PULSE OXIMETRY

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Continuous pulse oximetry monitoring measures oxygenation (SpO_2) and pulse rate.
- Pulse Oximetry is used to monitor children who are at risk of hypoxaemia.
- Pulse Oximetry is a non-invasive monitoring technique used to estimate the arterial oxyhaemoglobin saturation.
- Pulse oximetry does not assess ventilation
- Monitoring will depend on the patient's clinical status
- The value of isolated measurements is limited and trends are more important than absolute figures. Changes in saturation identify deterioration or improvement, caused either by changes in pathology, response to treatment, or both.
- Pulse Oximetry readings should be used in conjunction with observation and assessment of the child.
- It is important to use an appropriate size of sensor on an appropriate site.
- As it is possible to cause damage to the skin when using an oxygen saturation probe; *probe sites should be changed a minimum of two hours*.
- Sleep Unit oximetry probes will be changed when the child is in a sleep stage that will not interfere with data collection. *Probes in the Sleep Unit are left on for a maximum of 4 hours*.
- All pressure areas > stage 1 caused by saturation probes must be entered into IIMS.

Approved by:	SCHN Policy Procedure & Guideline Committee	
Date Effective:	1st August 2015	**Review Period**: 3 years
Team Leader:	CNC Respiratory	**Area/Dept**: Respiratory, SCH

Date of Publishing: 27 July 2015 9:31 AM Date of Printing:

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CHANGE SUMMARY

- New SCHN guideline - replaces facility documents:
  - Pulse Oximetry – CHW [2006:8053-01:02]
  - Pulse Oximetry – SCH [C.10.P.1]
- Change in practice: Introduction of Standard Paediatric Observation Chart (SPOC)

READ ACKNOWLEDGEMENT

- Clinical (medical and nursing) staff who use pulse oximetry to monitor patients should read and acknowledge this document.

Training

- Clinical staff must undertake any training or assessment as required locally.

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1 Rationale

- Oxygen saturation monitoring measures the oxygen present in haemoglobin.
- Continuous oxygen saturation monitoring provides a constant display of oxygen status and any alteration in patient's reading.
- Oxygen saturation provides an early indication of hypoxaemia.
- If a child has a procedure that requires sedation, the child's oxygen saturations should be monitored continuously throughout the procedure and post procedure until the child is fully awake. This is because of the potential respiratory depressant effect of drugs used for sedating purposes.

2 General Principles

- A pulse oximeter monitors the oxygen saturation of arterial haemoglobin in blood.
- This is obtained through a light source that is absorbed by haemoglobin and transmitted through tissues to a photo detector. The oxygen saturation is derived from the percentage of haemoglobin saturated with oxygen at the time of measurement.
- Children have been shown to exhibit fluctuations during a 24 hour cycle – that is maximum value late afternoon and minimal value first thing in the morning.

Abbreviations:

- SpO_2: when oxygen saturations are measured using a pulse oximeter.
- SaO_2: when arterial oxygen saturation is taken using a blood sample ('blood gas').

The same percentage ranges apply to both the SpO_2 and SaO_2.

3 Factors affecting accurate readings of SpO_2

- Poor positioning
- Motion Artefact
- Under perfusion
- Significant hypothermia
- Anaemia
- Holding or pressing the probe onto the skin too tightly
- Some nail varnish – black, blue, green and frosted
- Bruising under the fingernail
- Synthetic fingernails
- Dirty site
- Carbon monoxide poisoning
- Low battery level/ monitor malfunction
- Probe malfunction or wrong choice of probe
- Excessive light
- Dark skin pigmentation

4 Equipment

- Oxygen saturation monitor and power cord
- A suitable size sensor probe

NOTE: If the monitor/probe fails to operate or is faulty, attach a faulty tag and return to the Biomedical Engineering Department.

5 Set up

The probe must be fastened the right way up; the infrared light shines down through the skin and on the opposite side the photo detector picks up a reading.

It is particularly important that the photo detector should be directly opposite the light source.

It can be useful to turn the monitor on, before starting to place the probe so that it can be determined from which side the probe is emitting infrared light.

It can be beneficial to reduce the amount of ambient light that can affect the saturation reading.

Be aware of light sources from examination lights or overhead lights. If too much light is near the probe, it may affect the reading and result in a false reading.

Note: Each device has a unique dedicated calibration algorithm. Changing manufacturer of device may result in some initial variation of SpO_2.

Procedure [3]

- Explain the procedure to the child (if appropriate for age) and parent/carer.
- Plug oximeter into wall electricity supply if the unit is not portable. If the unit is portable, ensure sufficient battery charge by turning it on before using.
- Select desired sensor site. If using the digits, assess for warmth and capillary refill
- Select the appropriate pulse oximeter sensor for the area
- Apply the sensor in a manner that allows the light sensor to be directly opposite the photo detector and shielded from excessive environmental light.
- Add additional elastic cohesive retention bandage to secure- one layer only and ensure not too tight as will reduce blood flow to digit and provide an inaccurate reading
- After turning instrument on, allow 30 seconds for self-testing procedures and for detection and analysis of waveforms before values are displayed.
- Set appropriate alarm limits to the patient's condition.

Normally, low oxygen saturation is set at 95%

6 Choice of saturation probe and site

Choice of saturation sensor probe

Sensor probes can be disposable or re-usable and there are a variety of probes to select from, depending on what is available within the unit or ward.

Single Patient Use Probes

- Single patient use probes should not be used on multiple patients.
- If the patient requires continuous monitoring of oxygen saturation, the single patient use probe is recommended.
- These probes should be allocated to the patient when required and stay with the patient for the duration of their admission and discarded after the patient is discharged.
    - **At CHW** these probes are a ward stock item however extra can be obtained from Biomedical Engineering.
    - **At SCH** these probes are a ward stock item and can be ordered from Stores.

Reusable Probes

There are many styles of reusable probes and appropriate sizing should be considered.

- “Wrap” style sensor probes for the fingers (including thumb), big toe and nose.
- “Clip” or “Peg” style sensors are appropriate for fingers (except the thumb) and the earlobe. (However they should be used with caution on the earlobe as may ‘pinch’)

Choosing the correct size of the sensor probe will help decrease the incidence of excess ambient light interference.

- **At CHW** replacement probes can be obtained from Biomedical Engineering.
- **At SCH** replacement probes are a ward stock item and can ordered from stores

Choice of saturation site

Younger children:

- Finger
- Big toe
- Across the palm of the hand (the probe is sited near the base of the little finger)
- On the foot (the probe is placed on the outer aspect of the foot, at the base of the little toe)
- On the Achilles area

Older children:

- A finger
- Big toe
- The ear lobe

Use a limb that is not affected by a blood pressure cuff, intravascular infusion line or arterial line, as adequate arterial strength is necessary for obtaining accurate readings. Sites of blood transfusion should also be avoided due to venous engorgement.

7 Observations

The normal range of oxygen saturation in a healthy child is 97 – 100%

However, an oxygen saturation value of 95% is clinically accepted in a child with a normal haemoglobin level.

After initial assessment of the child, including existing medical conditions, the team will be aware of the expected oxygen saturation and the appropriate oxygen requirements. This must be documented with altered criteria on the SPOC chart.

It is important to note that in some circumstances, oxygen delivery may be contraindicated. Expected normal oxygen saturations for these patients should be documented and discussed with the team.

Frequency of observations will be determined by the patient's condition and clinical judgement. Guidelines for the frequency of the observations are found within the SPOC charts

8 Alarms

- An audible alarm system for determination of oxygen saturation values below a set acceptable limit is necessary as this is important in the overall management of the patient.
- Alarm limits for SpO_2 and heart rate should be set after turning the unit on and should be individual for each patient.
- The expected oxygen saturation for each child should be taken into account when setting the alarm limits.

9 Desaturation

- Be aware of changes in saturation. Assess the patient and check the equipment for reasons of desaturation.
- Notify the medical officer if a condition of low SpO_2 occurs.
- Check medical orders in reference to applying oxygen for desaturations as will be patient specifics.

10 Changing of probe site - safety concerns

It has been shown that prolonged application of the probe to one area can cause damage to the skin when using an oxygen saturation probe[1].

Oxygen saturation probes should not cause burns to the skin. However there is greater concern and risk of probes being secured too tightly or left on too long on one site. This potentially can cause necrosis to the skin - in a similar way that a patient receives a pressure sore.

If the child requires continuous monitoring, the probe site and perfusion of the extremity must be checked each hour, and documented on SPOC chart.

If continuous monitoring is not required, probes should be removed, to prevent a pressure area forming.

Probe sites must be changed every two hours.[1]

After surgery

Probe sites should be changed at the end of surgery and areas assessed.

Transferring patients from one area to another

Patients being transferred from one unit or ward to another on continuous oxygen saturation monitoring, should have their probe location checked to ensure the site has been changed recently and no pressure area noted.

Probe changes should be documented in the patient's clinical notes and the site recorded on the observation chart.

If a pressure area occurs, notify the nurse in charge and medical officer for review and commence appropriate treatment. These types of incidents must be entered into IIMS.

11 Documentation

Probe changes should be documented in the patient's clinical notes and the site recorded on the SPOC chart

All pressure areas caused by saturation probes must be entered into IIMS.

Documentation should include the following:

- Indication for the use of pulse oximetry
- Accepted range for patient saturations
- SpO_2 reading, with or without oxygen
- Patient's pulse.
- Recent blood gases if available
- Sensor site/change

- Skin assessment at sensor site
- Clinical assessment of the patient at the time of the saturation measurement
- Episodes of desaturation and events preceding desaturation
- Clinical interventions

12 Infection Control

Sensor probes can be disposable or re-usable. As they come in direct contact with patients, probes should be used/cleaned according to the manufacturer's recommendations.

The external portion of the monitor should be cleaned according to the manufacturer's recommendations whenever the device remains in a patient's room for prolonged periods, when soiled or when it has come in contact with potentially transmissible organisms.

13 Sleep unit

The sleep unit performs diagnostic and treatment polysomnography (PSG's or sleep studies) to monitor and diagnose sleep and breathing disorders in children.

Oxygen saturation probes in the Sleep unit are changed less frequently in the sleep unit, so as not to wake the child and/or interfere with the data collection.

During REM sleep a child is more likely to be disturbed and wake up, and REM sleep is the most important time to obtain PSG data (sleep disordered breathing is more likely to happen during REM).

It is more appropriate to change the probe when the child is in a certain stage of sleep and is less likely to rouse.

The safety of the child is still maintained as the probe is changed every 4 hours and the data obtained is still of a high quality.

14 Trouble shooting

Problem	Possible Causes	Intervention
Low SaO_2 <90%	Probe displaced Patient moving Actual reduction in SpO_2 or SaO_2	Assess patient Reposition probe Assess patient Correct any obvious causes If no improvement notify medical officer immediately. May be due to patient's worsening condition Apply oxygen if appropriate for patient's known medical condition Document event in patient's notes – detailing whether desaturation was self-resolving or action was taken
Poor signal	Probe displaced Reduced tissue perfusion	Assess patient Reposition probe Assess patient Move probe to another site
Noisy signal	Excessive movement	Assess patient Move probe to another site
Abnormal signal	Ectopic pulse Taping is restrictive and causing oedema at probe site	Assess patient (palpate pulse for signs of ectopic pulse) If no improvement and ectopic identified, notify medical officer immediately. Assess restriction of venous return, causing venous pulsation. Reassess and move probe to another site

If no obvious reason for persistent signal problems, consider monitor malfunction. Replace monitor and reassess patient.

If the monitor/probe is faulty, tag and send to Biomedical Engineering Department.

15 References

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