

Local Guideline and Procedure



John Hunter
Children's Hospital
CHILDREN, YOUNG PEOPLE AND FAMILIES



Health
Hunter New England
Local Health District

Monitoring of the Infant in NICU

Sites where Local Guideline and Procedure applies	Neonatal Intensive Care, Special Care and High Dependency Unit. 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 Neonatal clinical staff, who provide care to infants in NICU
Description	This guideline provides information about importance of monitoring and documenting baseline and ongoing observations to enable accurate assessment of the infant's condition and detection of deterioration.

[Hyperlink to Procedure](#)

Keywords	Assessment, blood pressure, cardiorespiratory, deterioration, monitor, oxygen saturations, vital signs, JHCH, NICU
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Replaces existing document?	No
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:	
	<ul style="list-style-type: none"> NSW Health Policy Directive 2014_036 Clinical Procedure Safety http://www0.health.nsw.gov.au/policies/pd/2014/pdf/PD2014_036.pdf NSW Health Policy PD 2005_406 Consent to Medical Treatment http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_406.pdf NSW Health Policy Directive PD 2007_036 Infection Control Policy http://www.health.nsw.gov.au/policies/pd/2007/pdf/PD2007_036.pdf
Prerequisites (if required)	Nil
Local Guideline and Procedure note	This document reflects what is currently regarded as safe and appropriate practice. The guideline section does not replace the need for the application of clinical judgment in respect to each individual patient but the procedure/s requires mandatory compliance . If staff believe that the procedure/s should not apply in a particular clinical situation they must seek advice from their unit manager/delegate and document the variance in the patients' health record.
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Note: Over time links in this document may cease working. Where this occurs please source the document in the PPG Directory at: <http://ppg.hne.health.nsw.gov.au/>

RISK STATEMENT

This local guideline has been developed to provide guidance to clinical staff in NICU to assist in assessment and management of the neonate by monitoring vital signs, growth parameters and general care observations. It ensures that the risks of harm to the infants when monitoring are identified and managed.

Any unplanned event resulting in, or with the potential for injury, damage or other loss to infants/staff/family as a result of this management must be reported through the Incident Information management System and managed in accordance with the Ministry of Health Policy Directive: Incident management PD2007_061. This would include unintended injury that results in disability, death or prolonged hospital stay.

Risk Category: Clinical Care & Patient Safety

GLOSSARY

Acronym or Term	Definition
AV	Atrio-ventricular
BP/MBP	Blood Pressure/Mean BP
CPG	Clinical Practice Guideline
ECG	Electrocardiograph
NICU/HDU/SCN	Neonatal intensive care unit/High Dependency Unit/Special Care Unit
O ₂	Oxygen
P,(Q,R,S complex), T	Points of transfer of electrical activity within the heart that generates heart beat
PVC	Premature ventricular contractions

Guideline Title - One Page Summary and Checklist

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GUIDELINE

This Guideline does not replace the need for the application of clinical judgment in respect to each individual patient.

Rationale

Monitoring of infants admitted to the NICU/HDU or SCN is vital, regardless of gestation or presentation. It is important for the nurse to observe and record

- baseline and ongoing observations to determine variance in condition
- changes in the infant's condition,
- recognition of early clinical deterioration - identified by the sudden change in the infant's behaviour or vital signs
- growth indicators-weight, head, length, fluid balance
- skin integrity to protect the infant from any further harm or errors.

It is essential to respond quickly with the appropriate treatment to prevent adverse outcomes for the infant (Elliot & Coventry 2012).

OUTCOMES

1	Variations from normal parameters for vital signs, pain scores, blood gas analysis and sugar results, growth / fluid balance and skin integrity monitoring from invasive devices are identified promptly for appropriate management
2	Early clinical deterioration of the infant is recognised
3	Appropriate management of the treatment required if an infant's observations are not within acceptable range
4	Understanding of who is monitored e.g. gestation, underlying conditions and clinical presentation
5	Maintaining safe use of equipment to monitor infants

Cardio respiratory monitoring

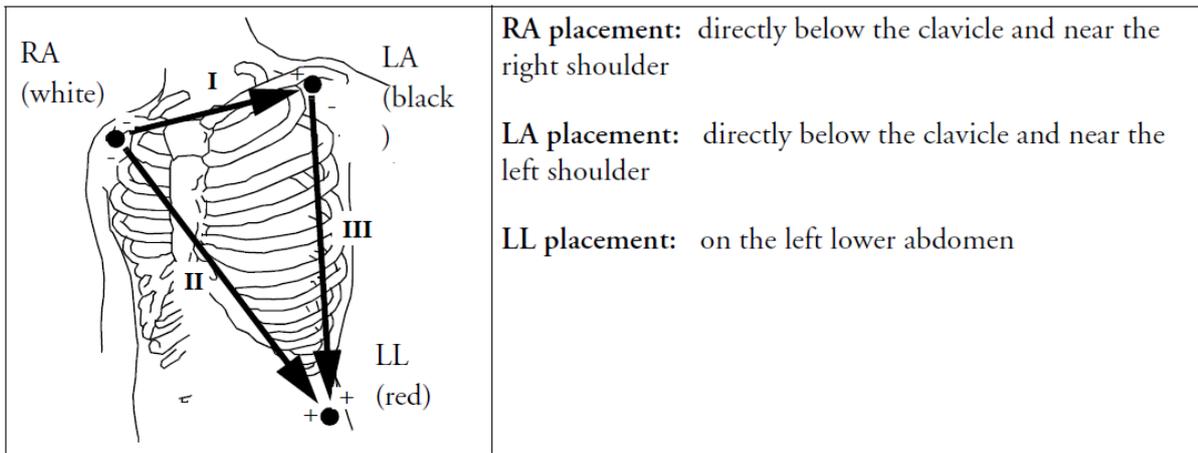
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The electrical activity of the infant's heart can be monitored by three leads placed on the infant's chest and connected to the monitor. These leads can record and display the infant's heart rate on the visual screen of the monitor along with an electrocardiographic waveform. It provides ability to visualise trends of heart rate over time, and monitors beat-to-beat variability.

The leads can also pick up the infant's respiratory pattern due to the chest leads electronically detecting chest movement with each respiration when placed on the infant correctly (Bradshaw & Tanaka 2011).

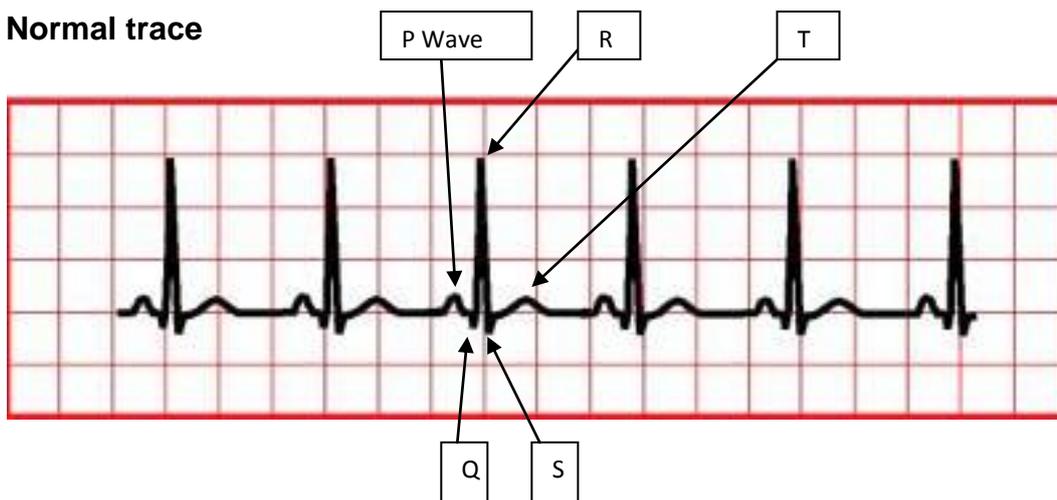
Note: It is good nursing practice to count the infant's heart rate and respiratory rate manually at commencement of shift to ensure good correlation with the monitor.

- The leads are placed on the infant on the right (RA) and left (LA) side of the chest and left (LL) lower abdomen.



Standard 3-lead placement (Phillips 2011)

- When placing the leads on the infant it is important to choose a flat and intact area of skin where the signal will not be interfered by either movement or bones and avoid using alcohol swabs as this can dry the skin and increase the resistance, (Phillips 2011).
- An acceptable and normal heart rate for the infant is between 120-160 beats per minute (bpm), (Karlsen 2013). It can vary between 80 to 200 bpm dependent on the infant's activity levels; for example an infant at rest will have a lower heart rate than an infant who is awake and alert, or crying.

Normal trace

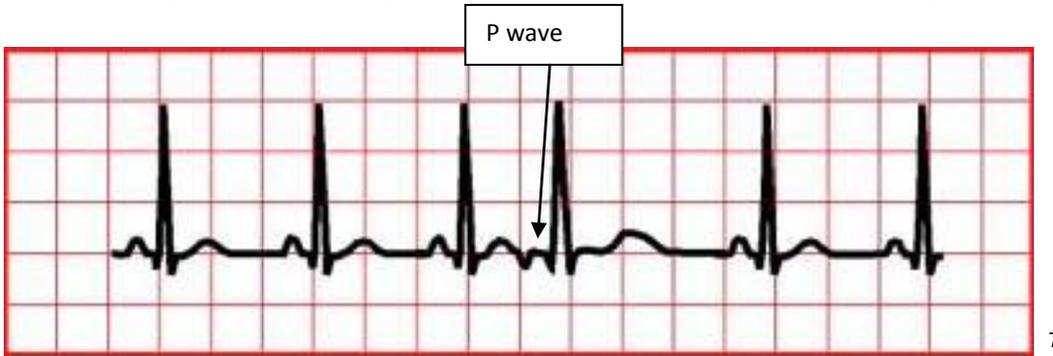
- Bradycardia is when the infant's heart rate is persistently < 100 bpm with signs of poor perfusion and tachycardia is when the infant's heart rate is persistently > 180bpm at rest (Karlsen 2013).
- If the infant experiences episodes of persistent bradycardia or tachycardia, inform the neonatologist, registrar, or nurse practitioner and team leader and have the infant reviewed. Consideration should also be given to an infant where the heart rate may be > 100 bpm but is persistently 20 above or below the infant's baseline heart rate.

Other Neonatal Arrhythmias

Disorders of the cardiac rhythm that are normally benign however on rare occasions may be life threatening. For this reason it is important for staff to identify if further investigations are required such as a 12 lead ECG.

Premature atrial contractions (PAC)

Premature atrial contractions-atrial beats (p waves) that occur earlier than the normal sinus beat-generally not significant and resolve in weeks following birth.



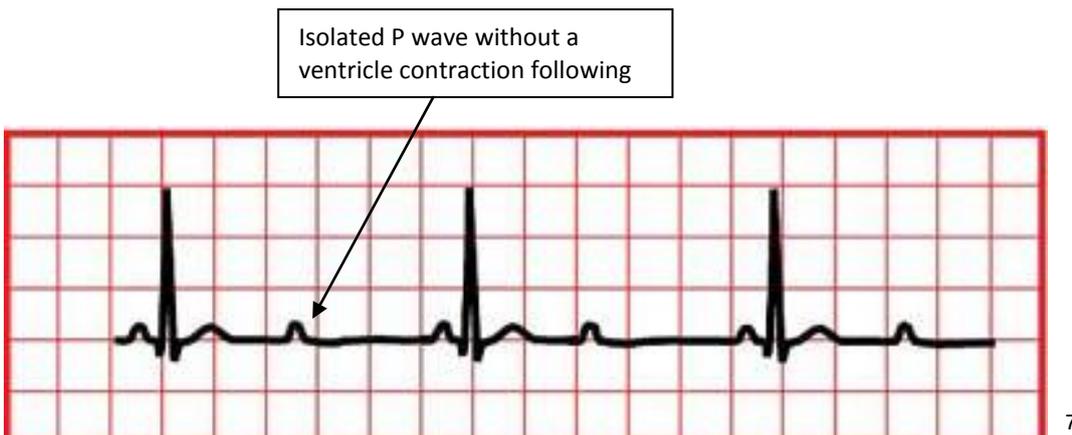
Premature Ventricular Contractions (PVC)

Less common than PACs-isolated events may occur in normal infant and require review if seen on ECG trace



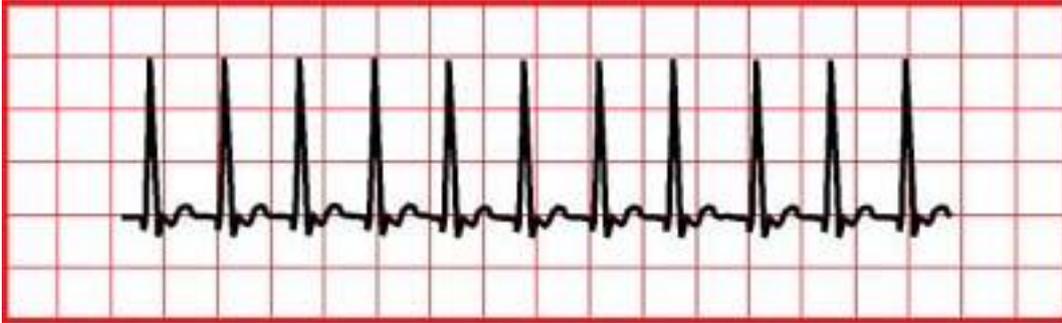
AV Block

This occurs when the conduction between the atria and the ventricles is either delayed or blocked. The sinus node may create a heartbeat causing the atria to contract however not all impulses are passed to the ventricle due to a block-various types of blocks may occur.



Supraventricular Tachycardia (SVT)

Shown as a rapid, regular rate of 230-300 beats/min with narrow QRS complexes, regular RR interval and absence of P waves-may start and cease abruptly. Most common form of tachycardia in the neonate and if not resolved or treated may lead to heart failure.



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<http://www.pedcard.rush.edu/PP/abnl%20rhythm%20for%20parents%20body.htm>

Oxygen saturation monitoring

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- The oxygen saturation is the percentage of hemoglobin transporting oxygen (O₂) (Karlsen 2013).
- By using a pulse oximeter the oxygen saturation levels can be monitored by placing the sensor on the infant's hand, wrist or foot (Bradshaw & Tanaka 2011).
- The oximetry sensor consists of sources of red & near infra red light and a photoreceptor which allows estimation of the amount of oxyHb in the arterial blood (Karlsen 2013), and is displayed on the monitor as a percentage of O₂ saturation.
- The light source and the receptor must be directly opposite each other over the area such as the finger, toe, foot or wrist whereby a pulse can be detected.
- The target range for oxygen saturations for all infants whether they have an oxygen requirement or not is between 90-94 % with the alarm limits set on the monitor between 88-96% (Stenson, Brocklehurst & Tarnow-Mordi 2011).
- Once an infant has been weaned to air, the higher alarm limit can be turned off (Stenson, Brocklehurst & Tarnow-Mordi 2011).

100	
97	
96	Alarm limit set
95	
94	TARGET ZONE
90	
89	
88	Alarm Limit set
87	

- If the infant is not reaching the target range despite an increased oxygen supply, increasing PEEP or ventilator settings, repositioning or suctioning, the infant should be reviewed by a medical officer or neonatal nurse practitioner (Stenson, Brocklehurst & Tarnow-Mordi 2011).
- At no point should the lower or higher alarm limit be turned off if infant is still requiring extra oxygen unless ordered and documented by the treating physician or nurse practitioner in the patient's medical charts (Stenson, Brocklehurst & Tarnow-Mordi 2011).

Note: The pulse oximeter sensor will also display a pulse rate on the monitor, if the infant has cardio respiratory monitoring compare the two heart rates to ensure they match and that the sensor is attached correctly.

Non-invasive blood pressure monitoring

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The infant's blood pressure can be monitored by either peripheral or umbilical continuous indwelling arterial catheter via a transducer/monitor (invasive) or by oscillometric method whereby a non-invasive blood pressure cuff is used on the infant's upper limbs.

The accuracy of BP measurements is dependent on technique (location of measurement, invasive, device) and this aspect deserves attention when considering treatment. The systolic pressure is the amount of pressure that blood exerts on arteries and vessels while the heart is beating, whereas the mean pressure is the average arterial pressure during a single cardiac cycle. Determinants of BP are stroke volume and arterial wall compliance (stiffness), and interactions between the two can vary depending on the physiological situation. Mean BP does not provide information about pulse pressure (systolic pressure - diastolic pressure), and might not reveal clues to certain underlying pathology.

Normal BP values are not easy to obtain in very preterm infants, as many would receive support that could influence cardiovascular function. BP is dependent on gestational age, and gradually increases over the first days of life. Table 2 provides a guide to the lowest centiles of BP values found in newborn infants. Refer to CPG 'Hypotension and poor circulation in neonates' JHCH_ICU_13.04 2015 for further information.

Guide to acceptable ranges for Systolic, Mean and Diastolic blood pressure

Table 1 is compiled using rounded data from studies by Hegyi 1996, Neonatal Nurse initiative UK 1999, Pejova 2006, Kent 2007 and Kent 2009. Measurements in the infants over 1000 gram are mostly done using oscillometry in selected 'well' babies, meaning no cardiovascular support and no mechanical ventilation.

Measurement	Weight	Gestation	Day1	Day2	Day7	Day 30
<i>Systolic</i> <i>Mean</i> <i>Diastolic</i>	>2500 gram	> 34wk	50-70 40-55 30-45	60-80 45-60 35-50	60-90 45-60 40-50	70-90 50-65 45-55
<i>Systolic</i> <i>Mean</i> <i>Diastolic</i>	1500 to 2500 gram	30-34wk	45-55 35-40 30-35	55-65 40-50 30-40	60-75 45-55 35-45	65-80 50-60 40-55
<i>Systolic</i> <i>Mean</i> <i>Diastolic</i>	1000- 1500 grams	27-30wk	40-60 27-45 25-35	40-60 30-50 25-35	50-65 35-50 25-35	55-80 40-55 25-45

Lowest percentiles of blood pressure (in mmHg) in newborn infants.

Gestation	Systolic	Mean	Diastolic
< 28 wk	36-38	24-28	
28-29 wk	42	33	25
30-35 wk	49	35	28
≥ 36 wk	57	40	30

(CPG 'Hypotension and poor circulation in neonates' JHCH_NICU_13.04 2015)

A low blood pressure after the transition, or a drop in blood pressure, is ALWAYS abnormal, even if perfusion is apparently normal with clinical examination.

To select the correct cuff, measure the infants upper arm circumference then follow the manufacturer's recommendations for the correct cuff size (Karlsen 2013).

Philips® (2011) recommends

- size 1 for measurements of 3.1-5.7cm,
- size 2 for measurements of 4.3-8.0cm,
- size 3 for 5.8-10.9cm,
- size 4 for 7.1-13.1cm and
- size 5 for 10.0-15.0cm.

An undersized cuff can result in a false high blood pressure reading and a cuff that is oversized can result in a false low blood pressure reading, so it is important to select and measure correctly (Karlsen 2013).

Most neonatal caregivers use a common practice where the mean arterial blood pressure is similar to their gestational age. For example an infant born at 26 weeks gestation neonatal care givers would aim for a mean arterial blood pressure of around 26mmHg in the first few days of life and for a term infant born at 40 weeks gestation neonatal caregivers would aim for a mean arterial blood pressure of around 40mmHg (Karlsen 2013).

There is controversy over the definition of Hypotension in a preterm, late preterm and term infant and how active to be in treating a low blood pressure in an otherwise stable infant. The decision for treatment should be based on the general condition of the infant, not on the mean arterial blood pressure alone.

If the infant's mean blood pressure is persistently below of above the infant's gestation in conjunction with other deteriorating clinical signs such as infant's decreased perfusion, inform doctor, registrar, resident and nurse practitioner and have the infant reviewed (Karlsen 2013).

Note: * refer to CPG "Hypotension and poor circulation in neonates JHCH_NICU_13.04 2015", CPG '[Umbilical lines in NICU](#)' JHCH_NICU_10.03 2015 & CPG 'Peripheral arterial line in NICU-insertion, care and removal of' 5.5.2, 2011

Transcutaneous oxygen and carbon dioxide monitoring

Indications may include

- Any baby on mechanical ventilation
- Any baby whom the Neonatologist has requested >4 gases in a day

Set the transducer temperature according to the infant's age and gestation

- <43°C for infants born <27/40, and < 2 weeks of age.
- 43 - 44°C for all other infants

Refer to CPG "[Transcutaneous Oxygen/Carbon Dioxide Monitoring in NICU](#) JHCH_NICU_12.05" for further information

Pain Assessment Monitoring

Assessment and recording of the infant's pain score is important so that adequate pain relief measures can be implemented. Refer to CPG "Assessment and management of Pain in the Neonate" JHCH_NICU_03.07 for further information.

Growth Assessment and Monitoring

Growth parameters such as **weight, head circumference and length** are important measures for assessment of caloric intake and nutritional status. Weighing an infant regularly ensures fluids and calories are administered to provide optimal weight gain.

All babies in NICU and SCN are weighed every 2nd day (unless requested by neonatologist for more frequent weighs e.g. ELBW infant). Plotting on a weekly chart for **weight and head circumference** may help to reduce the incidence of postnatal growth restriction and improve long term neurodevelopmental outcomes⁸. **Length** is only measured on discharge (unless infant under care of gastroenterologist team and may request more regular length measurements).

Blood Sugar Level (BSL) monitoring Term infants require about 4-6 mg/kg/min (preterm 6-8 mg/kg/min) of glucose to ensure that the processes of glycogenolysis and gluconeogenesis match the rate of glucose utilisation. Monitoring the blood sugar (BSL) levels are collected every 6-8 hours for up to 48-72 hours of age and then daily till enteral feeds are at 120ml/kg/day. Refer to CPG "[Parenteral Nutrition in NICU. JHCH NICU 09.02](#)" and "[Hypoglycaemia Screening and Management JHCH NICU 16.01](#)" for further information about monitoring BSLs.

Monitoring wavelength of phototherapy lights

The Ohmeda BiliBlanket Meter provides a quick and reliable measure of light from phototherapy systems used in the NICU/SCU. It is to be used to record the overall irradiance a baby is receiving whilst receiving phototherapy.

The purpose of this is to ensure the delivery of phototherapy achieves an average irradiance reading of 25 μ W.cm²/nm.

This measurement is to be taken once a shift or when phototherapy lights are added to, removed or changed. Refer to Appendix 1 in "Phototherapy in NICU and Postnatal wards", JHH JHCH_NICU_16.04. Record on the phototherapy chart in the box at the bottom of the chart corresponding to the day

Respiratory Support Monitoring

Types of respiratory support are documented on the infant's flow chart. The Fabian ventilator parameters continuously monitor and display on the screen to ensure that optimal ventilation is being provided to the infant. It is important to document the settings at the commencement of the shift in red as well as changes, and otherwise record hourly the current settings for ventilation type, oxygen %, PIP/PEEP, HFOV settings (Hertz & Amplitude), flow, trigger, backup rate, MAP, Inspiratory time, waveform, minute and tidal volume and airway temperature provided. The ventilator settings to record are those applicable to the ventilation type the infant requires.

Arterial Blood gas (ABG) collection times are dependent on clinical condition and request from the Neonatologist.

Orogastric tube position is important to monitor as migration or incorrect positioning can cause vomiting, feed intolerance and vagal response such as apnoeas and bradycardic episodes.

Measurement should be recorded on observation chart at time of insertion and thereafter confirmed and recorded every shift. Refer to CPG "[Enteral Feeding initiation, progression and methods. JHCH NICU 09.01](#)" for further information.

When to Monitor

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Admission

All infants admitted to NICU or SCN require a baseline set of vital signs which includes

- axillary temperature
- heart rate
- respirations
- oxygen saturation
- BP –measuring the systolic, diastolic and mean

Weight and Head Circumference

Type of ventilation and % of oxygen recorded on flow chart

Ongoing monitoring –NICU

Temperature

- apply a servo temperature probe under the axilla following admission-continue to do PA temp until good correlation with servo probe
- **Take PA temp each cares** to ensure good correlation with servo control temp probe measurement temperature
- If temperature reading outside normal values continue to monitor hourly until temperature returns to normal range -document the changes in practice that are made to improve the temperature
- **Servo temp** measurement will allow continuous monitoring of temperature -**record temperature on the observation chart hourly as well as the temperature set, and environmental temperature required to maintain the set temperature**
- Important to have temperature probe attached and servo control set when 'Natus neo blue mini' phototherapy lights in use to prevent the infant over heating
- The servo probe should be repositioned at least on a daily basis to reduce the risk of pressure marks occurring. Refer to CPG "[Thermoregulation of the Neonate in NICU JHCH NICU 04.02](#)" for further information.

Continuous monitoring of HR and respiration

- Cardiorespiratory monitoring with ECG leads allow for continuous monitoring of the heart rate and respirations.
- Auscultate the apex of the heart to count the heart rate for a full minute ensure monitor correlating- attend to this at least once or twice a shift. Listen for a minute to allow sufficient time to distinguish abnormal heart sounds e.g. murmurs or shunts.
- Record the heart rate **hourly** on the flow chart
- Count the respirations for a minute when the infant is at rest. This also provides an opportunity to observe the work of breathing, e.g. retractions, recession, periodic breathing.
- Record the respirations **hourly**.

Oxygen saturation monitoring

- Probe once applied provides a continuous reading for oxygen saturation levels
- Record the reading **hourly** on the flow chart
- Each observation of either preterm, late preterm or term infant is to be evaluated regularly so deviations from normal are detected and appropriate treatment is applied
- Reposition probe with cares every 3-4 hours to check site and optimize skin integrity

Blood Pressure

- Continuous if arterial line insitu and document **hourly** on flow chart
- If no arterial line insitu but infant on inotropes, suspected blood loss or hypovolaemia, difficult oxygenation, post significant hypoxic event , on mechanical ventilator support , or any baby deemed 'unstable' or significantly ill monitor 1/24 manual BPs.
- Ensure skin integrity checked regularly if manual cuff measurement required hourly
- All other infants attend to BP once a shift
- Daily BPs for high dependency babies in NICU following Neonatologist review

Ongoing monitoring –SCN

- PA temperature with cares & pre and post bath
- If temperature reading outside normal values continue to monitor hourly until temperature returns to normal range -document the changes in practice that are made to improve the temperature
- Heart rate and respirations-with cares- 3-4/24 or continuous HR & RR monitoring for all babies <35 weeks
- Daily BP until reviewed on ward rounds-document in flow chart when change made to monitoring

- Consider applying a temperature probe set on servo control for infants receiving phototherapy treatment on an open care cot to monitor temperature

Oxygen saturation monitoring

- All babies requiring oxygen therapy or HPCPAP to have continuous saturation monitoring, cardiac and respiratory monitoring and recording of vital signs 3/24
- Clinical team to decide when to cease observations

SCN infants in an incubator

- Babies to be assessed on an individual basis for their monitoring requirements
- Attach to monitor and record and document HR, RR and saturations until reviewed
- Maintain neutral thermal zone and monitor PA temperatures, particularly if nursed in a Drager incubator, as not able to set servo control

When to cease doing observations

- To discuss on ward round
- Continuous HR & RR can be ceased at 35weeks if there has been 5-7 days with no stimulated episodes bradycardia or apnoea and a minimum 5 days after ceasing caffeine

How to document

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- All observations are recorded and documented on the intensive care/special care observations flow chart located at each bedside.
- Demonstrates the changes which occur and the time.
- Be aware of the trending of the result not the actual result when documenting on flow chart
- If observations change and an intervention is required, it is important to document in the infant's notes as well as the observation chart.

Procedure

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1. Wash hands with water and soap or apply alcohol hand gel before and after each infant
2. Apply each apparatus to the infant as indicated above
3. Connect each apparatus to the monitor
4. Ensure an accurate signal of each apparatus is obtained
5. Check sites of each area where each apparatus is positioned, for bruises, pressure marks or burns
6. Change site positions as necessary
7. Maintain minimal artifact stimuli, making sure each apparatus is secured correctly
8. Ensure the alarm limits are set for each apparatus

Equipment

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- Echocardiograph leads
- Oximeter probe
- Appropriate sized blood pressure cuff
- Phillips™ Monitor
- Giraffe scales or portable scales in SCN
- Paper tape measure
- Pain score tool
- Ohmeda BiliBlanket Meter

References

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