
Management of Neonatal Respiratory Distress Syndrome

European Consensus Guidelines 2010 Update

Sweet DG, Carnielli V, Greisen G, Hallman M, Ozek E, Plavka R, Saugstad OD, Simeoni U, Speer CP, Halliday HL. European consensus guidelines on the management of neonatal respiratory distress syndrome in preterm infants – 2010 update*. *Neonatology* 2010; 97: 402–417

***Endorsed by the European Association of Perinatal Medicine**

The aim of this presentation is to provide an up to date evidence based approach to optimal care of babies with respiratory distress syndrome. This presentation is based on the European Consensus Guidelines published in *Neonatology* in 2010 and has been endorsed by the European Association of Perinatal Medicine.

The Guidelines are an evolving work in progress. The idea originally came about in 2005 Professor Henry Halliday from Belfast put together a team of senior neonatologists from Europe to come up with consensus guidelines as to how best to manage RDS. The original Guideline was published in the *Journal of Perinatal Medicine* in 2007 and has since been translated into several languages, including Chinese. The present Guideline is an update of the previous Guideline, using new evidence up to the end of 2009. More recent evidence on early management of RDS has become available since this Guideline was published and this will be included in the discussion as well.

Aims

- Discuss controversies in RDS management
- Examine the evidence for best practice
- Develop consensus guidelines from evidence available up to end of 2009
- Publish the consensus recommendations on management of RDS in 2010, updating those of 2007

The Guidelines group were set the task of discussing the current controversies in RDS management. They were then asked to look for the evidence of best practice from the literature, and finally they were asked to develop consensus Guidelines from the updated evidence to the end of 2009, taking on board some of the feedback regarding the previous 2007 guideline.

Grades of Evidence and Levels of Recommendation

- A = Meta-analysis or high quality RCT
 - B = Smaller RCT or systematic review of case-control studies
 - C = Good quality case-control or cohort study
 - D = Case series or expert opinion
- **Modified from SIGN guidelines handbook**
www.sign.ac.uk/guidelines/fulltext/50

The guidelines panel have graded the quality of the evidence supporting each of their recommendations. The grading system was a simplified version of that used for SIGN guidelines. Grade A evidence comes from high quality randomised trials or meta-analysis of these trials. Grade B evidence comes from smaller randomised trials or systematic review of case controlled studies, grade C evidence from good quality case control or cohort studies and grade D evidence from case series or simple expert opinion.

European Guidelines on RDS: 2010

- Prenatal Care
- Delivery Room Stabilisation
- Surfactant Therapy
- Oxygen Supplementation Beyond Stabilisation
- Role of CPAP
- Mechanical Ventilation (MV) Strategies
- Avoiding or Reducing Duration of MV
- Prophylactic Treatment for Sepsis
- Supportive Care: thermal, fluid and nutrition, tissue perfusion, ductus arteriosus
- Miscellaneous Considerations

The 2010 Guideline is divided into the following broad areas: Prenatal care, Delivery Room Stabilisation, Surfactant Therapy, Oxygen Supplementation Beyond Stabilisation, Role of CPAP, Mechanical Ventilation (MV) Strategies, Avoiding or Reducing Duration of MV, Prophylactic Treatment for Sepsis, Supportive Care: thermal, fluid and nutrition, tissue perfusion, ductus arteriosus, and Miscellaneous Considerations.

The Avoiding or reducing duration of mechanical ventilation and miscellaneous considerations were not in the previous version of the guideline.

European Guidelines on RDS: 2010

- Prenatal Care
- Delivery Room Stabilisation
- Surfactant Therapy
- Oxygen Supplementation Beyond Stabilisation
- Role of CPAP
- Mechanical Ventilation (MV) Strategies
- Avoiding or Reducing Duration of MV
- Prophylactic Treatment for Sepsis
- Supportive Care: thermal, fluid and nutrition, tissue perfusion, ductus arteriosus
- Miscellaneous Considerations

This presentation is focused on the areas that are relevant in terms of delivery room stabilisation, early respiratory care and particularly on the role of surfactant therapy.

Delivery Room Stabilisation

- Babies with RDS have difficulty maintaining FRC and alveolar aeration.
- Traditionally, many are resuscitated with bag & mask using 100% oxygen and there is emerging evidence that 100% oxygen may be harmful
- Many are intubated for prophylactic surfactant
- Uncontrolled tidal volumes are also detrimental to the immature lung and early CPAP is being advocated
- Delayed clamping of the cord may confer benefits
- Hypothermia should be avoided

The section on delivery room stabilisation in the 2010 Guideline is quite evidence based. We know that the majority of babies with RDS breath spontaneously after birth but have difficulty maintaining a functional residual capacity and alveolar aeration. Many trainee paediatricians and midwives are trained to resuscitate babies in the context of term babies with apnoea where they are encouraged to “bag” babies with 100% oxygen until they see their chest lifting and they become pink although this is probably not appropriate for the preterm baby with RDS. Many babies have in the past been intubated for prophylactic surfactant, although it is becoming clearer that not all preterm babies necessarily benefit from this. Early CPAP is increasingly being advocated and in recent years there have been several studies of its application from birth. There is also now evidence that delaying cord clamping to allow a placental transfusion may confer benefits and we know that hypothermia after birth must be avoided.

Delivery Room Stabilisation – Recommendations - 1

- If possible, delay cord clamping for at least 30-45 sec **(A)**.
- Oxygen should be controlled with a blender and the lowest possible concentration should be used (~30%), provided there is an adequate heart rate response **(B)**.
- 30% oxygen to start and titrate using pulse oximetry but note normal sats may be 40-60%, reaching 50-80% by 5 min but should be >85% by 10 min. Avoid hyperoxia **(B)**.
- If spontaneous breathing, stabilise with CPAP of 5-6 cm water via mask or prongs **(B)**. If breathing is insufficient consider a sustained inflation rather than IPPV **(B)**.
- Ventilation with a T-piece device is preferable to a self-inflating or flow-inflating bag to generate PEEP **(C)**.

The recommendations for delivery room management are that you should start if possible by trying to delay cord clamping for 30-45 seconds as this improves haematocrit and blood pressure. Oxygen delivery should be controlled with a blender, starting with about 30% and only increasing if there is an inadequate heart rate response – detected using pulse oximetry. We need to be aware of the recently published normative values of saturations in preterm infants, accepting starting saturations of 40-60%, reaching 50-80% by 5 minutes and more than 85% by 10 minutes. In spontaneously breathing preterm babies it is recommended that we initiate stabilisation in the delivery room using CPAP via a face mask or prongs. Only if breathing is insufficient should the chest be inflated and there is some evidence that a single sustained inflation is better than repeated bagging in preterm babies. It is recommended that we use a T-piece device that enables control of PEEP rather than a self inflating or flow inflating bag.

Delivery Room Stabilisation – Recommendations - 2

- If PPV is needed avoid excessive tidal volumes and maintain PEEP **(D)**.
- Reserve intubation for babies not responding to PPV or those requiring surfactant **(D)**.
- Verify correct position of the endotracheal tube using colorimetric CO₂ detection **(D)**.
- Plastic bags or occlusive wrapping under radiant warmers should be used for babies < 28 weeks' gestation **(A)**.

If positive pressure is required, we should aim to avoid excessive tidal volumes and maintain PEEP. Intubation should be reserved for those babies not responding to T-Piece inflations or those in whom it has been decided should be treated with prophylactic surfactant. Once intubated, the correct placement of the ET tube can be verified even in the smallest babies using a colorimetric CO₂ detector. Babies under 28 weeks should be put inside plastic bags during stabilisation as this helps to preserve body temperature.

Surfactant Therapy

- At least 100 mg/kg phospholipid is required and 200 mg/kg may be better for established RDS
- Administration by bolus results in better distribution
- Prophylaxis reduces mortality and air leaks, but more babies end up being treated.
- Surfactant can be given whilst avoiding mechanical ventilation using INSURE technique
- A second (and occasionally a third) dose is sometimes required

What about surfactant? Surfactants have revolutionised respiratory care over 2 decades and when given prophylactically, or as rescue therapy reduce death and pneumothoraces in RDS. Many randomised trials have been undertaken to determine the best surfactant and the optimal timing of dosing and re-dosing, but most of the trials were conducted in the era of low use of antenatal steroids and surfactant.

We know from pharmacokinetic studies that at least 100mg/kg of phospholipid is required and that 200mg/kg may be even better for treating established RDS. We know that administration by bolus results in better distribution. We know that the earlier it is given, the better it works. Prophylaxis seems to be the best, with randomised trials showing prophylaxis reducing mortality, however the studies often compared prophylaxis with fairly late rescue, more babies ended up receiving intubation and no reduction in BPD was demonstrated. We know that surfactant can also be given without mechanical ventilation using the INSURE technique – Intubate, surfactant, extubate to CPAP. We know that a second, and occasionally a third dose is sometimes required

Surfactant Therapy - Recommendations

- Babies with or at high risk of RDS should be given a **natural** surfactant preparation **(A)**.
- Prophylaxis for most babies < 26 weeks' gestation. Prophylaxis also if intubation required **(A)**.
- Early rescue for untreated babies if evidence of RDS such as increasing oxygen requirement **(A)**.
- Poractant alfa 200 mg/kg is better than 100 mg/kg (of poractant or beractant) for moderate to severe RDS **(B)**.
- Consider early extubation to CPAP if stable **(B)**.
- A 2nd/ 3rd dose should be given if ongoing evidence of RDS such as persistent oxygen or MV need **(A)**.

The recommendations from the 2010 Guideline are that babies with or at risk of RDS should be given **natural** surfactant. They felt that even in the current era of CPAP there are a group that warrant delivery room prophylaxis including any babies of 23, 24 and 25 week's gestation and those who require intubation for stabilisation. Babies who do not receive prophylaxis should be offered early rescue surfactant as soon as the signs of RDS become apparent, such as increasing oxygen requirement. There is no set cut off value for this but the FiO₂ at which you should intervene increases with increasing gestation and decreases with absence of antenatal steroid therapy. For rescue treatment Poractant Alpha at 200mg/kg is better than 100mg/kg or 100mg/kg of Beractant in moderate to severe RDS. Following surfactant we should try and extubate to CPAP as soon as possible. For babies with ongoing signs of RDS such as persistent need for oxygen and mechanical ventilation should be given a second, and occasionally a third dose of surfactant.

The role of CPAP in RDS

- CPAP is often used as a substitute for MV despite lack of large RCTs to show effectiveness
- CPAP and NIPPV via prongs reduce extubation failure and need for re-intubation
- The earlier CPAP is applied, the less likely MV will be needed
- CPAP from birth reduces need for surfactant and MV
- MV can often be avoided, even in babies who need surfactant, by using the INSURE technique
- CPAP without surfactant may increase risk of Ptx
- Short binasal prongs are better than a single prong for reducing need of re-intubation

What about the role of CPAP in RDS management. CPAP is now often used as a substitute for mechanical ventilation, although it is only very recently that this approach has been subjected to scientific appraisal. We know that CPAP and nasal ventilation are effective at reducing the need for re-intubation if applied following extubation. We know that the earlier nasal CPAP is applied, the more effective it will be at reducing the need for ventilation and we now know from several recent trials that if CPAP is initiated from birth it will reduce the need for surfactant and mechanical ventilation. We know that mechanical ventilation can be avoided for babies who need surfactant if we use the INSURE technique, however we know that if we use CPAP without surfactant we may be increasing the risk of a pneumothorax. In terms of methods of CPAP we know that short binasal prongs are better than a single long prong in terms of reducing the need for re-intubation

CPAP - Recommendations

- CPAP should be started from birth in all babies at risk of RDS, such as those <30 wk not needing MV, until clinical status can be assessed **(D)**.
- Short binasal prongs should be used rather than a single prong and a pressure of at least 6 cm water should be used **(A)**.
- CPAP with early rescue surfactant should be considered in babies with RDS to reduce MV **(A)**.

The Guidelines panel were unanimously in favour of maximising the use of CPAP. They recommended that CPAP should be initiated in all babies at risk of RDS, such as those less than 30 weeks gestation until their clinical status can be assessed. We should use short binasal prongs such as the Hudson prong and a pressure of at least 6 cm water should be applied. CPAP with early rescue surfactant should be considered in babies with RDS in order to reduce the need for mechanical ventilation.

Delivery room surfactant vs. CPAP

Most recent evidence

- COIN TRIAL
- CURPAP TRIAL
- SUPPORT TRIAL

Since the publication of the European Consensus Guidelines 2010 there has been ongoing debate about the issue of delivery room surfactant versus CPAP. We know that centres that use more CPAP and less mechanical ventilation have similar survival outcomes for VLBW infants with a lower incidence of BPD and there was therefore a strong argument to try and determine which babies really require surfactant prophylaxis if antenatal steroids and CPAP were used. It is only very recently that the question of delivery room surfactant versus early initiation of CPAP has been addressed for the smallest babies. Three important studies have recently been published which may further help to refine decision making.

COIN TRIAL

- 610 babies 25⁺⁰ - 28⁺⁶ weeks breathing spontaneously at 5 mins
- Rx - Initiate CPAP (8cm H₂O) or intubate
- CPAP group intubated if apnoeic/ acidotic/ FiO₂ > 60
- Surfactant therapy not mandated – purely a study of intubation vs. CPAP

The first of these studies was the COIN trial. In this study 610 babies born between 25 + 0 and 28 + 6 weeks gestation and who were breathing spontaneously but requiring respiratory support were randomised to initiation of nCPAP (8cm H₂O) or intubation and mechanical ventilation in the delivery suite. Babies in the CPAP arm were not given surfactant unless they required intubation which was determined by predefined criteria including apnoea, respiratory acidosis or need for more than 60% oxygen. As this was purely a study of nCPAP versus mechanical ventilation, surfactant therapy was not mandated in the intubation arm of the trial, with 77% of babies who were intubated receiving surfactant compared with 38% who were initiated on nCPAP. The primary outcome of death or BPD was no different between groups (34% CPAP group vs. 39 % intubation group; (odds ratio favouring CPAP, 0.80; 95% CI 0.58 to 1.12; P = 0.19). The early nCPAP group had fewer days of mechanical ventilation (median 3 vs. 4 days; P < 0.001) but had a higher incidence of pneumothoraces (9% vs. 3%; P < 0.001). This study proved that for a selected population of preterm babies where antenatal steroid use was high (94%) and who were breathing after 5 minutes that initiation of early CPAP would reduce the need for mechanical ventilation and surfactant therapy without there being any reduction in survival or increase in BPD. There was still some concern, however, that by attempting to manage babies with RDS without early surfactant that they were being exposed to the increased risk of air leak. Since no protocol requirement for the administration of surfactant was defined, the study does not provide evidence for the superiority of 'CPAP' over early surfactant.

COIN TRIAL

	CPAP	INTUBATE	P-value
n	307	303	
Received Surfactant	38%	77%	
Death or BPD	34%	39%	= 0.19
Median days of Ventilation	3	4	< 0.0001
Pneumothorax	9%	3%	< 0.001

As this was purely a study of nCPAP versus mechanical ventilation, surfactant therapy was not mandated in the intubation arm of the trial, with 77% of babies who were intubated receiving surfactant compared with 38% who were initiated on nCPAP. The primary outcome of death or BPD was no different between groups (34% CPAP group vs. 39% intubation group). The early nCPAP group had fewer days of mechanical ventilation (median 3 vs. 4 days; $P < 0.001$) but had a higher incidence of pneumothoraces (9% vs. 3%; $P < 0.001$). This study proved that for a selected population of preterm babies where antenatal steroid use was high (94%) and who were breathing after 5 minutes that initiation of early CPAP would reduce the need for mechanical ventilation and surfactant therapy without there being any reduction in survival or increase in BPD. There was still some concern, however, that by attempting to manage babies with RDS without early surfactant that they were being exposed to the increased risk of air leak. Since no protocol requirement for the administration of surfactant was defined, the study does not provide evidence for the superiority of 'CPAP' over early surfactant.

CURPAP TRIAL

- 208 babies 25 to 28 weeks' gestation
- Eligible if they did not need intubation for stabilisation within 30 minutes after birth
- Randomised to nCPAP or intubated for surfactant followed by extubation to nCPAP

The second study designed to assess if prophylactic surfactant was really needed in the era of CPAP was the CURPAP study. This study randomised 208 babies of 25 to 28 weeks' gestation if they did not need intubation for stabilisation. Within 30 minutes after birth babies were either initiated on nCPAP or else intubated for prophylactic surfactant followed by immediate extubation to nCPAP.

CURPAP TRIAL

	nCPAP Group	Surf & CPAP group	P value
Needed intubation within 5 days	31 %	33%	NS
Survival without BPD	79%	78%	NS

Conclusion: Prophylactic surfactant and CPAP was no better than CPAP alone for decreasing the need for mechanical ventilation in the first 5 days of life and subsequent BPD in **spontaneously breathing** babies of 25 – 28 weeks gestation.

The number needing subsequent intubation and mechanical ventilation within the first 5 days of life was similar in both groups (31% SURF group vs. 33% nCPAP group). A total of 78.1% of infants in the prophylactic surfactant group and 78.6% in the nCPAP group survived in room air at 36 weeks' postmenstrual age. This trial demonstrated that prophylactic surfactant was not superior to nCPAP and early selective surfactant in decreasing the need for mechanical ventilation in the first 5 days of life and the incidence of main morbidities.

SUPPORT TRIAL

- 2 x 2 factorial study also looking at high versus low oxygen saturation targeting
- 1316 babies 24+0 to 27+6 weeks recruited before birth (95% exposure to ANCS)
- Randomised to initiation of nCPAP or intubation and prophylactic surfactant within 1 hour of birth

The largest study designed to address this issue was the SUPPORT trial. In this multicentre 2-by-2 factorial study (also designed to assess the benefits of high versus low oxygen saturation targeting) a total of 1316 babies born between 24 +0 and 27+6 weeks were randomised to receive intubation and surfactant within one hour of birth or early initiation of CPAP. As the babies had to be recruited before birth there was a very high rate of successful completion of full course of antenatal steroids of about 70% in the study population, with over 95% having had exposure to the benefit of at least one dose of steroid.

SUPPORT TRIAL

	Intubate & Surf group	CPAP group	P-Value
Received surfactant	99%	67%	< 0.001
Days of MV	28	25	0.03
Steroids for BPD	13%	7%	< 0.001
Death or BPD at 36 weeks	51%	48%	NS

Conclusion: No argument for routine intubation for surfactant in the current era of CPAP use

The intended treatments allocations were largely successful, with the surfactant treatment taking place 99% of the time in the surfactant group and initiation of CPAP in the delivery room 81% of the time for the CPAP group. Thirty three percent of the CPAP group never received surfactant. The CPAP group had a reduced total number of days of mechanical ventilation (Mean 25 vs. 28; $P = 0.03$), a reduced incidence of steroid therapy for BPD (7.2 vs. 13.2%; $P < 0.001$) but there was no significant difference in the combined outcome of death or BPD at 36 weeks postmenstrual age (48 vs. 51%; $P = 0.3$). Post hoc analyses also showed a significant reduction in mortality in the CPAP group in the lower gestational age band of 24 + 0 weeks to 25 + 6 weeks. This study offers a strong argument against routine intubation for prophylactic surfactant in extremely preterm babies in the current era of CPAP use. However, one cannot assume that this finding should be generalized to include babies in whom there had been inadequate time for completion of antenatal steroids.

O₂ supplementation beyond stabilisation

- Currently no firm evidence to guide optimal oxygen saturations in NICU
- Suggestions to target between 85% and 93% and not exceed 95% to reduce ROP and BPD
- Long-term neuro-developmental outcomes are unknown
- Hyperoxia can occur following surfactant therapy
- Fluctuations in oxygen saturations may also increase the risk of ROP
- Optimal saturation targets recently studied in BOOST-II, COT and SUPPORT which have stopped recruitment but follow up not done

There is a section in the Guideline on oxygen supplementation beyond stabilisation. There is currently no firm evidence to guide optimal saturations in the NICU, but there is a consensus that at present we should target saturations somewhere between 85 and 93% and not exceed 95% when in oxygen in order to reduce ROP and BPD. The 2010 guideline was written before the SUPPORT trial showed us that targeting lower saturations reduced ROP but increased mortality and the long term follow up data from the multicentre trials aren't yet available. At present all we know is that we should avoid hyperoxia such as often occurs following surfactant and the upper saturation limit should be set at about 95% when in oxygen. The lower limit is still up for debate.

Oxygen supplementation beyond stabilisation

- In oxygen, saturations should be maintained at all times between 85 and 93% **(D)**.
- After surfactant, avoid a hyperoxic peak, which is associated with IVH, by rapid reduction in oxygen **(C)**.
- Avoid fluctuations in oxygen saturations in the postnatal period **(D)**.

The 2010 recommendations aren't evidence based and were made before SUPPORT published. Maintain saturations when in oxygen between 85 and 93% - this is likely to be revised upwards. Avoid hyperoxia, especially following surfactant and aim to avoid too many fluctuations in saturation in the postnatal period.

Mechanical Ventilation Strategies

- Aim of MV to provide acceptable blood gases with minimum lung injury, haemodynamic upset and other adverse effects such as hypocarbia associated with neurological impairment.
- Can be provided by IPPV or HFOV
- Principle is to stabilise the lung after recruitment of optimal lung volume with PEEP or CDP on HFOV
- Technique more important than mode of ventilation
- Mech. ventilation saves lives but increases risk of:
 - Air leaks
 - Lung damage
 - BPD

There is a section in the Guideline on mechanical ventilation strategies. The section takes a fairly broad brush approach, rather than getting into minutiae. The aim of mechanical ventilation is to provide acceptable blood gases whilst at the same time trying to minimise lung injury, hemodynamic upset and avoid long term sequelae. Effective ventilation can be provided both with conventional ventilation or high frequency. The principle using both methods is to stabilise the lung after recruitment using optimal PEEP and avoid over distension with technique being more important than mode. Both modes of ventilation are associated with lung injury that can lead to BPD.

Mechanical Ventilation Recommendations

- MV should be used to support babies with respiratory failure as this improves survival **(A)**.
- Avoid hypocarbia, as this is associated with increased risks of BPD and PVL **(B)**.
- Settings of MV should be adjusted frequently with the aim of maintaining optimum lung volume **(C)**.
- Duration of MV should be minimised to reduce injurious effect on the lung **(B)**.

The recommendations are that of course we should mechanical ventilation in babies with respiratory failure. If ventilating we should avoid hypocarbia as this is associated with increased of BPD and PVL. If ventilating we should adjust the settings frequently with the aim of maintaining optimum lung volume and we should aim always to minimise the duration of ventilation to reduce the risk of lung injury.

Avoiding or Reducing Duration of MV

- Clear links between MV and development of BPD and neurological sequelae
- Interventions to avoid or shorten MV include: caffeine, CPAP or NIPPV with or without surfactant, INSURE technique, permissive hypercarbia and aggressive weaning with early extubation

The present Guideline has a new section on avoiding or reducing duration of mechanical ventilation. There are clear links between mechanical ventilation and adverse outcome such as BPD and neurological sequelae. Interventions that have been employed to reduce the duration of mechanical ventilation include caffeine therapy, CPAP or NIPPV, INSURE technique and permissive hypercarbia with aggressive weaning towards extubation

Avoiding or Reducing Duration of MV: Recommendations: 2010

- Caffeine should be used to treat apnoea and to facilitate weaning from MV **(A)**. It should also be considered for those at high risk of MV (e.g. <1250 g on CPAP or NIPPV) **(B)**.
- CPAP or NIPPV should be used if possible to avoid MV through an endotracheal tube **(B)**.
- Weaning from MV - reasonable to tolerate moderate hypercarbia provided pH > 7.22 **(D)**.
- Synchronised and targeted tidal volume modes with aggressive weaning should be used **(B)**.

There is now grade A evidence from the CAP trial that Caffeine should be used to facilitate weaning from ventilation as it shortens duration of ventilation and improves long term outcomes. It should also be used in babies at high risk of needing ventilation such as those less than 1250 g on CPAP. Where possible babies should be maintained on CPAP or nasal ventilation to avoid mechanical ventilation. When weaning, it is reasonable to tolerate moderately high carbon dioxide levels provided the pH is maintained above 7.22. When ventilating we should use synchronisation and targeted tidal volume modes if possible in order to minimise time on the ventilator.

Miscellaneous Considerations

- Babies at or near term, especially if born by elective caesarean section, can develop severe RDS.
- Some term babies with RDS may have genetic disorders (SP-B or ABCA3 deficiency).
- If pulmonary hypertension is present iNO may help, otherwise not.
- If pulmonary haemorrhage occurs surfactant may help at least transiently.
- Later surfactant therapy has not been shown to reduce or modify course of BPD.

The present Guideline has a new section entitled miscellaneous considerations. Not all babies with RDS are preterm infants, and near term babies can also develop quite severe RDS, particularly if born by elective caesarean section. Occasionally babies have genetic mutations rendering them incapable of producing surfactant. Nitric oxide can be helpful in term babies with RDS if pulmonary hypertension is present. Surfactant may also be helpful in improving oxygenation in babies following pulmonary haemorrhage. Surfactant has been tried in BPD but results in only short term improvements in oxygenation

Miscellaneous Considerations: Recommendations: 2010

- Elective caesarean section in low risk pregnancies should not be done < 39 wk **(B)**.
- Inhaled NO is not beneficial in management of babies with RDS unless pulmonary hypertension is present in near term infants **(A)**.
- Surfactant improves oxygenation in babies with pulmonary haemorrhages **(C)**.
- Surfactant cannot be recommended for prevention of evolving BPD **(C)**.

Recommendations are that we should aim to reduce RDS by avoiding elective caesarean section before 39 completed weeks of gestation. We should only use inhaled nitric oxide in the setting of term or near term babies in whom pulmonary hypertension has been demonstrated. Surfactant may be used to improve oxygenation in babies with pulmonary haemorrhage but not for babies with established BPD.

Guidelines 2010: What is New?

- New evidence from recent Cochrane reviews and the literature since 2007.
- Many of the previous recommendations are now more firmly evidence-based.
- The section on delivery room stabilisation has been considerably expanded.
- New recommendations on delaying cord clamping and a new section on avoiding or reducing duration of mechanical ventilation
- A new miscellaneous section has also been added covering aspects of RDS management that arise infrequently

What is new in this Guideline is that it contains more evidence from recent literature and Cochrane Reviews since 2007. Many of the recommendations are unchanged, but now more firmly evidence based. The section on delivery room stabilisation has been considerably expanded. There are new recommendations on delaying cord clamping and a new section on avoiding or reducing mechanical ventilation, including recommendations on Caffeine, nasal ventilation, permissive hypercapnia and the role of newer ventilation modalities. A new miscellaneous section has been added covering aspects of RDS management that occur infrequently.