Implementation of Bubble CPAP in a Humanitarian Context:

The Experience of Médecins Sans Frontières in Mosul, Iraq

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Ethical Statement

This study fulfils the exemption criteria set by the MSF ERB and was approved for submission by the OCG Medical Director.

Introduction: The Critical Care Resource Paradox

- The vast majority of annual global paediatric deaths occur in LMICs

- **Access** to basic, life-saving paediatric emergency and critical resources is **limited globally**, particularly **in regions with the highest burden of paediatric critical illness**

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Introduction: CPAP at a glance

CPAP is widely used in high-income countries, but less so in low- and middle-income settings.

Early CPAP is strongly recommended by the WHO for the treatment of neonates with respiratory distress syndrome.

World Health Organization

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Neonatal CPAP: Evidence Review

In preterm babies with RDS, CPAP (compared to spontaneous breathing with supplemental oxygen) is associated with:

✓ **Reduced** use of **mechanical ventilation**

✓ **Reduced** overall **mortality** (47% reduction)

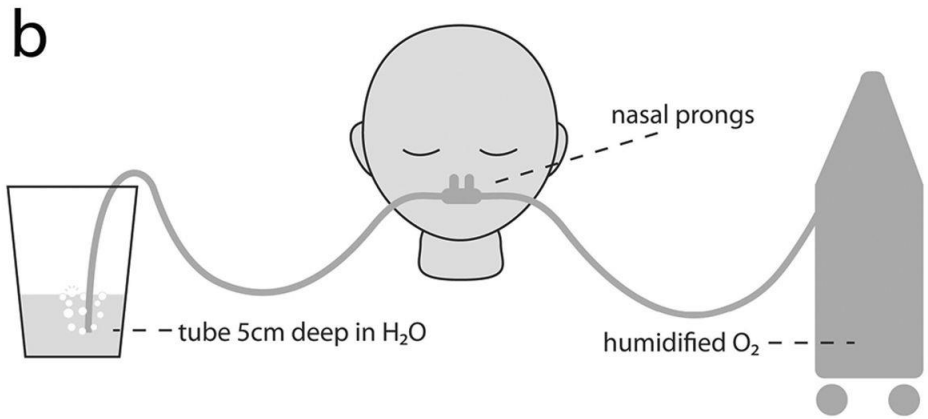
X **Increased** rate of **pneumothorax**

Cochrane Review - Ho et al, 2020

- Limited data in low/middle income countries
  - **Bubble CPAP** **reduced** the need for **mechanical ventilation** by 30-50%.

Systematic Review – Martin, 2014

Bubble CPAP?



bCPAP is a closed circuit capable of delivering pressure to a patient. The bCPAP circuit consists of four parts: 1) inspiratory limb 2) nasal interface 3) expiratory limb 4) sterile water reservoir.

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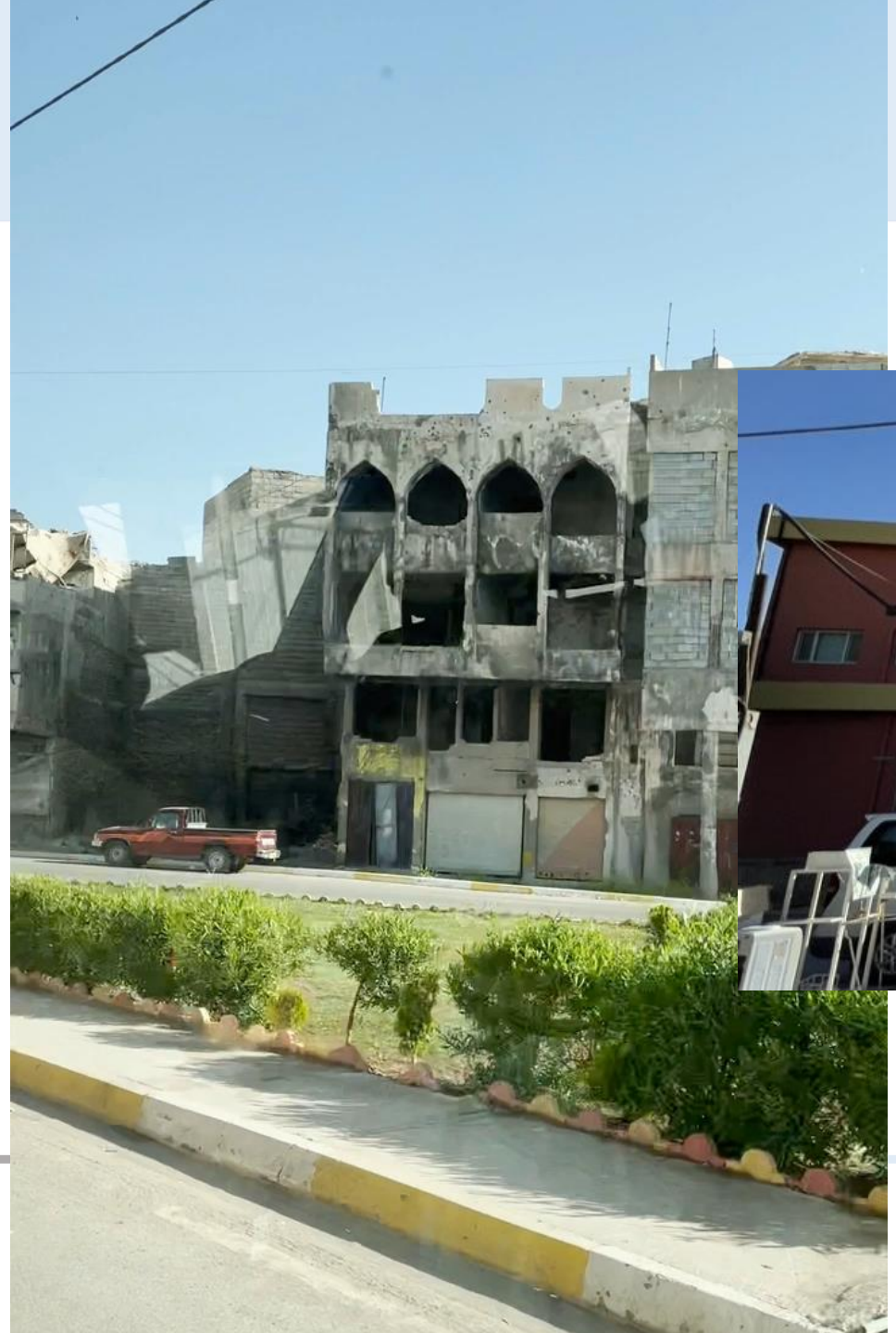
Mosul, Iraq



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Objective

To **assess key aspects of implementing bubble CPAP** in a humanitarian setting and **describe the initial cohort of neonates** treated, along with their clinical outcomes.

Methods

- Clinical data was recorded over **16 months** starting from CPAP implementation: 13 April 2021- 21 July 2022.

- **Descriptive statistics** were used to assess the **feasibility** and **outcomes** of using CPAP.

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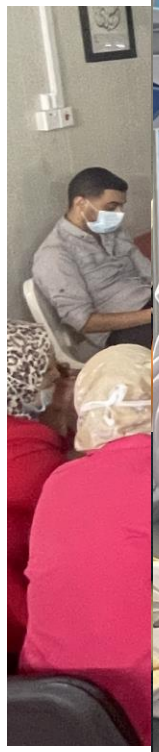
Results

- **>50 healthcare providers** trained
- Multi-modal teaching
  - Theoretical interactive
  - Case-based scenarios
  - Hands-on practical training
  - Supervised implementation



Indications and Contraindications

BIRTH WEIGHT

- **Neonates > 1000G and ≥32 weeks, gestation**

WITHOUT ANY OTHER CONTRA-INDICATION

RESPIRATORY CONDITION

- Respiratory distress syndrome (RDS)
- Transient tachypnea of the newborn (TTN)[1]
- Neonatal pneumonia
- Meconium aspiration syndrome (MAS)

CLINICAL SIGNS

At least one of the following:

- At least one sign of severe respiratory distress (see Table 1 next page)

OR

- Saturation O_2 <90% despite > 2L/min oxygen administration with nasal prongs[2]

OR

- Transient frequent apneas[3], with or without bradycardia

- Neonates with birth weight **<1000g or <32 weeks' gestation (i.e. not meeting Nablus Hospital NICU admission criteria)**
- Neonates evaluated by the medical team to be **candidates for non-curative palliative care** only (See doc: "Limitations of Newborn Care MSF OCG 2018")
- **Respiratory or cardiac arrest** in infants with no resumption of spontaneous breathing
- Very poor respiratory drive (bradypnoea or gasping)
- Any clinical suspicion of **pneumothorax**
- **Facial injuries** secondary to obstetric trauma compromising the nose and facial bones
- **Congenital anomalies affecting respiratory tract/lungs** (e.g. choanal atresia, cleft palate, tracheoesophageal fistula, diaphragmatic hernia) or **any major malformation clearly incompatible with life** (e.g. anencephaly, ectopia cordis, severe congenital cardiac anomalies with no options for surgical repair)
- **Severe neurological impairment** (e.g. severe hypoxic ischemic encephalopathy- Sarnat stage 3 – see Figure 1 below for Sarnat Staging, uncontrollable seizures).
- **High suspicion of Necrotizing Enterocolitis** (NEC) or **Gastrointestinal perforation**
- **Cyanotic congenital cardiac disease** when the cause of hypoxia is cardiac in origin.[5]
- **Severe cardiovascular instability** (persistent hypotension, bradycardia, oliguria or anuria, poor perfusion) or **non-reversible heart failure**

Training the trainers

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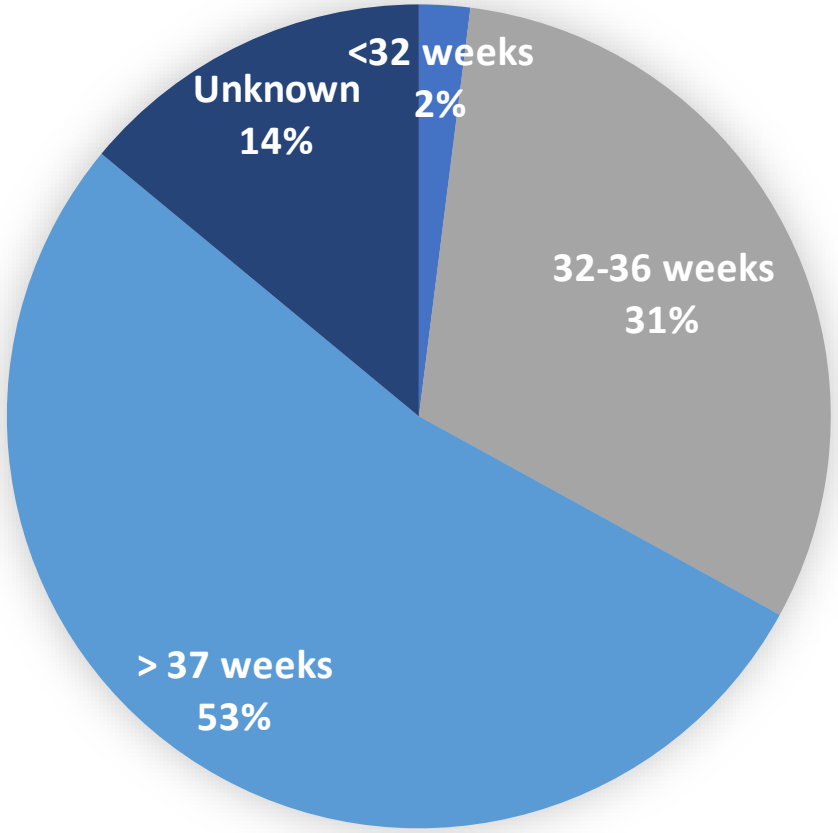
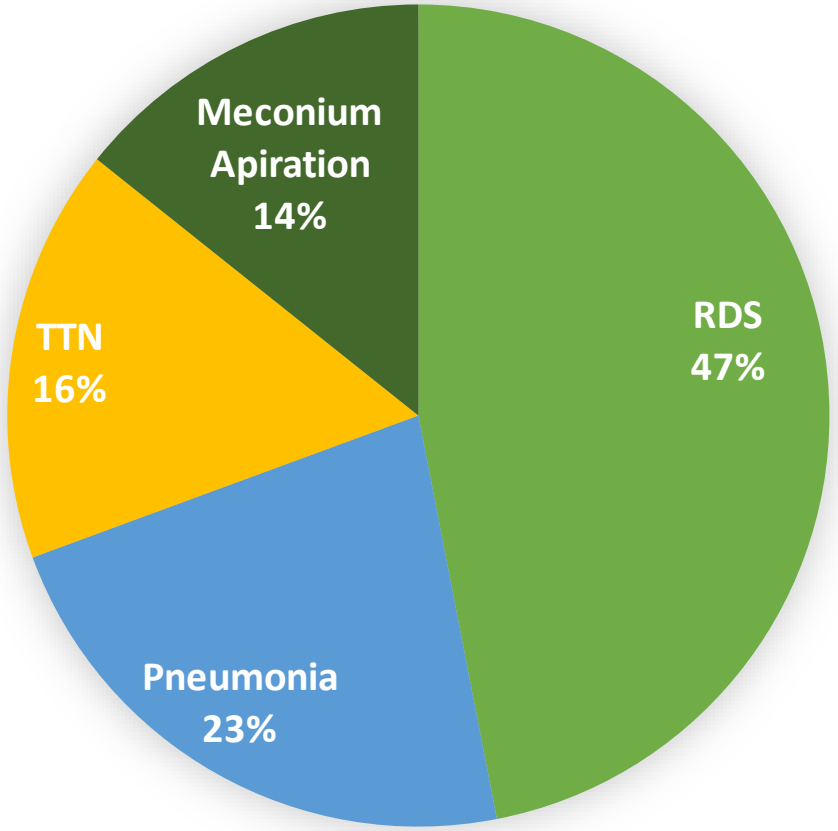
Demographics – N=93 neonates

Estimated Gestational Age



Indication



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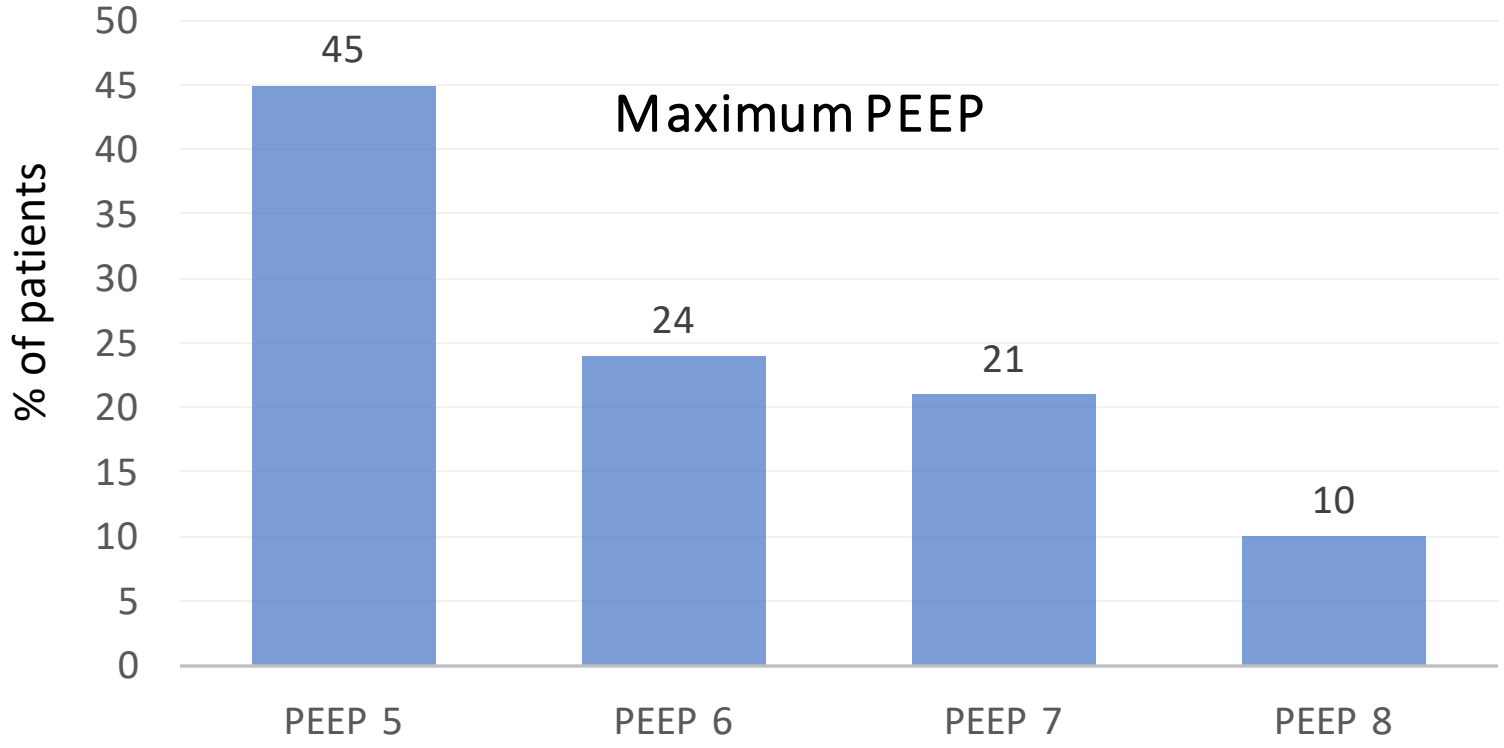
CPAP parameters

- Average **duration** on CPAP was **53 hours**
- **>75%** of patients **did not exceed PEEP 6**



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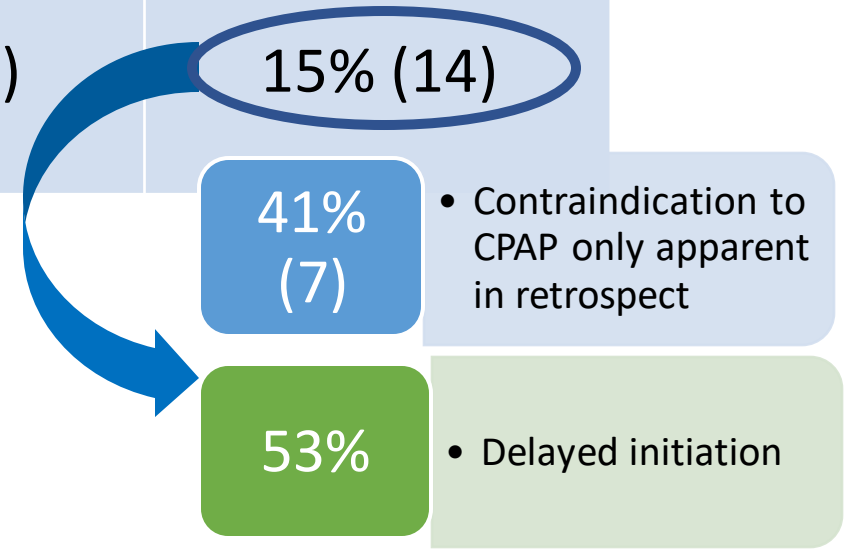
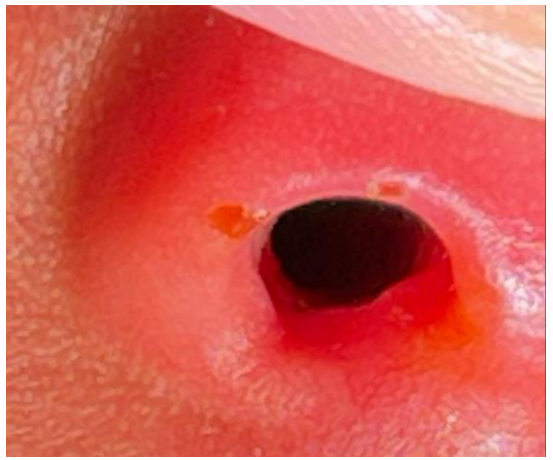
Results - Outcomes

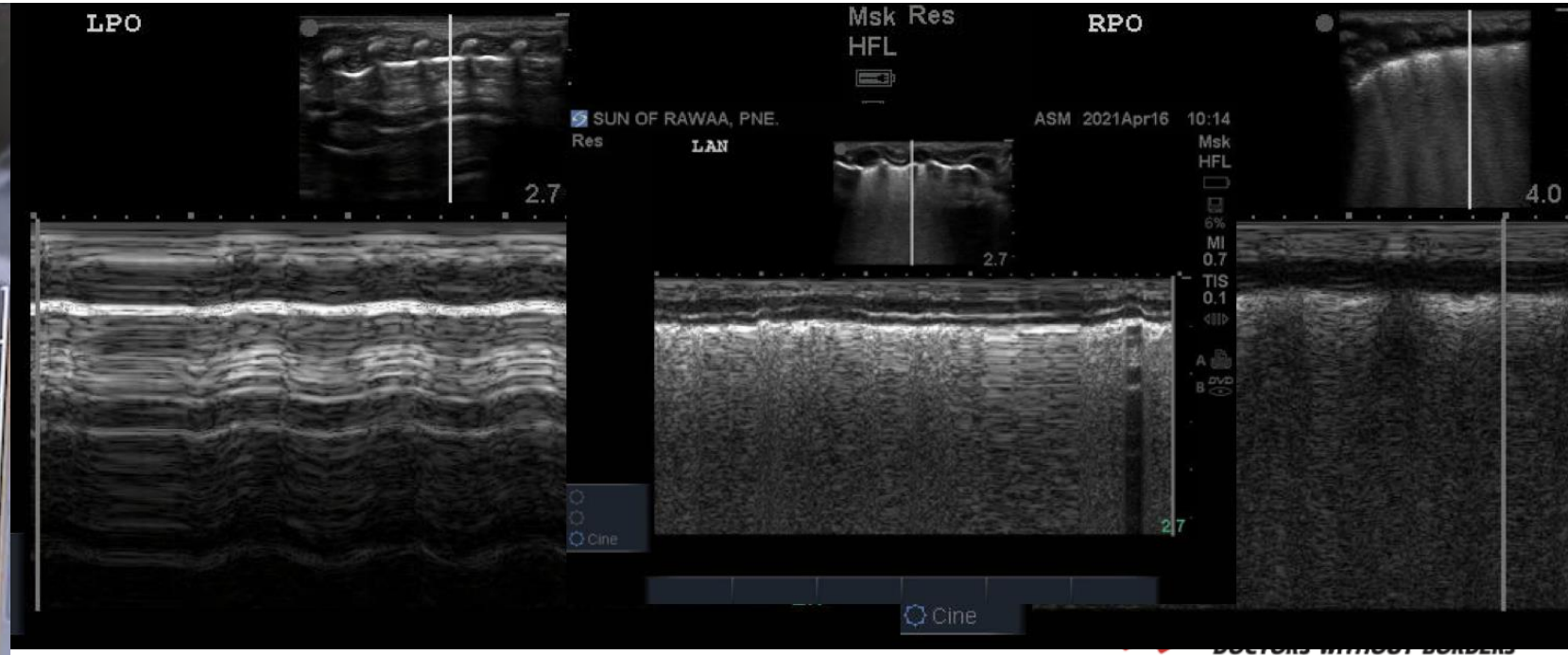
	Recovered/ discharged home	Discharged against medical advice	Referred	Died
% (N)	63% (59)	8% (7)	9% (8)	15% (14)



Complications

- Minor nasal lesions (17%)
- Irritability (8%)
- Pneumothoraces (5%)





Barriers to Implementation and Lessons Learned

- **High nurse to patient ratio**
  - The safe nurse to patient ratio determined in the protocol is 1 nurse to 2 patients on CPAP, or 1 nurse to patient on CPAP plus 3 additional non-critical patients if only one patient is on CPAP.
- **Prolonged training needs**
  - Training paediatrician and training nurse essential for successful implementation of CPAP.
  - Provider-to-provider clinical mentorship model can aid in the transfer of ownership and facilitate continuity of training and quality assurance.
  - CPAP implementation experience in other MSF settings is an invaluable resource that should be tapped into early.
- **Misapplications of inclusion/exclusion criteria**
  - Regular review of CPAP data with ensure any inconsistencies in management/care are recognized early
  - In practice, contraindications may only be apparent in retrospect
- **Cultural acceptance**
  - At the start of the implementation process, it is crucial that selected cases placed on CPAP are relatively straightforward to facilitate team learning and boost team morale.

Conclusions

- Almost 2/3^{rds} of patients improved with CPAP, with minimal associated morbidity.

- A significant number of contraindications were only identified after initiation of CPAP, highlighting the **importance of clear context-appropriate indication criteria and training**.

- Using CPAP in a humanitarian setting may be **feasible** but is associated with high human resource needs for both training and practice, and requires further evaluation.

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