the children's hospital at Westmead

SLEEP SCREENING TROLLEY STUDY - CHW

PROCEDURE ©

DOCUMENT SUMMARY/KEY POINTS

- Sleep disorders, such as Obstructive Sleep Apnoea, can be treated by Continuous Positive Airway Pressure (CPAP) or BiLevel Ventilation. The Screening Trolley Study is used in the wards to assess the effectiveness of CPAP/BiLevel treatment.
- The Screening Trolley Study continuously monitors the patient overnight in the ward and records Transcutaneous Carbon Dioxide levels, Oxygen Saturations and heart rate.
- The Screening Trolley Study is coordinated through the Sleep/Respiratory Support Team; contact the Sleep Fellow page 7042
- The Screening Trolley Study can be obtained from Biomedical Engineering.
- Blood gases must be performed for all screening studies unless specified by a Medical Officer from the Sleep/Respiratory team.
- Blood gases are performed at 0600 hours or within 15 minutes of wakening.
- This document details the setup and calibration procedure when using the trolley
- This document includes frequently asked questions

Important

When a child is suffering from a sleep disorder, one of the main reasons the child is in hospital is for the sleep screening study. Failure of the equipment to work properly will lead to an increased length of stay. The on call Biomedical Engineer **MUST** be paged through switchboard if there are any problems with the equipment.

Approved by:	SCHN Policy and Procedure Committee	
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Team Leader:	Manager	**Area/Dept**: Sleep Unit - CHW

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1 Introduction

Children with sleep disorders, left untreated, can develop pulmonary hypertension and cognitive impairment (developmental delay, or symptoms similar to Attention Deficit Hyperactivity Disorder (ADHD))[4, 5].

Children can be *screened* for a diagnosis of sleep-associated respiratory abnormalities, (including Obstructive Sleep Apnoea (OSA)) on the ward using a combination of oxygen saturation and carbon dioxide monitoring.

The procedure described within this document is to be used for **screening** patients who have commenced CPAP/BiLevel treatment or as a prelude to a formal overnight sleep study. Within The Children's Hospital at Westmead (CHW), **Screening Trolley Studies** can be performed using the Ward Screening Trolley Study (obtained from Biomedical Engineering).

Once a child has adapted to CPAP/BiLevel treatment a formal polysomnograph (PSG) or also known as 'overnight sleep study' is then used to objectively assess the optimum treatment pressures for the patient.

1.1 What is Obstructive Sleep Apnoea (OSA)?

Obstructive sleep apnoea (OSA) is characterised by obstruction of the upper airways resulting in episodes of ineffective breathing efforts during sleep (recurrent episodes of hypopnoea and apnoea). The main symptom of obstructive apnoea is snoring, resulting from limited airflow. Episodes of partial or complete airway occlusion cause oxygen desaturation, carbon dioxide retention and disturbed sleep. Clinically, this manifests as loud snoring.

In children, the estimated prevalence of snoring is 3 to 12 percent and of OSA is 1 to 4 percent [1-3]. The majority of these children have mild symptoms, and many outgrow the condition. The most common cause of OSA is adenotonsillar hypertrophy, although children with other conditions such as craniofacial abnormalities and skeletal or neuromuscular disease may be at increased risk of the disease.

1.2 How to treat Obstructive Sleep Apnoea (OSA)

The first treatment used in children with OSA is adenotonsillectomy. However, treatment can also be effectively provided by the delivery of Continuous Positive Airway Pressure (CPAP) or BiLevel Ventilation via a nasal mask.

Continuous Positive Airway Pressure (CPAP)

This device generates airflow at positive pressure. A pressure regulatory system allows a specific pressure to be set and thus to deliver a *continuous pressure* to the airway through a nasal or face mask. In children, CPAP is used to treat moderate to severe OSA, either before or after surgery for adenotonsillectomy. The increased pressure prevents collapse of the airway and normal sleep is restored. This reduces both immediate and long term symptoms by improving ventilation during sleep[6, 7].

BiLevel Positive Airway Pressure

BiLevel Positive Airway Pressure (or also known as BiPAP) differs from CPAP in that it delivers both an inspiratory pressure and a *lower* expiratory pressure. This device assists ventilation during sleep and can be used in the presence of upper airway obstruction or other

disorders where ventilation is compromised during sleep, including other causes of respiratory failure. Bilevel ventilation is commonly used to treat nocturnal hypoventilation.

Screening patients using the CPAP/BiPAP methods is performed via the Screening Trolley Study.

Note: When introducing positive pressure treatments (CPAP or BiPAP), children benefit from behavioural interventions that allow them time to gradually adapt to wearing a face/nose mask and breathing in the presence of the positive pressure delivered by these devices.

2 Screening Trolley Study

2.1 Requesting the Screening Trolley Study

- For all wards other than Turner Care by Parent Unit (TCBP), the Screening Trolley Study is coordinated through the Sleep/Respiratory Support Team; contact the Sleep Fellow page 7042.
- In the Sleep Unit (using the Endocrine area) or in TCBP (for complex patients for multiple reviews), the Screening Trolley Study is coordinated for studies after discussion with the Sleep/Respiratory Support Team and the Sleep Unit Manager.
- The Screening Trolley Study can be obtained from the Biomedical Engineering Department (ext 52062). Biomedical Engineering is responsible for maintaining the Screening Trolley Study equipment.

2.2 Staff Education / Training

- Biomedical Engineering should be contacted for training on usage of the Screening Trolley Study equipment.
- The Respiratory Support Service CNC should be contacted for education on the clinical indications for use of the Screening Trolley Study.

2.3 Tests Performed during the Screening Trolley Study

During the Screening Trolley Study the patient is *continuously* monitored, overnight and results are recorded on the Radiometer TCM4. The following are monitored and recorded:

1. Transcutaneous carbon dioxide ($TcCO_2$) using a Radiometer TCM4
2. Oxygen saturation (SaO_2) and heart rate using a Radiometer TCM4
3. Blood Gas

The Radiometer TCM4 is located on the Screening Trolley Study.

The study is terminated 0600 hours or upon patient wakening in the morning.

1. Transcutaneous Carbon Dioxide ($TcCO_2$) Monitoring

Transcutaneous carbon dioxide monitoring measures the skin-surface carbon dioxide pressure which provides an estimation of the arterial partial pressure of carbon dioxide ($PaCO_2$). The

device induces hyper perfusion by *local heating of the skin* and measures the partial pressure of carbon dioxide electrochemically.

Monitoring

- Continuous (overnight)
- Alarms are preset - high 80mmHg, low 25 mmHg
- Hourly recordings:
  - Transcutaneous readings, patient's wake/sleep state, body position (eg. Side, back, front), respiratory rate, activity level, inspired oxygen concentration, or supplemental oxygen flow in L/min and mode of support **MUST all be recorded**.
  - These are to be recorded on the Paediatric Sleep Screening (Trolley Study) Form M85D. The form is attached to the trolley.
- CPAP/BiPAP settings, probe changes and factors that affect the reading should be charted on the continuous trace.
- If the monitor continues to alarm or ward staff are concerned about the patient, contact the Medical Registrar on-call.
- Probe sites should be changed at least every four hours.

Sources of error

- Poor contact with skin
- Poorly perfused area eg oedema, adipose tissue

Infection Control

- No special precautions are necessary when using the equipment at the bedside, although standard universal precautions apply.
- Biomedical Engineering will clean:
  - the probe after each use
  - the equipment as per the manufacturer's recommendations

2. Oxygen Saturation (SaO_2) Monitoring

Pulse oximeters detect the change in transmission of light across the capillary bed, **usually** in the finger. Other sites include the foot, toe and ear lobe. The sensor is placed on the nail with the light source against the finger pulp. The detectors detect oxyhaemoglobin and partially bound oxyhaemoglobin. By comparing the difference in light transmission through the "arterialised" capillary bed and the non pulsatile venous bed the oximeter can calculate the haemoglobin saturation, known as the "functional saturation" [11].

Probe sites must be change every two hours.

Please refer to the 'Pulse Oximetry' procedure for more information on Oxygen Saturation monitoring.

Monitoring

- Continuous (overnight).

- Alarms are preset – high 100%, low 85% (unless otherwise specified).
- Hourly recordings of oxygen saturation readings and patients pulse rate MUST be documented on the Paediatric Sleep Screening (Trolley Study) Form M85D.
- If oxygen saturations are less than 85% or you have concerns regarding the patient, page the Medical Team Registrar on-call.
- As the study is to see how effective treatment is, when breathing room air saturations >85% are acceptable (unless otherwise specified).

Clinical application

- Probe sites should be changed at least every two hours.

Sources of error

- Ensure the device is calibrated.
- Nail polish must be removed as signal strength can be reduced.
- Excessive motion and strong incidental light can cause an effect and give erroneous signals.
- Abnormal haemoglobin and anaemia can affect the accuracy of the measurements.

Infection Control

- No special precautions are necessary when using the equipment at the bedside, although standard universal precautions apply.
- Biomedical Engineering will clean the probe after each use.
- Biomedical engineering will clean the equipment as per the manufactures recommendations.

3. Blood gas

Blood gases are routinely performed for all sleep screening studies, unless specified beforehand by the Sleep/Respiratory team.

A blood gas **must be performed within 15 minutes of termination** of the study (or patient wakening in the morning). Blood gases must be obtained by the subspecialty Registrar (Pager no. 6176) or other suitable practitioner.

Please refer to the PICU Departmental Practice Guideline "Arterial Lines and Blood gases in PICU" for more blood gas information.

2.4 Reporting of the Screening Trolley Study

The results of the Screening Trolley Study are discussed amongst the Sleep/Respiratory Support Team prior to being reported by the patient's admitting Sleep Physician. The report is available within 1 week and is to be stored in patient's medical records.

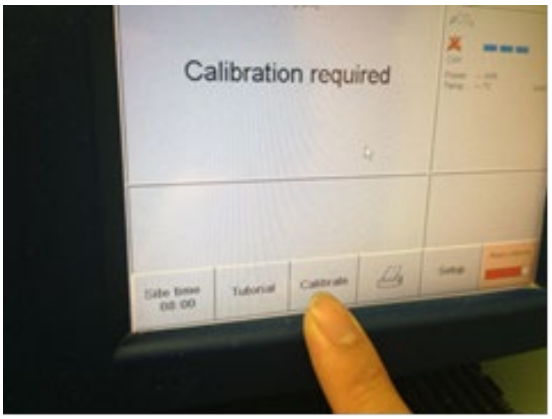
2.5 Setting Up the Screening Trolley Study

1. Plug in and turn on the mains power cable. **All equipment is connected to a single mains cable.**
2. Switch on the Radiometer TCM4. The switch is located at the bottom right hand side at the front.

3. Calibrate the transcutaneous electrode:
    i. Carefully place the transcutaneous electrode in the calibration holder.

    ii. Swing the electrode retainer over the back of the electrode to hold it in place.
    iii. "Calibration required" will appear on the screen of the TCM4.

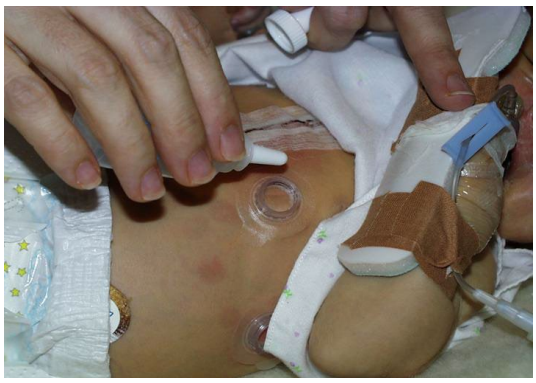
Press the "calibrate" button on the screen of the TCC4 to start the calibration gas flowing to the electrode.

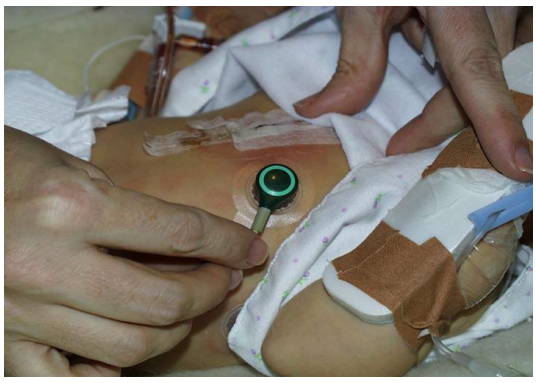


iv. After 1– 5 minutes, the TCM4 will "beep" and the screen will display "READY." The electrode is calibrated and ready for use.

4. Apply a fixation ring to the measuring site:

- Select a well perfused site. Typically, the abdomen is used. However, in older children who may be obese, the large amount of adipose tissue on the abdomen may make this an inappropriate site. Other sites that can be used include the upper chest and the area above the collar bone.
- Clean the skin with an alcohol swab.
- Allow to dry.
- Remove the protective film from the disk.
- Press the centre of the fixation ring on to the measuring site with a finger.
- Run a finger around the rim circumference – press firmly to prevent leaks. Fill the hole in the fixation ring with 3-5 drops of the S44416 contact liquid.
- Mount the electrode by placing the electrode in the fixation ring and turning ¼ turn clockwise.





5. In older children, tape can be used to anchor the electrode cable to the patient's skin about 5 cm from the electrode to prevent pulling on the electrode and fixation ring.

6. Attach the Nellcor pulse oximeter probe to the patient. Refer to Pulse Oximetry.
7. The Pulse Oximeter reading will automatically appear on the screen and record on the TCM4

Please Note

Oxygen saturation probe site *must be changed regularly* and left on one site for **no longer** than four hours.

- The timing is only a guide and should be reduced depending on the patient's age, skin integrity or perfusion.

The **transcutaneous carbon dioxide monitor**, the TCM4, has an inbuilt timer that is set for four hours. The $TcCO_2$ will alarm and cease to work after this time. The probe needs to be recalibrated as described above and applied to a new site.

- The timing is only a guide and should be reduced depending on the patient's age, skin integrity or perfusion.

Important

When a child is suffering from a sleep disorder, the main reason the child is in hospital is for the Screening Trolley Study. Failure of the equipment to work properly will lead to an increased length of stay. The on-call Biomedical Engineer **MUST** be paged through switchboard if there are any problems with the equipment.

3 Commonly asked questions

The Radiometer TCM4 will not calibrate

- Gas exhausted - Change TCC3 gas cylinder (see below)
- Re-calibrate
- Possible damaged probe. Contact Biomedical Engineering on call

The Radiometer TCC4 gas is exhausted

- Contents pressure gauge reads zero:
  - **i.** Unscrew the old canister from the TCC4 module counter clockwise.
  - **ii.** Replace with a new canister (available on trolley), gently screwing clockwise.
  - **iii.** Time and date the new canister.
  - **iv.** Write on the old canister "empty".
  - **v.** Do not dispose of the old canister. Keep with trolley.
  - **vi.** In office hours contact Biomedical Engineering and inform them of the empty canister.

The Radiometer TCC4 gas will not switch on

- Gas exhausted - change cylinder.
- Equipment failure - contact Biomedical Engineer on call.

$TcCO_2$ is not reading

- If the electrode is not removed from the calibration holder within 30 minutes after calibration, the electrode is switched off and must be recalibrated
- Ensure that the TC ring has not lifted off the skin. Typically, the TcO_2 reading will be high
- It will take 3-7 minutes for a stable $TcCO_2$ reading to be reached on the display. The TcO_2 reading will either be --- or a number

Membrane is damaged

- Generally, re-membraning the electrode is generally unnecessary and will rarely solve problems unless the membrane is clearly damaged.
  - **i.** Remove and discard the 2 "O" rings from the probe
  - **ii.** Discard the two protective clear sheaths
  - **iii.** Gently wipe the electrode with the supplied blotting paper
  - **iv.** Apply 1 drop of the contact gel. **Note:** this is NOT the same as the solution that is used on the patient
  - **v.** Using the green sheath applicator, attach the applicator to the probe and push firmly
  - **vi.** Re-calibrate.

Unusual graph tracing

- Thick black line on CO_2 trace can be caused by switching on the Radiometer TCM4 *before* mains power is switched on
- Pulse oximeter traces disappear when the probe is not on the patient or when the numbers are lost from the screen of the pulse oximeter.

Graph readings not clinically meaningful

- Incorrect calibration procedure - Recalibrate the probe
- Fixation ring lifted from skin - Locate an appropriate new site. Recalibrate and fix the probe to the new site. Review after ten minutes.
- Poorly perfused site - Locate an appropriate new site. Recalibrate and fix the probe to the new site. Review after ten minutes. Site change time should be reduced to two hours.

Electrode will not calibrate

- Re calibrate again.

Further problems contact the on-call Biomedical Engineer through switchboard.

Important

When a child is suffering from a sleep disorder, the main reason the child is in hospital is for the sleep screening study. Failure of the equipment to work properly will lead to an increased length of stay. The on call Biomedical Engineer **MUST** be paged through switchboard if there are any problems with the equipment

4 References

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