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# Algorithm for the management of preterm infants less than 35 weeks' gestation at birth

Non-invasive respiratory management of the extremely preterm infant at birth is increasingly being supported by an abundance of evidence suggesting some improved outcome. Converting this knowledge into an applicable practical approach is a challenge. We have tried to resolve this by reviewing the literature systematically and producing a structured algorithm that can be followed by any member of staff with sufficient experience in the resuscitation of preterm infants.

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**Key points**

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1. Extremely preterm infants can succesfully be managed without intubation and surfactant at birth.
2. Successful CPAP management of extremely preterm infants at birth is dependent on clear and strict guidance.
3. A structured resuscitation algorithm for extremely preterm infants enables all members of staff to adopt the same approach.

Recent evidence suggests that 50% of extremely preterm infants can be successfully managed without intubation and prophylactic surfactant at birth[1]. Their respiratory and overall outcome is not significantly different to those intubated newborns who have received prophylactic surfactant[1]. Moreover it has been shown that the early use of nCPAP can obviate the need for transfer from smaller paediatric units to larger neonatal centres for ongoing respiratory care[2]. In addition to its clinical benefits this approach also seems to be a financially attractive alternative to ventilation[2].

Unfortunately translating this knowledge into successful practice is not easy. Structured guidance and training has not been systematically established. Using early ongoing nCPAP in the delivery room and neonatal unit has therefore remained dependent on the experience of staff in individual units. We therefore reviewed the literature to design a structured algorithm that could be used by all members of our neonatal team at the Trevor Mann Baby Unit when attending deliveries of very preterm infants (**FIGURE 1**).

## Use of CPAP and assessing response

Until now it has been widespread practice to intubate every newborn ≤28 weeks[3,4]. We therefore selected this specific gestational age as the cut-off to dermine entry into either arm of the algorithm. Preterm infants ≥28$^{+0}$ weeks were considered primarily for nCPAP, those <28 weeks primarily for intubation and surfactant.

To allow for flexibility in our initial decision making, the following factors which are known to influence respiratory outcome[1,5] were included:

- chorioamnionitis
- antenatal steroids
- estimated fetal weight.

For example a well-grown 25 week preterm infant whose mother did not have any evidence of chorioamnionitis and who had received a full course of antenatal steroids could primarily be considered for early nCPAP.

Although neonatologists use the term resuscitation we rarely practise resuscitation in a similar manner to our adult physician colleagues. An adult with cardiorespiratory arrest needs chest compressions and ventilation urgently. Such episodes are very uncommon in neonates. Most apnoeic newborn infants respond well to effective aeration of the lungs[5]. If the heart rate does not increase quickly then the ventilation technique is probably unsatisfactory[5]. Observing chest expansions during ventilation in the delivery room in a preterm newborn is particularly difficult and bears the risk of overdistending the lungs if no pressure limits are set[5]. Since oxygenation is related to lung volume and oxygenation of the myocardium improves heart rate we felt it was better to focus on heart rate response in the first instance in line with NLS recommendations for term infants[5,6].

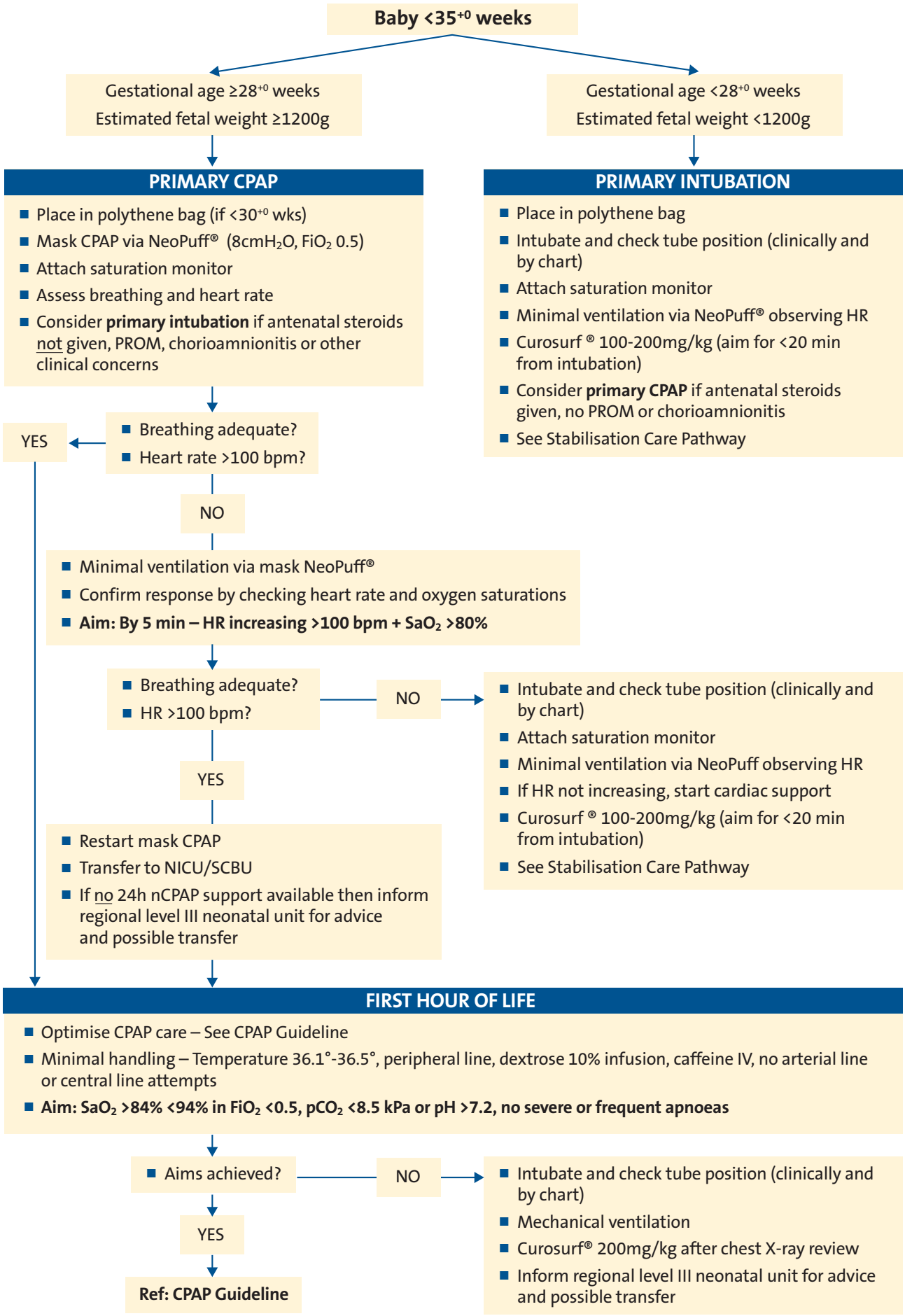


**FIGURE 1** Algorithm for management of preterm infants. PROM – prolonged rupture of membranes (>24h before birth); nCPAP – nasal continuous positive airway pressure; HR – heart rate

## Use of oxygen and assessing response

The use of 100% oxygen during the initial resuscitation of term newborns is associated with increased mortality when compared to resuscitation with air[5]. It has been suggested that even a brief exposure to high oxygen concentrations at birth in very low birthweight infants is also harmful[5]. Several studies have found evidence of oxidative damage in infants after short exposure to 100% oxygen in the delivery room[5]. A large proportion of preterm infants seem to become hyperoxic very quickly[5]. Consequently we introduced the use of pulse oximetry to monitor oxygen delivery as assessment of heart rate and skin colour are known to be unreliable proxies of oxygenation[5].

Despite studies suggesting that as little as 30% oxygen can be given to preterm infants at birth without influencing overall outcome it is still not clear what the lower margin of oxygen delivery is to provide a safe $SpO_2$ range[5,7-11]. It is also not clear how quickly this range should be attained, although several studies have described normal ranges for the increase of saturations at birth[5]. From our review it appeared that starting with 50% oxygen on nCPAP or ventilation and aiming for a saturation of no less than 80% at five minutes and no more than 93%, was a reasonable approach to adopt[11].

To facilitate the understanding of the algorithm we followed the general concept of the NLS algorithm suggesting three cycles of 'extended resuscitation' before moving on to intubation and surfactant[6]. We attempted to simplify our approach by suggesting that mask intermittent positive pressure ventilation (IPPV) is given via a T-piece device that can be used for both controlled ventilation (positive inspiratory pressure (PIP) 20cm $H_2O$) with positive end-expiratory pressure (PEEP) or mask CPAP (6-8cm $H_2O$)[5]. We also felt that using inflation breaths was less beneficial for the initial support as most preterm newborns would be either apnoeic and require ongoing intubation and IPPV or breath, have partially aerated lungs and benefit from continuous CPAP immediately. Recent animal work suggests that a combination of a sustained inflation breath for 20 seconds followed by PEEP may be beneficial in establishing a larger functional residual capacity and more uniform preterm lung aeration potentially promoting the establishment of effective breathing[12].

After arrival on the NICU the newborns have a stabilisation period of 1 hour. During this time priority is given to the optimisation of nCPAP care and minimal handling. We delay intubation and surfactant depending on initial assessment and the clinical course for a maximum of two hours aiming to have given surfactant (200 mg/kg) at the latest by three hours of life. Overall outcome and in particular mortality is clearly worse if surfactant is given later[1,13-15]. We consider a further dose of surfactant depending on the clinical course without waiting for 12 hours and proceed to extubation as soon as possible thereafter[13,16]. Subsequent care after the first 2-3 hours of life is dependent on the mode of respiratory support and overall clinical status. This is part of a separate guideline and not discussed in this article.

At the Trevor Mann Baby Unit we have been using this streamlined and harmonised approach since mid-2007 and continue to review and audit the clinical course and outcomes of these babies aiming to improve our algorithm.

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