saving children's lives
ETAT+
Emergency Triage Assessement and Treatment plus admission

# Respiratory Distress Syndrome (RDS) and Using CPAP

REPUBLIC OF KENYA
MINISTRY OF HEALTH

NEST360°

University of Nairobi

KENYA PAEDIATRIC ASSOCIATION

KEMRI | Wellcome Trust

Keprecon
Kenya Paediatric Research Consortium

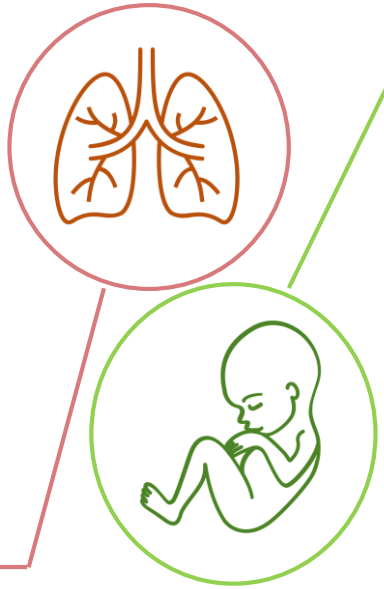
# Objectives

- Define Respiratory Distress Syndrome (RDS) and its clinical course
- Briefly outline lung growth and development
- Discuss the prevention of RDS
- Outline the specific management of RDS – using CPAP
- Illustrate the complications of CPAP and their prevention
- List strategies to improve CPAP success rates

# Introduction

# Definition of Respiratory Distress Syndrome (RDS)

Disease caused by absence/inadequate production of pulmonary surfactant & related lung underdevelopment



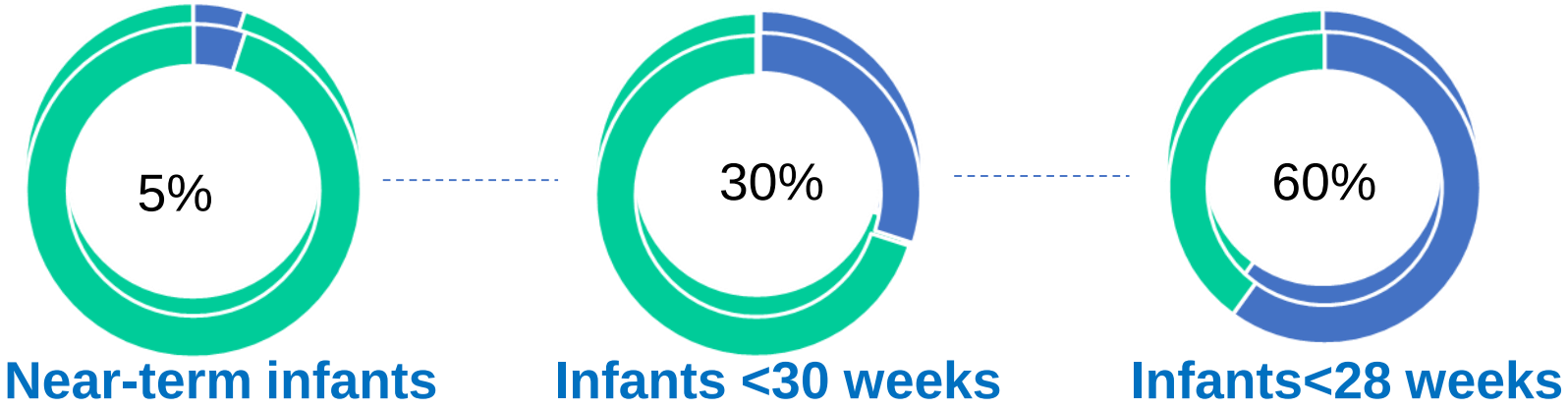
The disease is found mainly in preterm newborns (before 37 weeks' gestation)

Characterized by a **progressive increase in respiratory effort** and a decrease in the amount of air entering the lungs favoring hypoxia.

*Sweet LR, Keech C, Klein NP, et al. Respiratory distress in the neonate: Case definition & guidelines for data collection, analysis, and presentation of maternal immunization safety data. Vaccine. 2017;35(48 Pt A):6566-6547. doi:10.1016/j.vaccine.2017.01.046; Bahadue FL, Soll R. Early versus delayed selective surfactant treatment for neonatal respiratory distress syndrome. Cochrane Database Syst Rev. 2012;11(11):CD001456. Published 2012 Nov 14. doi:10.1002/14651858.CD001456.pub2*

# RDS increases with decreasing gestational age

- The risk of RDS is inversely proportional to gestational age; occurs in approximately:

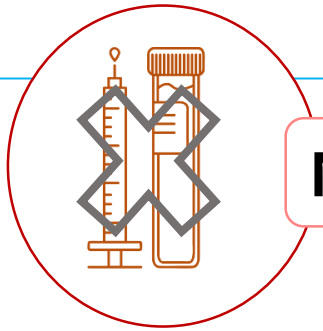



- RDS is seen soon after birth, worsens during the first few hours of life
- In contrast to Transient Tachypnea of the Newborn (TTN), worse at birth but improves within hours of birth



Sweet LR, Keech C, Klein NP, et al. Respiratory distress in the neonate: Case definition & guidelines for data collection, analysis, and presentation of maternal immunization safety data. Vaccine. 2017;35(48 Pt A):6506-6517. doi:10.1016/j.vaccine.2017.01.046

# How is diagnosis of RDS made?



**No laboratory test to diagnose RDS**

**Diagnosis is based on:**

Initial clinical symptoms

The clinical course

Response to surfactant treatment.

A chest radiograph

*Kamath BD, Macguire ER, McClure EM, Goldenberg RL, Jobe AH. Neonatal mortality from respiratory distress syndrome: lessons for low-resource countries. Pediatrics. 2011;127(6):1139-1146. doi:10.1542/peds.2010-3212*

# Clinical Course of RDS

Neonates present within the first several hours of life

- **Hours after birth**

If untreated the disease worsens

- **24 - 48 hours**

The course of RDS is self-limited

- **5 - 7 days**

Very preterm infants will not be able to make it without support.

*Sweet D, G, Carnielli V, Greisen G, Hallman M, Ozek E, te Pas A, Plavka R, Roehr C, C, Saugstad O, D, Simeoni U, Speer C, P, Vento M, Visser G, H, A, Halliday H, L: European Consensus Guidelines on the Management of Respiratory Distress Syndrome – 2019 Update. Neonatology 2019;115:432-450. doi: 10.1159/000499361*

# Periods of Treatment for RDS

RDS was first described by Hochheim 14 in **1903,** who noted unusual membranes in the lungs of 2 infants who died shortly after birth

**Period 1 - Before 1950s:** No widely used treatment

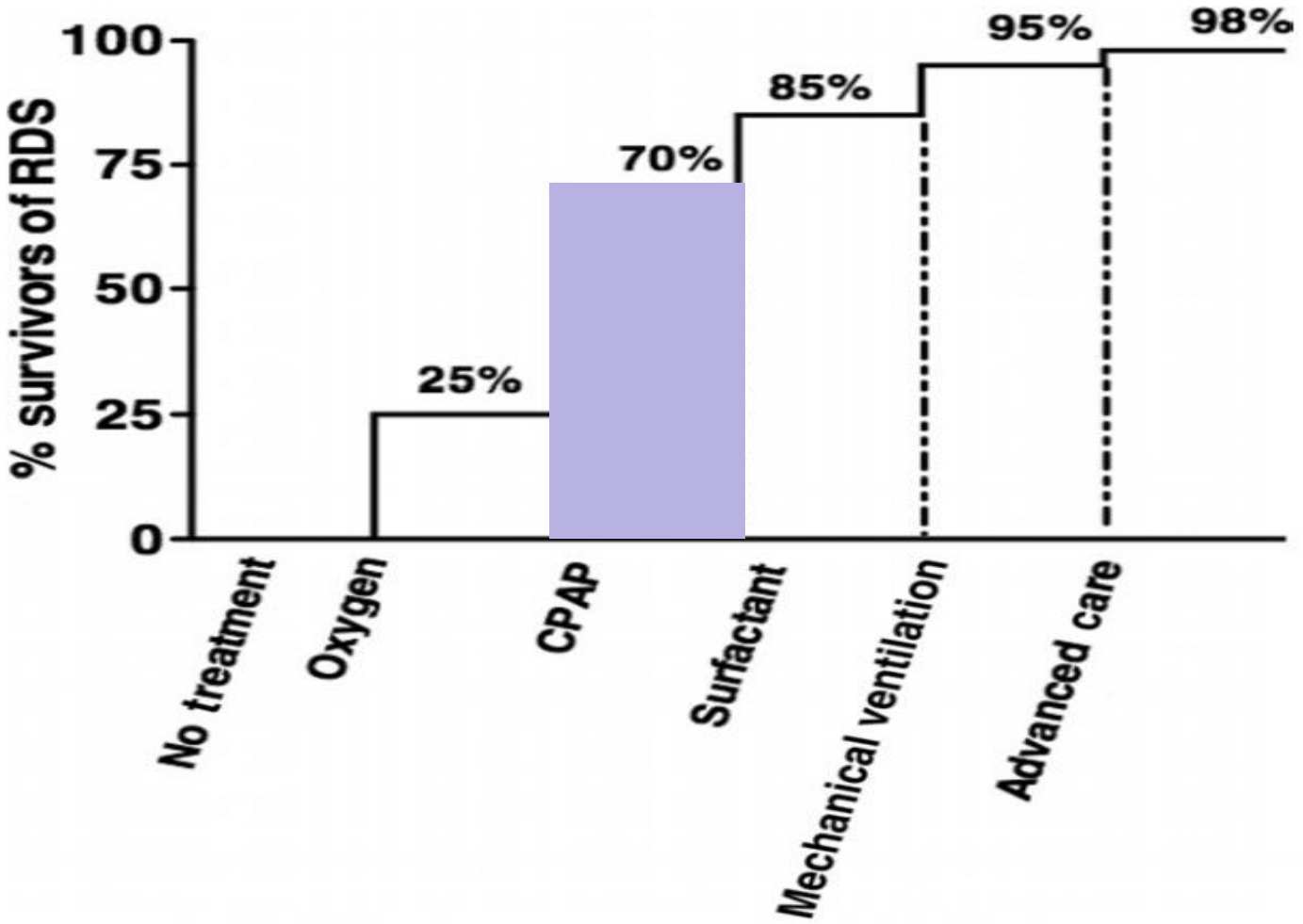
**Period 2 – 1950 – 1969:** Oxygen therapy was the specific intervention

**Period 3 – 1970 – 1989:** CPAP therapy was the specific intervention. Later on use of mechanical ventilation was attempted

**Period 4 – After 1990:** Antenatal corticosteroids, surfactant, advanced care technologies e.g. ECMO, high frequency oscillation

Beena D. Kamath, Emily R. MacGuire, Elizabeth M. McClure, Robert L. Goldenberg and Alan H. Jobe,Neonatal Mortality From Respiratory Distress Syndrome: Lessons for Low-Resource Countries,Pediatrics June 2011 127 (6) 1139-1146

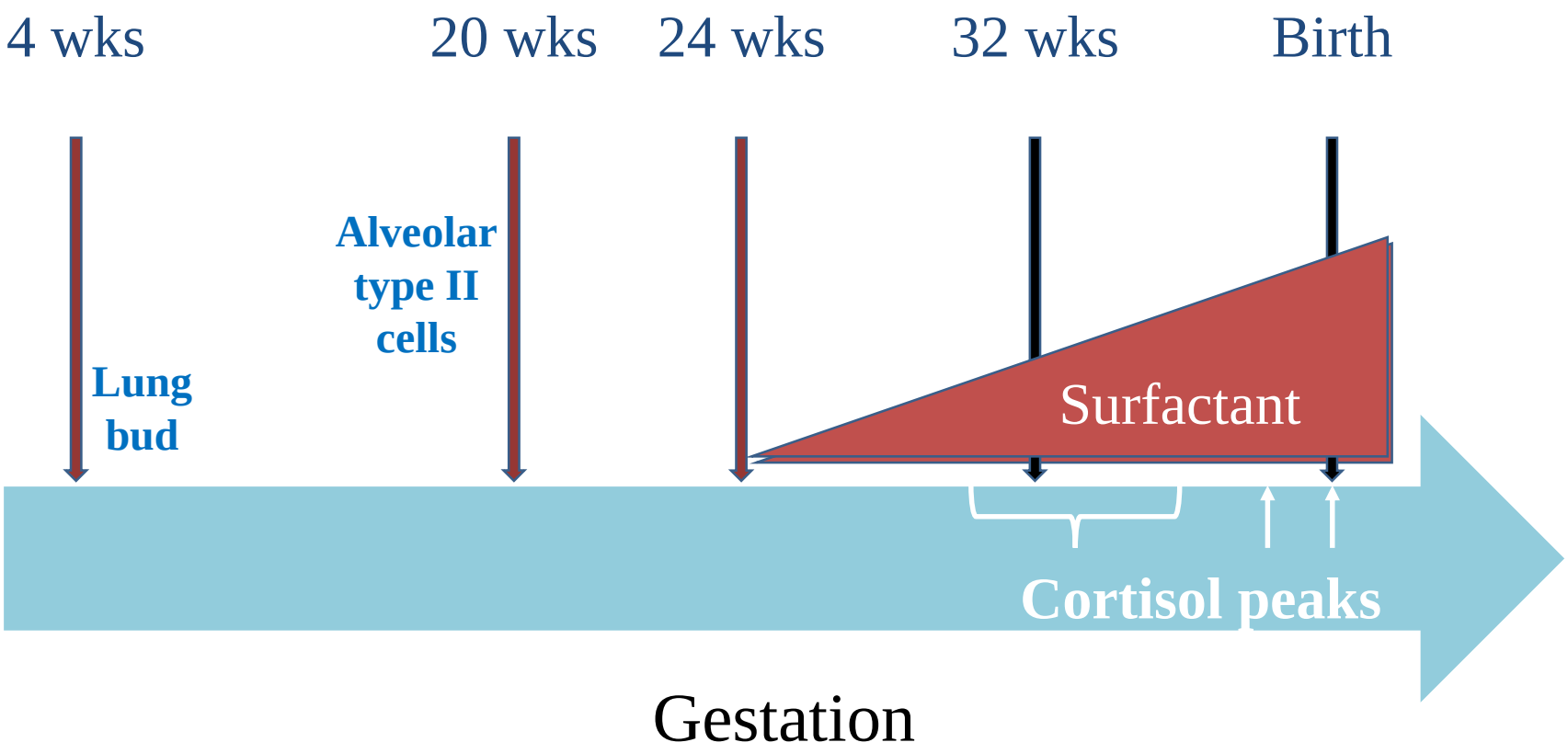
# Increased % in RDS survivors with introduction of specific treatments




Beena D. Kamath, Emily R. MacGuire, Elizabeth M. McClure, Robert L. Goldenberg and Alan H. Jobe,Neonatal Mortality From Respiratory Distress Syndrome: Lessons for Low-Resource Countries,Pediatrics June 2011, 127 (6) 1139-1146

# Lung Growth and Development

# Lung growth and Development



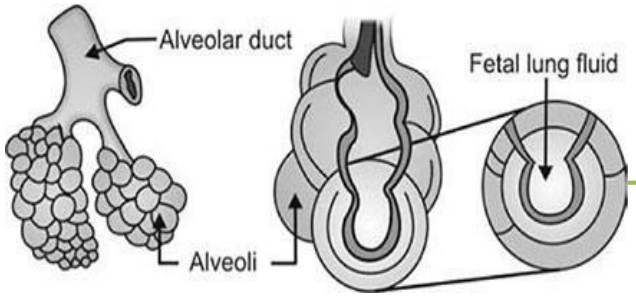

Schittny, Johannes C. "Development of the lung." Cell and tissue research vol. 367,3 (2017)

# Transition to extrauterine life

## Cortisol

✓ Levels increase at **30 - 36 wks**, **prior** to term labor & peak **at labour**
✓ Regulates thyroid hormones and catecholamine release

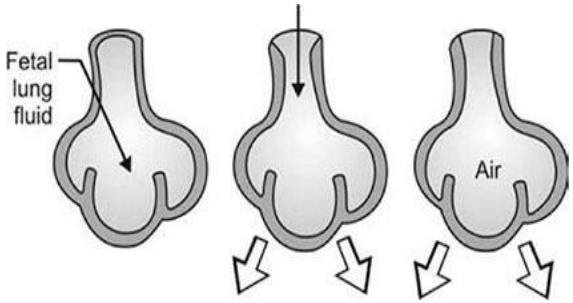
## Fetal lungs




- ✓ Fetal fluid secreted into lungs
- ✓ Promotes development
- ✓ Maintains distension
- ✓ Pressure = 2 - 4cm$H_20$
- ✓ Mechanical stretch stimulates surfactant production

## Birth

## Neonatal lungs




- ✓ Fluid replaced by air (labour & delivery, first breath and cry)
- ✓ Reduced secretion; increased absorption (regulated by hormones)
- ✓ Surfactant coats alveoli

Source - Neonatal Asphyxia, Resuscitation and Beyond. Dipak, Rashmi, Padmapriya. Chapter 1 – intrauterine and Natal Cardiopulmonary physiology
Hillman, Noah H et al. "Physiology of transition from intrauterine to extrauterine life." Clinics in perinatology vol. 39,4 (2012)

# Surfactant

- A complex mixture of phospholipids and proteins
- Reduces surface tension at the air-liquid interface o the alveoli
- Prevents collapse of alveoli during end exhalation
- Secretion is stimulated by hormones such as thyroxine and glucocorticoids
- Mechanical stretch (distension and hyperventilatio can stimulate secretion from Alveolar type II cells

Surfactant production can be hindered by inflammation, genetic defects, infection

Nkadi, Paul O et al. "An overview of pulmonary surfactant in the neonate: genetics, metabolism, and the role of surfactant in health and disease." Molecular genetics and metabolism vol. 97,2 (2009):

# What can go wrong during transition?

Premature delivery – insufficient surfactant

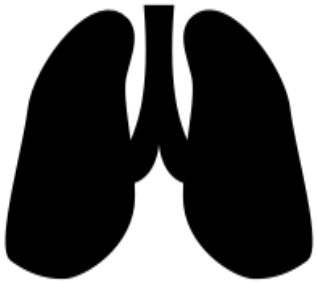
Premature delivery – lung absorptive capacity not optimum

Meconium aspiration inactivates surfactant

Cold stress inactivates surfactant

Caesarian section – no benefit from catecholamine surge

Caesarian section – no benefit from mechanical force of labour

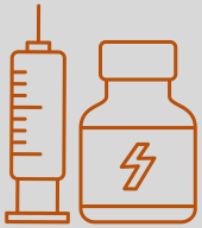


Hillman, Noah H et al. "Physiology of transition from intrauterine to extrauterine life." Clinics in perinatology vol. 39,4 (2012)
Morton, Sarah U, and Dara Brodsky. "Fetal Physiology and the Transition to Extrauterine Life." Clinics in perinatology vol. 43,3 (2016):

# Prevention of RDS

# Antenatal steroids and the fetal lung

24 - 34 weeks



Administration of antenatal corticosteroids (ACS)

Fetal lung maturation

How is lung maturation induced?

| | |
|---|---|
| Enhance Surfactant Production | Antioxidant Enzyme Production |
| Stimulates lung fluid absorption | Enhance alveolar development |

*Glucocorticoids and Lung Development in the Fetus and Preterm Infant R J Bolt-, M M van Weissenbruch, H N Lafeber, H A Delemarre-van de Waal 2001*

*Antenatal Corticosteroids for Accelerating Fetal Lung Maturation for Women at Risk of Preterm Birth Devender Roberts, Julie Brown-, Nancy Medley-, Stuart R Dalziel, 2015*

# Administration of ACS

- Betamethasone 12 mg IM every 24 hours for 2 doses
- Total dose (24mg)

**24 - 34 weeks gestation [2]**

- Dexamethasone 6mg IM 12 hours apart for 4 doses
- Total dose (24mg)

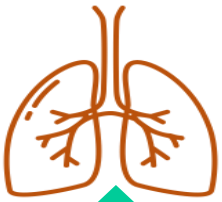
- **1-7 days before anticipated delivery- Betamethasone vs dexamethasone - none superior over the other.**

1. Association Between Antenatal Corticosteroid Administration-to-Birth Interval and Outcomes of Preterm Neonates Melamed N, Shah J, Soraisham A, Yoon EW, Lee SK, Shah PS, Murphy KE Obstet Gynecol. 2015;125(6):137; 2. WHO recommendations on interventions to improve preterm birth outcomes 2015
3.Brownfoot FC, Gagliardi DI, Bain E, Middleton P, Crowther CA. Different corticosteroids and regimens for accelerating fetal lung maturation for women at risk of preterm birth. Cochrane Database Syst Rev. 2013;8:CD006764.

# WHO recommendations on use of ACS

- Administer within 1-7 days before imminent preterm birth (24 - 34 weeks)
- Use IM Dexamethasome or beclomethasone (total 24mg)
- Use for both single and multiple gestation pregnancies
- Recommended for women with PROM and no signs of infection, hypertensive disorders, at risk of delivering IUGR baby, Maternal DM
- A single repeat course of ACS recommended if preterm birth does not occur within 7 days after the initial dose and the risk of preterm birth is still there
- Not recommended for those with chorioamnionitis and those undergoing c/s for late preterms.

# Benefits of ACS



Respiratory distress syndrome
RR- (0.66, 95% CI- (0.56-0.77))

Intraventricular hemorrhage
(RR- 0.69, 95% CI-(0.59-0.81))

Necrotizing enterocolitis
(RR-0.50, 95% CI-(0.32-078))

Neonatal sepsis
(RR-0.60, 95% CI- (0.41-0.88))

Mechanical ventilation
(RR-0.68, 95% CI-(0.56-0.84))

# Management of RDS

# Approach to management

**Keep warm** and Maintain neutral thermal environment - Reduce oxygen consumption

**A**irway patency should be ensured

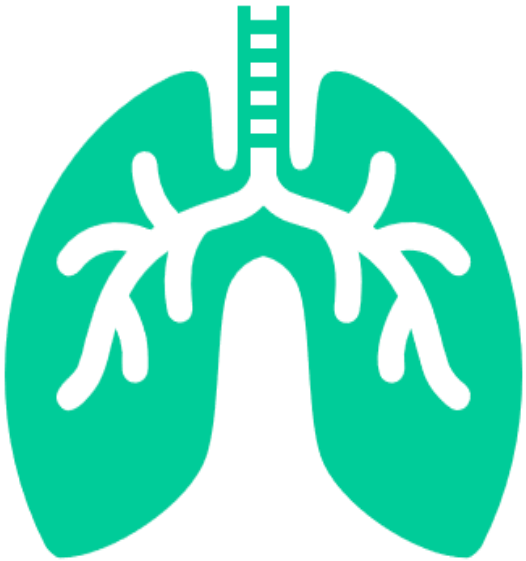
**B**reathing - Specific management; Surfactant use and Respiratory Support (CPAP)

**C**irculation- feeds and fluids; Initiation of early feeds & Maintenance fluids

**D** - Close monitoring of vitals; Blood sugars, Hypotension common in early RDS, Antibiotics, Caffeine

# Specific Management

# Continuous Positive Airway Pressure (CPAP)



Non invasive method of **oxygen delivery**

Provides **continuous distending pressure** that's keeps alveoli open during expiration

Reduces work of breathing therefore improves oxygenation

Decreases atelectasis and respiratory fatigue

# Why use CPAP?

## In-utero

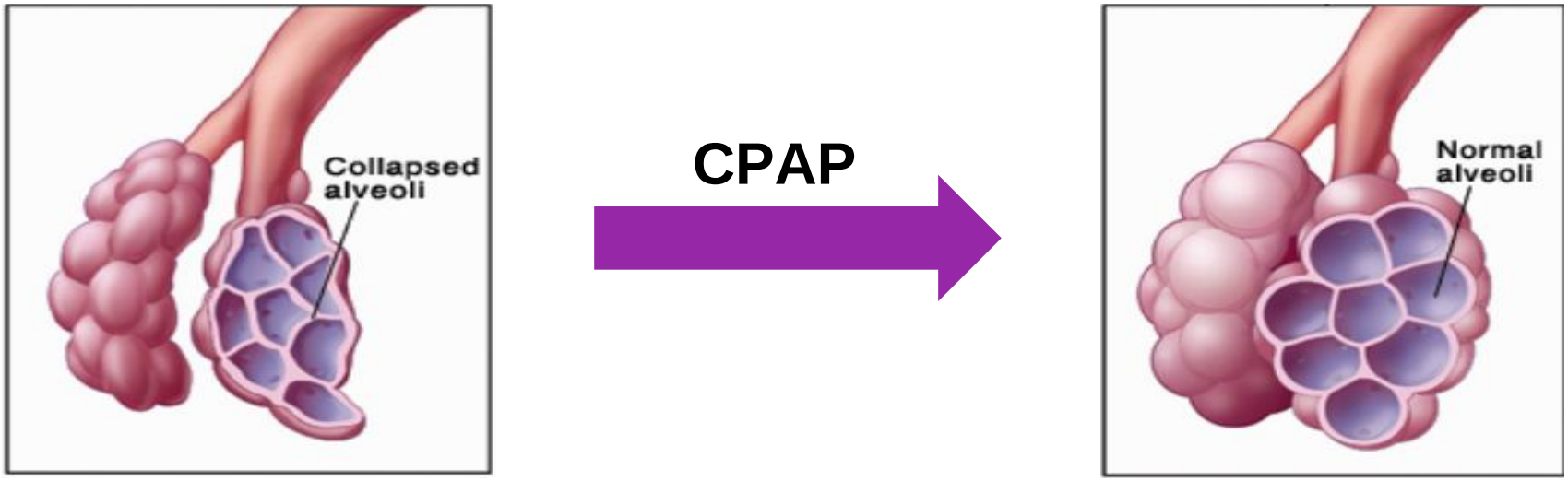
- Fetal lungs in utero remain distended due to the pressure of 3-4 cm/$H_20$ maintained by the fluid in the fetal lungs

## CPAP

- CPAP mimics normal physiology.
- Constant distending pressure at 2-3cm/$H_20$.

*Nasal Continuous Positive Airway Pressure (CPAP)for the Respiratory Care of the Newborn Infant Robert M DiBlasi RRT-NPS 2009*
*Image borrowed from https://consultqd.clevelandclinic.org/bubble-cpap-for-prevention-of-chronic-lung-disease-in-premature-infants/*

# Benefits of using CPAP




1. Improves oxygenation
2. Continuous distending pressure keeps alveoli open which maintains FRC
3. Promotes Lung growth and development.
4. Promote surfactant production

Image borrowed from https://newbornsbaby.blogspot.com/2019/01/premature-baby-lung-complications.html

# Prophylactic versus Rescue CPAP

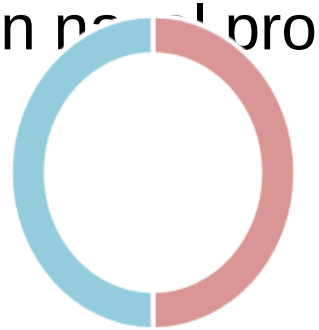
**Prophylactic CPAP**



**Rescue CPAP**

- **28 - 30 weeks (1-1.3kgs)**
- Initiated as soon as possible within the delivery room
- For the newly born with good cardiac activity and breathing spontaneously
- Not in respiratory distress
- Intended to avoid mechanical ventilation

- **Above 30 weeks (>1.3kgs)**
- Initiated after trial of oxygen therapy
- Neonate with increased work of breathing and $SpO_2$< 90% on nasal prongs at 1L/min



*Nasal Continuous Positive Airway Pressure (CPAP)for the Respiratory Care of the Newborn Infant Robert M DiBlasi RRT-NPS 2009*

# How CPAP delivers varying Fraction of Inspired Oxygen ($FIO_2$)

Oxygen sources provide > 90% Oxygen

+

Ambient air provides 21% oxygen

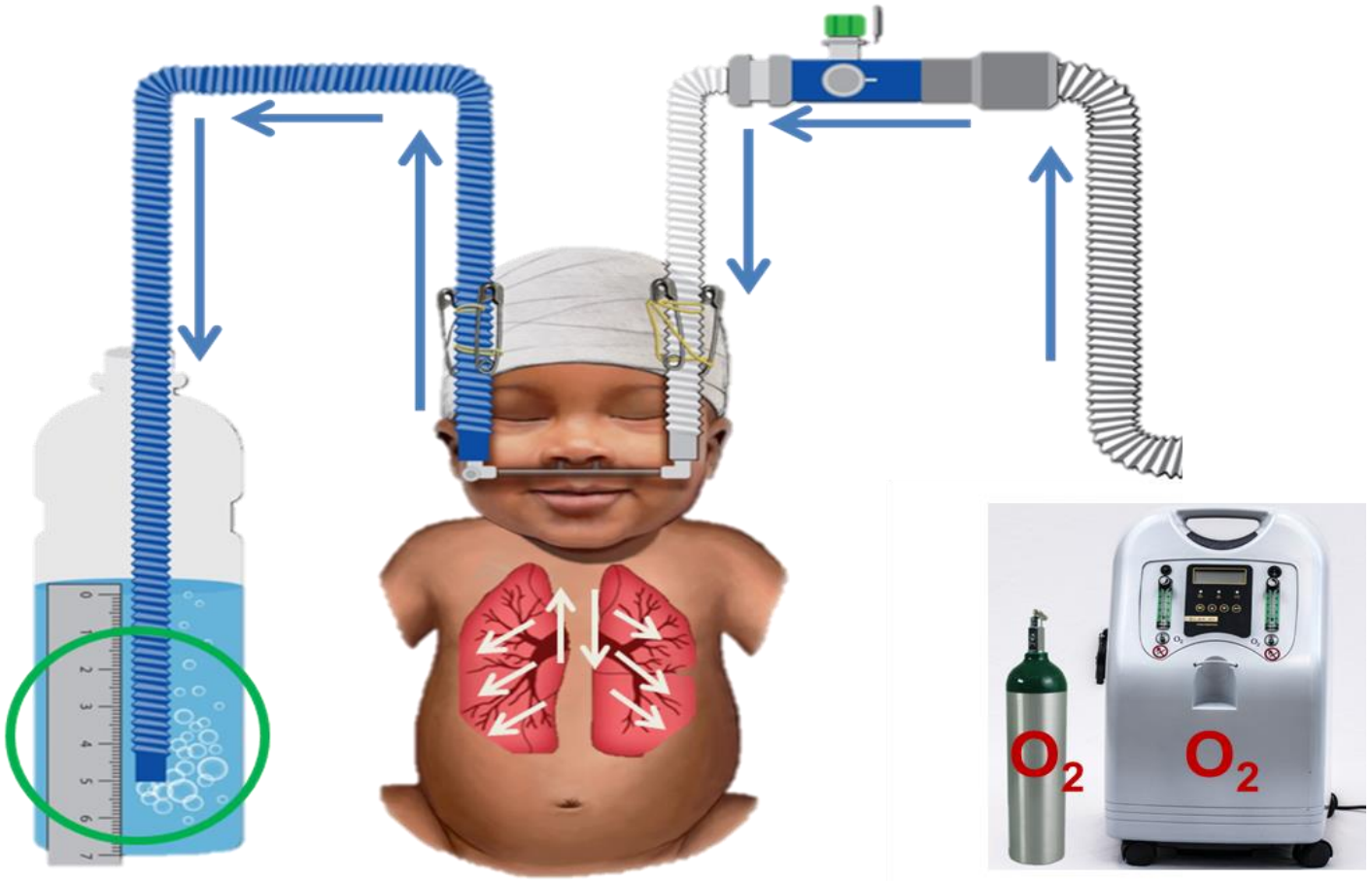
Blend ambient air with the oxygen from the source

- Varying $FiO_2$ delivered to the baby depending on the oxygen saturations.
- **Pulse oximetry is important**
- Titrate to achieve targets of $SPO_2$ 90-95%

- Titrate the flow rate from the oxygen source by increasing or decreasing 1L/min to achieve varying levels of $FiO_2$ (30-100%)
- **Need for a ***blender**

# Using CPAP

# bCPAP Components

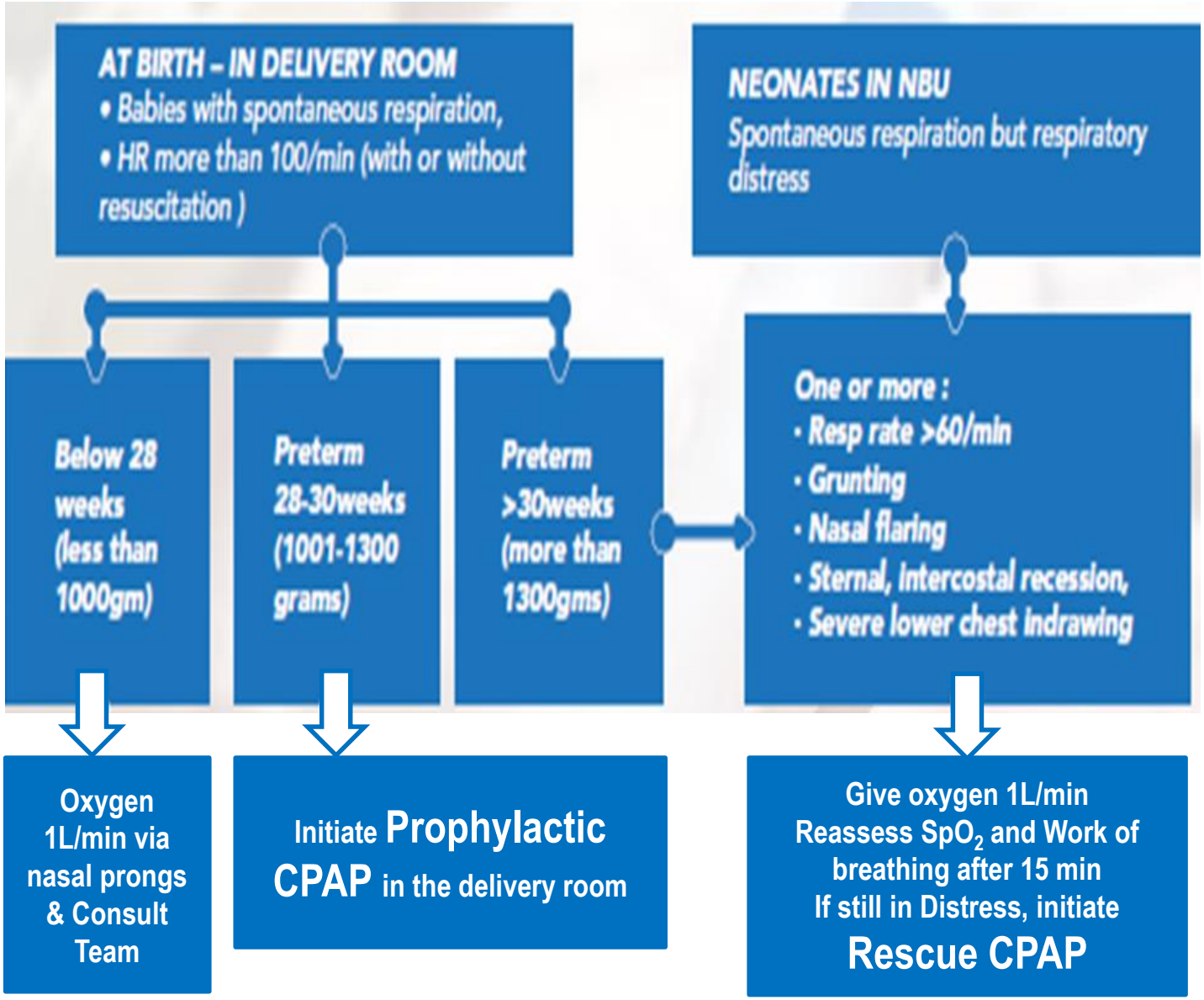



Expiratory Limb

Interface (Nasal Prongs)

Inspiratory Limb

# bCPAP Initiation Criteria



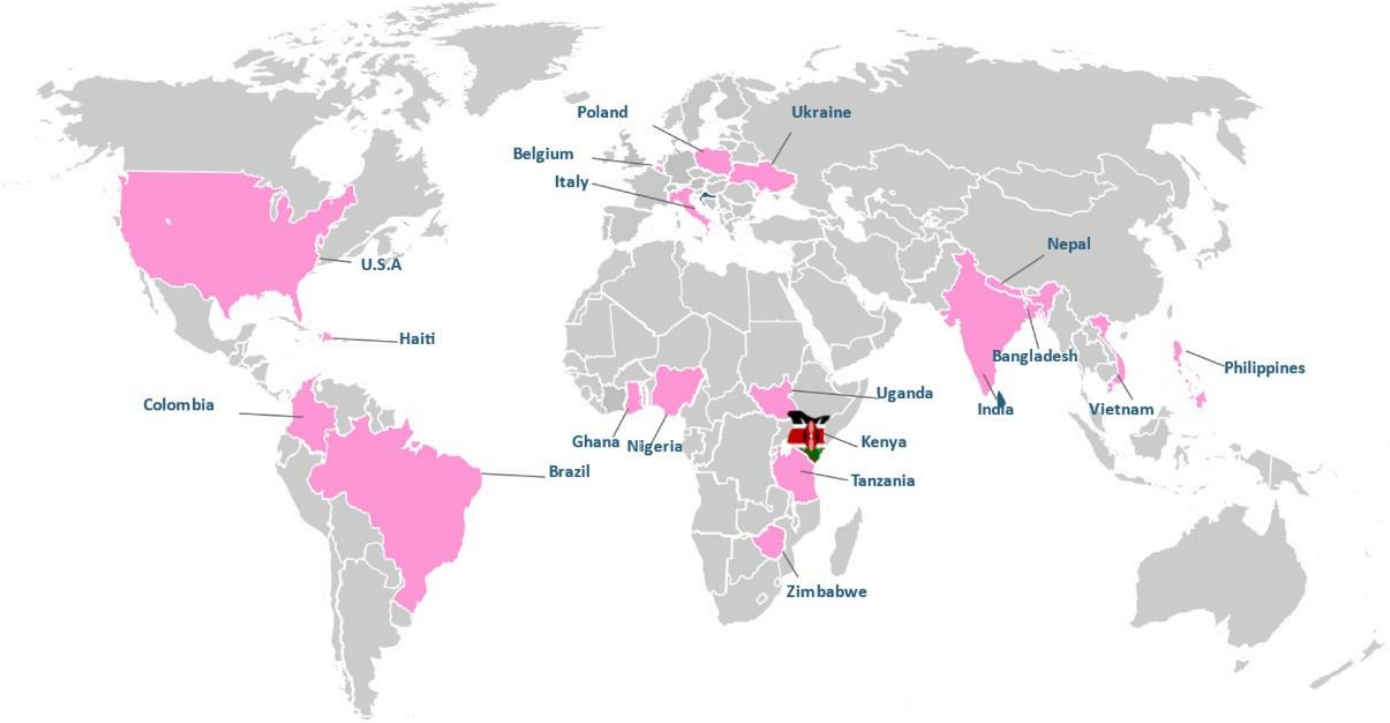

*Adapted from the TRY algorithm*

# VAYU

Implemented: Kenya, Tanzania, Uganda, Zimbabwe, Nigeria, USA, Belgium, Italy, Poland, Ukraine, Vietnam, Nepal, India, Bangladesh,and Brazil (16)

Coming soon: Colombia, Ghana, Haiti (3)

3,000+ babies treated




saving children's lives
ETAT+
Emergency Triage Assessment and Treatment plus admission

# VAYU bCPAP

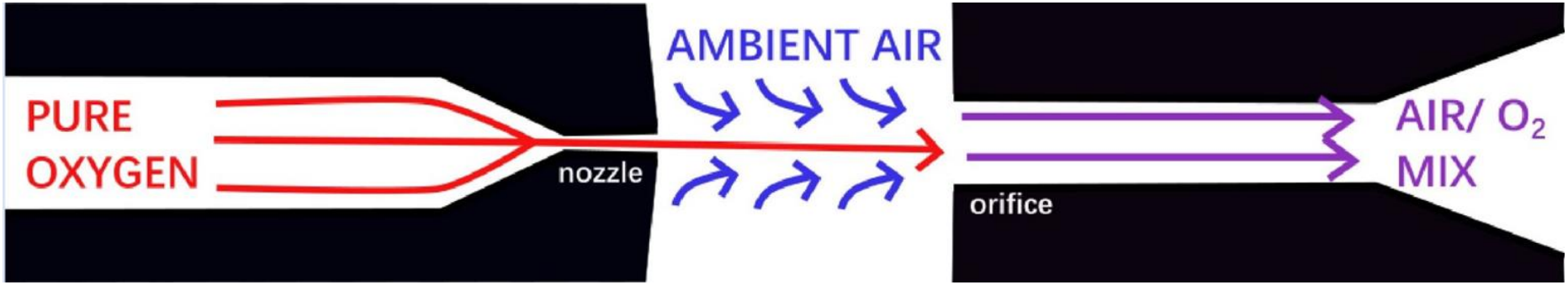
## Accessibility matters. The Vayu bCPAP system...

- Does not require electricity or compressed air (only pressurized oxygen)
- Costs a fraction of the price of previous CPAP systems

## Quality of care matters. The Vayu bCPAP system...

- Pressurizes, humidifies, filters and blends oxygen
- Low work of breathing
- Received Emergency Use Authorization (EUA) by the US FDA and approved by Kenya's PPB and Tanzania's TMDA

# Device Walkthrough

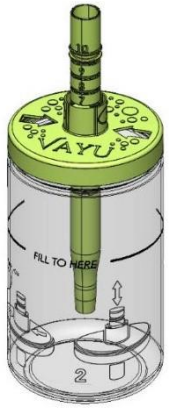



No electricity? Compressed Air? Why?
Venturi Effect…

- High speed jet of pure oxygen crosses nozzle
- Pulls in ambient air (21% $O_2$ ) due to a pressure differential in chapter
- Provider able to deliver oxygen at an adjustable concentration (30% → 100%)

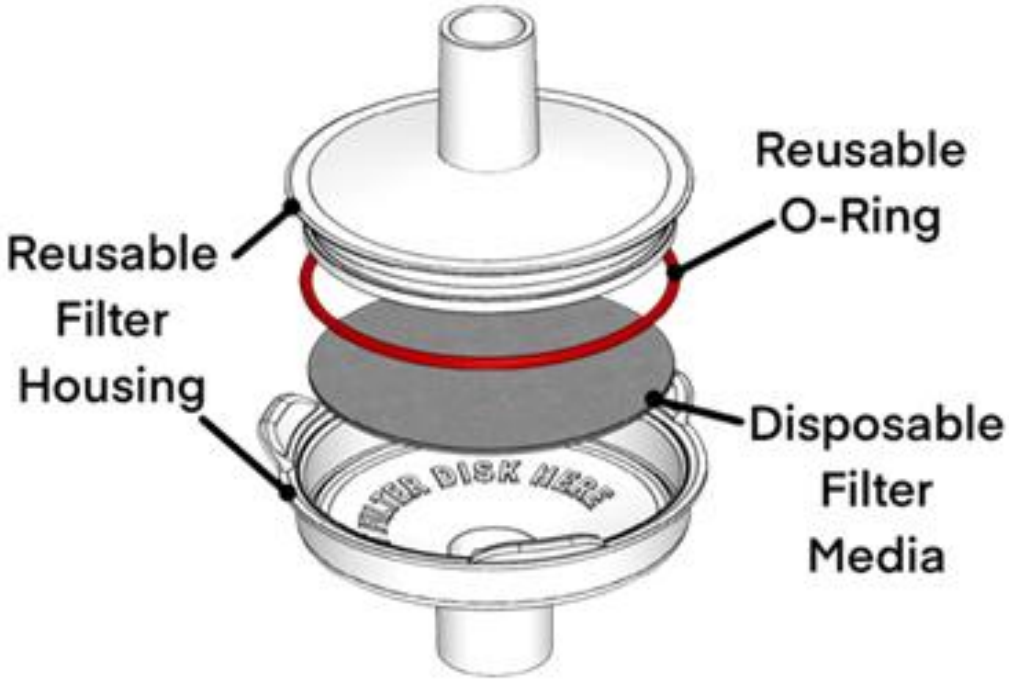
# Device Assembly


Fill with sterile water.

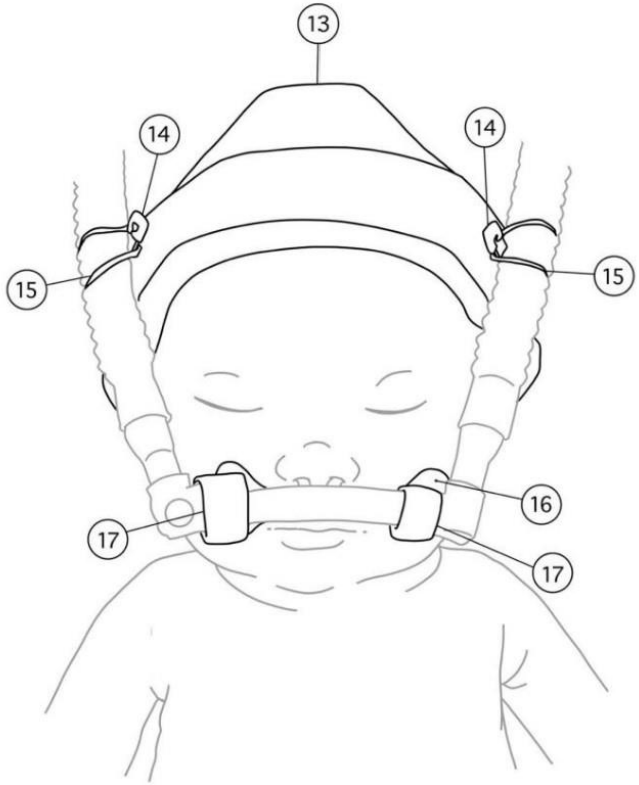



Fill with clean water + 2 tablespoons of acetic acid/vinegar if available.

# Reusable Filter

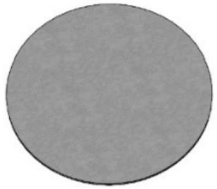


# Patient Application



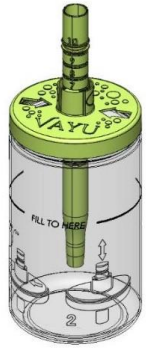

| INDEX | DESCRIPTION | QTY |
|---|---|---|
| 13 | Hat | 1 |
| 14 | Safety Pin | 2 |
| 15 | Rubber Band | 2 |
| 16 | Hook Moustache | 1 |
| 17 | Soft Loop Fastener | 2 |

# Monitoring the Device



Replace every 24 hours
or when discolored


Refill regularly (8-12h)
Replace contents every
24 hours




Refill regularly
Replace contents every
24 hours

**Regularly check for bubbling in the pressure generator**

**In bubble CPAP,**
**no bubbles mean no CPAP**

# Reusable Components

**Oxygen Tube**

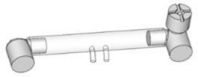
**Vayu Air/Oxygen Blender**
Disassemble into blender and locknut

**Rotator**

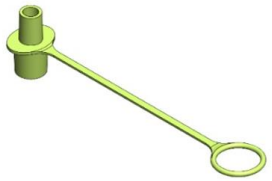
**Humidifier Tube**


**Humidifier**
Disassemble into jar and lid

**Breathing Tubes**

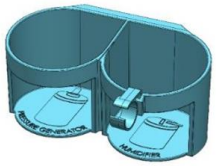


**Nasal Prongs**

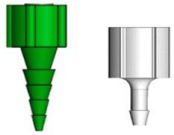


**Pressure Generator Connector**


**Pressure Generator**
Disassemble into jar, lid, and wand

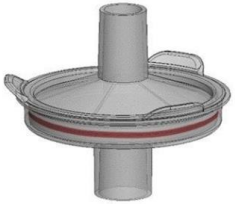


**Warmer Bracket & Blender Clip**
Disassemble into warmer bracket and blender clip



**Oxygen Source Adapters**

**Hats**



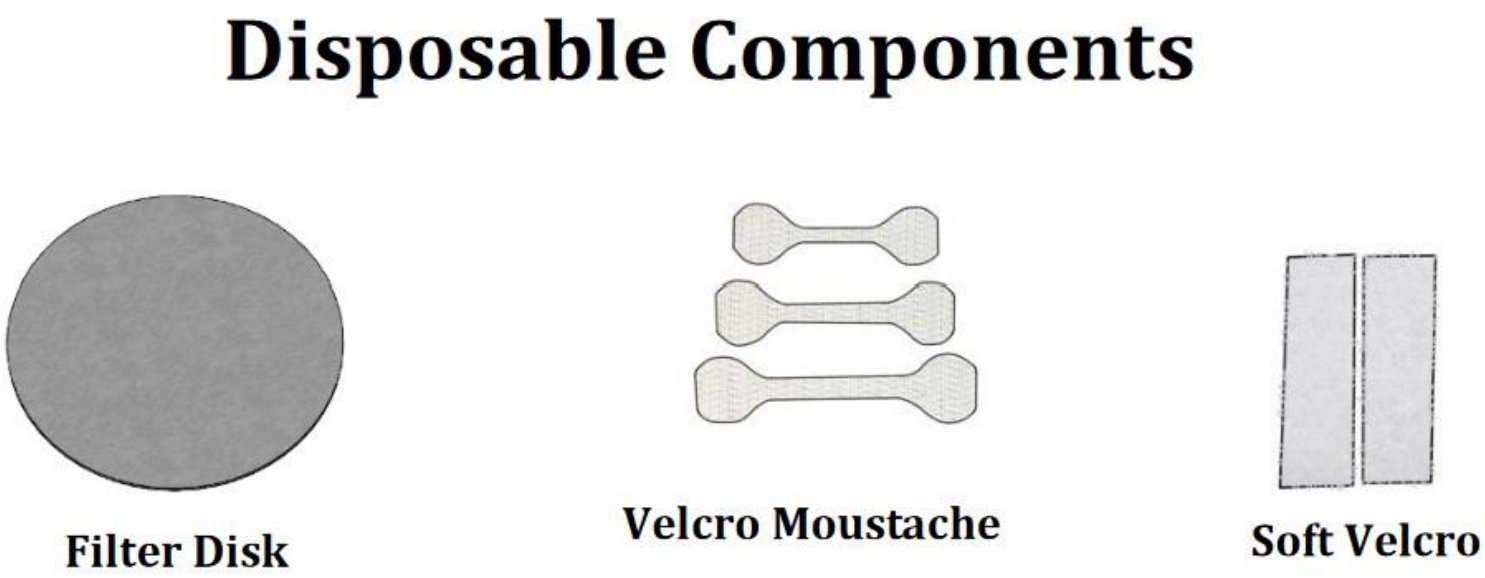
**Bacterial Viral Filter Housing and O-Ring**
Diassemble into filter housing top, filter housing bottom, and O-ring

**Safety Pins**

**Rubber Bands**

*Adapted from the TRY algorithm*

# Disposable Components



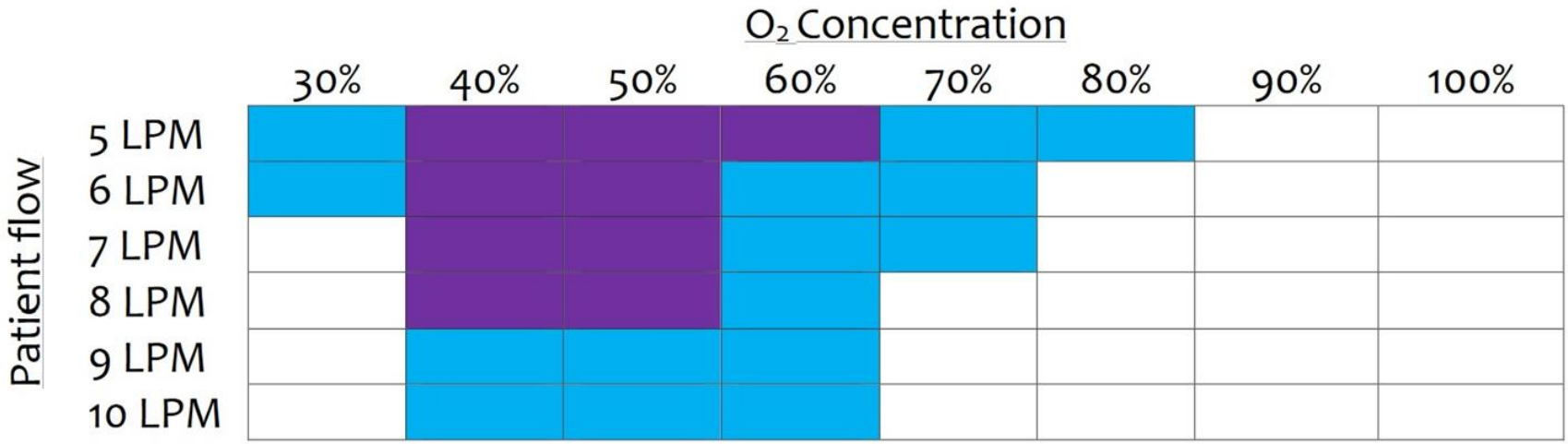

| | | | |
|---|---|---|---|
| **Replace** | every 24 hours | after every patient | after every patient |

# Reprocessing Instructions

- Discard moustache, filter disc and soft loop fasteners
- Launder hats
- Disassemble
- Manually clean each component with enzymatic detergent or scrub with soap
- Dry
- High level chemical disinfection with gluteraldehyde solution or chlorine solution
- Dry
- Store

For more details refer to Vayu bCPAP Reprocessing Instructions

# Using Oxygen Concentrators



# Oxygen Blender System

- Precisely blends air and oxygen to an adjustable concentration
- Delivers 0.5- 4 LPM of flow
- Includes multiple nasal prong sizes for patients up to 5 years old
- Is approved by Kenya's PPB and Tanzania's TMDA

# Increasing bCPAP Treatment

**Before increasing bCPAP Treatment;**

- **Is the water bubbling?**
- **Is the connection circuit complete and well secured?**
- **Does the baby need suctioning?**

**When increasing bCPAP Treatment**

- **Base need to increase bCPAP on $SPO_2$ and work of breathing**

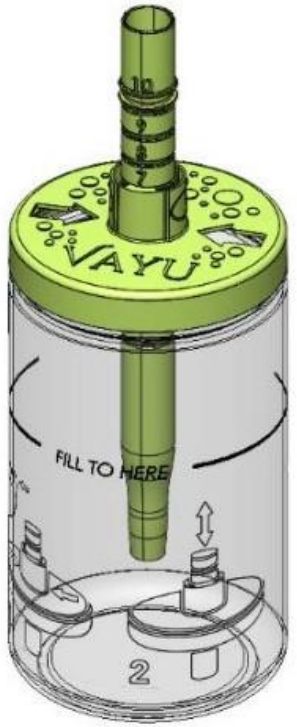
**After changing bCPAP Treatment**

- **Reassess the baby's immediate response and then at 15 min, 1 hour then 3-4hourly**

# Weaning & Stopping bCPAP

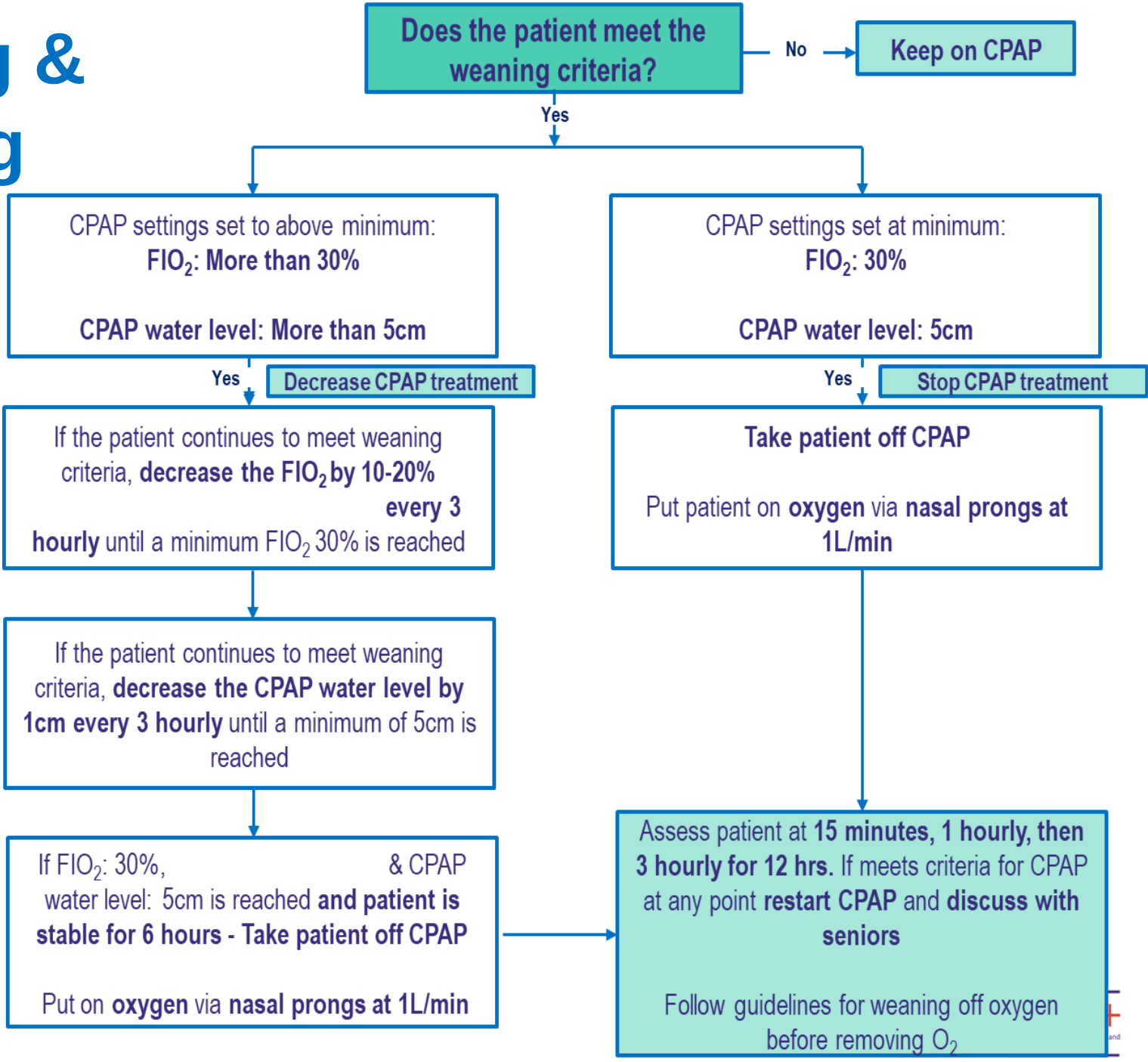
**Criteria for weaning CPAP Treatment**

1. **Baby has been on CPAP for at least 24hours**
2. **RR less than 60/min for at least 6 hours**
3. **Oxygen saturation consistently greater than 90% for at least 6 hours**
4. **No significant grunting, indrawing, nasal flaring, apnoea or bradycardia for at least 6 hours**




Decrease pressure by moving the wand up

# Weaning & Stopping bCPAP

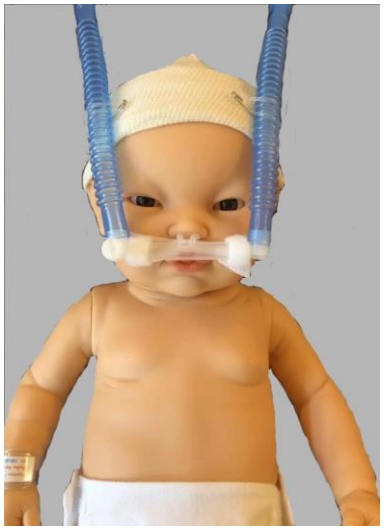


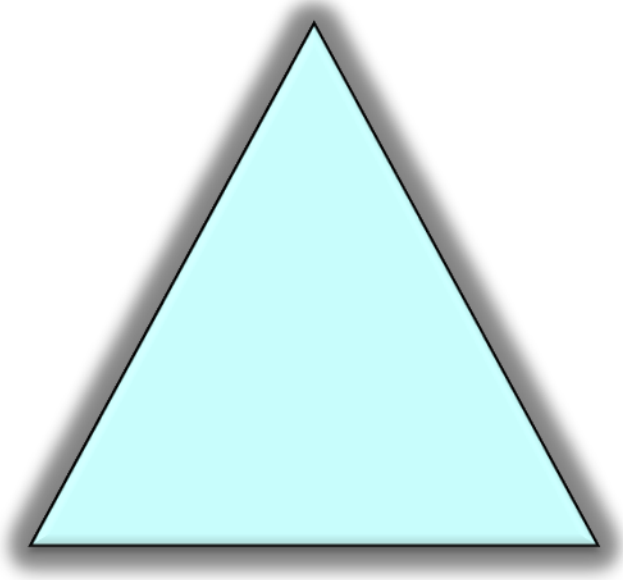
# Monitoring babies on bCPAP

saving children's lives
ETAT+
Emergency Triage Assessement and Treatment plus admission

# Monitoring

- Vital signs
- Work of breathing
- Nasal blockage
- Abdominal distension






**Attachment**

- Position of the prongs
- Nasal septum intact
- Tubing not kinked
- Hat snuggly fit

**Functioning**

- Correct water level
- There is bubbling
- Humidifier is filled
- Correct blender setting

# Monitoring the Baby

[HOSPITAL NAME] COMPREHENSIVE NEWBORN MONITORING CHART Version 2.7

| | | | | | |
|---|---|---|---|---|---|
| Name | IP NO | Sex M ☐ F ☐ | D.O.A | D.O.B | |
| Date today | Diagnosis | | | | |
| Birth Wt gm | *Interventions:* CPAP ☐ Oxygen ☐ Phototherapy ☐ Blood tranfusion ☐ Exchange transfusion ☐ KMC ☐ | | | | |

**Daily Clinician Feed and Fluid prescription**

| | | |
|---|---|---|
| Day of Life | Current Wt = gm | |
| Total input(feed and fluid) 24hrs = ml | | |
| Feed: BF ☐ EBM ☐ Term Formula ☐ Pre-Term Formula ☐ | | |
| Route: Cup☐ NGT☐ OGT☐ | | |
| Volume & Frequency = _____ml 3hrly ☐ 2hrly ☐ | | |
| Total 24hr Volume = _____ml | | |
| IV Fluid & Additives | Vol (ml) | Duration |
| | | |
| | | |
| | | |
| | | |

Other prescribing instructions

Clinician's name Time:

**Daily IV Fluid Nursing plan**

Start time:

Hourly rate= _____ ml (____ drops/min)

Planned vol = _____ ml in_____ hrs

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monitoring Freq___hrs \| Time | | | | | | | | | | | | |
| Vitals | Temp ($^0$C) | | | | | | | | | | | | |
| | Pulse (b/min) | | | | | | | | | | | | |
| | Resp Rate (b/min) | | | | | | | | | | | | |
| | Oxy Sat (%) or Cy$^0$ Cy$^+$ | | | | | | | | | | | | |
| Assessment | Resp Distress 0,+,+++ | | | | | | | | | | | | |
| | CPAP Pressure (cm $H_2O$) | | | | | | | | | | | | |
| | $FiO_2$ (%) | | | | | | | | | | | | |
| | Jaundice 0,+,+++ | | | | | | | | | | | | |
| | Apnoea Y/N | | | | | | | | | | | | |
| | Blood Sugar (mmol/l) | | | | | | | | | | | | |
| | Completed by (name) | | | | | | | | | | | | |
| Feed | Breastfeeding sufficient Y/N | | | | | | | | | | | | |
| | EBM vol given (ml) | | | | | | | | | | | | |
| | Formula vol given (ml) | | | | | | | | | | | | |
| Fluid | IV volume given (ml) | | | | | | | | | | | | |
| | IV Line working Y/N | | | | | | | | | | | | |
| Output | Vomit Y/N | | | | | | | | | | | | |
| | Urine Y/N | | | | | | | | | | | | |
| | Stool Y/N | | | | | | | | | | | | |
| | Completed by (name) | | | | | | | | | | | | |

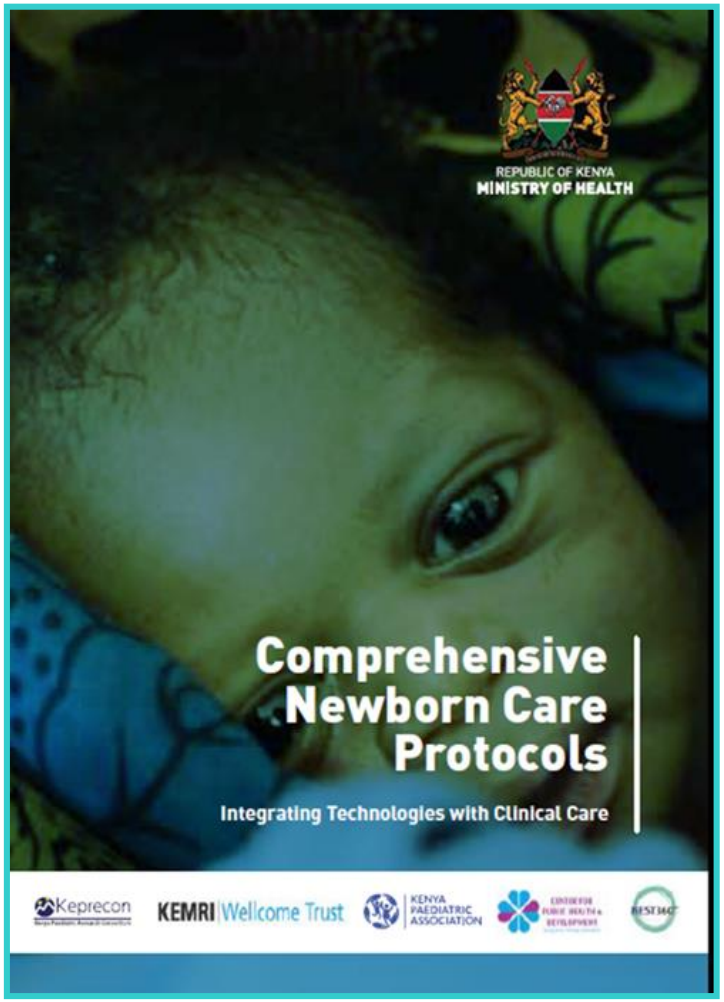
Morning shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Deficit_____ ml

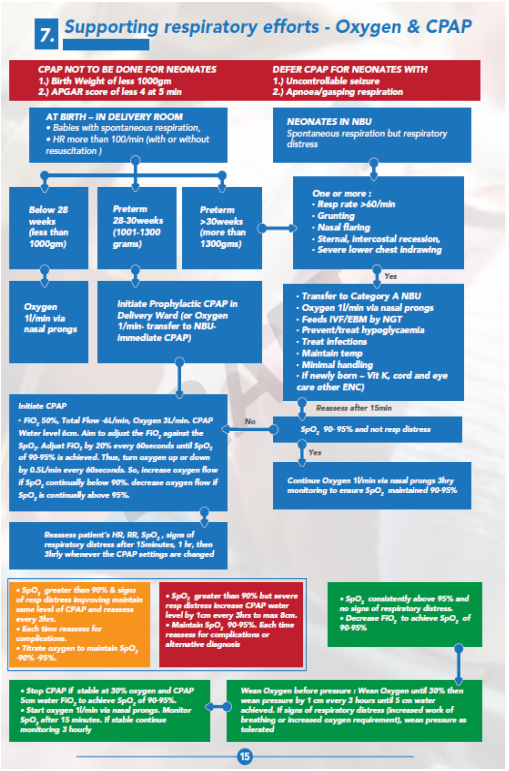
Afternoon shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Deficit_____ ml

Night shift notes
Category: A☐ B☐ C☐
Total feed+fluid in this shift_____ ml Completed by (name)
Total feed+fluid in 24hrs_____ ml
Deficit_____ ml

Jaundice 0 none, +mild(face),+++severe(feet) Tick the category of baby after assessment Alerts : circle readings outside normal range with red pen and action

# Available Guidelines




### 3.) Use of Bubble Continuous Positive Airway Pressure (bCPAP)

**Indications for bCPAP**

- Preterm babies gestation age 28 - 30 weeks (prophylactic)
  - Respiratory distress syndrome
  - Respiratory distress (respiratory rate above 60/min, nasal flaring, grunting, sternal retractions and severe lower chest wall in-drawing)
  - An oxygen saturations of less than 90% after ensuring a clear airway and proper positioning on oxygen 1L/min
- Babies above 30 weeks (Rescue) – See supporting respiratory efforts protocols.

**Family Centered Care**

- Inform the mother (parents) that their baby needs CPAP to be able to breathe better.
- Explain what the procedure involves in layman terms – the connections to the machine, other tubings like the oral gastric tube (OGT), nasal prongs etc.
- Explain that the procedure is safe and CPAP has been shown to improve newborn outcomes.
- Answer any questions/concerns they may have
- Ensure the baby is on oxygen via nasal prongs 1L/min as you explain all this to the parents

**Items required to initiate bCPAP**

| Checklist for Machine Preparation | Check List for Baby preparation |
|---|---|
| • bCPAP machine | • Hat or gauze roll |
| • Power cable | • Hat clips |
| • Patient (Inspiratory) tubing | • Orogastric (OG) tube |
| • Bottle (Expiratory) tubing | • Normal saline in a 2ml Syringe |
| • CPAP Bottle with a lid | • Clear adhesive Tape |
| • CPAP assorted sizes nasal prongs | • Suction catheter size 6 and 8 |
| • Elbow connectors | • Assorted nasal prongs (00 – 5) |
| • Oxygen tubing | • Blue litmus paper |
| • Oxygen source | • 5cc syringe |
| • Distilled water (at least 500mls) | • Stethoscope |
| • Trolley | • Alcohol based hand rub |
| • 50cc syringe | • Suction machine |
| • Nasal prongs measuring tape | • Pulse oximeter |

# Complications of CPAP

# Skin Complications

- Constant pressure on nares, ears, head and forehead can lead to reduced skin integrity and injury causing pressure ulcers.

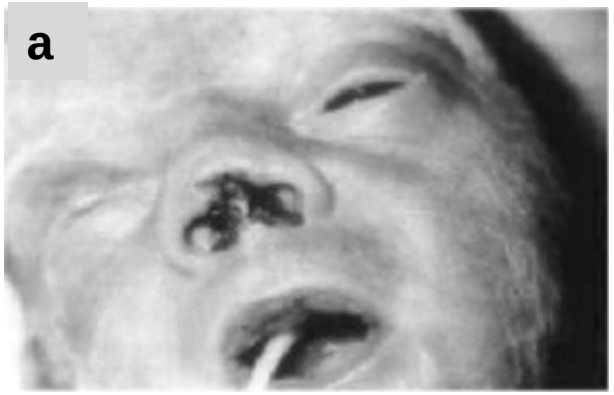

First sign of skin breakdown is nasal erythema.

## Prevention

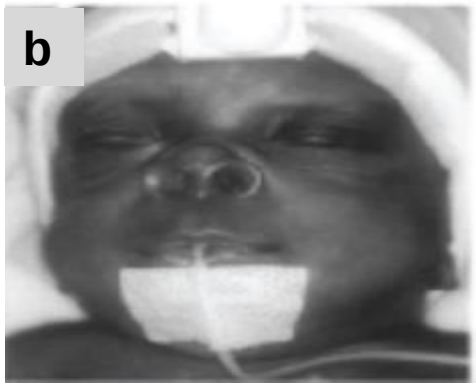
- **Frequent observation**
- **Minimize points of contact**
- **Keep skin dry and clean**
- **Avoid tight fitting hat over forehead, ears and bony prominences**

*Fischer C, Bertelle V, Hohlfeld J, et alNasal trauma due to continuous positive airway pressure in neonates Archives of Disease in Childhood - Fetal and Neonatal Edition 2010;**95:**F447-F451.newborn care protocols. Queensland Clinical Guidelines. Respiratory distress and CPAP Guideline No. MN20.3-V7-R25. Queensland Health. 2020.*

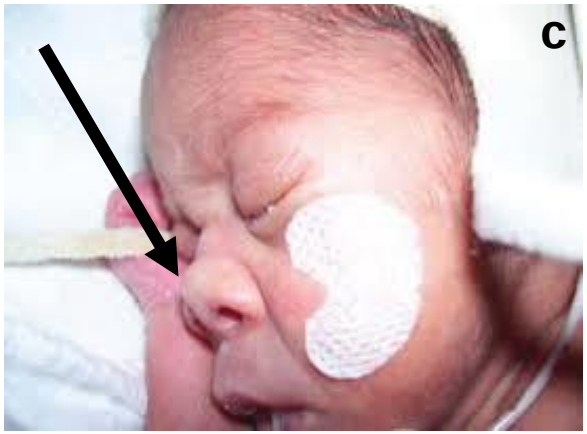
# Nasal Complications




Nasal septal injury




Nasal flaring


Nasal snubbing

## Prevention

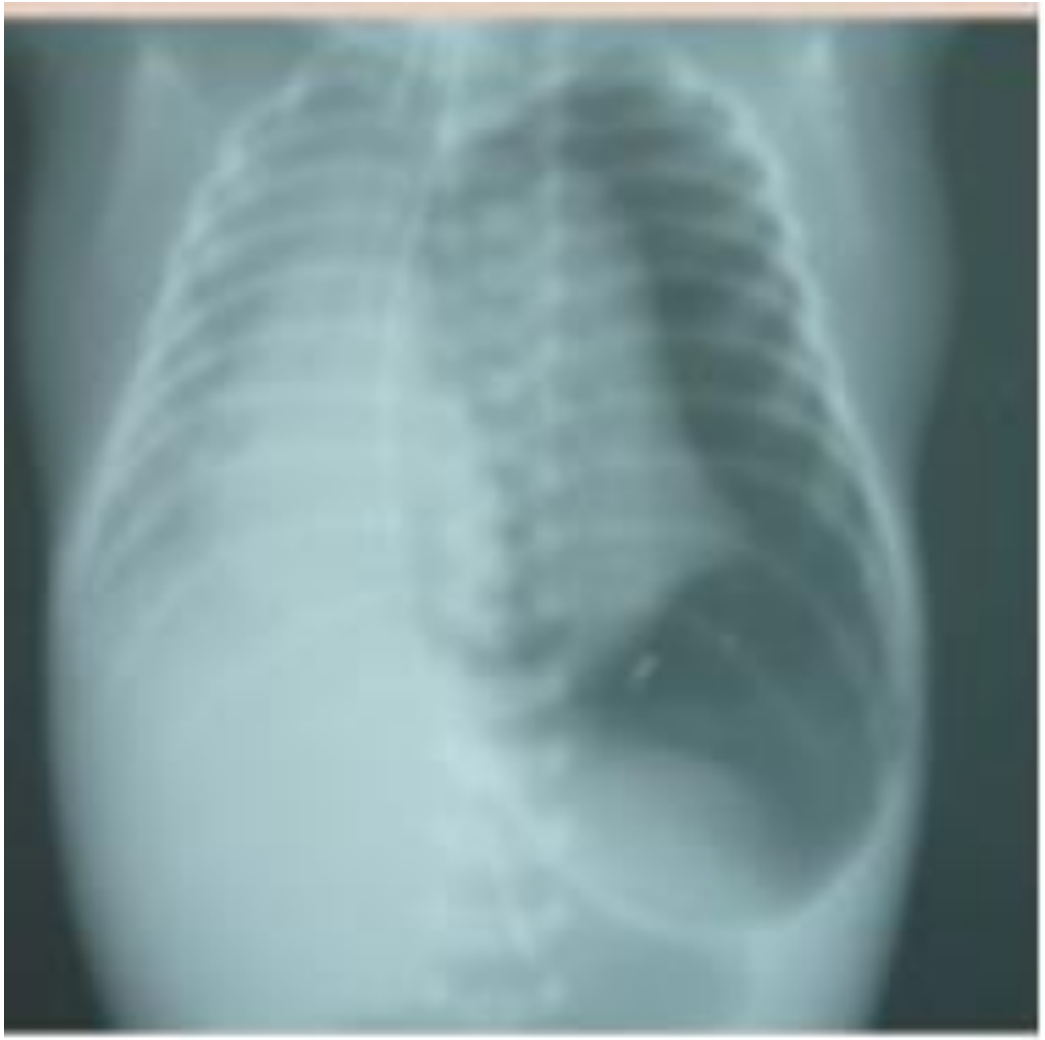
a) Maintain 2mm distance between columella and nasal prongs

b) The prongs should fill the entire nare without blanching the external nare

c) Ensure appropriate size of the nasal prongs and positioning of the whole interface

*Source: Respir Care 2009; 54(9):1209 1235 –Comprehensive newborn care protocols, connect.springerpub.com, Queensland Clinical Guidelines. Respiratory distress and CPAP Guideline No. MN20.3-V7-R25. Queensland Health. 2020.*

# Lung Complications



**Pneumothorax**
CPAP increases risk of air leaks.

**Prevention**

a) Always check CPAP pressure
b) Do not exceed pressures of 8cm $H_20$.
c) Check for any air leaks in circuit

*PRIYADARSHI, A., HINDER, M., BADAWI, N., LUIG, M., TRACY, M.. Continuous Positive Airway Pressure Belly Syndrome: Challenges of a Changing Paradigm.* ***International Journal of Clinical Pediatrics****, North America, 9, Feb. 2020,*
*Queensland Clinical Guidelines. Respiratory distress and CPAP Guideline No. MN20.3-V7-R25. Queensland Health. 2020.*
*Abdominal distension Image borrowed from https://ep.bmj.com/content/102/3/166*

# Lung Complications

## Hyperinflation of lungs

- Occurs due to high CPAP pressures.
- Results in reduced cardiac output secondary to reduced venous return.

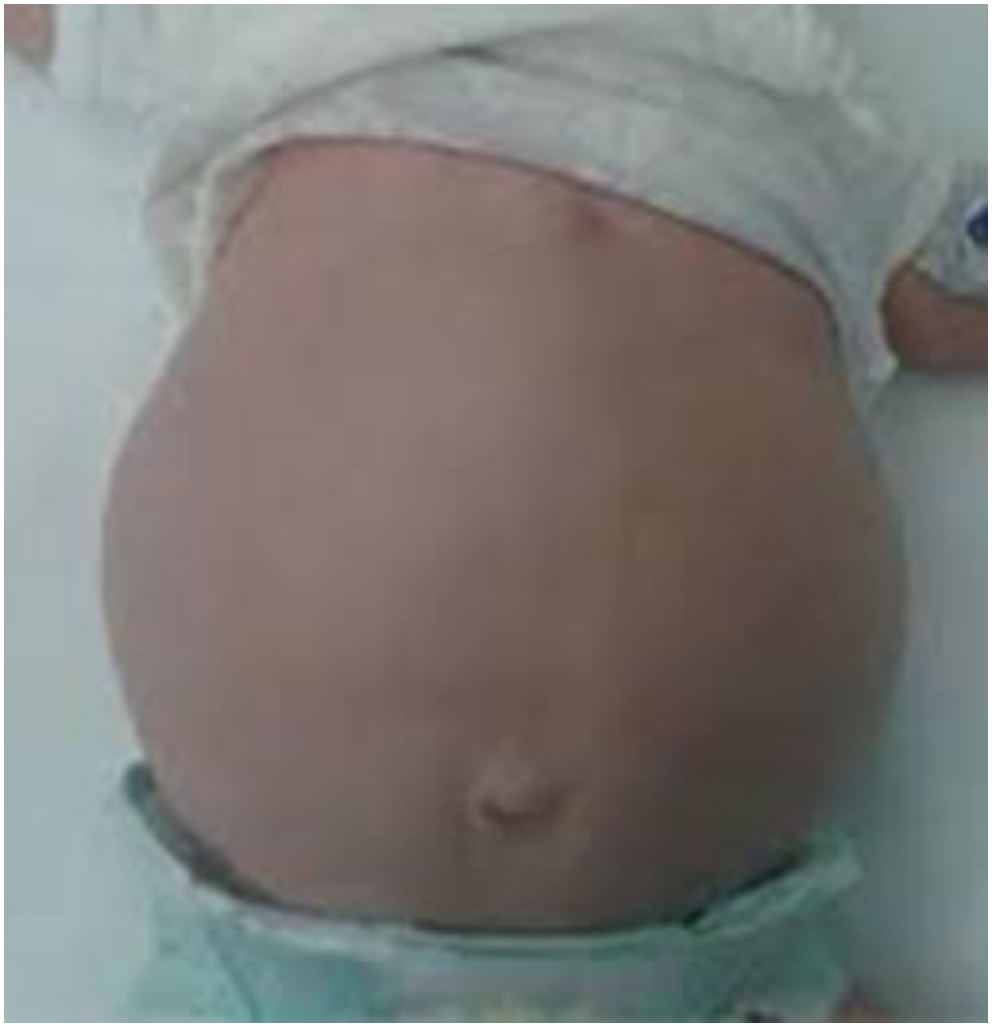
## Prevention

a) Always check CPAP pressure

b) Do not exceed pressures of 8cm $H_20$.

*PRIYADARSHI, A., HINDER, M., BADAWI, N., LUIG, M., TRACY, M.. Continuous Positive Airway Pressure Belly Syndrome: Challenges of a Changing Paradigm.* ***International Journal of Clinical Pediatrics****, North America, 9, Feb. 2020,*
*Queensland Clinical Guidelines. Respiratory distress and CPAP Guideline No. MN20.3-V7-R25. Queensland Health. 2020.*
*Abdominal distension Image borrowed from https://ep.bmj.com/content/102/3/166*

# Abdominal Complications



## Abdominal distention

- Excessive swallowed air
- Feeding intolerance and desaturation episodes.

## Prevention

a) Insert an OGT
b) Leave OGT open
c) If OGT is used for feeding, close for 30mins after feeding the baby then open OGT

*PRIYADARSHI, A., HINDER, M., BADAWI, N., LUIG, M., TRACY, M.. Continuous Positive Airway Pressure Belly Syndrome: Challenges of a Changing Paradigm.* ***International Journal of Clinical Pediatrics****, North America, 9, Feb. 2020,*
*Queensland Clinical Guidelines. Respiratory distress and CPAP Guideline No. MN20.3-V7-R25. Queensland Health. 2020.*
*Abdominal distension Image borrowed from https://ep.bmj.com/content/102/3/166*

# Oxygen Therapy Complications

**Hypoxia**
$SPO_2$ - 85 - 89%

- Increases mortality
- Does not alter rates of developing;
  a) Chronic lung disease- BPD
  b) Blindness
  c) Neurodevelopmental impairment.

**Hyperoxia**
$SPO_2$ - > 95%

- Free radicals that cannot be metabolized by immature antioxidant systems.
- Chronic lung disease - BPD
- Eye Injury - RoP

## Prevention

**a) Monitor $SpO_2$**
**b) Aim for $O_2$ saturation of 90-95%**
**c) Titrate the $FiO_2$ based on $SpO_2$**

*Walsh BK, Smallwood CD. Pediatric Oxygen Therapy: A Review and Update. Respir Care. 2017;62(6):645-661. doi:10.4187/respcare.05245*

# CPAP Failure

CPAP leads to a 35% reduction in death and use of assisted ventilation[1].

It however can fail

A diagnosis of CPAP failure is made on any baby who has been on correctly applied CPAP and continues to have:

1. Moderate to severe recessions and grunting
2. FiO2 greater than 40% to maintain target SpO2 with 7 cmH2O CPAP
3. Rapid increase of oxygen requirement including a rise of 10% over 2 hours or less
4. Respiratory acidosis
5. Recurrent apnoeic episodes.
6. Development of pneumothorax
7. Baby agitated and not settled by comfort measures

*Ho JJ, Subramaniam P, Davis PG. Continuous distending pressure for respiratory distress in preterm infants. Cochrane Database of Systematic Reviews 2015, Issue 7. Art. No.: CD002271. DOI: 10.1002/14651858.CD002271.pub2Wright CJ, Sherlock LG, Sahni R, Polin RA. Preventing Continuous Positive Airway Pressure Failure: Evidence-Based and Physiologically Sound Practices from Delivery Room to the Neonatal Intensive Care Unit. Clin Perinatol. 2018;45(2):257-271. doi:10.1016/j.clp.2018.01.011*

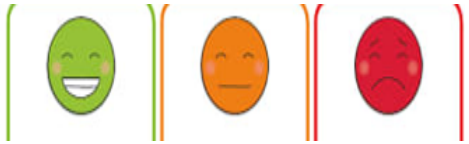
# Risk factors for CPAP failure

**Newborn Characteristics**

- Weight <1000g
- Gestation <28 weeks
- Sex - Male

**Maternal Factors**

- Poor antenatal steroid coverage
- PPROM



**Severity of the Disease**

- Moderate or Severe RDS
- Delayed onset of treatment

*Ho JJ, Subramaniam P, Davis PG. Continuous distending pressure for respiratory distress in preterm infants. Cochrane Database of Systematic Reviews 2015, Issue 7. Art. No.: CD002271. DOI: 10.1002/14651858.CD002271.pub2Wright CJ, Sherlock LG, Sahni R, Polin RA. Preventing Continuous Positive Airway Pressure Failure: Evidence-Based and Physiologically Sound Practices from Delivery Room to the Neonatal Intensive Care Unit. Clin Perinatol. 2018;45(2):257-271. doi:10.1016/j.clp.2018.01.011*

# Implementing CPAP

# Increasing CPAP success rates

**Policy Change Required**

1. Improved ANC care to ensure **antenatal steroid coverage** in management of preterm labor.
2. The NBU care of patients on CPAP is one level below NICU, this means **staffing** is key as poor supervision increases mortality.
3. **Nursing care takes priority** - proper application of CPAP interface, monitoring, providing supportive care and above all a gentle and human care.

# Questions

# Summary

1. CPAP promotes lung growth/development and protects lung – all babies deserves the best care.
2. CPAP should be initiated at an $FiO_2$ of 50%, which then is titrated upwards or downwards to achieve oxygen saturation targets of 90-95%
3. Regularly monitor patient to optimize CPAP benefits and reduce risk of complications