University of Nairobi

Respiratory distress syndrome and use of CPAP

An initiative of ETAT+ Trainers in partnership with CPHD

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Outline

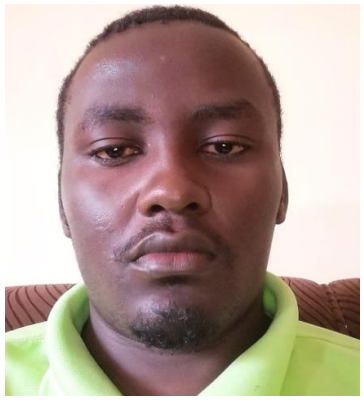
Prof. Grace Irimu
Facilitator

Dr. Rachael Kanguha
(Host) / introduction

Dr. Lydia Kanyoro
Lung growth and development

Dr. Fareen Musa
Prevention and treatment of RDS

Edith Gicheha
Using CPAP



Samuel Wachira
Using CPAP

Simon Pkemoi
Monitoring babies on CPAP

Dr. Sylvia Mwathi
Complications of CPAP

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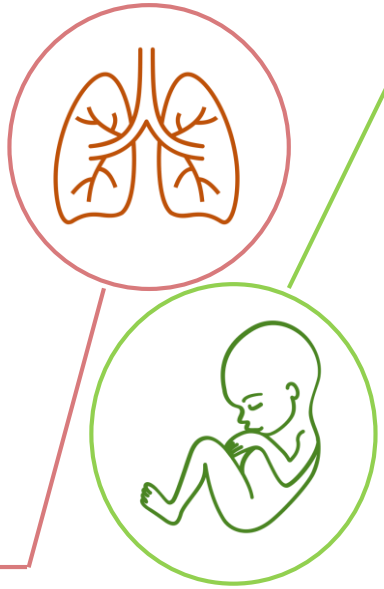
Introduction and definition

Definition of respiratory distress syndrome

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



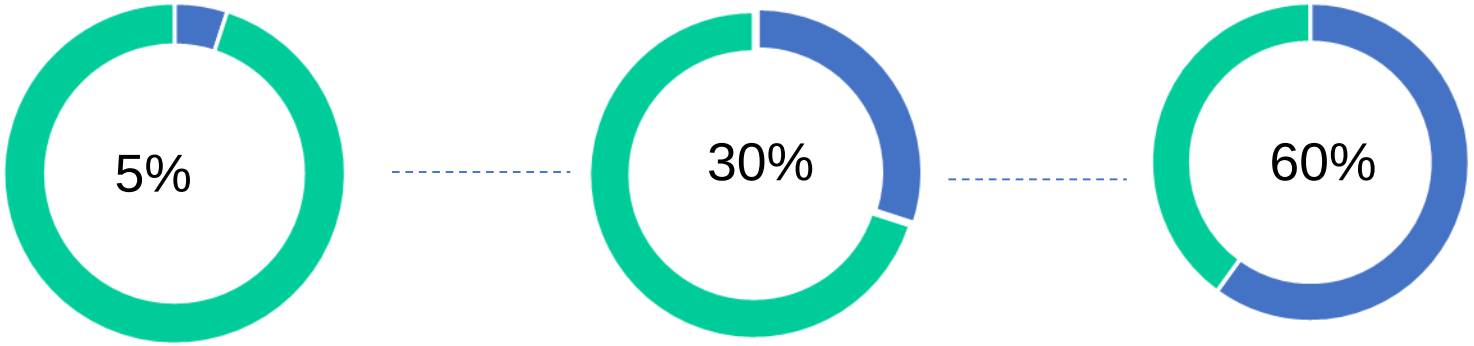
The disease is found mainly in preterm newborns (before 37 weeks' gestation)

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):6506-6517. 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:



Near-term infants

Infants <30 wks gestational age

Infants<28 wks gestational age

- 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

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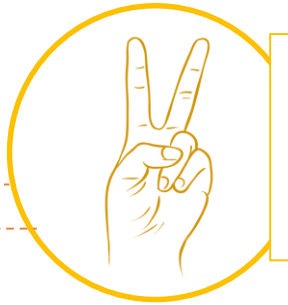
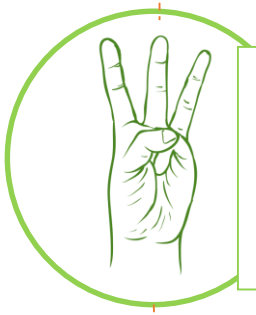
Why focus on RDS?

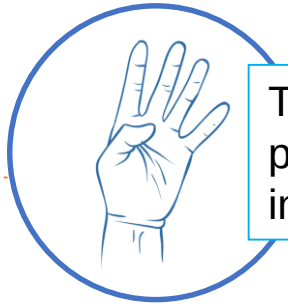
RDS affects premature neonates predorminantly.



Every year, an estimated 15 million babies are born preterm (before 37 wks)
In Kenya, preterm birth rate is 12/100 live births



Preterm birth complications are the leading cause of death among children under 5 years of age



Three-quarters of these deaths could be prevented with current, cost-effective interventions

World health organisation. Preterm birth. 2018 . https://www.who.int/news-room/fact-sheets/detail/preterm-birth

How Sustainable Development Goals link to prevention of preterm births and RDS

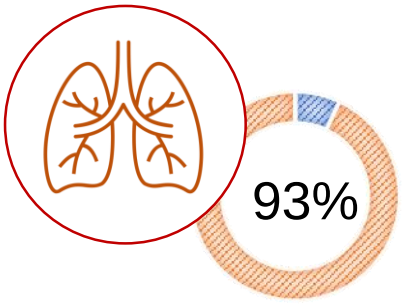
Low social economic status, poor maternal health and nutrition and limited access to health facilities has an impact on preterm births- thereby increasing chances of having premature babies at risk of RDS

Therefore Prevention of preterm births is a complex problem involving many sectors.

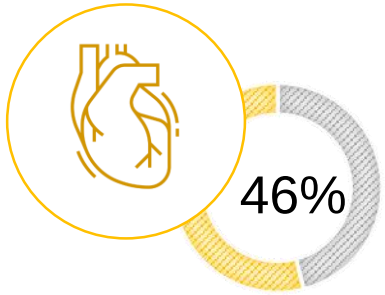
Born Too Soon: The Global Action Report on Preterm Birth 2012.
https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

How common is RDS?

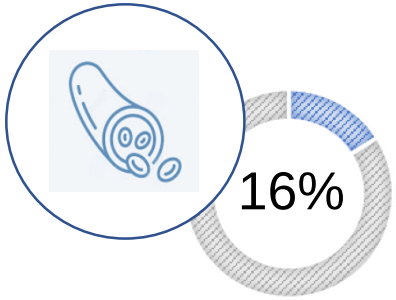
Perinatal/neonatal data were collected for 9575 infants of extremely low GA (22-28 weeks) & VLBW(401-1500 g)



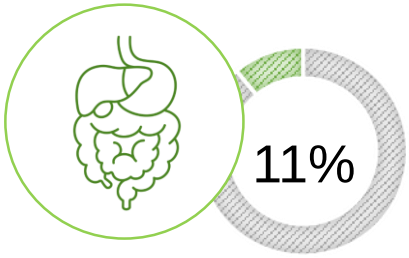
Respiratory distress syndrome



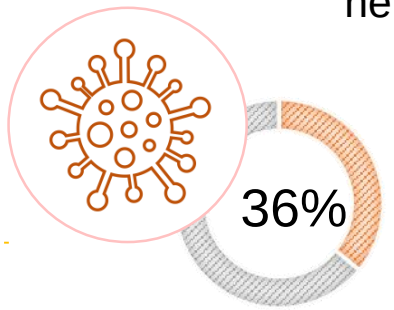
Patent ductus arteriosus



Severe intraventricular hemorrhage



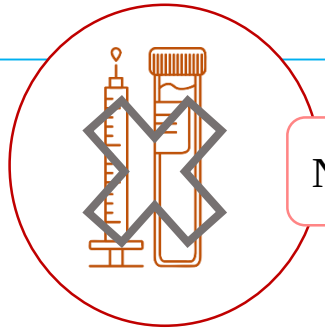
Necrotizing enterocolitis



Late-onset sepsis

Stoll BJ, Hansen NI, Bell EF, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. Pediatrics.2010;126(3):443-456. doi:10.1542/peds.2009-2959

How is diagnosis of RDS made?



No laboratory test to diagnose RDS

Diagnosis is based on:

Initial clinical symptoms

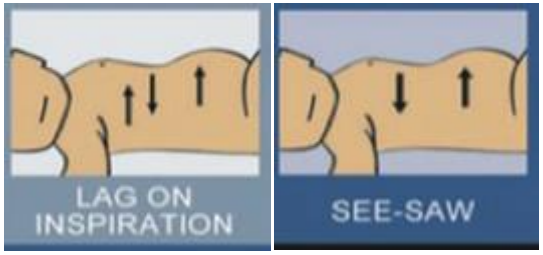
A chest radiograph consistent with RDS

The clinical course

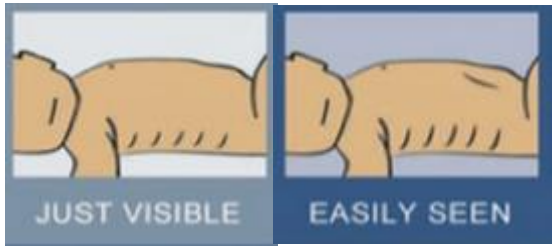
Response to surfactant treatment.

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

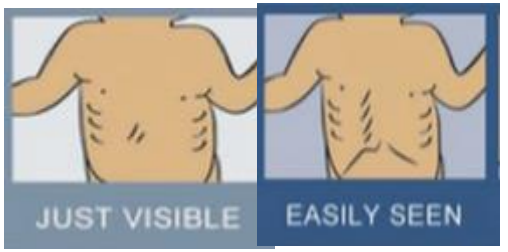
Clinical signs of respiratory distress (increased work of breathing)



Chest movement



Lower chest wall retractions



Xiphoid retraction

Expiratory grunt

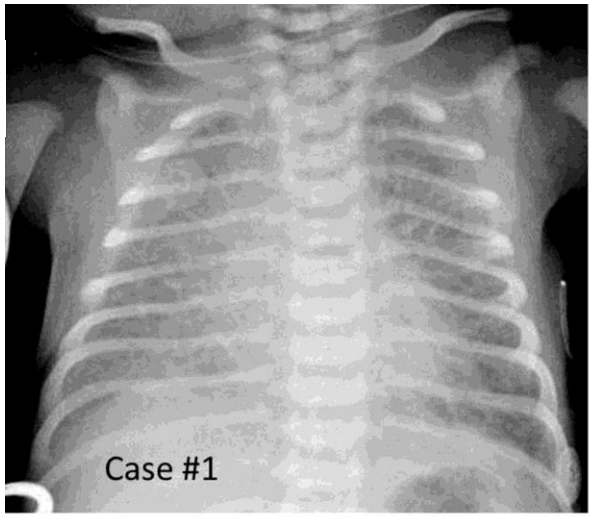
Flaring of the nasal alae

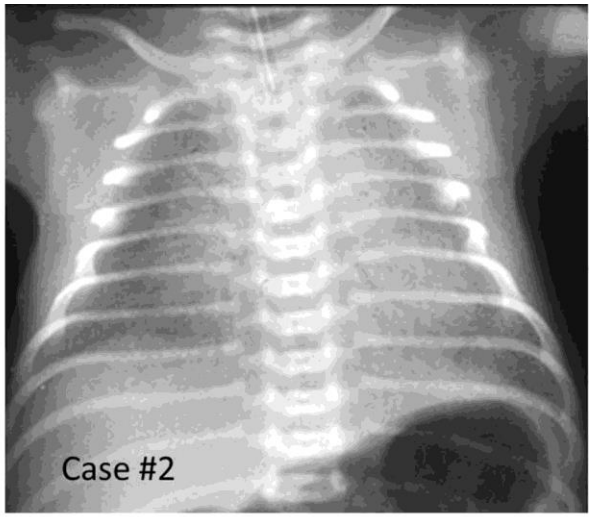
Tachypnoea. RR>60

McAdams RM, Hedstrom AB, DiBlasi RM, Mant JE, Nyonyintono J, Otai CD, et al. Implementation of bubble CPAP in a rural Ugandan neonatal ICU. Respir Care. 2015;60:437–45.
Silverman WA, Andersen DH. A controlled clinical trial of effects of water mist on obstructive respiratory signs, death rate and necropsy findings among premature infants. Pediatrics. 1956;17:1–10.

Chest Xray findings of RDS compared to other differential diagnosis

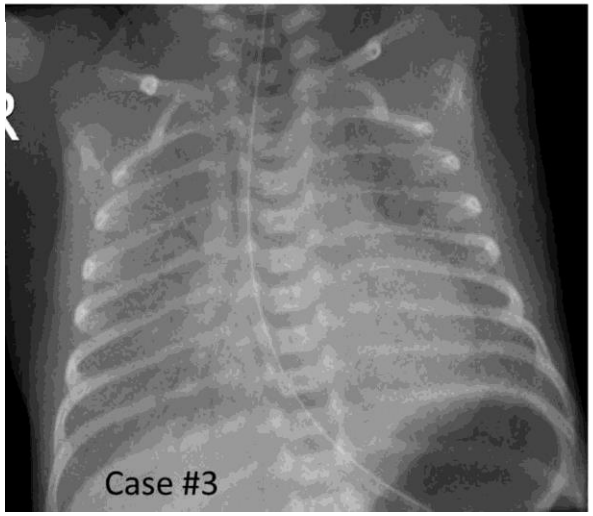
TTN

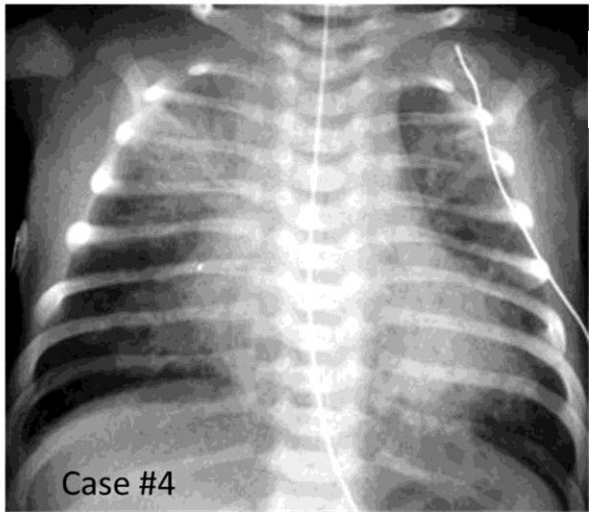




PNEUMONIA

RDS





MAS

Suzanne Reuter, Chuanpit Moser, Michelle Baack. Respiratory Distress in the Newborn.Pediatrics in Review Oct 2014, 35 (10) 417-429; DOI: 10.1542/pir.35-10-417

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Clinical course of RDS

Neonates present within the first several hours of life, often immediately after birth.

- **Hours after birth**

If untreated the disease worsens

- **24-48 hours**

The course of RDS is self-limited and typically improves at the end of this period

- **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

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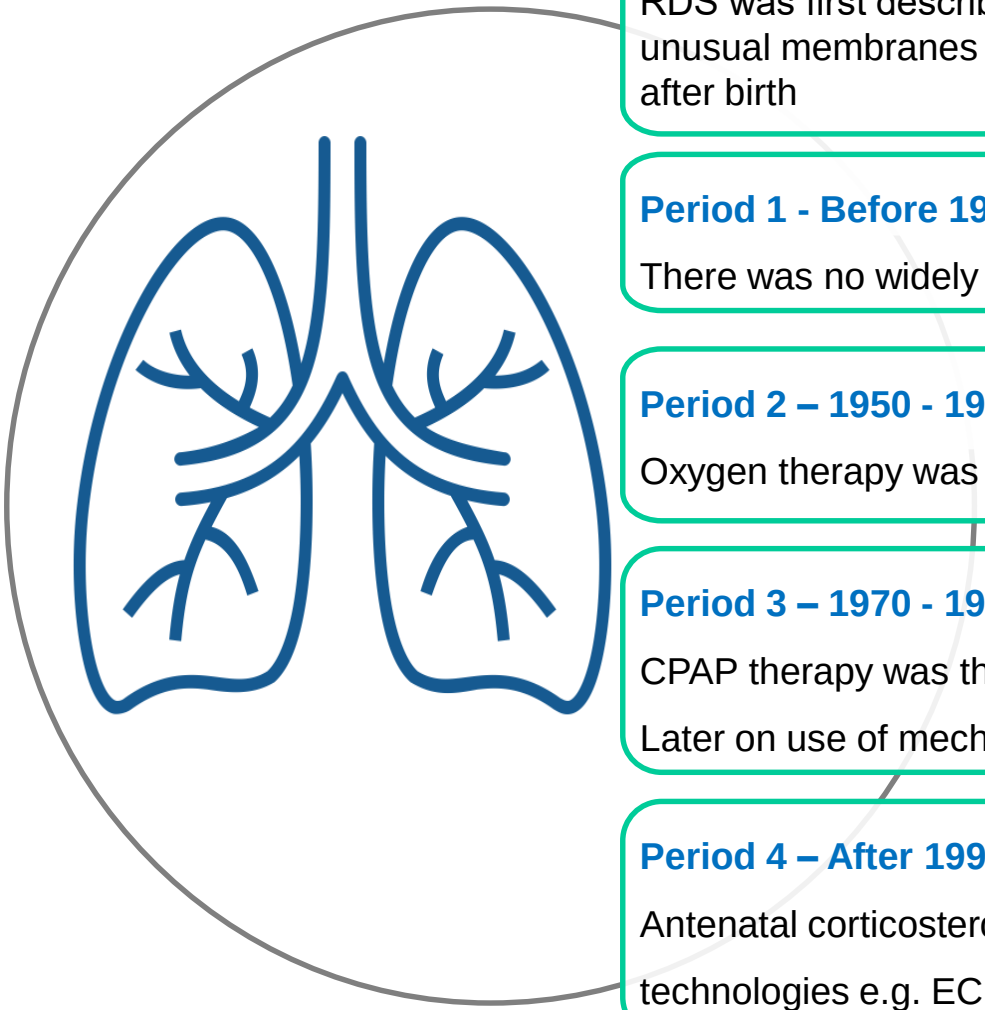
Periods of treatment for RDS



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

There was no widely used treatment

Period 2 – 1950 - 1969

Oxygen therapy was the RDS specific intervention

Period 3 – 1970 - 1989

CPAP therapy was the RDS specific intervention

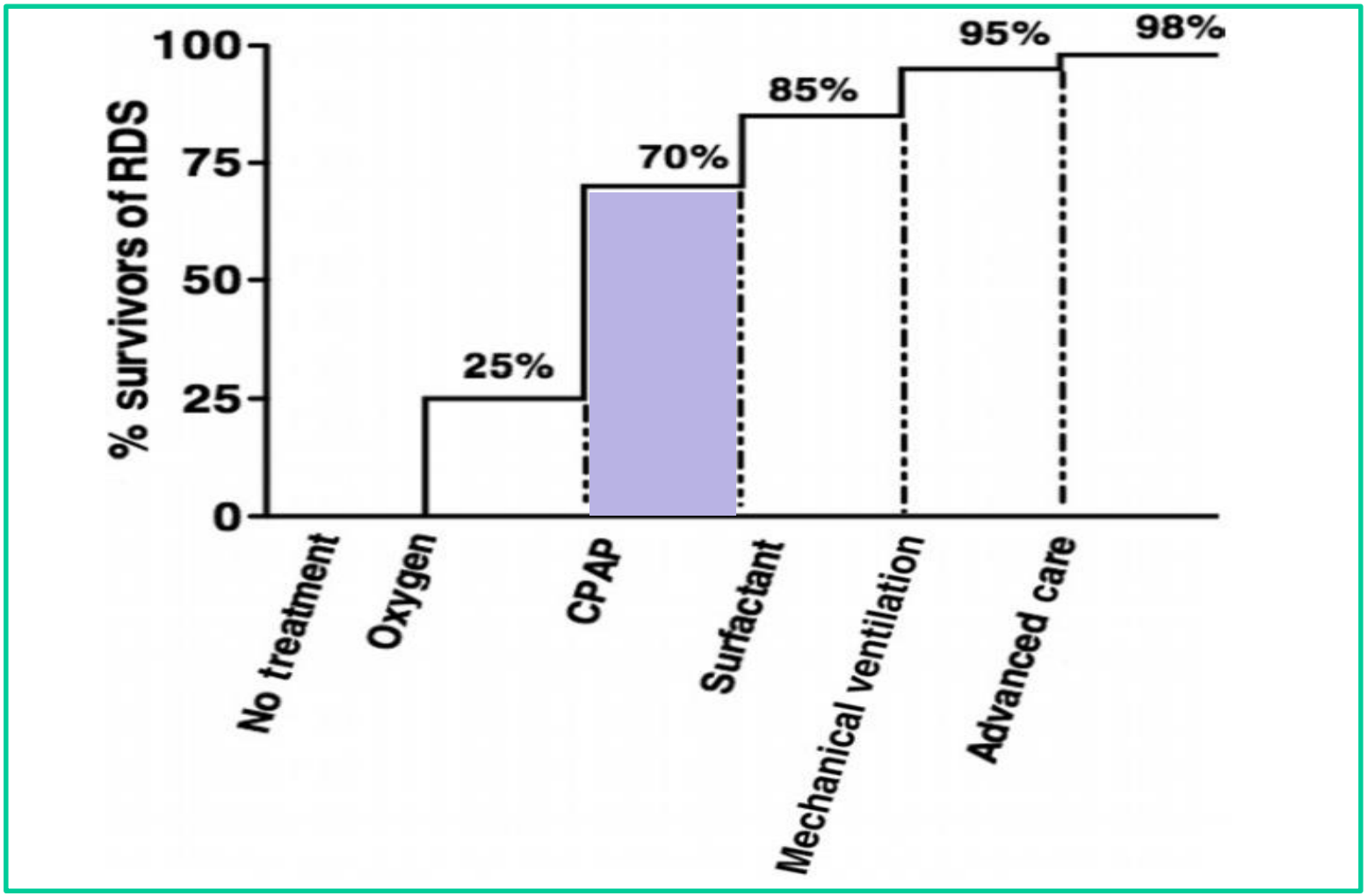
Later on use of mechanical ventilation for RDS was attempted

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

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Lung Growth and Development

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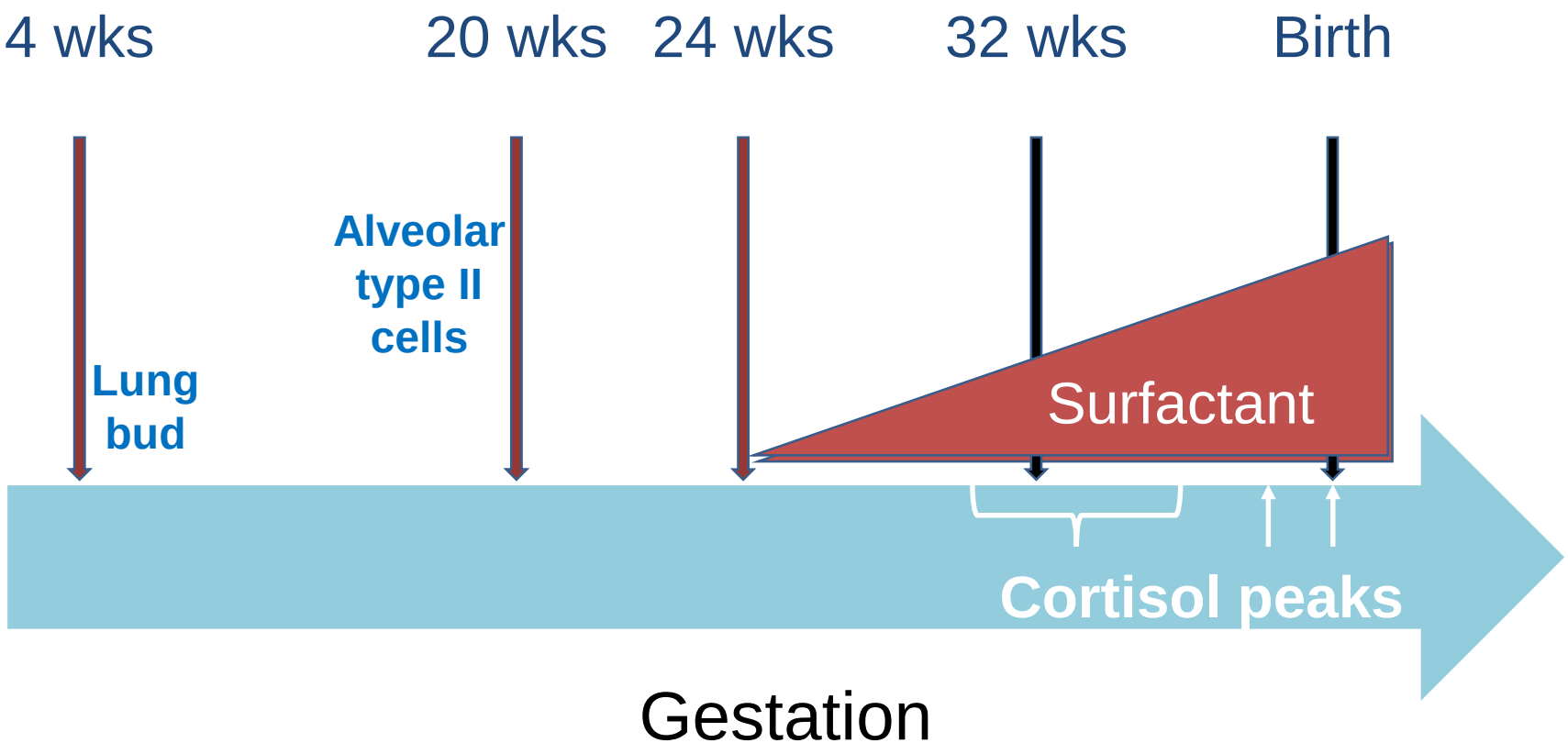
Lung growth and Development



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

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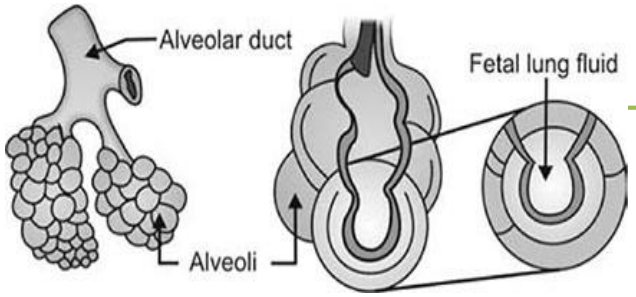
Transition to extrauterine life

Cortisol

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

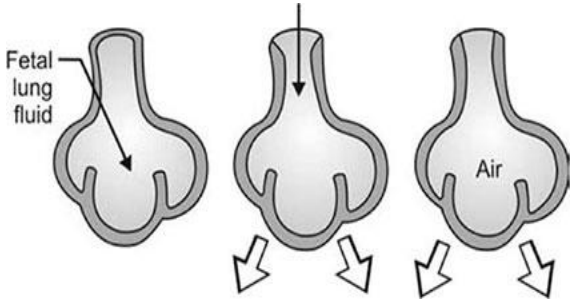
Fetal lungs



- ✓ Fetal fluid secreted into lungs
- ✓ Promotes development
- ✓ Maintains distension
- ✓ Pressure = 2 - 4cmH_20
- ✓ Mechanical stretch stimulates surfactant production

Birth

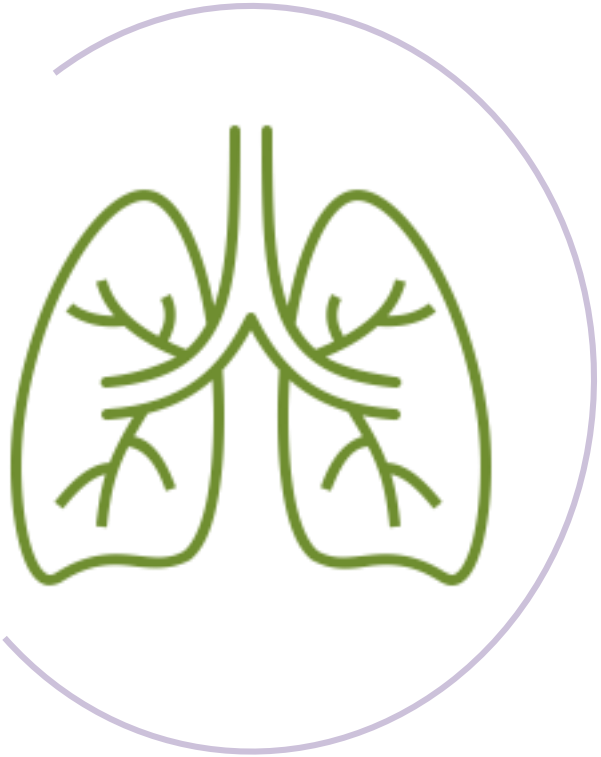
Neonatal lungs



- ✓ 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

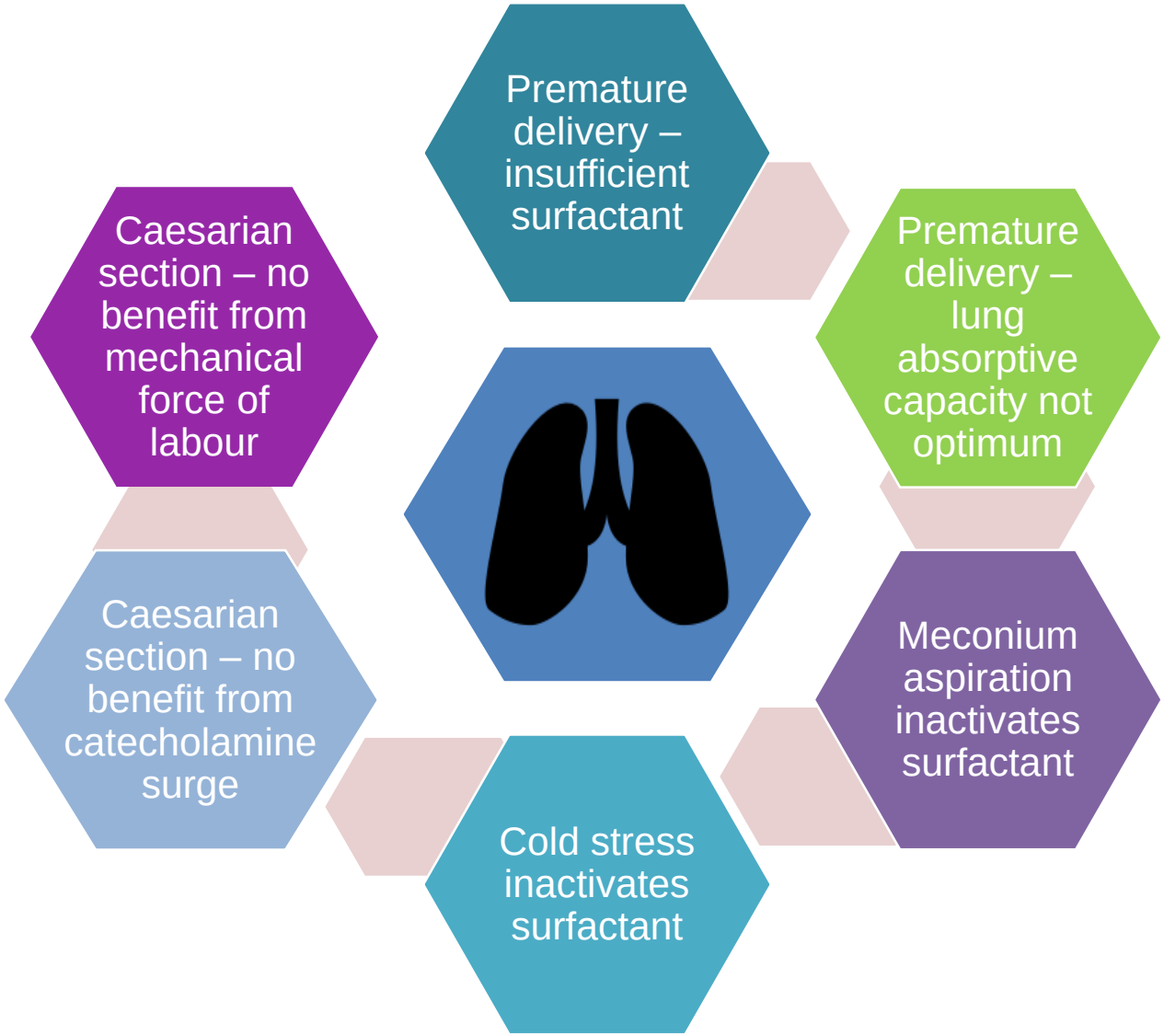


- A complex mixture of phospholipids and proteins
- Reduces surface tension at the air-liquid interface of the alveoli
- Prevents collapse of alveoli during end exhalation
- Secretion is stimulated through the action of hormones like thyroxine as well as glucocorticoids
- Mechanical stretch (distension and hyperventilation) 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?



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):

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Prevention of RDS

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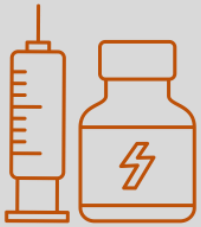
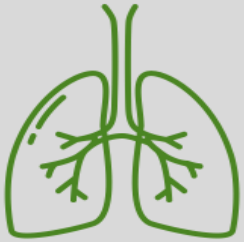
Antenatal steroids and the fetal lung

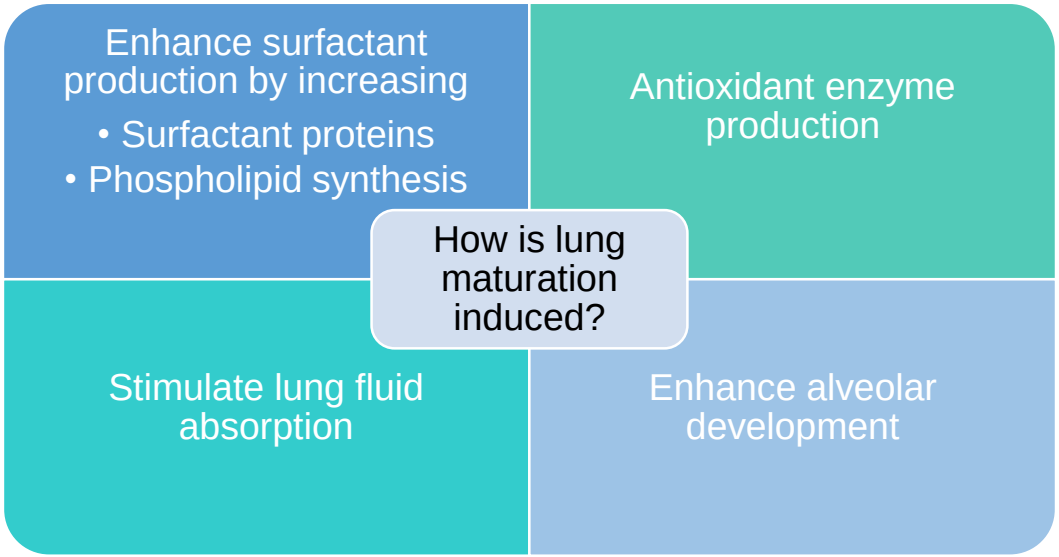
24-34 weeks



Administration of antenatal corticosteroids



Fetal lung maturation



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

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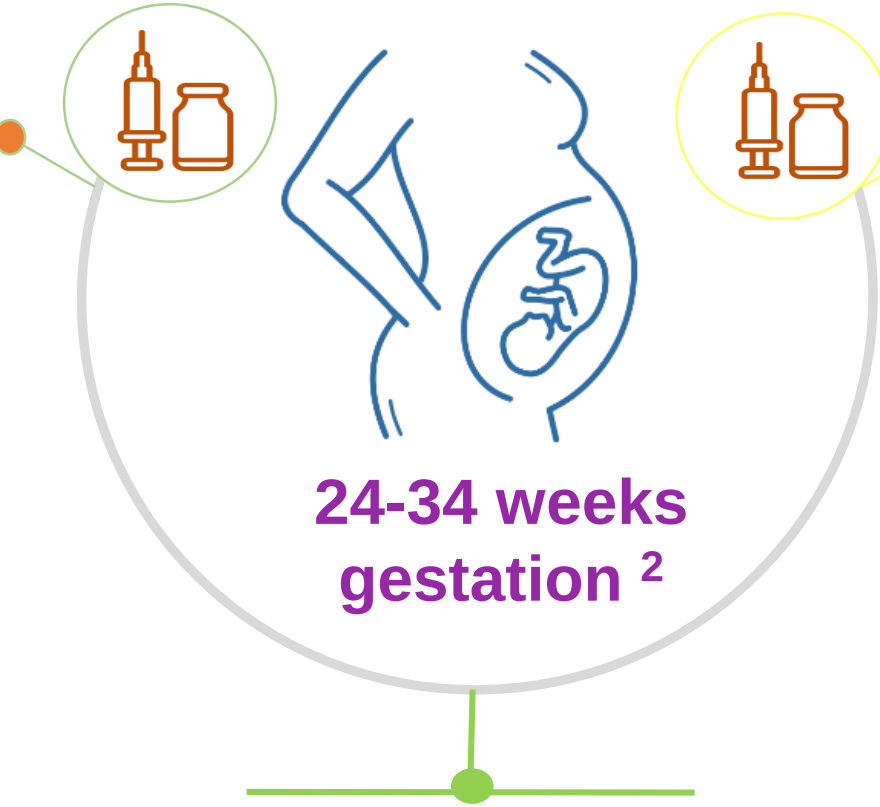
Administration of ACS

- 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 [1]
- 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.

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WHO recommendations on use of ACS

- Administer within 1-7 days before birth, gestational age 24-34 weeks
- IM Dexamethasome or beclomethasone (total 24mg)
- For both single and multiple gestation pregnancies
- Recommended- 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 for those with chorioamnionitis and those undergoing c/s for late preterms .

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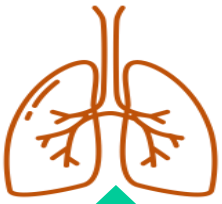
Benefits of ACS



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))

Antenatal corticosteroids for accelerating fetal lung maturation for women at risk of preterm birth (Review) Roberts D, Brown J, Medley N, Dalziel SR 2017

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Management of RDS

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Approach to management

Keep warm and Maintain neutral thermal environment
- Reduce oxygen consumption

Airway patency should be ensured

Breathing
- Specific management
  - Surfactant use and respiratory support

Circulation- feeds and fluids
- Initiation of early feeds.
- Maintenance fluids

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

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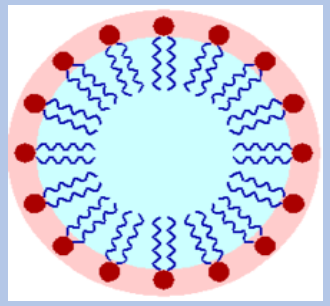
Specific Management

Role of Exogenous Surfactant



Reduction in:

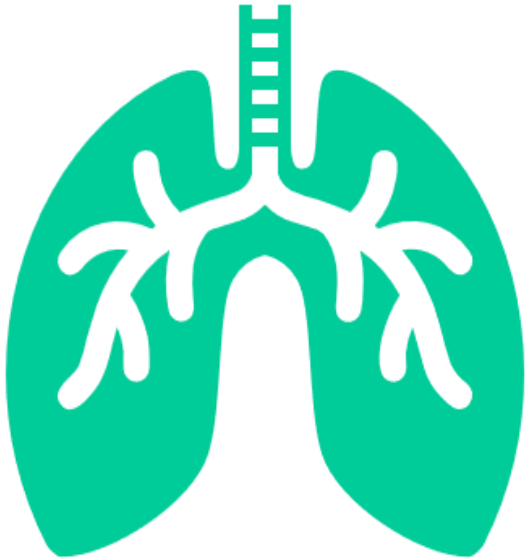
Neonatal mortality

Lower rates of RDS complications e.g. pneumothorax

- Main function: reduce surface tension in the lungs [1.]
- Surfactant pool: term 100mg/kg vs preterms 5-10 Mg/kg [2]
- Natural exogenous surfactant recommended over synthetic forms[3]

1. *Surfactant for Respiratory Distress Syndrome: New Ideas on a Familiar Drug with Innovative Applications H.J. Niemarkt, M.C. Hütten, and Boris W. Kramer 2017*
2. *2.Sardesai S, Biniwale M, Wertheimer F, Garingo A, Ramanathan R. Evolution of surfactant therapy for respiratory distress syndrome: past, present, and future. Pediatr Res. 2017;81:240–248*
3. *Animal derived surfactant extract versus protein free synthetic surfactant for the prevention and treatment of respiratory distress syndrome (Review) Ardell S, Pfister RH, Soll 2015*

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

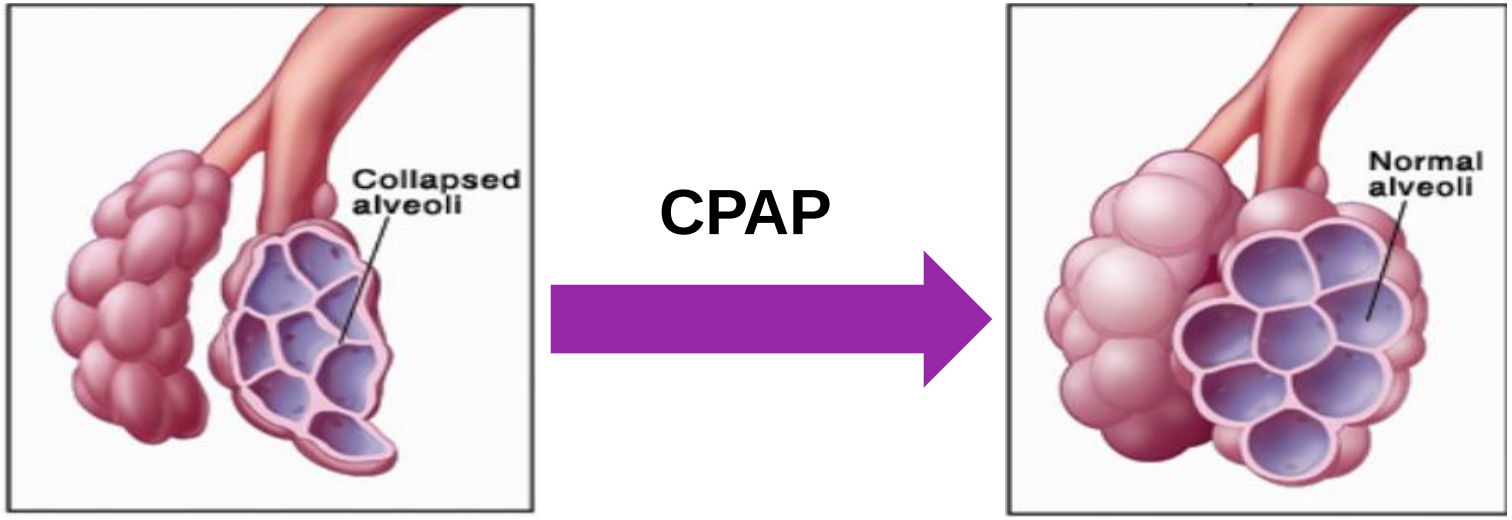
- Fetal lungs in utero remain distended due to the 3-4 cm H_20 maintained by the fluid in the fetal lungs

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.

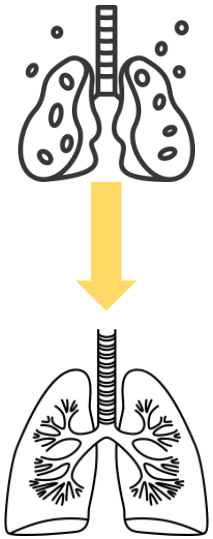
- Promote surfactant production

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

Indications of CPAP

Only for use in a spontaneously breathing patient

- Respiratory distress syndrome
- Pneumonia
- Meconium aspiration syndrome
- Weaning off mechanical ventilation
- Bronchiolitis
- Tracheomalacia
- Severe respiratory distress, hypoxemia despite receiving oxygen



Prophylactic versus Rescue CPAP

Prophylactic CPAP

Rescue CPAP

- **28-30 wks(1000-1300gms)**
- 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 does CPAP work?

Oxygen sources provide> 90% Oxygen

Ambient air provides 21% oxygen

Blend ambient air with the oxygen from the source

- 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**

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

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Using CPAP

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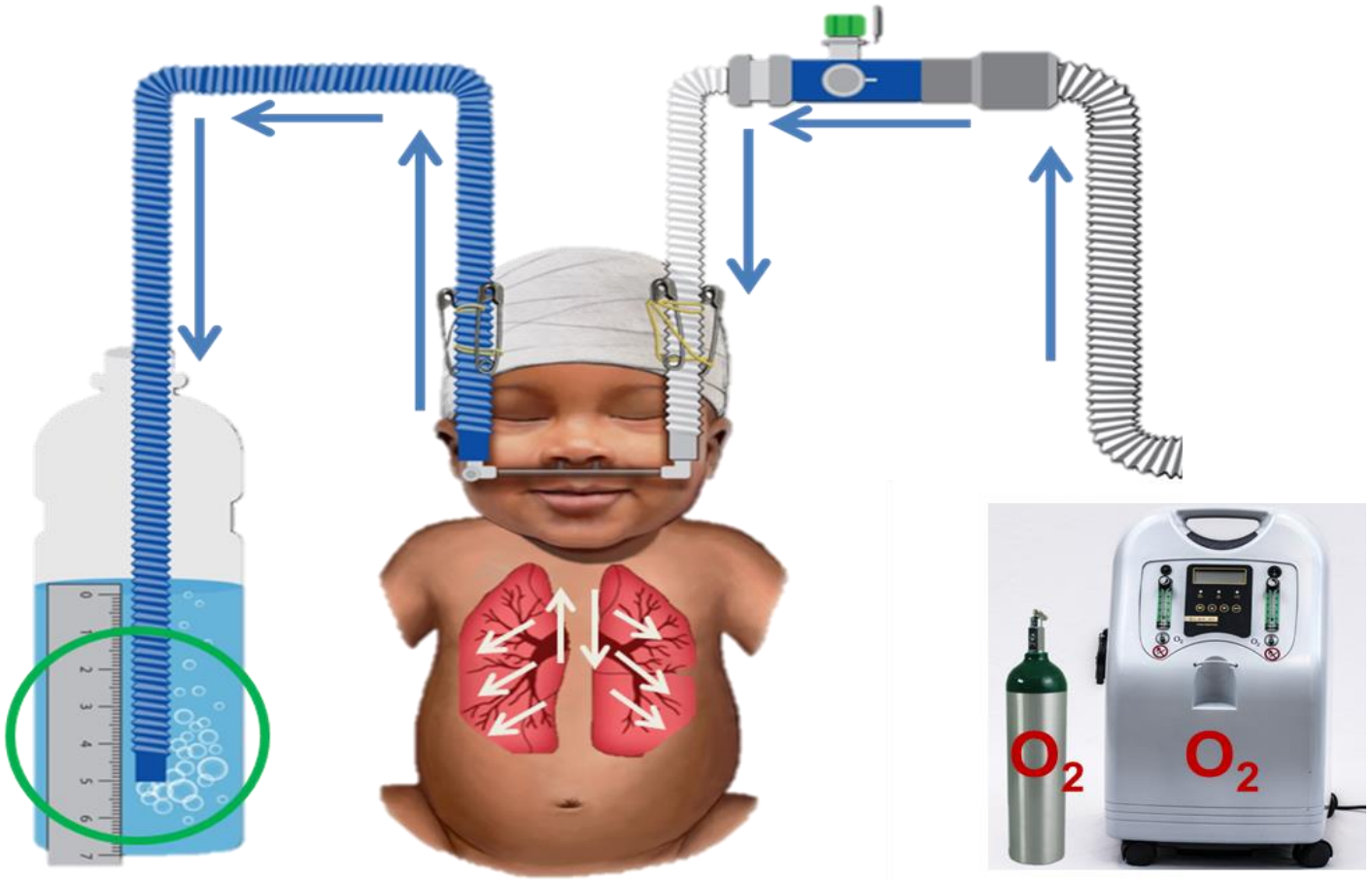
bCPAP Components



Expiratory Limb

Interface (Nasal Prongs)

Inspiratory Limb

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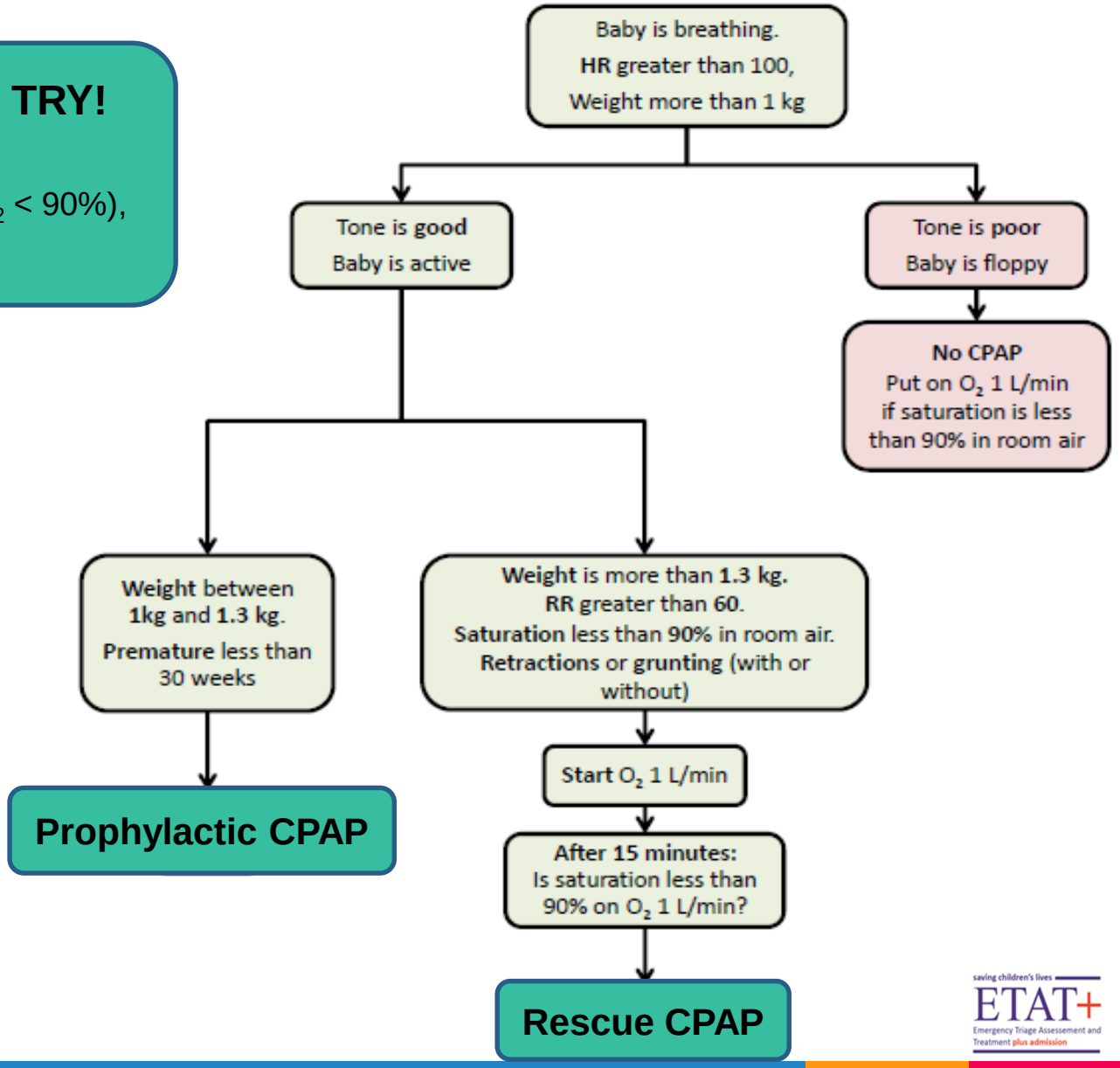
bCPAP Initiation Criteria –TRY algorithm

ABC assessment then TRY!

T – Good **Tone,**

R - Respiratory Distress: (SpO_2 < 90%),

Y - Yes for HR >100/min



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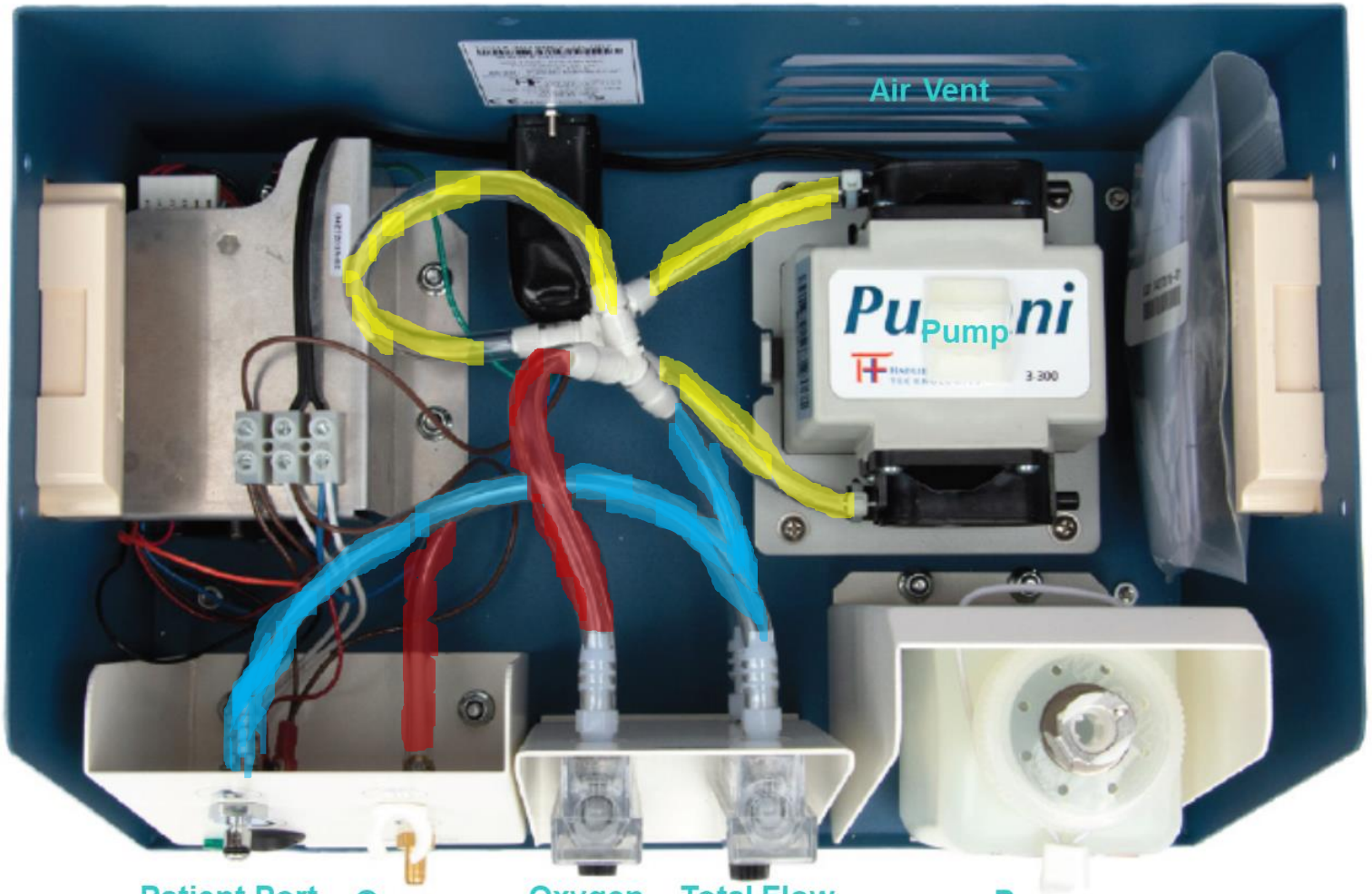
The Pumani bCPAP

The Pumani bCPAP

The Pumani bCPAP

Back View



Front View

The Pumani bCPAP – Blending table

Appendix A: Oxygen Blending Table

1. Choose the Total Flow Rate (L/min) to deliver to the patient.
2. Choose the Fraction of Inspired Oxygen (FiO_2) Level to deliver to the patient.
3. The table value where the Total Flow Rate and FiO_2 Level meet is the Suggested O_2 Flow Rate*.

An **Example Setting** is shown in the table to the right:

A patient requires a Total Flow Rate of 8 L/min and an FiO_2 Level of 60%. Therefore, the Suggested O_2 Flow Rate is 5 L/min.

OXYGEN BLENDING TABLE

FIO_2	Total Flow Rate (L/min)					
	5	6	7	(8)	9	10
	Suggested O_2 Flow Rate (L/min)					
20% O_2	0	0	0	0	0	0
30% O_2	1	1	1.5	2	2	2.5
40% O_2	2	2.5	2.5	3	3.5	3.5
50% O_2	2.5	3	3.5	4	4.5	5
(60% O_2)	3	3.5	4.5	(5)	5.5	6
70% O_2	3.5	4	5	5.5	6	7
80% O_2	4	4.5	5.5	6	7	7.5
90% O_2	4.5	5	6	7	7.5	8.5

*Note that the Suggested O_2 Flow Rate may need to be increased at higher altitudes to meet FiO_2 Level requirements.

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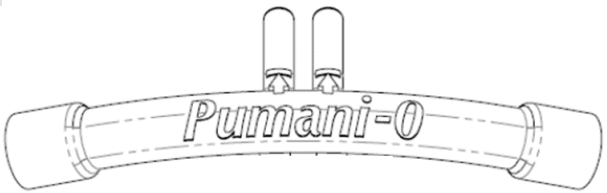
The Pumani bCPAP - Interface

Assorted hats

Pumani Hat Size Selection Chart

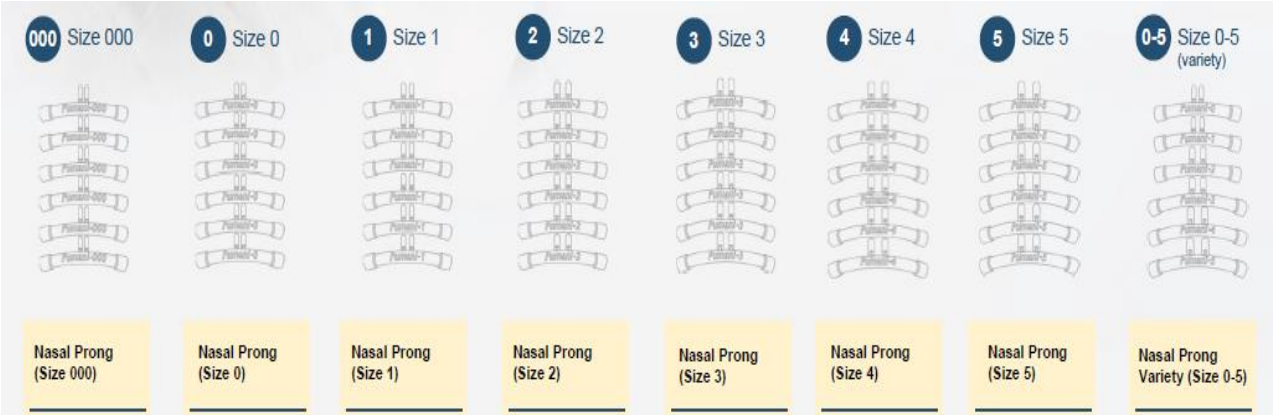
Patient Weight Range	Hat Size
Less than 1,500 grams	Small
1,500 grams to 3,000 grams	Medium
Over 3,000 grams	Large



Hat Clips

Connection Elbows

Assorted nasal prongs



Pumani Nasal Prong Size Selection Chart

Patient Weight Range	Nasal Prong Size
Less than 1,000 grams	000 or 0
1,000 grams to 1,250 grams	1
1,250 grams to 2,000 grams	2
2,000 grams to 3,000 grams	3
3,000 grams to 4,000 grams	4
Over 4,000 grams	5

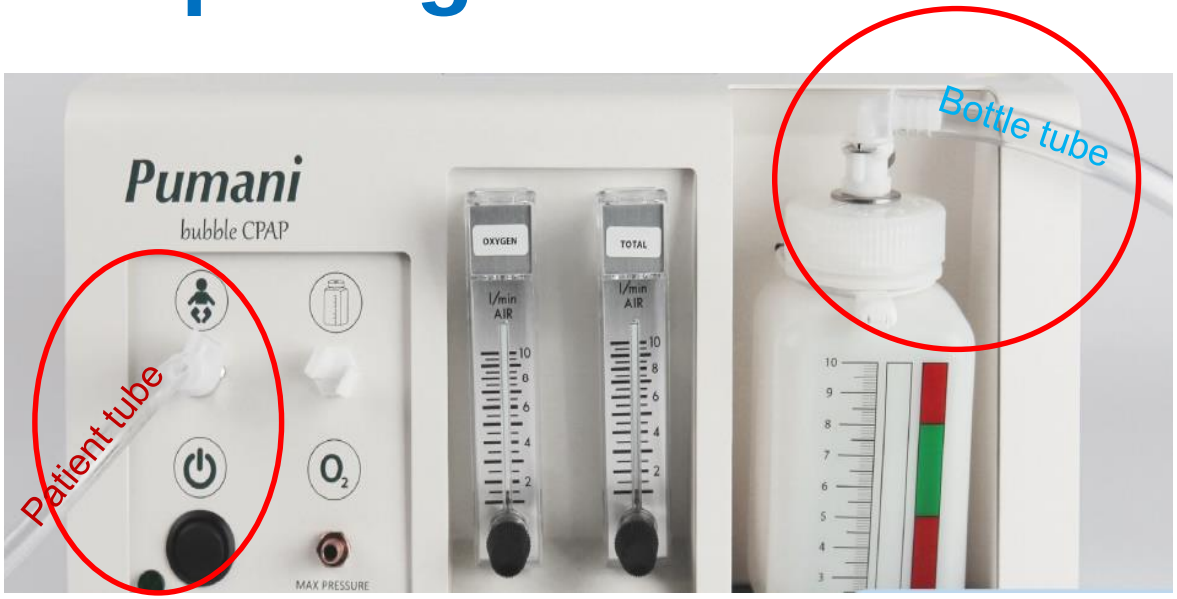
Preparing the Pumani bCPAP

1. Observe Hand Hygiene

2. Position CPAP machine 30cm from wall on a firm surface

3. Fill Pressure generating bottle with 6cm water

Preparing the Pumani CPAP



4. Connect the patient tubing to the patient port and bottle tubing to bottle port. Must hear a click!

5. Connect the correct size of nasal prongs to the bottle and patient tubings using right and left elbows

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Preparing the Pumani CPAP

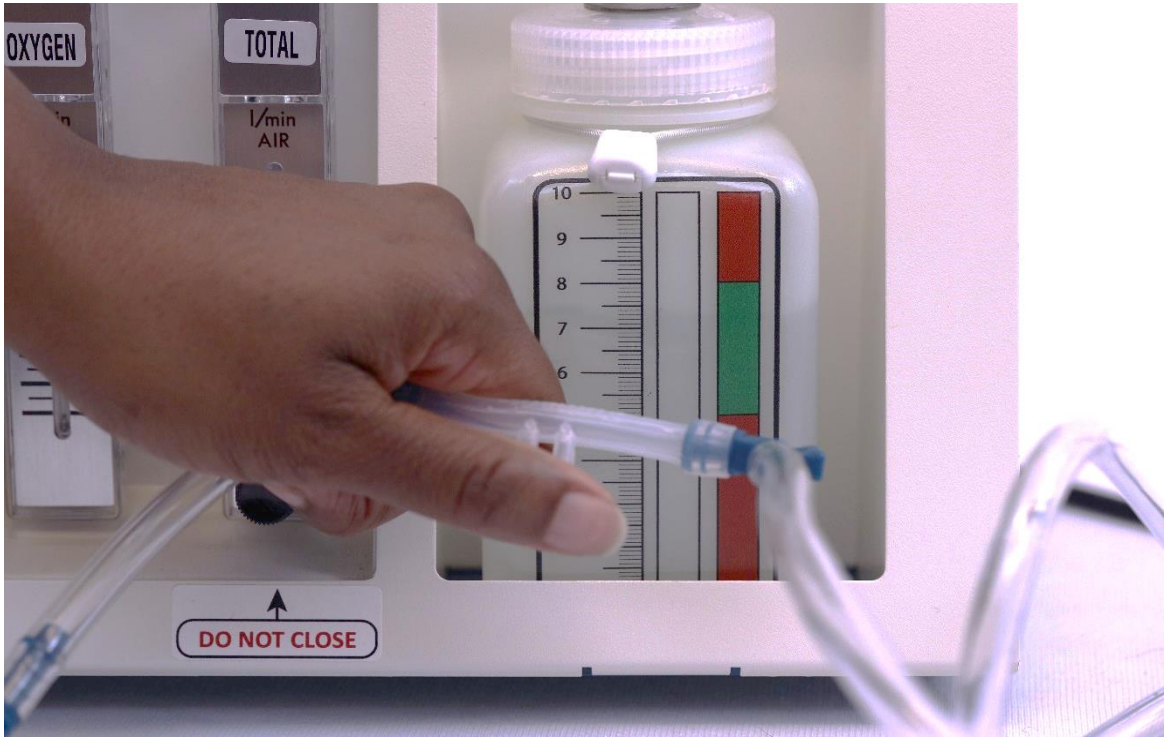
OXYGEN BLENDING TABLE

FIO_2	Total Flow Rate (L/min)					
	5	6	7	8	9	10
	Suggested O_2 Flow Rate (L/min)					
20% O_2	0	0	0	0	0	0
30% O_2	1	1	1.5	2	2	2.5
40% O_2	2	2.5	2.5	3	3.5	3.5
50% O_2	2.5	3	3.5	4	4.5	5
60% O_2	3	3.5	4.5	5	5.5	6
70% O_2	3.5	4	5	5.5	6	7
80% O_2	4	4.5	5.5	6	7	7.5
90% O_2	4.5	5	6	7	7.5	8.5

6. Connect an oxygen source to the CPAP machine and determine the oxygen flowrate to use

- Set the total flow at 6L/min
- Start at 50% FIO_2.
- Using the blending table, read value where the total flow rate of 6L/min meets 50% FIO_2
- Set value read (3L/min) on the oxygen flowmeter on the oxygen source

Preparing the Pumani CPAP

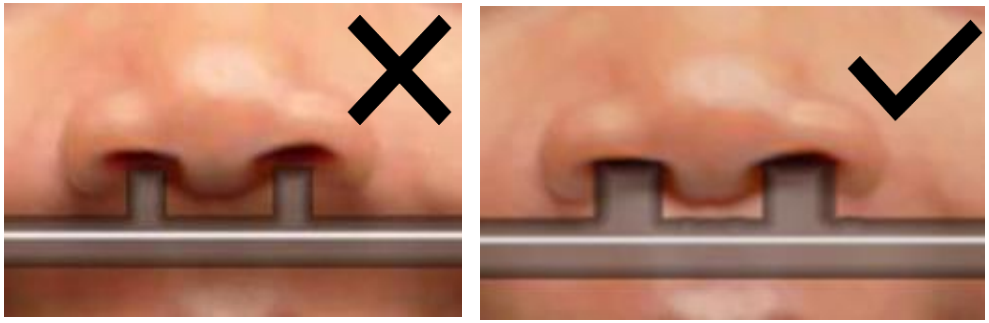


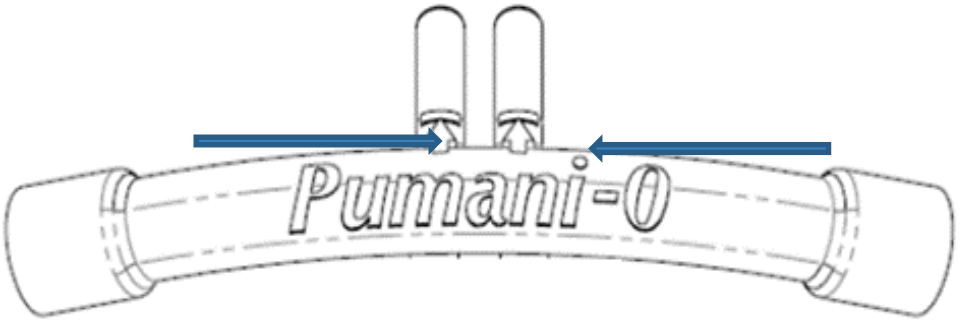
7. Test for functioning (bubbling)

- Turn on the machine
- Pinch the nasal prongs with your fingers.
- Water in the pressure generator bottle should bubble
- Machine is ready for use

Preparing the Baby for CPAP

1. Determining correct size of the hat and its placement
2. Insert an orogastric tube (OGT)
3. Suction the nostrils if necessary
4. Instill a drop of normal saline in each nostril
5. Size, insert and secure nasal prongs



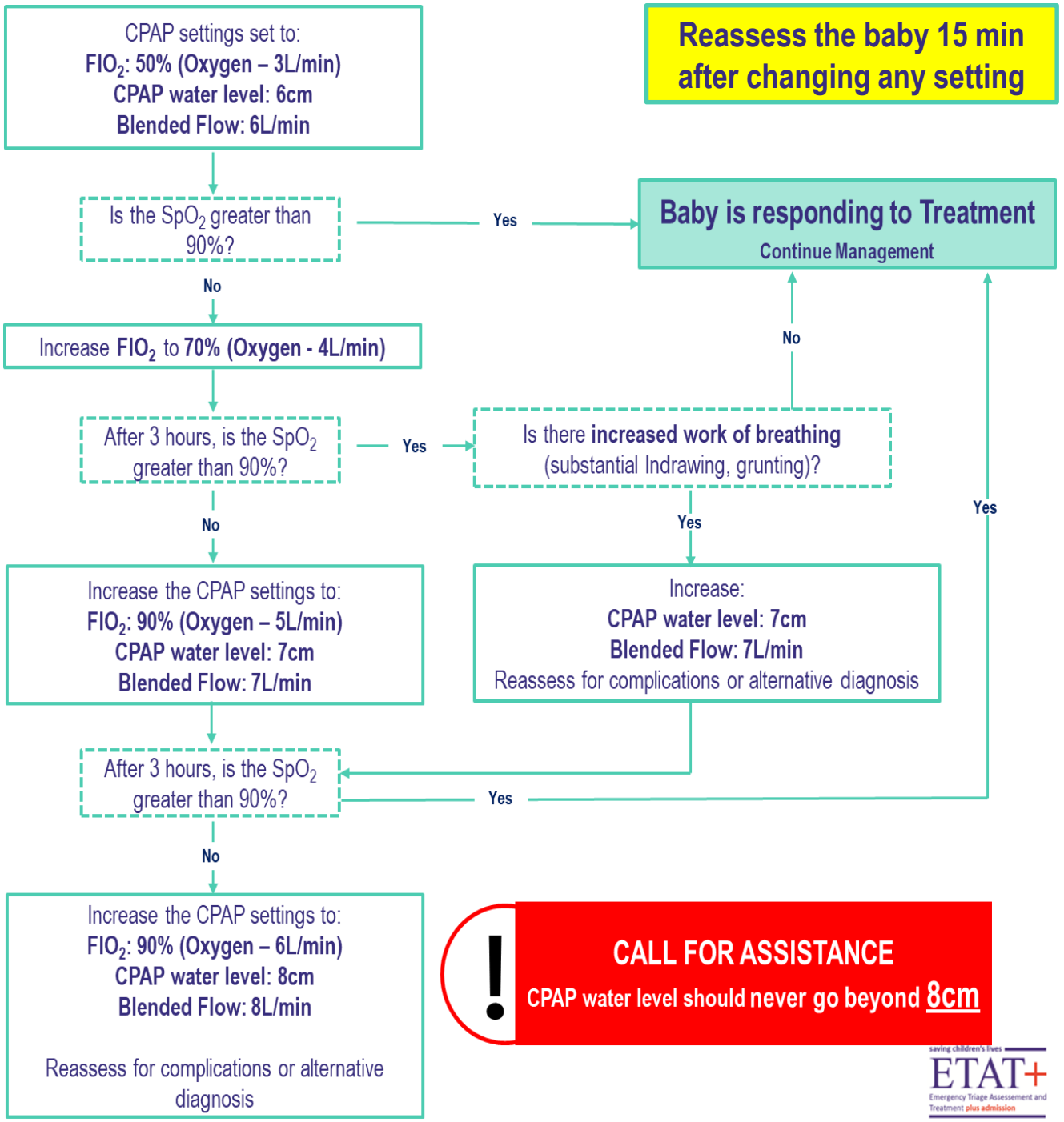


Preparing the Baby for CPAP

6. Check for effective functioning (water bubbling)
7. Attach pulse oximeter
8. Check baby's response to bCPAP (assess WoB, HR and SpO_2)
9. Increase flow rate of **oxygen by 1liter/min every 60 seconds** to achieve **SpO_2 of 90-95%.**
10. Institute supportive care

Increasing bCPAP Treatment

Always check the connection before increasing treatment
Is the water bubbling?
Does the baby need suctioning?



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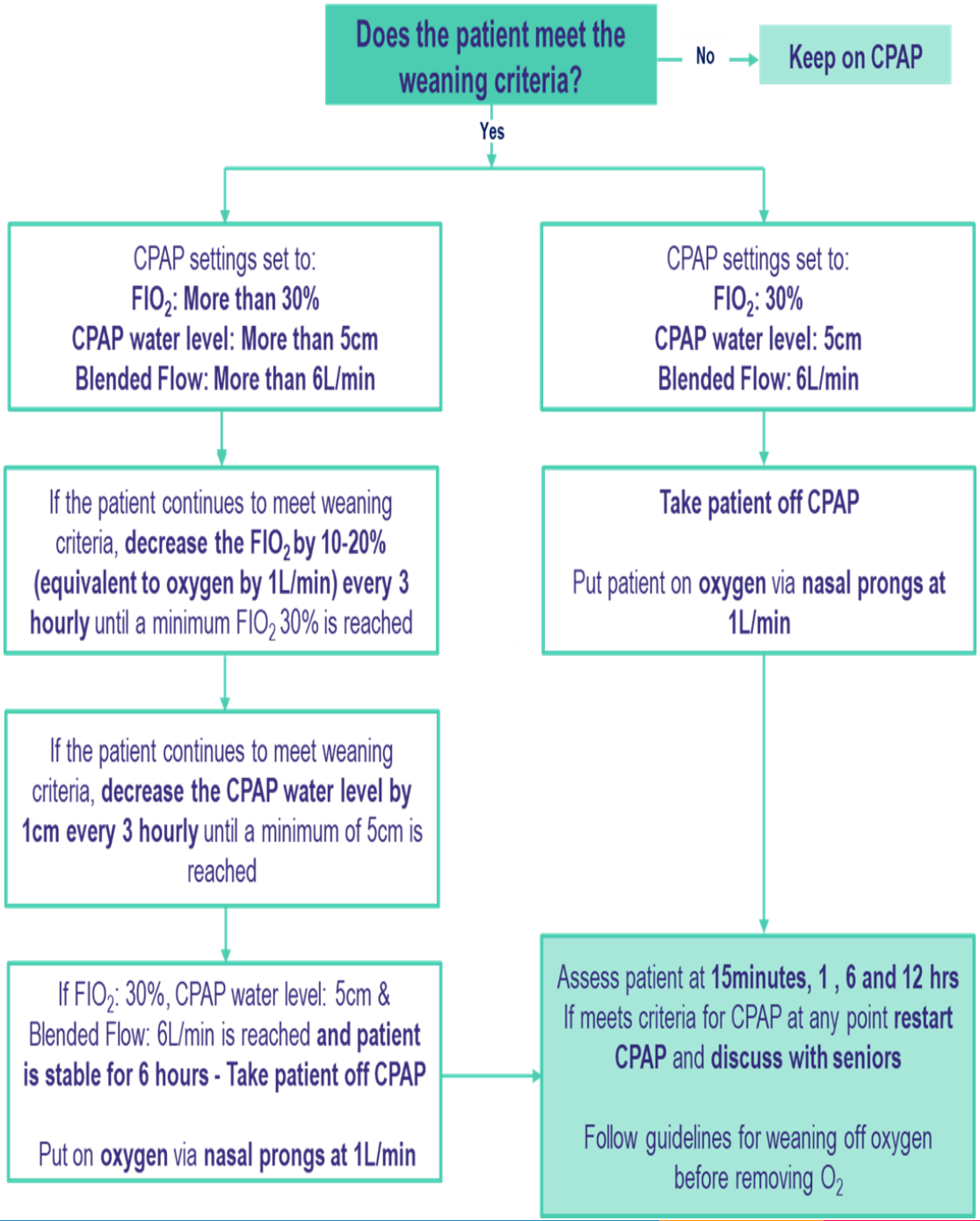
Weaning off bCPAP

Criteria for weaning CPAP treatment:
Patient is clinically stable as below:

1. Patient has been on bCPAP at least 24 hours
2. RR less than 60/minute for at least 6 hours
3. O_2 saturations consistently greater than 90% for at least 6 hours
4. No signiÞcant grunting, indrawing, nasal ßaring, apnoea or bradycardia for at least 6 hours



Monitoring babies on bCPAP

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Monitoring

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

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

- Correct water level
- There is bubbling
- Correct total Flow rate
- Correct oxygen flow rate
- Circuit is complete

Monitoring the patient

[HOSPITAL NAME]

NEONATAL MONITORING CHART + CPAP

Version 2.5

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	9.00am	9.15am	10.15am	1.15pm	4.15pm	7.15pm	10.15pm	1.15am	4.15am	7.15am	10.15am	1.15am
Vitals	Temp (^{0}C)	36.8	36.8	36.8	36.8	36.8	36.5	36.7	36.8	36.7	36.7	36.8	36.5
	Pulse (b/min)	152	148	150	149	147	145	142	143	140	142	150	145
	Resp Rate (b/min)	80	80	78	78	76	68	64	60	58	64	78	68
	Oxy Sat (%) or Cy^0 Cy$^+$	90%	92%	93%	90%	90%	93%	95%	93%	91%	91%	93%	91%
Assessment	Resp Distress 0,+,+++	+++	+++	+++	+++	++	++	++	+	+			
	CPAP Pressure (cm H_2O)	6	6	6	6	6	6	6	6	6	6	6	6
	FiO_2 (%)	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	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												
	IV Line working Y/N												
Output	Vomit Y/N												
	Urine(diapers changed)												
	Stool Y/N												
	Completed by (name)												

Morning shift notes — Completed by (name)

Category: A☐ B☐ C☐

Total feed+fluid in this shift_____ ml

Afternoon shift notes — Completed by (name)

Category: A☐ B☐ C☐

Total feed+fluid in this shift_____ ml

Night shift notes — Completed by (name)

Category: A☐ B☐ C☐

Total feed+fluid in this shift_____ ml

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

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CPAP- Infection prevention and control

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CPAP - Infection Prevention & Control

Cleaning

Removal of visible or non visible organic and inorganic material (e.g. blood, nasal secretions) using water and a detergent or enzymatic product.

Disinfection

Reduction in the number of viable pathogenic microbes using **chemical agents** to a level that they do not pose a threat to the normal host defenses.
High level disinfection agents:
i) 70-90% alcohol
ii) 0.5% sodium hypochlorite

Sterilization

A process that destroys all microorganisms including bacterial spores. E.g. autoclaving, sterilization in CSSD

Trevor Duke (2014) CPAP: a guide for clinicians in developing countries, Paediatrics and International Child Health, 34:1, 3-11, DOI: 10.1179/2046905513Y.0000000102
Anna M. Bonner & Petra Davidson (2020) Infection Prevention: 2020 Review and Update for Neurodiagnostic Technologists, The Neurodiagnostic Journal, 60:1, 11-35, DOI:10.1080/21646821.2020.1701341

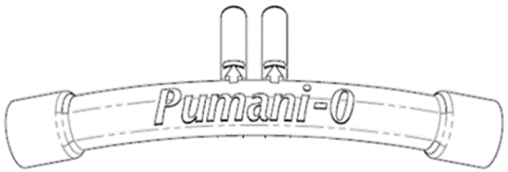
CPAP - Infection Prevention & Control

Non-critical patient care items

- Items which come in to contact with **patient's intact skin**
- E.g. Hat, Hat clips, pressure generating bottle, the tube hanger, the CPAP machine itself
- Non metallic items to be cleaned
- Metallic items for disinfection with 70% alcohol

Semi-critical patient care items

- Items which come in to contact with **patient's mucosa and non intact skin (non sterile body parts)**
- E.g. Elbow connectors, tubings Nasal Prongs,
- Elbow connectors & tubings for high level disinfection
- Silicon Nasal Prongs for Autoclaving



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Anna M. Bonner & Petra Davidson (2020) Infection Prevention: 2020 Review and Update for Neurodiagnostic Technologists, The Neurodiagnostic Journal, 60:1, 11-35, DOI:10.1080/21646821.2020.1701341

High Level Disinfection with 0.5% Sodium Hypochlorite

Thoroughly Clean

- Wear appropriate PPE
- Immerse all items in soapy water
- Scrub under the water to avoid splashing
- Rinse in clean water

Soak in 0.5% Sodium hypochlorite

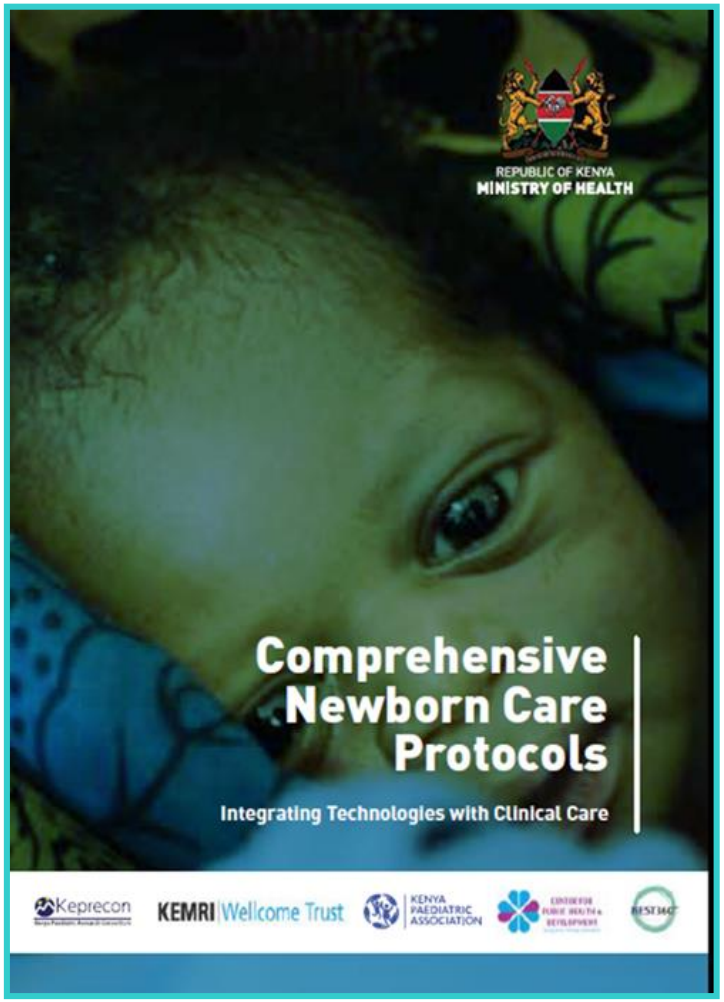
- Immerse in opaque bucket for 10 - 60min
- Rinse with clean water
- Drip dry/air dry
- Discard the Na^+ hypochlorite immediately after use

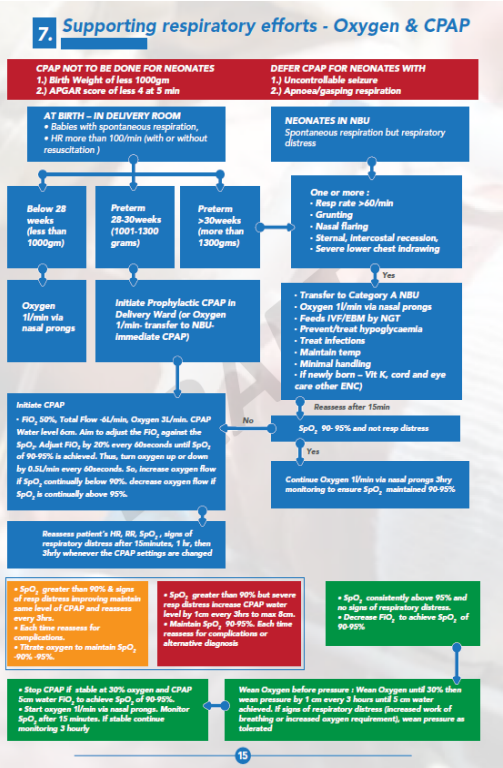
Store in clean dry area

- Store in clean dry plastic bags
- Label date

Trevor Duke (2014) CPAP: a guide for clinicians in developing countries, Paediatrics and International Child Health, 34:1, 3-11, DOI: 10.1179/2046905513Y.0000000102

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

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Complications of CPAP

Nasal

Respiratory

Cardiac

GIT

Skin

Follow the CPAP SOPs diligently!

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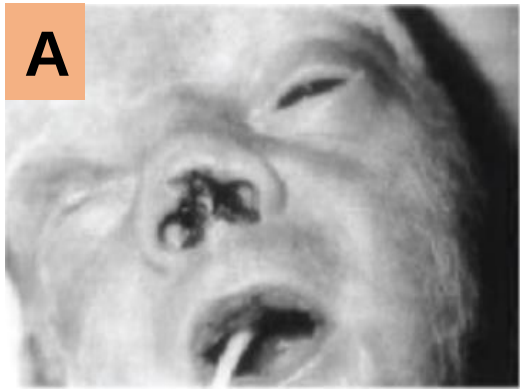
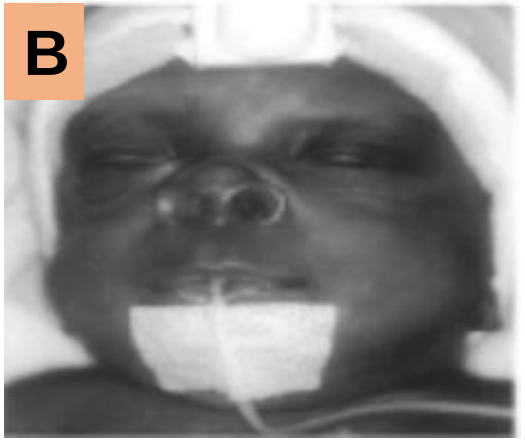
Nasal complications

A



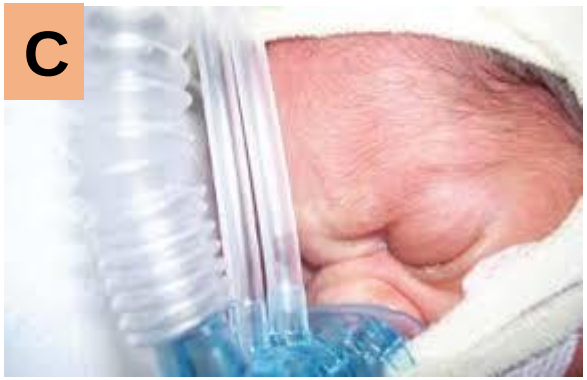
Nasal septal injury

B



Nasal flaring

C



Nasal snubbing

C

columella

Prevention

A. Maintain **2mm** distance between columella and nasal prongs.

B. Ensure appropriate size and correct softness of prongs.

C. Prevent CPAP circuit weight from falling on nose.

The prongs should fill the entire nare without blanching the external nare.

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.

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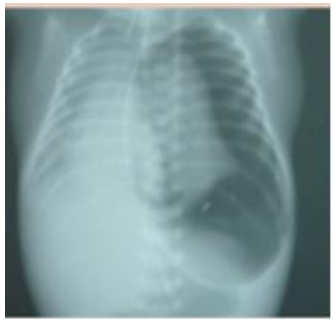
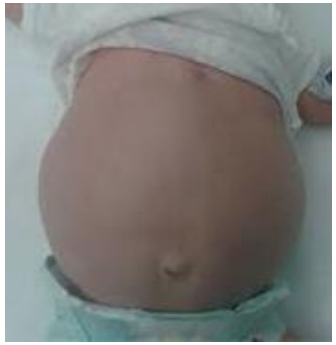
Complications of CPAP



Pneumothorax

- CPAP increases risk of air leaks.
- Do not exceed pressures of 8cmH_20.
- Check for any air leaks in circuit

Check pressure of CPAP!



Abdominal distention

- Excessive swallowed air.
- Feeding intolerance and desaturation episodes.
- Insertion of an OGT and 30mins after feeding the baby open OGT for drainage.

Leaving OGT open!

Hyperinflation of lungs

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

Max 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

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Skin complications

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

Prevention

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

First sign of skin breakdown is nasal erythema.

*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.*

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Complications of oxygen therapy

Monitor SpO_2 ,aim for O_2 saturation of 90-95% in order to maintain normal tissue perfusion while minimizing toxicity and titrate the FiO_2 based on SpO_2.

Hypoxia

SPO_2 - 85-89%

- Increases mortality.

- Does not alter rates of developing:
  - ❖ Chronic lung disease- BPD
  - ❖ Blindness
  - ❖ Neurodevelopmental impairment.

Hyperoxia

SPO_2 > 96%

- High SPO_2 induce injury by producing free radicals that cannot be metabolized by the immature antioxidant systems.
- Chronic Lung disease – BPD(<28 wks. /<1000g)
- Eye injury- ROP

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

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Risk factors for CPAP failure

Infant characteristics

Weight <1000g
Gestation <28 weeks
Male sex

Maternal factors

Poor antenatal steroid coverage PPROM

Disease severity

FiO_2 >40% in the first 4 hours
Moderate or Severe RDS on CXR
Delayed onset of treatment

CPAP failure: Any baby who continues to have(72hrs) :

- ✓ moderate to severe recessions and grunting
- ✓ has saturations <90%
- ✓ has recurrent apneas even on a maximum CPAP pressure of 8 cm H_20 and FiO_2 of > 40%.

There is a 35% reduction in death and use of assisted ventilation[1].

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

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How to increase CPAP success rates

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.
4. **Conclusion:**
   Improved ANC, improved NBU care and more nurses will result in increased survival.

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Summary

CPAP promotes lung growth/development and protects lung – all babies deserves the best care.

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%

Regularly monitor patient to optimize CPAP benefits and reduce risk of complications

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