OXYGEN THERAPY AND DELIVERY DEVICES

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- This policy is for standard oxygen delivery devices and does not refer to humidified oxygen delivery.
- Supplemental oxygen may be required for one or more of the following:
  - Acute or emergency situation if the child is in respiratory distress.
  - Acute and chronic hypoxaemia.
  - Hypoxia
  - If indicated post-surgical/anaesthetic procedure
  - Palliative care
- It is important to select the appropriate device for delivery of oxygen.
- Oxygen can have adverse events related to high doses and prolonged use, so needs to be prescribed and administered with care.
- Providing supplemental oxygen may cause hypoventilation (increased carbon dioxide levels) or apnoea in infants and children. Oxygen is a potentially hazardous substance.
- Oxygen should be used with correct regulator and pressure gauge.

Other Relevant policies:

- SCHN Pulse Oximetry Practice Guideline
- **At CHW:**
  - Humidified High Flow Nasal Prong Oxygen: Administration in Wards & ED – CHW Practice Guideline.
  - **For Neonates:** Respiratory Support in Grace Centre for Newborn Care - CHW Practice Guideline
- **At SCH:** Humidified Low Flow Oxygen on the Ward – SCH Practice Guideline

Approved by:	SCHN Policy, Procedure and Guideline Committee	
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Team Leader:	CNE [at CHW] and CNC [at SCH]	**Area/Dept:** Respiratory Medicine CHW & SCH

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CHANGE SUMMARY

- New SCHN guideline; SCH and CHW guidelines have been rescinded.
- Changes to practice: Partial re- breather bags and head boxes are redundant equipment
- Introduction of Standard Paediatric Observation chart

READ ACKNOWLEDGEMENT

- All clinical staff using oxygen therapy devices are to read and acknowledge they understand the contents of this guideline.

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1 Overview of Supplemental Oxygen

- Supplemental oxygen is the most common drug prescribed in hospitals.
- Supplemental oxygen is provided to correct or prevent hypoxemia and hypoxia which can occur as a result of cardiovascular, metabolic, neurological or respiratory dysfunction[2].
- Supplemental oxygen is generally set to maintain oxygen saturation over 95%, unless an altered calling criterion is documented on the patients SPOC chart.
- As oxygen is a drug, it is to be prescribed by a medical officer who determines the device and length of time that it is to be administered.
- Target range – minimum and maximum oxygen saturation values (Spo_2) to be documented in patient notes
- Oxygen therapy may be administered by a nurse when deemed necessary, however the relevant Medical Officer should be notified

1.1 Indications for Oxygen Therapy

- Respiratory distress
- If indicated post-surgical/anaesthetic procedure
- Hypoxia
- Acute and chronic hypoxaemia

2 Observations of the patient receiving oxygen therapy

- Record on child's SPOC chart:
  - **Continuous** - pulse oximetry
  - **Hourly**
    - pulse
    - respiratory rate
    - respiratory effort
    - oxygen flow rate
    - oxygen saturations
    - capillary refill time

3 Documentation

Document in child's progress/clinical notes:

- Work of breathing
- The administration of oxygen
- The method (device) of oxygen delivery and the flow rate (or % oxygen concentration)
- Assess and evaluate the child's response to the delivery of oxygen.

4 Clinical Bedside Handover

All oxygen delivery systems (including tubing and gas connection) are checked by **TWO** staff members and the status documented at **EVERY SHIFT** change. This includes correct tubing is connected to the correct flow meter (either oxygen or air) and the set flow is correct. The delivery system needs to be checked minimum one hourly.

Equipment checks

- Care must be taken that all connections are secure and are tight, otherwise a reduced volume or concentration will be administered.
- Check the oxygen is flowing through the flow meter by turning the oxygen supply on and placing finger at the outlet to feel flow.
- Flow meters must be vertical to be read accurately.
- Each meter is read differently. Refer to the meter in use to determine if reading should be taken from the middle or top of the ball.
- Check tubing is not twisted, kinked or blocked in some way and is connected securely. Ensure the mouth or nose is not obstructed by food, secretions or other articles.
- Ensure the regulator/flow meters are on the correct setting as ordered by the Medical Officer.
- Ensure gas cylinders are secured to avoid injury

Document in the Handover checklist

5 Environmental Considerations

- Oxygen is a potentially hazardous substance.
- The presence of oxygen is one of the three ingredients necessary for a fire to occur, as are a combustible material and a source of ignition.
- Therefore anything that supports or initiates combustion should be avoided, such as oil, grease, alcohol, smoking and static producing toys or equipment.
- Parents and/or care givers should be instructed not only about the risks of smoking near oxygen delivery devices but the nurse should also use this as an opportunity to undertake health education and discuss with the parents the effects of exposure to second hand smoke on the child's health.

6 Possible Complications

- Supplemental oxygen improves oxygenation but does not change ventilation.
- **Administration of supplemental oxygen to patients with certain congenital cardiac lesions** will cause an increase in alveolar oxygen tension and may compromise the balance between pulmonary and systemic blood flow. If unsure please consult a Cardiologist.
- **Patients with chronic respiratory obstruction or respiratory insufficiency may develop CO_2 narcosis**. In these patients, the respiratory centre relies on hypoxaemia to maintain adequate ventilation. If they are given oxygen this can reduce their respiratory drive, causing respiratory depression and a further rise in $PaCO_2$ resulting in narcosis.
- **Check for contraindications between oxygen therapy and some chemotherapy**.
- **Excess arterial and intra-alveolar oxygen concentrations are toxic in preterm infants and must be avoided by appropriate monitoring and adhering to target SpO_2.**

To avoid re-breathing if a mask is used, flow rates need to be maintained at 4 L/min; this can be made up of an entire flow of oxygen or a mixture of oxygen and air.

In the emergency situation, unprescribed oxygen can be administered immediately.

7 Oxygen Delivery Devices - Standard

ALERT: Self inflating resuscitation bags are not to be used as a source of free flow oxygen. They are not designed to be independently attached to a patient's face to deliver oxygen without manual ventilation.[1] Oxygen should be delivered via nasal prongs, face mask or non-rebreather mask depending on concentration required to maintain SpO_2 levels.

Bag valve and mask should certainly be readily available if the patient becomes compromised.

Note: At CHW Humidified **low flow** oxygen is not used.

At SCH, refer to Humidified Low Flow Oxygen on the Ward – SCH Practice Guideline

7.1 Nasal Prongs

Nasal prongs:

- Should not be used for children who require more than 30% oxygen.
- Deliver oxygen directly into the nostrils to a maximum flow rate of 2 litres per minute.
- Higher flows are uncomfortable for the child and can cause drying and potential bleeding of the nasal mucosa.

Nasal prong oxygen must only be administered by a low flow oxygen regulator. Always ensure that a standard 15L/min regulator is connected at all times to be used in emergency situations.

Nasal prongs are:

- Available in sizes neonatal, infant, child and adult.
- Prong size is selected so the patient can entrain room air and there is NOT a complete seal.
- Prong size should be approximately half the diameter of the nares.
- If used continuously, they need to be changed every 3 days

Care and considerations of child with simple nasal prongs:

- Position the nasal prongs along the patient's cheek and secure the nasal prongs on the patient's face with adhesive tape.
- Position the tubing over the ears and secure behind the patient's head. Ensure straps and tubing are away from the patient's neck to prevent risk of airway obstruction. Connect to oxygen flow meter
- Check nasal prong and tubing for patency, kinks or twists at any point in the tubing and clear or change prongs if necessary.
- Check nares for patency - clear with suction as required.
- Change the adhesive tape weekly or more frequently as required.

Oxygen flow (Litre/minute)	FiO_2
1	0.24
2	0.28

7.2 Simple Face Mask

- The face mask is applied over the mouth and nose. This increases the size of the oxygen reservoir so that a higher flow rate can be administered.
- The FiO_2 inspired will vary depending on the patient's inspiratory flow, mask fit/size and patient's respiratory rate.
- **The minimum flow rate through any face mask or tracheostomy mask is 4 LPM as this prevents the possibility of CO_2 accumulation, CO_2 re-breathing and drowsiness.**

NON CONTACT (ALSO REFERRED TO "WAFTING", OR "BLOW OVER") IS NOT A THERAPEUTIC APPROACH TO OXYGEN DELIVERY.

Oxygen flow Litre/minute	FiO_2
4	0.36
5	0.40
6-7	0.50
7-8	0.60

7.2 Non re-breathing mask with reservoir bag

- The non-re-breathing bag is similar to the face mask but with the addition of an oxygen reservoir bag that has a one-way valve system which prevents exhaled gases mixing with fresh gas flow. The non-rebreathing mask system may also have a valve on the side ports of the mask which prevents entrainment of room air into the mask.
- These masks are not commonly used but a non-rebreathing mask can provide higher concentration of FiO_2 (> 60%) than is able to be provided with a standard face mask (which is approximately 40% - 50%)
- **The reservoir bag must remain inflated on inspiration and the oxygen flow rate regulated so that it is sufficient enough to only deflate the bag by ⅓ on inspiration.**
- It is important the mask fits snugly to allow the inspiration of 100% oxygen.

Care and Considerations when using a non-rebreathing face mask

- To ensure the highest concentration of oxygen is delivered to the patient the reservoir bag needs to be inflated prior to placing on the patients face.
- Ensure the flow rate from the wall to the mask is adequate to maintain a fully inflated reservoir bag during the whole respiratory cycle (i.e. inspiration and expiration).
- Do not use with humidification system as this can cause excessive 'rain out' in the reservoir bag.
- **Not routinely used outside of ED and PICU and should only be used in consultation with the medical team.**

Oxygen flow Litre/minute	FiO_2
8-15	0.80-1.0

Flow Meters: There are a variety of flow meters available – ranging from 200 mL/minute to 70L/minute. Always check the flow meter is correct for individual patients' oxygen delivery each shift.

Ensure a standard 15L/minute is insitu at the bed space at all times.

At SCH, refer to Humidified Low Flow Oxygen on the Ward – SCH Practice Guideline

Note: At CHW Humidified **low flow** oxygen is not used.

If high flow humidified oxygen is required refer to:

- **At CHW:** Humidified High Flow Nasal Prong Oxygen: Administration in Wards & ED – CHW Practice Guideline
- **At SCH:** Humidified High Flow Nasal Prong Oxygen

8 Weaning of Short Term Oxygen for an improving patient with an acute illness

Weaning can be gradually attempted by lowering the concentration of oxygen for a fixed period re-evaluating clinical parameters and SpO_2 as required.

Weaning of oxygen is to be documented in patient's medical notes. It is standard practice that a patient may be considered for discharged if oxygen saturations are maintained in air >92-94% for at least 6 hours or more, and have observations in the white and blue parameters of the SPOC chart.

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APPENDIX: Sydney Children's Hospital

Weaning of LONG TERM home oxygen therapy for Chronic Neonatal Lung Disease (CNLD)

- **Definition:** Chronic Neonatal Lung Disease (CNLD) is defined as a requirement for supplemental oxygen beyond 36 weeks post-conception, with more severely affected infants requiring oxygen beyond full term equivalent age.
- **Home oxygen therapy:** Infants with CNLD on supplemental oxygen may be discharged from hospital provided regular clinical assessment and appropriate physician supervised oxygen titration expertise is available.
- **Goal of home oxygen therapy:** The goal of home oxygen therapy is to prevent the effects of chronic hypoxaemia which include; pulmonary hypertension; bronchial constriction and airway obstruction; impaired pulmonary and ocular vascular development and poor somatic growth, whilst enhancing the parent-infant relationship and reducing medical and social costs. The long term consequences of mild hypoxaemia on cognitive development are unknown.
- **Prior to discharge** the following factors need to be addressed:
  - Firstly that the infant's Carbon Dioxide (CO_2) level is known. This can be assessed by capillary blood sampling.

Caution: Infants with high CO_2 levels (>55mmHg), high supplemental oxygen requirements (>500mL/min nasal prong oxygen) or any level of CPAP/Bi-Level pressure support should be discussed with the Respiratory Consultant on-call prior to their discharge and a follow-up appointment in the Respiratory Clinic made within 4-6 weeks of discharge.

  - Secondly parents should have received education and training in Cardiopulmonary Resuscitation, the use of all equipment and the recognition of clinical signs of hypoxaemia. These include unexplained pallor or cyanosis, increasing breathlessness during feeds or increasing duration of feeds. Furthermore the parents should be advised about smoking cessation. Smoking in the home is strongly discouraged and is a significant fire hazard. The local Fire Brigade should be notified of the presence of oxygen cylinders within the home
  - Thirdly an ECG needs to be performed to assess the right heart and exclude pulmonary hypertension. An **Air Challenge** should be performed to assess the infant's safety in the event of unintentional disconnection from oxygen therapy. This requires that the infant maintains a minimum SpO_2 greater than 80% for 30 minutes in room air (off all oxygen).

    A child with home oxygen should be follow-up by community nursing within 24 hours.
  - Finally the infant needs to be booked into the Medical Day Unit for monthly RSV prophylaxis if on oxygen or within six months of weaning off oxygen during the months April to August. RSV prophylaxis (Palivizumab) has been shown to reduce

RSV related hospitalisation rates in infants with CNLD. Palivizumab is a monoclonal antibody against RSV and is given by monthly intramuscular injection.

- **Guidelines for weaning home oxygen therapy:** There is currently a lack of evidence to guide the weaning of home oxygen therapy in infants with CNLD. However a recent Australian Expert Consensus Guideline recommends that a minimum mean target range for SpO_2 of 93-95% is achieved during continuous overnight oximetry. In addition no more than 5% of the artefact-free recording time should be below 90%.
    - This is usually achieved at SCHN, Randwick by an overnight admission to either C1S or the Care by Parent Unit using the downloadable Nelcor 595 pulse oximetry unit.
    - Admission for overnight oximetry is usually scheduled every 4 weeks until the infant is weaned off supplemental oxygen. Usually the infant is weaned off oxygen during the day first and then 4 weeks later is rescheduled for the final weaning off nocturnal oxygen supplementation.
    - An infant can be weaned to a lower level of oxygen concentration (lower flow) when infant has:
        - **i.** No symptoms of respiratory distress (increasing tachypnoea, tachycardia, pallor, cyanosis, or increased work of breathing)
        - **ii.** No change in activity level, endurance or increase in irritability
        - **iii.** Sustained weight gain
        - **iv.** No recent or inter-current illnesses and improving health overall
        - **v.** No evidence of pulmonary hypertension
    - Once these criteria are met, the flow of supplementary oxygen can be reduced. In practical terms the infant is admitted in the afternoon to the ward and baseline oxygen monitoring commences so that periods of activity including bathing, feeding and sleep are assessed prior to any reduction of oxygen concentration. Usually this involves observing the infant at their current level of oxygen supplementation for 2 hours. If stable (minimum mean SpO_2 is greater than 93-95%) then their supplemental oxygen can be reduced by 0.1L/min if the oxygen cylinder has a regulator with decimal graduations or halved if the regulator dial has fractional graduations i.e a dial down from 250mL/min to 125mL/min corresponding to a dial down from ¼ to 1/8 on the regulator).
    - The infant should be closely monitored for any clinical deterioration including increased tachypnoea or work of breathing, poor sleep with frequent arousals or apnoeas.
    - If the infant fails to achieve a minimum mean SpO_2 greater than 93-95% then the infant's usual oxygen supplementation dose should be reinstated for the rest of the night.
    - Prior to discharge the following day the Respiratory Consultant will review and report on the detailed downloaded recording of the entire night's oximetry and recommended changes to oxygen therapy as appropriate. The final decision to

wean the infant's oxygen supplementation takes into account the infant's general progress and somatic growth.

- Short duration/intermittent oximetry is unreliable and should not be used to wean oxygen supplementation.
- Pulse oximeters are not loaned out to parents as the carers' perception of SpO_2 readings may be unreliable and this potentially may complicate weaning due to misinterpretation of events especially in the context of frequent false alarms.
- Oxygen equipment should be kept in the home for at least 3 months after the infant has been weaned off supplemental oxygen (or longer if this is over winter).
- Procedure for weaning is to be documented in patient's medical notes by a Medical Officer.

- **Clinical Deterioration whilst on supplemental oxygen therapy:** The parents should be advised to seek medical review within 24 hours (preferably at a Paediatric Emergency Department) for oxygen saturation monitoring if their child develops a respiratory virus and there is a change in their clinical condition. If the parents are uncertain they can double their child's oxygen whilst arranging this review.
- **Failure to reduce supplemental oxygen in infants with CNLD after one year:** This requires (Respiratory) Specialist review to exclude significant co-morbidities such as recurrent aspiration, tracheobronchomalacia, unsuspected cardiac disease, upper airway obstruction or cystic fibrosis.
- Flight Assessment (The **Hypoxic Challenge Test):** Infants with CNLD are at higher risk of apnoea and death within the first 12 months of life. Risks are greater with long haul flights.
  - Infants with CNLD may deteriorate significantly during air travel where inspired oxygen is equivalent to 15%, cabin pressure is reduced compared to sea level and air is dry (reduced humidity of recycled aircraft ambient air). Even infants with CNLD who have normal SpO_2 in air may desaturate to below 80% in 15% oxygen. Flight assessment therefore is recommended in infants receiving supplement oxygen and those who were oxygen dependent within the previous six months.
  - If the infant's SpO_2 falls below 90% during 20 minutes of exposure to a 15% oxygen environment, this is an indication to postpone flying or provide supplemental oxygen which can be titrated during the test. Oxygen needs will have to be reassessed if the infant has an URTI at the time of flying.