

## Nasal Intermittent Positive Pressure Ventilation in Newborn Intensive Care Unit

### Procedure Responsibilities and Authorisation

<b>Department Responsible for Procedure</b>	Neonatal Intensive Care Unit
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<b>Target Audience</b>	NICU medical and nursing staff
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### Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
1	Arun Nair, SMO NICU and Aira Javier, ACNM NICU	Feb 2020	New procedure
2	Arun Nair, SMO NICU and Aira Javier, ACNM NICU	Aug 2022	New Ventilator SLE6000, review of practice

## Nasal Intermittent Positive Pressure Ventilation in Newborn Intensive Care Unit

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## Nasal Intermittent Positive Pressure Ventilation in Newborn Intensive Care Unit

### 1 Overview

#### 1.1 Purpose

The purpose of this procedure is to guide staff in the use of Nasal Intermittent Positive Pressure Ventilation (NIPPV) to increase extubation success in preterm infants as an alternative to Nasal Continuous Positive Airways Pressure (nCPAP).

#### 1.2 Overview

Nasal Intermittent Positive Pressure Ventilation (NIPPV) superimposes an intermittent peak pressure on CPAP and is delivered to the infant with a ventilator SLE6000. NIPPV can be achieved by a combination of PEEP and PIP and respiratory rate.

NIPPV, in particular when synchronized, improves extubation success in preterm infants, but does not seem to be beneficial for the primary treatment of RDS. NIPPV does not reduce the rate of death or BPD.

NIPPV is NOT a replacement for endotracheal ventilation, it should be seen as alternative to nCPAP. Sepsis and other pathologies should always be considered in infants with increased work of breathing or other respiratory deterioration. Intubation should be considered for these infants.

#### 1.3 Scope

Medical and nursing staff working in the Neonatal Intensive Care Unit (NICU)

#### 1.4 Patient / client group

NIPPV can be considered for infants after extubation with previous unsuccessful extubation attempts and/or on-going apnoeas or to avoid intubation. Those infants should be treated with an optimised dose of caffeine citrate ( $\geq 10$  mg/kg/day)

[Caffeine Citrate for neonates](#) (Ref 0591)

A high or increasing pCO<sub>2</sub> level is a sign of hypoventilation. NIPPV might not sufficiently increase tidal volume, and intubation and ventilation should be considered for infants with high or increasing pCO<sub>2</sub>.

#### 1.5 Exceptions / contraindications

Any contraindications to CPAP is applicable to NIPPV.

#### 1.6 Definitions

<b>BPD</b>	Bronchopulmonary Dysplasia
<b>BPM</b>	Breath per minute
<b>CMV</b>	Continuous Mandatory Ventilation

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<b>CPAP</b>	Continuous Positive Airway Pressure
<b>ELBW</b>	Extremely Low Birth Weight
<b>ETT</b>	Endotracheal Tube
<b>NBM</b>	Nil by mouth
<b>NEC</b>	Necrotising Enterocolitis
<b>NIPPV</b>	Nasal Intermittent Positive Pressure Ventilation
<b>NIPPV Tr</b>	Triggered NIPPV. Adds a Triggered NIPPV mode to the ventilator using a proximal pressure trigger to initiate patient-driven pressure supported breaths in dual-limb mode
<b>NIV</b>	Non-Invasive Ventilation
<b>OGT</b>	Orogastric tube
<b>PEEP</b>	Positive End Expiratory Pressure
<b>PIP</b>	Peak Inspiratory Pressure
<b>RDS</b>	Respiratory Distress Syndrome

## 2 Clinical Management

### 2.1 Competency required

Registered nurse who has completed Level 3 (NICU) ventilator orientation

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**2.2 Procedure**

We are using SLE6000 Ventilator for provision of NIPPV



Figure 1

**2.2.1 NIPPV Set-Up**

There are two circuit options available on SLE6000 ventilator – NIV Single limb & NIV dual limb. Use Dual limb option for the NIPPV with F& P interface.



Figure 2. Dual Limb set up for F& P interface

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Remove flow sensor cable for NIPPV.

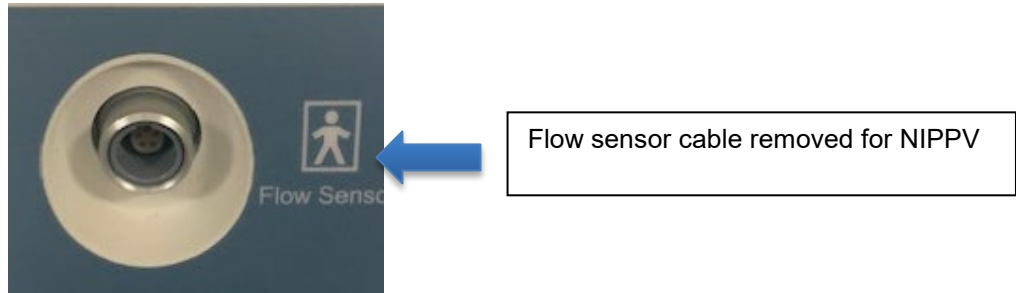


Figure 3

Ensure all equipment for NIPPV is available prior to commencement/ extubation (including mask and headgear).

Provide IPPV via Neopuff as needed.

### 2.2.2 NIPPV Settings:

For details check <https://www.youtube.com/watch?v=LJXnt1BOiJc>

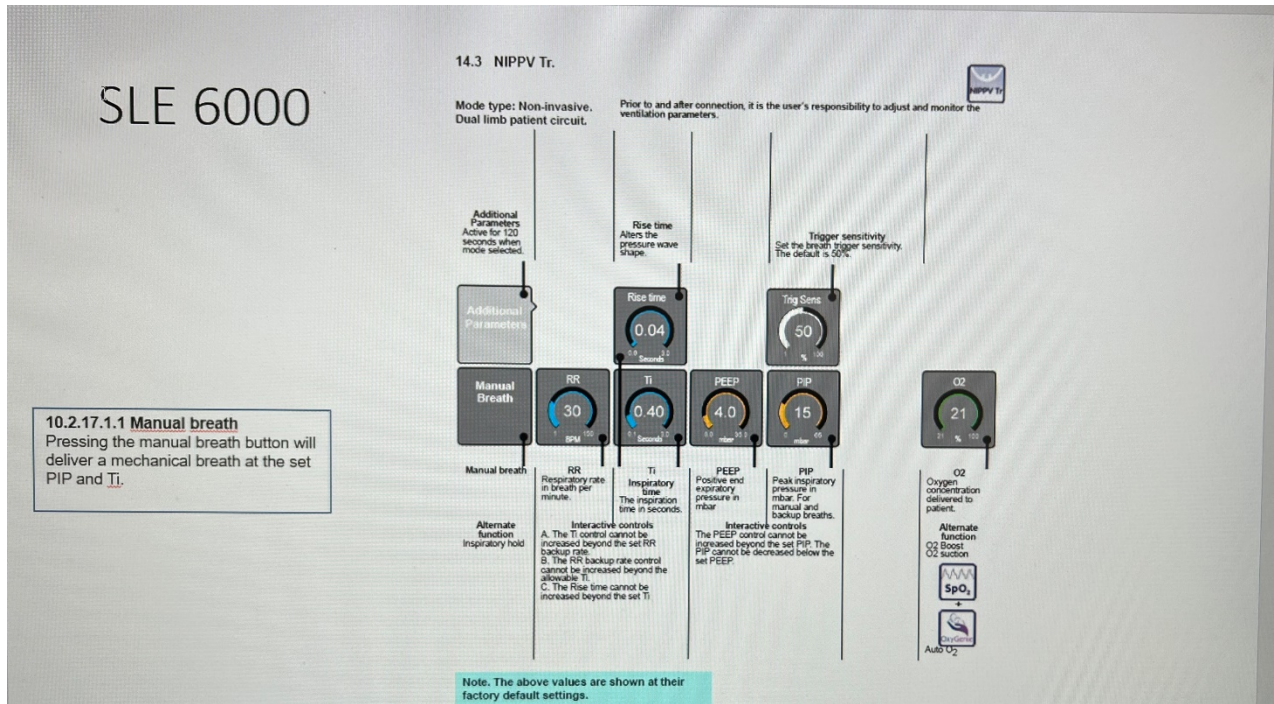


Figure 4

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<b>Ventilator &amp; Mode</b>	SLE6000, Non-invasive mode then select NIPPV Tr (synchronised trigger NIPPV)
<b>Peak Inspiratory Pressure (PIP)</b>	14 - 20 cm H <sub>2</sub> O, in discussion with a consultant may be increased to 24 cm H <sub>2</sub> O as required In NIPPV Tr <b>all</b> breaths are supported to set PIP.
<b>Positive End Expiratory Pressure (PEEP)</b>	5-10 cm H <sub>2</sub> O  Note: Changes to PIP and PEEP settings should be discussed with SMO and charted by the medical team  <b>Initially aim to achieve same mean airway pressure (MAP) as when on CPAP</b>
<b>Respiratory Rate (RR)</b>	This is a back-up rate for apnoeas. 20-30 breaths/min, not higher than spontaneous respiratory rate It is important that the backup rate in NIPPV TR is about 10-15 BPM lower than the babies actual rate which will minimise patient effort and risk of ventilator asynchrony. In discussion with a consultant. Higher rates than this may result in desynchronization. The ventilator would provide the set rate in case there is no spontaneous breath detected. If the pCO <sub>2</sub> is rising, increase the PIP instead of the rate.
<b>Inspiratory time (Ti)</b>	0.3-0.5s, similar to Ti on the ventilator (starting point approximately 1/3 of inspiratory time)  For <26/40 - short Ti (0.3) to match respiratory time constants
<b>Trigger &amp; Trigger Sensitivity Setting</b>	This is the default mode in NICU Waikato.. Trigger is used to augment the spontaneous breath, all breaths will be supported and are synchronised. NIPPV <b>without</b> trigger does not synchronise the breaths, manual breath option can be used to give additional supported breath.  Set trigger sensitivity to 100% and only reduce if there is auto cycling. Higher numbers are more sensitive (this is the opposite to invasive ventilation).

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	Initially set Highest trigger sensitivity and then adjust the level as per needs based on the clinical assessment of work of breathing and blood gases, the lowest level is as good as being not on trigger)
<b>Rise time</b>	Default set at 0.04 sec ( there is no need to alter this)
<b>Alarm Setting</b>	Automatically set based on the PIP and PEEP setting. Can be altered if needed (see SLE6000 user guide). <u>Note:</u> The Apnoea alarm is Off as default, this needs to be manually set up.
<b>Flow &amp; Flow Sensor</b>	Flow is Auto set by the SLE6000 ventilator. <u>Note:</u> Flow sensor at the proximal airway (hotwire) is not utilised in NIPPV and is removed from the circuit. Flow is measured within the ventilator.
<b>FiO2</b>	Set as required. <u>Note:</u> OxyGenie can be used in NIPPV Tr mode as well
<b>Weaning</b>	Wean PIP first May change to CPAP when deemed clinically stable.

### 2.2.3 Maintenance of NIPPV

<b>High/low pCO<sub>2</sub></b>	NIPPV is <b>NOT</b> a replacement for endotracheal ventilation. If the infant is deteriorating, intubate and ventilate. For NIPPV, there is minimal evidence in regards to the effect of adjusting pressures and rates; however, you may adjust the settings to the maximum allowed PIP before resorting to invasive ventilation. Increasing the respiratory rate should not be utilised for elevated pCO <sub>2</sub>
<b>O<sub>2</sub> concentration adjustment</b>	This is done manually on the ventilator, unless on OxyGenie
<b>Documentation/ Charting</b>	Prescribe on NICU General Treatment Sheet (T1481HWF), NICU Respiratory Flow Chart (A1743HWF) and document in 'Level Three' respiratory chart (A1301HWF). Ventilator mode is charted as NIPPV Tr to document it is not ventilation through an endotracheal tube.



## Nasal Intermittent Positive Pressure Ventilation in Newborn Intensive Care Unit

<b>Observations</b>	Observe respiratory effort, pattern Regularly check correct placement of prongs/ mask. Regular/daily review of RR histogram and SpO2 histogram is recommended
<b>Recordings</b>	Record FiO <sub>2</sub> (plus reference range) respiratory rate, pressures (PIP, PEEP and MAP), Ti and flow as well as vital signs hourly as per usual for 'Level Three' chart. Also document whether baby is using Prongs or Mask in Level Three Observation Chart.
<b>Gastric Tube</b>	A gastric tube needs to be in place and should be left on free drainage if NBM while the baby is on NIPPV. Consider using 8Fr tube if baby has significant gastric distension . Decompress gastric tube in between bolus feeds or insert another gastric tube for venting if on continuous gastric feeds.
<b>Suctioning</b>	Same as for babies on CPAP; special considerations for ELBW babies <a href="#">Extremely Low Birth Weight (ELBW) Bundle of Care for Prevention of Intra Ventricular Haemorrhage (IVH)</a> Ref 6240
<b>Kangaroo Care</b>	The same considerations for babies on CPAP; special considerations for ELBW babies <a href="#">Extremely Low Birth Weight (ELBW) Bundle of Care for Prevention of Intra Ventricular Haemorrhage (IVH)</a> Ref 6240

### 2.2.4 Troubleshooting NIPPV

**Cycle Fail Alarm** The cycle fail alarm threshold autotracks the PIP parameter. This is triggered when set PIP value is close or equal (0 to 5 mbar) to PEEP or CPAP value. **This alarm cannot be disabled** as this is a safety feature.

**Low Pressure** This is triggered when PIP or PEEP is below the set pressure alarm limits.

#### **Actions for Cycle Fail Alarm/ Low Pressure Alarm:**

- Check for tubing disconnection or leak in circuit.
- Ensure prong/mask is the correct size for infant and is properly fitted/ positioned.
- Consider using a duoderm patch for prongs to improve seal, and/or
- Use a second chin strap (blue chinstrap more preferable)
- For **Low Pressure Alarms**, **DO NOT** alter default PIP/PEEP pressure alarm settings on ventilator without discussing with medical team.

## Nasal Intermittent Positive Pressure Ventilation in Newborn Intensive Care Unit

### 2.3 Potential complications

Complications are similar to treatment with CPAP. Appropriate nursing care should prevent nasal septal erosion and nasal obstruction. The risk of nasal septal damage should be prevented with careful positioning of the prongs, close monitoring, or alternating with a CPAP mask. A nasopharyngeal airway is an alternative option to nasal prongs (see 'Nasopharyngeal CPAP') [Continuous Positive Airway Pressure \(CPAP\) - Management in NICU](#) (Ref 4939). However, studies have shown that for CPAP, short binasal prongs are more effective at preventing reintubation than single nasopharyngeal prongs.

Settling the infant can be difficult and time consuming. Make sure the prongs are in a good position and that the infant is positioned comfortably. Consider alternating prongs with mask and try non-pharmacologic comfort measures.

There have been concerns regarding NEC, feed intolerance, and intestinal perforation in association with NIPPV, but a recent Cochrane review could not confirm this<sup>2</sup>. Given that the airway pressures with NIPPV are higher than those given with CPAP, a gastric tube needs to be in place for gastric decompression while the infant is on NIPPV.

### 2.4 After care

Discard used equipment.

## 3 Audit

### 3.1 Indicators

- Documented assessments and observations are available for all infants on NIPPV for every shift
- Re-intubation after commencement of NIPPV.

## 4 Evidence base

### 4.1 Bibliography

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14. The Starship Guideline for NIPPV; <https://www.starship.org.nz/guidelines/nasal-intermittent-positive-pressure-ventilation-nippv>
15. Neonatal Handbook. Christchurch Women's Hospital – update 2022.
16. SLE 6000 handbook

### 4.2 Associated Te Whatu Ora Waikato Documents

- [Extremely Low Birth Weight \(ELBW\) Bundle of Care for Prevention of Intra Ventricular Haemorrhage \(IVH\)](#) (Ref. 6240)
- [Continuous Positive Airway Pressure Nursing Management in Newborn Intensive Care Unit \(NICU\)](#) procedure (Ref. 4939)
- NICU General Treatment Sheet T1481HWF
- NICU Respiratory Flow Chart A1743HWF
- Level Three – Respiratory Chart A1301HWF

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