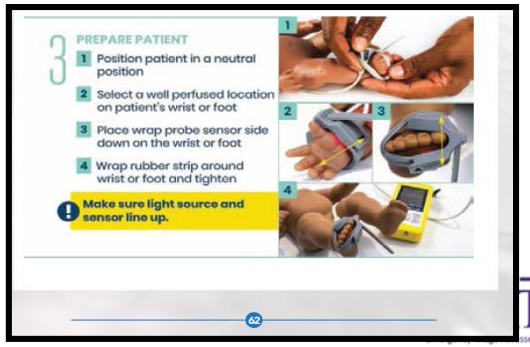


Preparing the Oxygen Concentrator for use

- Assess the neonate's nostrils for secretions and suction if necessary.
- Lubricate the nostrils with a drop of normal saline in each nostril.

If using Nasal Prongs

- Insert the nasal prongs into the nostrils. The distal prong should fit well into the nostril (premature infants; 1 mm, term infants; 2 mm).
- Secure the prongs in place on both cheeks with tape.
- Adjust loop adjustment slider at the back of the baby to hold nasal prongs in place securely.
- Protect the sides of the nose and cheek where the tubing could rub and injure the skin.

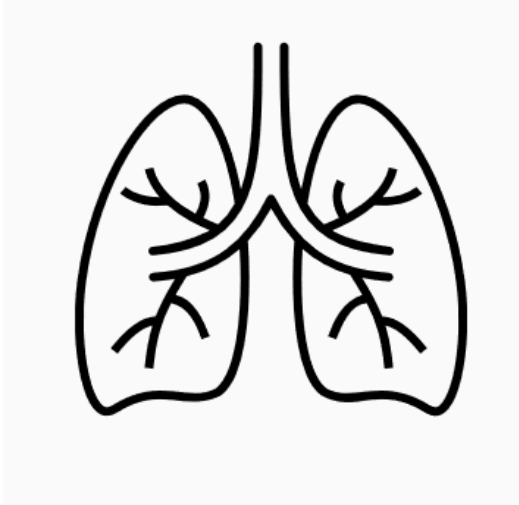


Complications of Oxygen Therapy

Complications of oxygen therapy

a) O_2 toxicity (Hyperoxia, overdose >95%)

Peripheral Vessels constrict reducing blood supply to the organs



- Can cause chest pain and irritation of the airway.
- In the long term can cause lung stiffness (fibrosis)

Helmerhorst, H.J.F., Schultz, M.J., van der Voort, P.H.J. et al. Bench-to-bedside review: the effects of hyperoxia during critical illness. Crit Care **19,** 284 (2015). https://doi.org/10.1186/s13054-015-0996-4

Complications of oxygen therapy

a) O_2 toxicity (Hyperoxia, overdose >95%)

In the CNS, produces toxic substances that destroy nerves making the patient present with convulsions

Associated with Retinopathy of prematurity (RoP)

Helmerhorst, H.J.F., Schultz, M.J., van der Voort, P.H.J. et al. Bench-to-bedside review: the effects of hyperoxia during critical illness. Crit Care **19,** 284 (2015). https://doi.org/10.1186/s13054-015-0996-4

Complications of oxygen therapy

b) Hypoxia (Under dose <90%)

Makes all cells in the body function abnormally leading to organ failure and death

Makes the vessels in the lungs constrict and if they constrict for long this can cause high pressure in the lungs (pulmonary hypertension)

Helmerhorst, H.J.F., Schultz, M.J., van der Voort, P.H.J. et al. Bench-to-bedside review: the effects of hyperoxia during critical illness. Crit Care **19,** 284 (2015). https://doi.org/10.1186/s13054-015-0996-4

Questions

Summary

1. Use of clinical signs should be augmented by use of objective measures e.g. by use of pulse oximeters
2. Oxygen is a medicine, therefore it should be measured, given at the right dose and only when indicated.
3. Correctly identify and administer oxygen to patients who need oxygen