BIPAP

(Bi-level Positive Airway Pressure)

Self Instructional Learning Package

BCCH Acute Inpatient Units
**What is BiPAP?**

One of the most utilized forms of non invasive ventilation utilized in pediatric care is:

**BiPAP: Bi-level Positive Airway Pressure.**

Non-invasive positive pressure ventilator support is a technology utilized to augment alveolar ventilation for prescribed periods without an artificial airway.

**Why would a pediatric patient need BiPAP?**

Different pediatric patients require the use of BiPAP for different reasons, some of the most common indications are:

- Airway obstruction
- Increased work of breathing due to pulmonary congestion
- Muscle weakness leading to inadequate respirations
- Restrictive lung disease leading to poor lung expansion
- Poor lung compliance leading to poor lung expansion
- Obesity and cardiac failure

On the acute care units at BC Children’s Hospital, Non-Invasive Positive Pressure Ventilation (BiPAP) may be delivered to patients established on home BiPAP program that are considered to be **clinically stable on the acute inpatient areas.**

**BiPAP is not to be initiated as a new treatment for escalation of care on the acute inpatient areas at BC Children’s Hospital**

Some contraindications for BiPAP include patients who have:

- Pneumothorax
- DO NOT have a respiratory drive to breath
- Upper gastrointestinal bleeding
- Recent gastric or esophageal surgery
- Tracheostomy or other airway disorders
How Does BIPAP Work?

A BIPAP machine is a relatively small device. Children’s Hospital and most children in the community use the Synchrony BIPAP machine (type I or II):

It is connected by flexible tubing to a face mask worn by the patient:

Patients at BC Children’s Hospital using a BIPAP machine will have a pre-printed order set that will outline the machine settings and patient care parameters. (see appendix)
**BIPAP Principles and Operation:**

A BIPAP machine is programmed to assist a patient’s spontaneous respirations by delivering a flow of air at two different pressures:

- positive pressure on inspiration (IPAP – Inspiratory Positive Airway Pressure) and
- positive pressure on expiration (EPAP – Expiratory Positive Airway Pressure).

In this way the BIPAP machine helps the patient to push air and oxygen into their lungs and then helps to maintain airway patency, thereby allowing more oxygen to diffuse to the pulmonary circulation.

**BIPAP Modes**
The mode controls how the BIPAP machine works to assist breathing.

The S or Spontaneous mode offers support to the breaths the patient takes on his/her own.

The CPAP or Continuous Positive Airway Pressure mode supports spontaneous respirations by providing one continuous positive pressure on inspiration and expiration.

The S/T or Spontaneous/Timed mode offers a combination of machine delivered breaths (set respiratory rate) and spontaneous (patient triggered) assisted breaths.

**BIPAP Settings**

**IPAP** – Inspiratory Positive Airway Pressure is the positive pressure generated during inspiration allows the child to take a deeper breath than he or she would normally.

**EPAP** – Expiratory Positive Airway Pressure is the positive pressure generated during expiration helps to splint open the upper airway, maintain the necessary resting volume in the lungs at end of expiration and helps to avoid secretion build up and collapse. If this resting volume is maintained, the lungs will also expand better.

**RR** - Respiratory Rate is the number of breaths the machine will deliver regardless of patient effort.

**Ti** - Inspiratory Time is the length of time it takes for a “breath” to be delivered.

**The Rise** - is a function of how quickly the BIPAP machine will go from the EPAP pressure to the IPAP pressure during inspiration.
**BIPAP Setup, Monitoring and Clinical Decision Making:**

At BC Children’s Hospital, physicians, Registered Nurses (RNs) and Respiratory Therapists (RT) will work together to care for children using BIPAP and provide patient and family teaching specific to the disease process and plan of care:

- The physician will order the BIPAP settings and care via the preprinted orders: Non Invasive Ventilation – Bilevel Positive Airway Pressure (BiPAP)
- The Respiratory Therapist will set up, turn on and take off the BIPAP. They will also discuss the patient’s care on BIPAP at the start of each shift with the RN and monitor the BIPAP every 3 hours.
- The RN is responsible for the overall care of the child, assessing and monitoring the child while they are on BIPAP. They will identify, document and inform the physician and RT if problems and/or escalation of patient care occur.

1. Together, the RN and RT will assemble the circuit and put mask on the patient, adjusting the head gear. Bottom straps should be secured first and then the top straps. You should be able to get one finger underneath each strap.
2. The RT will turn the machine on and, with the RN, will check for appropriate settings and attach tubing to the mask.
3. You should feel some air leaking from the mask. In case of unintentional leaks (eg. air directed at child’s eyes), try adjusting the mask on the child’s face ensuring it is not pushing into their eyes or mouth.
4. Sometimes a chin strap will help if there is too much air escaping from the mouth. If using a chin strap, secure lightly to jaw bone only to prevent the child’s tongue from obstructing the airway.

NOTE: *over tightening can cause more leaks and pressure sores*
**Patient Care and Safety:**

**Equipment Setting and Alarms:**

This information will be validated in the clinical setting.

RTs will discuss the patient’s care with the RN at the beginning of the shift and will monitor the BIPAP every 3 hours. RTs will be available by pager for concerns and/or questions.

RNs will be familiar with BIPAP machine settings and alarms, by completing the following

- Read through the attached appendix for instructions on how to obtain the machine information.
- Complete a BIPAP Clinical Skill Validation: Noninvasive Ventilation

RNs and RTs will work together to optimize the care of patients using BIPAP, trouble shoot problems and care for equipment.

**Possible complications of BIPAP:**

- **Skin Breakdown**- check mask fit, the RT may try an alternate mask. Place duoderm over area of breakdown.
- **Eye Irritation**- check for leaks and mask pressure around eyes and refit as appropriate.
- **Sinus Congestion**- check mask tightness, RT may consider adding humidification to BIPAP, or increasing the temperature of the humidity. Consult physician to discuss adequate fluid intake and/or consider Otrivin nasal spray.
- **Oro/nasal Drying**- see information for sinus congestion.
- **Patient Discomfort with Ventilation**- Contact RT and physician to discuss ventilator settings.
- **Gastric Distension**- If noted, inform physician and discuss placement of NG or OG tube for air venting.
- **Aspiration**- Contact physician to assess feeding parameters.

**Set up Precautions:**

1. Do not block air intake filter.
2. Should the power go out while the BIPAP is on, take the mask off.
3. Do not block exhalation port or built in leaks on mask.

*All masks require an exhalation port attachment or a built in leak in order for CO2 to escape.
**BIPAP Equipment Care:**

**Equipment Cleaning and Disinfecting:**

The child’s BIPAP facemask and headgear needs to be clean and dry at all times.

RNs and RTs will clean the BIPAP mask (daily) and the headgear as needed.

The outside of the BIPAP machine can be wiped down with damp cloth when needed.

- Please read the appendix for equipment cleaning instructions

**Conclusion**

BIPAP is commonly used in pediatric patients who require non-invasive ventilation.

At BC Children’s hospital physicians, nurses and respiratory therapists will work together, along with the families, to ensure the best care for clinically stable children who use BIPAP.

- Please read the appendix and the online BCCH Child and Youth Health Policies for:

**BCCH Child & Youth Health Policy and Procedure Policy:**
**Non-Invasive Ventilation Management**
**BIPAP Case Studies**

1.) Olivia is a 2 year old with bronchopulmonary dysplasia. She has come to the hospital for cardiac catheterization. Her family has traveled from northern BC for this procedure. Olivia is admitted for further study and will be arriving on your unit within 2 hours. Olivia is on BIPAP only at night. Her respiratory status is stable. Her BIPAP orders are:

- **BIPAP mode:** S/T
- **IPAP:** 12 cm H20
- **EPAP:** 7 cmH20
- **RR:** 15
- **Ti:** 0.8
- **Rise:** 2
- **Humidifier:** 3
- **Mask:** Small gel mask

Using the above information:

What equipment and supplies do you anticipate that her family will bring to the hospital? Who will assist with the equipment set up?

What policy will you refer to for her care?

What will you include in your assessment of Olivia?

How will you collaborate with the RT in the monitoring and documentation of Olivia’s care? How will her family be involved?
2.) Joshua is a 16 year old with history of restrictive lung disease (nemaline myopathy). He is currently in hospital with a fractured leg. His condition is otherwise stable. Joshua will be having a muscle biopsy done for investigation purposes. He will be on BIPAP at only at night.

His BIPAP orders are:
- BIPAP mode: S
- IPAP: 15 cm H20
- EPAP: 5 cmH20
- Ramp: 5 minutes
- Disconnect: 60 seconds
- Mask: Medium Resmed

Skin care is necessary for any patient and Joshua is no exception.

As part of routine care you must assess the skin on Joshua’s face, under and around the mask. You notice that his skin on his face at the edges of the mask and at the bridge of his nose is red, shiny and moist.

Joshua tells you this is normal for him and asks you to leave him alone.

What are your actions?

What are some strategies that could be employed to keep the skin on his face from breaking down?

Describe how you would assess for a proper fit of a BIPAP mask for Joshua.
3.) Katya is a 7 year old who has been admitted with flu like symptoms and upper airway congestion. She has residual airway obstruction secondary to laryngo and tracheomalacia. She also has hemangioendthelioma of her neck and superior mediastinum. She is on respiratory isolation. Her BIPAP orders are:
- Synchrony 1: S
- IPAP: 12 cm H2O
- EPAP: 8 cmH2O
- Rise: 1
- Disconnect: 60 seconds
- Mask: Petite blue gel mask

The Emergency nurse has just left after transferring Katya and her Mom, Jill to your unit. You have received a verbal report from the Emergency nurse and are now entering the isolation room to introduce yourself. Mom begins to tell you about the last two days. She hasn’t had much sleep because Katya has required frequent oral/nasal suctioning as her secretions have been thick and copious.

How will you assess Katya?
What specific information would you like to obtain from Katya’s Mom?

As the night progresses, Katya’s respiratory condition changes as follows:

- Neuro: drowsy but rousable, will obey your command after being touched. Temp 39C rectal
- CVS: Tachycardic at 150, pulses faintly palpable to all four limbs, cool from elbows and knees down, mottled, clammy to touch, cap refill >4secs
- Resp: Tachypneic, air entry decreased to both bases, coarse rales throughout, using accessory muscles to assist ventilations (indrawing, retractions), thick creamy yellow mucous draining out nose. Coughing frequently and productively, Sats drop from 93% to 88% with coughing. BIPAP mask snuggly fitted to face.

Does anything concern you about your assessment?
If so, what is it?

What will you do next?
4.) Keegan is a 14 year old who is admitted post rod surgery for scoliosis. Keegan has a history of developmental delay, spastic quadriplegia, upper airway obstruction and seizures. He is fed via a j-tube. 
His orders are: 
CPAP 12 cm H2O 
Mask: Resmed full face mask

During your night shift Keegan begins to cough productively and you notice secretions in the mask.

During a vigorous coughing episode, Keegan vomits approximately 100 cc of creamy fluid that is similar to the feeds infusing through his j-tube.

What are your next actions?
Next Steps

To meet the clinical competency for caring for a child using BIPAP you must:

- Read and understand the preprinted orders:  
  Non Invasive Ventilation – Bilevel Positive Airway Pressure (BiPAP)

- Read and understand the BCCH Child & Youth Health Policy and Procedure Policy:  
  Non-Invasive Ventilation Management

- Complete the BIPAP Clinical Skill Validation: Noninvasive Ventilation

For more information about caring for children using BIPAP: refer to the following reference and the articles in the attached appendix
References


Appendix

**BIPAP Settings and Alarms**

The BIPAP Synchrony I machine can be monitored by scrolling through 4 pages of information.

**Page 1:**
Mode: __ 1/4
IPAP: __ cm H2O (Watch for ● when patient inhales)
EPAP: __ cm H2O (Watch for ● when patient exhales)
RR: ___ BPM

To access page 2, press the ↓ key

**Page 2:**
Mode: __ 2/4
Vte __ ml
MinVent ___ L/min
Leak ___ L/min

To access page 3, press the ↓ key

**Page 3:**
CONTROLS: 3/4
Rise time: __

To access page 4, press the ↓ key

**Page 4:**
SET UP: 4/4
► Parameters
Alarms
Mode Options

To verify set Parameters press “enter” key.
To verify the Alarms set, press the ↓ key until ► Alarms appears and then press the “enter” key.

To return to page 1 press either the ↓ key or the ↑ key repeatedly to return to page 1.

**Patient Lock Out (Synchrony I):**
It appears that more patients have their BIPAP’s locked out to prevent them from changing their parameters.
From the Options Menu, press the DOWN key until the Lockout command is selected, then press the ENTER key.
1. press the UP or DOWN key to toggle the Lockout command between YES and NO.
2. Press the ENTER key to implement the Lockout command.
3. Press the up or down key and exit twice. Only page 1 and 2 will be available in the lockout mode.
Unlocking the lock out (Synchrony I).
1. Press the alarm silence and enter key simultaneously until ½ on top right hand corner turns to ¾.
2. Go to the Options menu with the up or down key and then go to Lockout and press the enter key.
3. Enter NO with up or down key and press enter.
4. Exit once.

Monitoring on the Synchrony II:

Pressing the small round button on the right hand side of the screen allows you to access 4 measured parameters:
1. Leak – shows the average of the leak values for the previous six breaths.
2. Respiratory Rate – shows the average rate of respiration for the previous six breaths.
3. Minute Ventilation – shows the estimated Exhaled Minute Ventilation based on the average of the previous six breaths
4. Exhaled Tidal Volume (Vte) – estimated exhaled tidal volume of each breath.

When the Synchrony II is powered on, the following will be displayed on the screen.
1. Mode – PC, CPAP, S, S/T
2. IPAP
3. EPAP
4. BPM ( if on S/T or PC)
5. Ti (if on S/T or PC)

To power up the Synchrony II:
1. Pressure the power button on the left hand side of the machine.
2. Press the humidifier button to power on the humidifier. It does not turn on automatically with the machine.
3. Attach tubing to patient’s mask and ensure patient is comfortable.

To change parameters on the Synchrony II:
1. Press and hold the alarm silence button and the right arrow key simultaneously until you hear a “beep beep”.
2. The right and left arrow keys now turn the pages and the humidifier and ramp key increase or decrease the setting, respectively.
3. There is no confirmation button like the Synchrony I
4. If you have an option of 0 or 1, 0 means off and 1 means on. (ie. Always have AVAPS on 0; always have FLEX on 0 as neither are recommended in children)
5. When parameters are set, pressure the alarm silence button to return to the normal screen.
6. If you need to change the humidifier setting, press and hold the humidifier button until a number shows up on the screen. The higher the number, the warmer the metal plate and the higher the temperature, therefore more humidity.
**Equipment Cleaning and Disinfecting:**

**Daily:**
- Wash mask with detergent and water, rinse with water and let air dry
- If needed, wash headgear with detergent and water, rinse in water, let air dry
- Empty humidifier and allow to air dry during the day.

**Weekly:**
- Wash the flexible tubing in detergent and water, rinse in water and soak in a vinegar and water solution (1 part vinegar and 2 parts water) for at least 30 minutes to disinfect. Rinse well in water and allow to air dry.
- Wash humidifier in detergent and water, rinse in water and soak in a vinegar and water solution (1 part vinegar and 2 parts water) for at least 30 minutes to disinfect. Rinse well in water and allow to air dry.

**Monthly:**
- Change bacterial filter and white air intake filter once per month or when obviously soiled.
- Wash re-useable black filter once per month or when obviously soiled.

Wash the filter in detergent and water, rinse in water and allow the filter to air dry. Ensure that the filter is dry before installing into the back of the BIPAP.