Local Guideline

Transcutaneous Monitoring in Neonates

Sites where Local Guideline and Procedure applies	Neonatal Intensive Care Unit (NICU) JHCH
This Local Guideline and Procedure applies to:	
1. Adults	No
2. Children up to 16 years	No
3. Neonates – less than 29 days	Yes
Target audience	All clinicians caring for infants in NICU
Description	Provides guidance to neonatal clinicians for the use and management of transcutaneous monitoring in infants

Go to Guideline

Keywords	NICU, SCU, JHCH, neonate, newborn, transcutaneous, TCM, carbon dioxide, CO_2 monitoring
Document registration number	JHCH_NICU_12.05
Replaces existing document?	Yes
Registration number and dates of superseded documents	Transcutaneous Oxygen/Carbon Dioxide Monitoring in Neonates JHCH_NICU_12.05

Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:

- NSW Health Policy Directive PD2017_013 Infection Prevention and Control Policy
- NSW Health Policy Directive PD2017_032 Clinical Procedure Safety
- NSW Health Policy Directive PD2020_020: Incident Management Policy
- NSW Health Policy Directive PD2014_007 Pressure Injury Prevention and Management

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Date authorised	25/11/2020
This document contains advice on therapeutics	No
Issue date	25/11/2020
Review date	25/11/2023

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PURPOSE AND RISKS

This local clinical procedure has been developed to provide instruction to the health clinician and to ensure that the risks of harm to the child associated with application of transcutaneous monitoring (TCM) in NICU are prevented, identified and managed.

The risks are:

- *Epidermal damage*
- *Pressure injury*
- *Skin burns*

The risks are minimised by:

- *Clinicians having knowledge of transcutaneous carbon dioxide monitoring implementation and management*
- *Following the instructions set out in this document*
- *Recognition of the common clinical signs of the epidermal damage*
- *Notification and management of the complications/risks to the patient*

Any unplanned event resulting in, or with the potential for injury, damage or other loss to infants/staff/family as a result of this procedure must be reported through the Incident Management System and managed in accordance with the NSW Health Policy Directive PD2020_020: Incident Management Policy. This would include unintended injury that results in disability, death or prolonged hospital stay.

*It is mandatory for staff to follow relevant: "Five moments of hand hygiene", infection control, moving safely/safe manual handling, documentation practices and to use HAIDET for patient/carer communication: **H**and hygiene **A**cknowledge, **I**ntroduce, **D**uration, **E**xplanation, **T**hank you or closing comment.*

Risk Category*:* *Clinical Care & Patient Safety*

CLINICAL PROCEDURE SAFETY LEVEL

Every clinician involved in the procedure is responsible for ensuring the processes for clinical procedure safety are followed. The following level applies to this procedure (click on the link for more information):

Level 1 procedure

CONTENT

TRANSCUTANEOUS MONITORING SUMMARY

- TCM allows for continuous monitoring of capillary O_2 and CO_2, and adjust respiratory support accordingly
- TCM has the potential to reduce bloodletting
- TCM has skin integrity risks associated with its use (i.e. burns, pressure injury, epidermal stripping), strict observation for risks is required

GUIDELINE

While not requiring mandatory compliance, staff must have sound reasons for not implementing standards or practices set out within guidelines issued by HNE Health, or for measuring consistent variance in practice.

Introduction

Transcutaneous monitoring (TCM) is non-invasive and continuous transcutaneous oxygen and carbon dioxide measurement system. Using TCM has the potential to reduce the number of blood gases needed to manage respiratory support and/or mechanical ventilation. Provides real time alert to clinicians about potential changes in clinical condition of the infant. The sensor heats the skin, effectively increasing local perfusion so that O_2 and CO_2 can diffuse to the skin surface more easily and enabling monitoring transcutaneous partial pressure of oxygen/carbon dioxide ($tcPO_2$/$tcPCO_2$).

Considerations for Use

Top

Any baby where continuous CO_2 monitoring could help target respiratory support and/or reduce bloodletting. Examples include:

- Infants with significant respiratory illness/rapidly changing respiratory disease
- Unstable infants requiring mechanical ventilation/CPAP support
- Infants requiring reduction in number of blood gases
- Other infants who require additional monitoring and targeting of respiratory support

Contraindications for Use

Top

- Infants with compromised skin integrity
- Infants undergoing body cooling
- Infants with poor perfusion (i.e. sepsis or cardiac condition) or inotropic support (may lead to false high $tcPCO_2$ and falsely low $tcPO_2$)

Equipment Required

Top

- Transcutaneous monitor (see Figure 1)
- Fixation rings
- Contact gel/fluid

Figure 1: *SenTec Transcutaneous Module (Image from SenTec Quick Reference Guide)*

Transcutaneous Monitor Settings

Top

Ensure the current settings and profile are on the neonatal settings (user profile). Temperature Settings and sensor site timeframes are outlined in Table 1.

SENSOR TEMPERATURE SETTING	RECOMMENDED SENSOR SITE TIMES
41.0 ºC	4 hours
43.0 ºC	2 hours

Table 1: *Recommended sensor temperature settings and site times*

Note: Consideration when using TCM on extreme preterm infants (<29 weeks) is required. Monitoring for any compromise to skin integrity and consider using 41° temperature setting for 2 hour time period only

Sensor Positioning

Top

Optimum measurement is obtained from a site that has high blood flow, capillary density and thin epidermis (avoid the nipples at all times). Sensor sites should not be used more than a single time, and fixation rings not in use should be removed at all times. Infants must never be positioned where they are laying on the sensor ring or TCM cable as this has potential to cause a pressure injury.

Ideal sensor sites are outlined in Figure 2 (Note; the infant's forehead is not used in JHCH NICU as sensor application site).

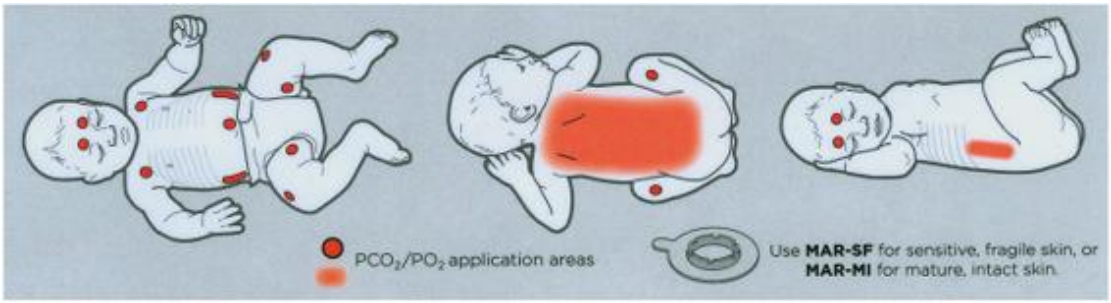

Figure 2: *Neonatal Sensor Application Sites (Image from SenTec Quick Reference Guide)*

Sensor Application

Top

- Choose relevant Multi-site Attachment Ring (MAR):
  - MAR-MI; standard ring for mature/intact skin
  - MAR-SF; ring for more sensitive/fragile skin
- Clean site with alcohol wipe and let it dry (follow steps in Figure 3)
- Attach the ring to the selected sensor site, ensuring that the skin underneath the sensor site is not wrinkled (see Figure 3)
- Apply one small drop of contact liquid to the skin area in the centre of the ring (see Figure 3)
- Holding the sensor at its neck, approach the MAR from the flap side and first insert the nose of the sensor into the ring (see Figure 3)
- Click in the sensor by applying slight downward pressure on its neck (see Figure 3)
- Rotate the sensor in the ring into the best position and press the sensor gently against the skin to spread the contact liquid (see Figure 3)
- Verify that air gaps between the skin and the sensor are eliminated and that the sensor can easily be rotated

- After sensor application, $tcPCO_2$ readings stabilize within 2 to 10 minutes. After stabilization the displayed values turn from grey to green

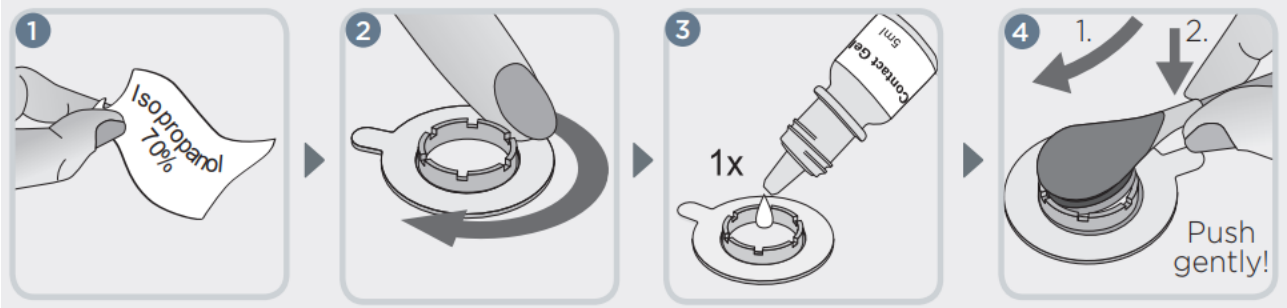

Figure 3: *Sensor Application using a MAR (Image from SenTec Quick Reference Guide)*

Changing the Sensor Site

Top

Sensor timer is set to 2 to 4 hours (see Table 1). When a sensor requires changing, a low priority alarm sounds, the message 'Site Time Elapse' will be displayed on the status bar and the 'Remaining Monitoring Time' icon turns red.

- Apply a second, new attachment ring to the patient prior to removing the sensor cable
- Remove sensor from current site and wipe clean with alcohol swab
- Insert sensor into docking station (this will calibrate sensor and also reset the 'site time')
- From this point it is ready for use again

Infants with poor skin integrity and/or poor perfusion may need more frequent sensor site changes

Sensor Calibration

Top

Calibration should occur in the following circumstances:

- A new monitoring period is to commence
- The membrane has been changed on the sensor
- The sensor operating temperature has been changed
- The accuracy of the measurement is in doubt (troubleshooting step)
- The monitoring site has been changed

To calibrate the TCM:

- Wipe away any excess contact gel on sensor and clean with 70% alcohol swab only
- Place sensor in docking station
- Once returned to docking station, calibration is automatic

Sensor Membrane Replacement

Top

The sensor membrane needs to be changed using the membrane cartridge and insert.

Sensor membrane needs to be changed in the following circumstances:

- Every 28 days
- When damaged/or missing
- There is a loose fitting membrane
- The electrode has air trapped or becomes dry
- When a sensor 12 error message appears

The sensor membrane is changed by the Technical Assistants (or nursing staff after hours when required).

Please see the following link for SenTec How to Videos (for available tutorials sensor application, sensor cleaning and sensor membrane change).

IMPLEMENTATION PLAN

The clinical guideline will be:

- Circulated to Head of Department and Managers in NICU
- Circulated to the clinicians via the Children Young People and Families Network and the Women's Health and Maternity Network (where applicable)
- Made available on the intranet (PPG) and HNEKids website
- Presented at facility/unit meetings and tabled for staff to action

MONITORING AND AUDITING PLAN

- The person or leadership team approving the clinical guideline is responsible for ensuring timely and effective review of the guideline.
- Evaluation will require a review of the most current evidence as well as consideration of the experience of Neonatal staff at JHCH in the implementation of the clinical guideline.
- Data derived from monitoring and evaluation should inform the review of the clinical guideline either as required or scheduled.
- Implementation, education support and monitoring compliance be completed by local Clinical Educators and Unit Managers.
- Amendments to the guideline will be ratified by the Clinical Director and Manager of Newborn Services prior to final sign off by the JHCH.

CONSULTATION WITH KEY STAKEHOLDERS

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APPENDICES

1. Glossary & Abbreviations

REFERENCES

1. Bruschettini M, Romantsik O, Zappettini S, Ramenghi LA, Calevo MG. Transcutaneous carbon dioxide monitoring for the prevention of neonatal morbidity and mortality. Cochrane Database Syst Rev. 2016 Feb 13;2:CD011494
2. Hochwald O, Borenstein-Levin L, Dinur G, Jubran H, Ben-David S, Kugelman A. Continuous Noninvasive Carbon Dioxide Monitoring in Neonates: From Theory to Standard of Care. Pediatrics. 2019;144(1):e20183640
3. Mukhopadhyay S, Maurer R, Puopolo KM. Neonatal Transcutaneous Carbon Dioxide Monitoring--Effect on Clinical Management and Outcomes. Respir Care. 2016;61(1):90-7
4. Restrepo RD, Hirst KR, Wittnebel L, Wettstein R. AARC clinical practice guideline: transcutaneous monitoring of carbon dioxide and oxygen: 2012. Respiratory Care. 2012; 57(11):1955-62.
5. SenTec Transcutaneous Monitoring System Product Information and Website

FEEDBACK

Any feedback on this document should be sent to the Contact Officer listed on the front page.

APPENDIX 1

GLOSSARY & ABBREVIATIONS

Acronym or Term	Definition
CO_2	Carbon Dioxide
CPAP	Continuous Positive Airway Pressure
HNELHD	Hunter New England Local Health District
JHCH	John Hunter Children's Hospital
MAR	Multi-Site Attachment Ring
MAR-MI	Multi-Site Attachment Ring – Mature/Intact (skin)
MAR-SF	Multi-Site Attachment Rings – Sensitive/fragile (skin)
NICU	Neonatal Intensive Care Unit
O_2	Oxygen
SCU	Special Care Unit
TCM	Transcutaneous Monitoring
$TcPCO_2$	Transcutaneous Partial Pressure of Carbon Dioxide
$TcPO_2$	Transcutaneous Partial Pressure of Oxygen Dioxide