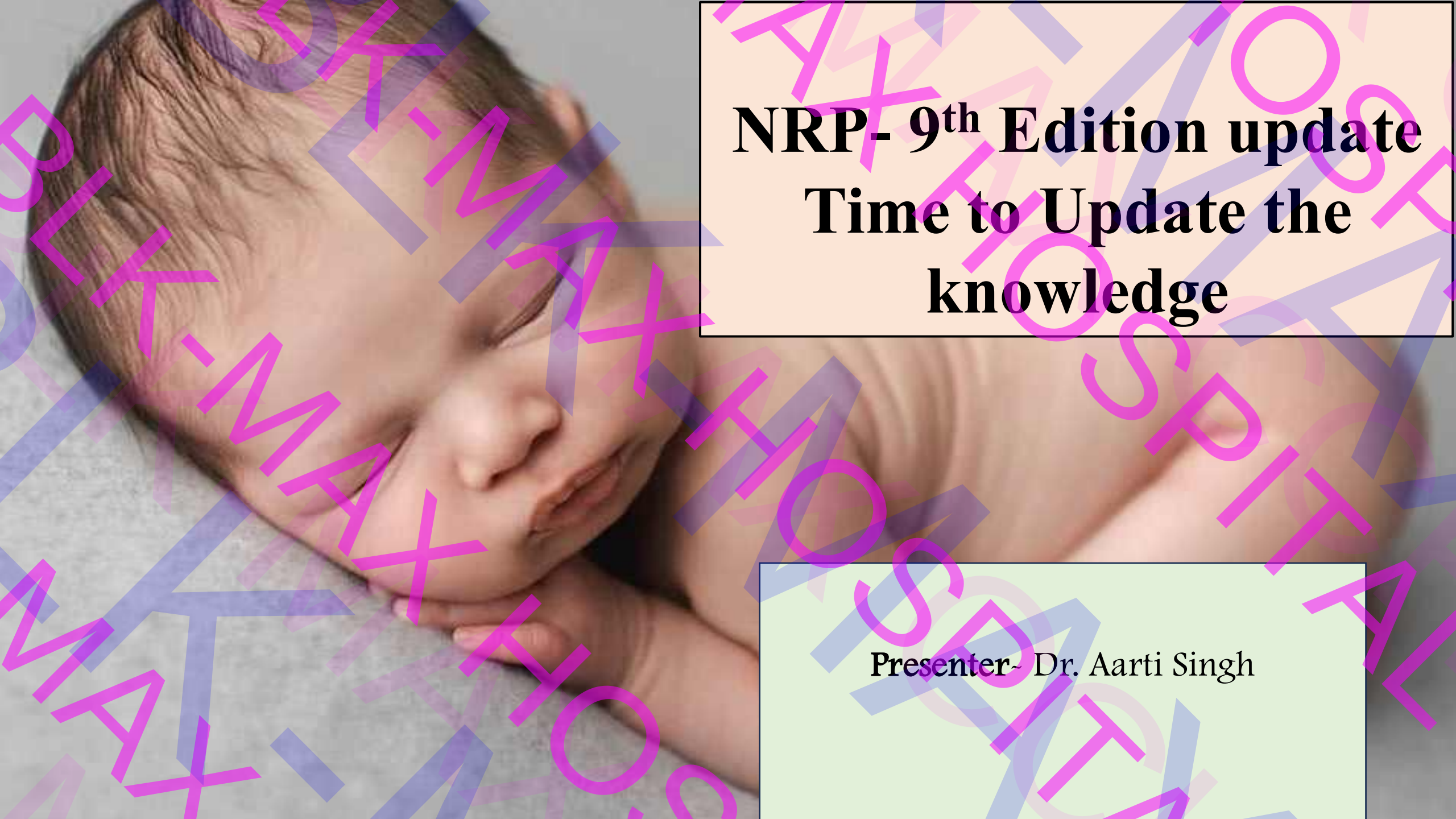


NRP- 9th Edition update
Time to Update the knowledge

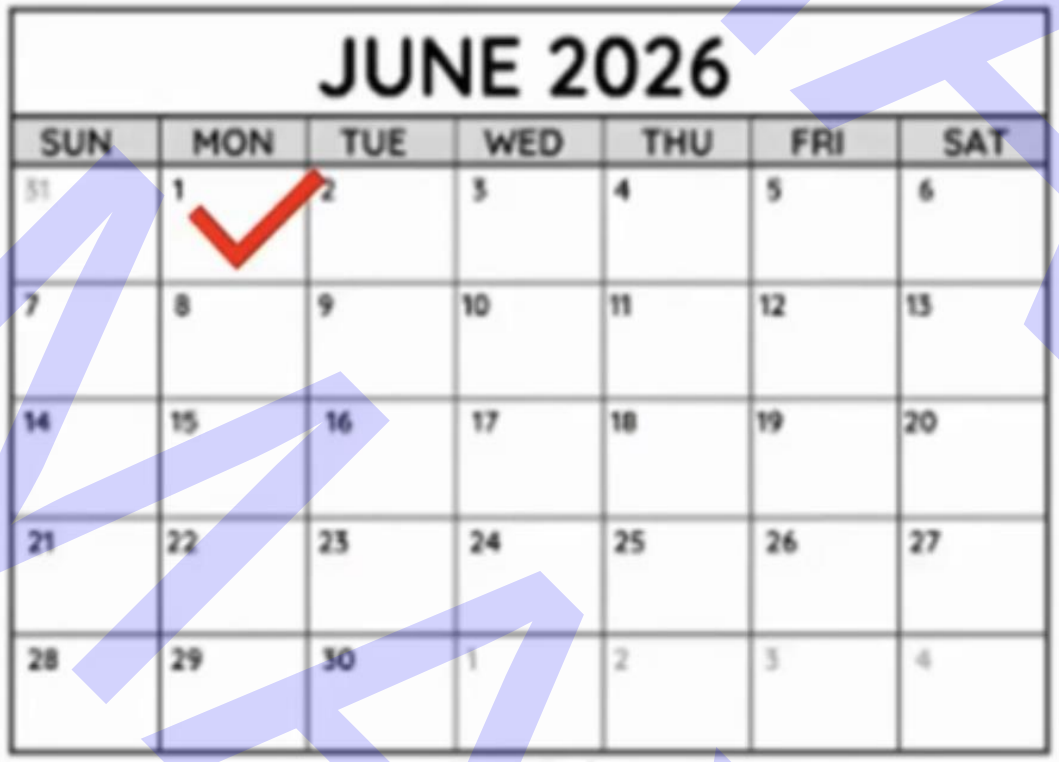
Presenter- Dr. Aarti Singh

Implementation Timeline

Neonatal Resuscitation Program®

- 9th Edition changes must be incorporated by June 1, 2026

- Work with your institution to develop an implementation plan for a smooth transition.



The *Textbook of Neonatal Resuscitation, 9th Edition*

11 lessons and 5 Supplemental Lessons

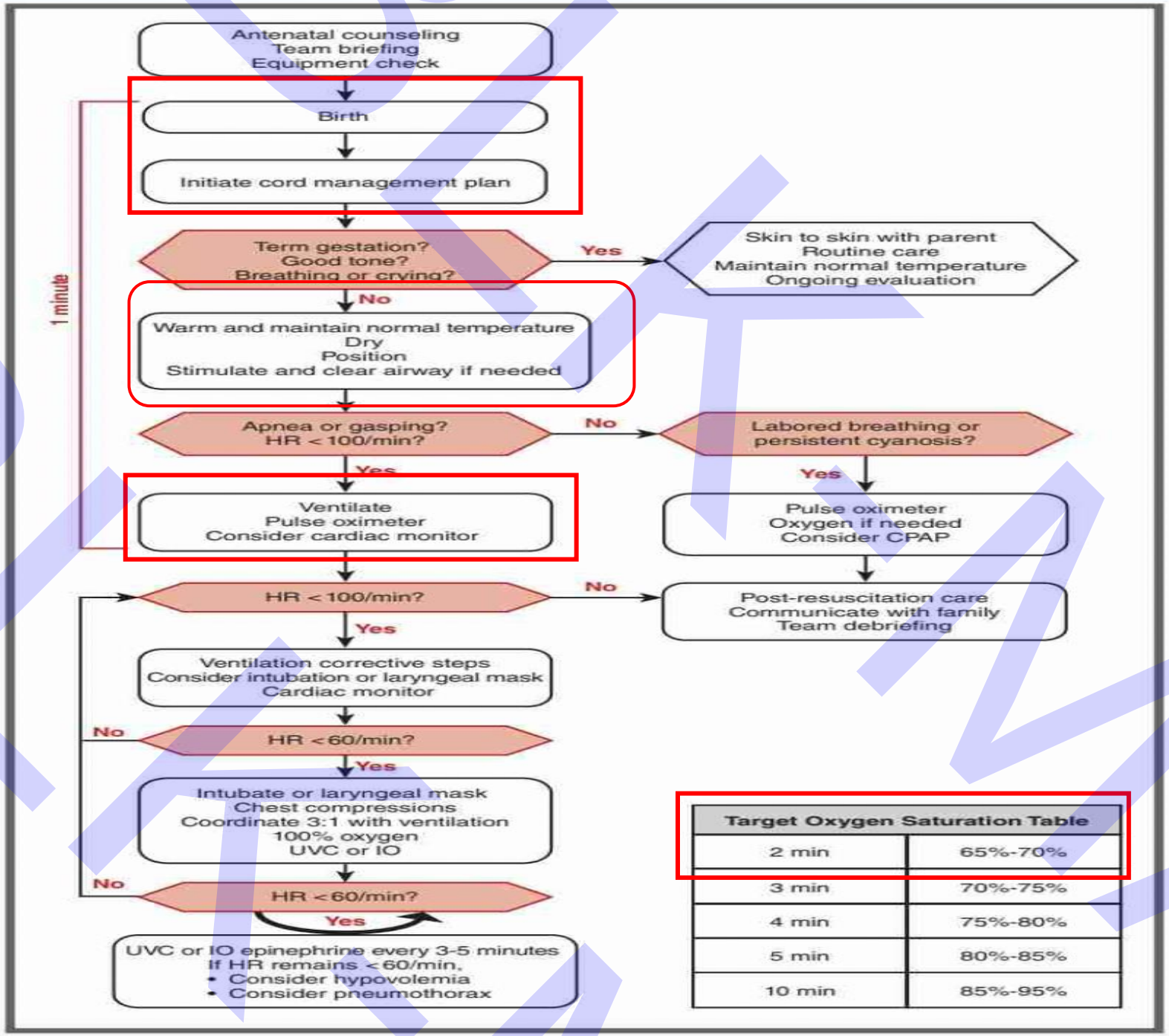
1. Foundations of Neonatal Resuscitation
2. Anticipating and Preparing for Resuscitation
3. Initial Steps of Newborn Care
4. Ventilation
5. Endotracheal Intubation
6. Chest Compressions
7. Medications
8. Resuscitation and Stabilization of Infants Born Preterm
9. Post-resuscitation Care
10. Special Considerations
11. Ethics and Care at the End of Life

Supplemental Lessons (for enhanced learning; no exam questions for this material)

12. Improving Resuscitation Team Performance
13. Resuscitation Outside the Delivery Room
14. Bringing Quality Improvement to Your Resuscitation Team
15. *NEW:* Resuscitation and Stabilization of Newborn Infants with Congenital Heart Disease
16. *NEW:* Resuscitation in the Neonatal Intensive Care Unit

NRP Algorithm

Neonatal Resuscitation Program®



Target Oxygen Saturation Table	
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%

Figure 1.3. Neonatal Resuscitation Program Algorithm.

Hexagon shows - assessment
Rectangle shows- Action

AHA, AAP and NRP 2025 Algorithm
Exactly same

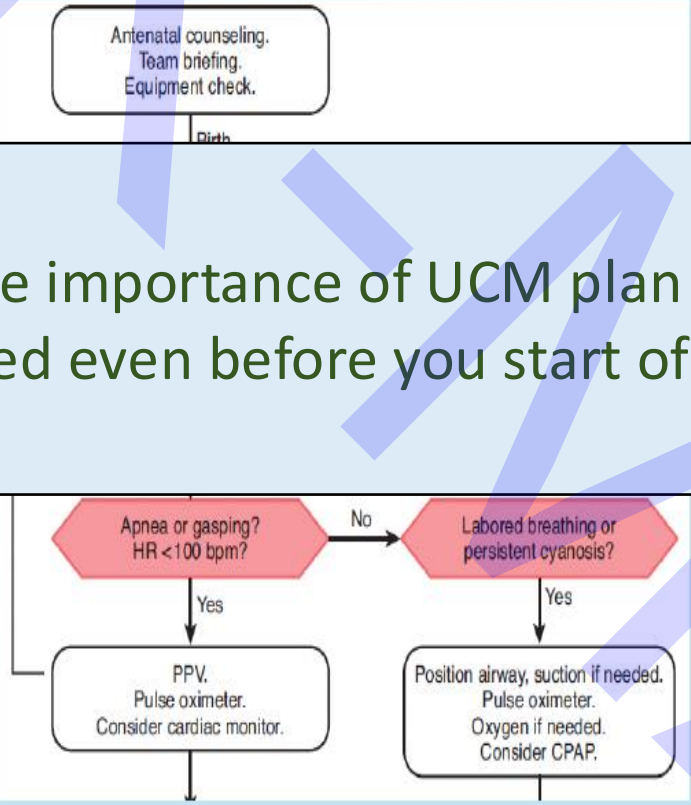
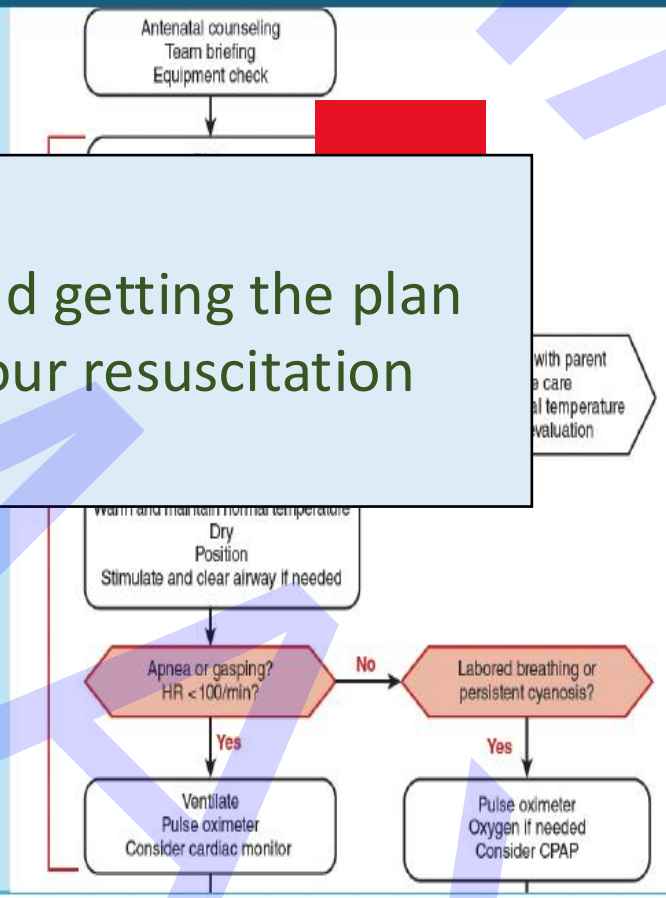
Algorithm Changes

Umbilical Cord Management Emphasis
The algorithm has been updated to emphasize the importance of umbilical cord management after birth.

Routine Suction De-emphasized in the Initial Steps
Routine initial steps include warm, maintain normal temperature, dry, position. Stimulate and clear airway if needed.

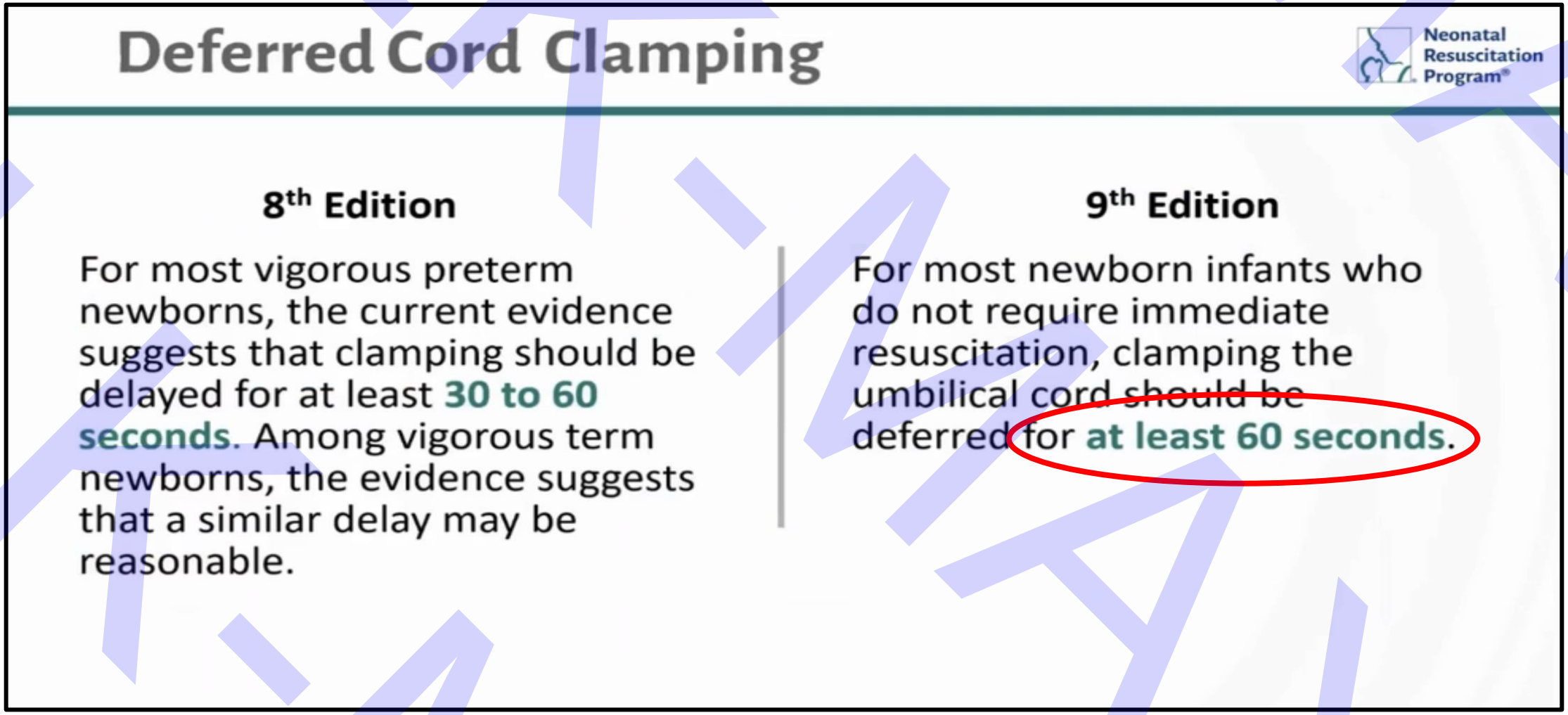
Oxygen Saturation Table
The target oxygen saturation table starts at 2-minutes, reflecting that is is unlikely teams can obtain an oxygen saturation at 1-minute after birth.

Change 1: Birth and Initiate cord management part in Rectangle- Denotes Action

Change	8th Edition	9th Edition
Changes have been made to the algorithm: • Adde… **Cord** as act… minut… • Remo… Warm, dry, stimulate, position the airway, suction if needed.		

Emphasize the importance of UCM plan and getting the plan implemented even before you start of your resuscitation

Change 2: Deferred Cord Clamping



Change 3: Umbilical cord Milking

Umbilical Cord Milking

Neonatal Resuscitation Program®

8th Edition

For newborns **less than 28 weeks' gestation, umbilical cord milking is not recommended** because it has been associated with an increased risk of intraventricular hemorrhage.

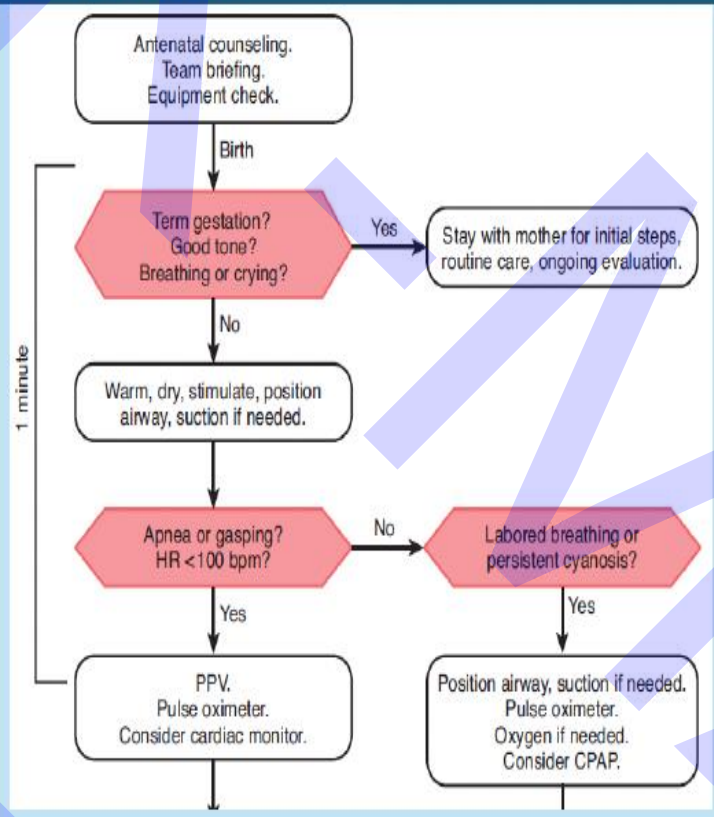
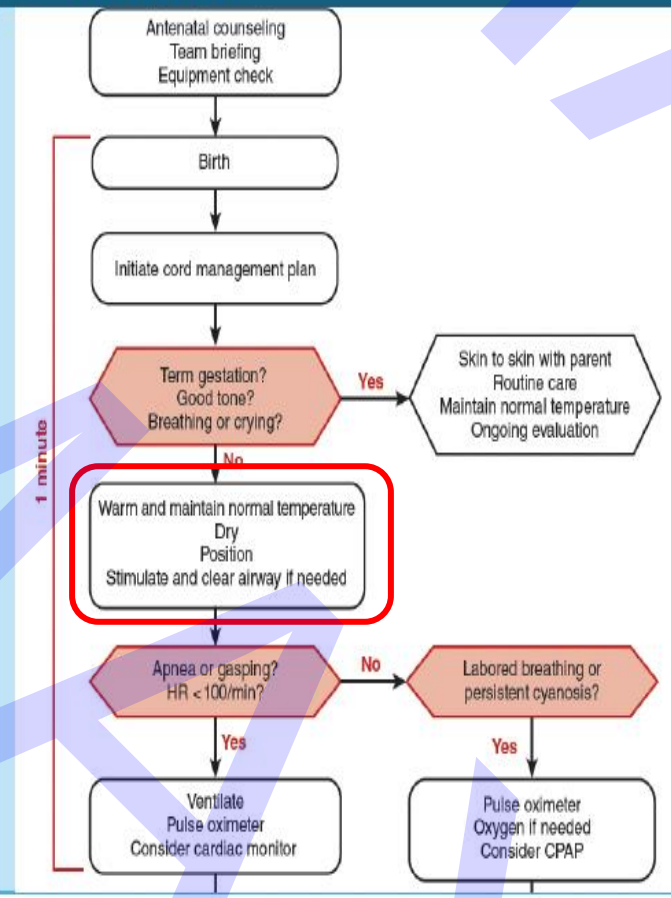
9th Edition

- For newborn infants 35-42 weeks' gestation, who remain non-vigorous despite stimulation, umbilical cord milking **may be a reasonable alternative** to early cord clamping.

-For non-vigorous preterm infants born at 28 to 34 weeks' gestation, there is **not enough evidence to recommend** routinely milking the intact umbilical cord.

- Intact umbilical cord milking is **not recommended for preterm newborn infants less than 28 weeks' gestation** because it has been associated with an increased risk of severe intra-ventricular hemorrhage.

Change 4: Removed suction from initial steps

Change	8th Edition	9th Edition
Changes have been made to the algorithm: • Added **Birth and Initiate Cord Management Plan** as actions in the first 1 minute. • Removed **suction** from Warm, dry, stimulate, position the airway, suction if needed.		

Why suction was omitted? Science behind

- An EvUp conducted for 2025.

Summary of Evidence

- QI study (999 infants)- focused on reducing unnecessary suctioning of clear amniotic fluid in the DR, 12% received oropharyngeal suctioning in the first phase of the study and 4% in the second.
- No disadvantages of the more selective suctioning approach

Treatment Recommendations (2022)

- Suctioning of clear amniotic fluid from the nose and mouth should not be used as a routine step for newborn infants at birth **(Weak recommendation, Very low–certainty evidence).**
- Airway positioning and suctioning should be considered if airway obstruction is suspected **(Good practice statement).**

Change 5: Terminology update

Terminology updates to be consistent with AHA/AAP Guidelines	Refers to Positive Pressure Ventilation (PPV)	Refers to Ventilation

Why "Ventilation" Replaced "PPV" in the NRP 9th Edition

Focus on physiology, not procedure:
The term **"ventilation"** emphasizes the **goal of air entry and lung aeration**, not just the act of giving positive pressure breaths.

Simplifies communication:

Using "ventilation" is clearer during team resuscitation — all efforts aim to ensure the **baby is being ventilated**, regardless of device used (mask, T-piece, or ET tube).

Evidence-based shift:

Studies consistently show **effective ventilation** is the single most important intervention in neonatal resuscitation; other steps depend on it.

Change 6: Target oxygen saturation

Target Oxygen Saturation Table **now starts at 2 minutes** versus 1 minute.

Target Oxygen Saturation Table	
1 minute	60%-65%
2 minutes	65%-70%
3 minutes	70%-75%
4 minutes	75%-80%
5 minutes	80%-85%
10 minutes	85%-95%

Target Oxygen Saturation Table	
2 minutes	65%-70%
3 minutes	70%-75%
4 minutes	75%-80%
5 minutes	80%-85%
10 minutes	85%-95%

Pulse oximeters often take **20–30 seconds or more** to pick up a stable signal after birth.

The 1-minute SpO_2 value is therefore **inaccurate and inconsistent** across babies.

Re-emphasised, at 5 min, SpO_2 should be 80-85%

Change 7: Oxygen Concentration

Oxygen Concentration

Neonatal Resuscitation Program®

8th Edition

Oxygen Concentration (FIO_2)	
Weeks' gestation	Initial Setting
≥35 weeks	21%
< 35 weeks	21% - 30%

9th Edition

Oxygen Concentration (FIO_2)	
Weeks' gestation	Initial Setting
≥35 weeks	21%
32-34 weeks	21% - 30%
<32 weeks	≥30%

Justification and Evidence-to-Decision Framework Highlights

NetMotion: *Network Meta-analysis of Trials of Initial Oxygen in Preterm Newborns*

- Suggested benefit from higher Fio2 (0.90–1.00) has lowest mortality.

Whichever initial oxygen concentration was used, oxygen saturation monitoring and individualized adjustments of inspired oxygen concentration were used in most of the clinical trials and are likely to be needed to optimize outcomes

- 2 pending multicenter trials are using FIO2 of 0.50 vs 0.00 for their treatment arms (CTRI-ACTRN12618000879268 and NCT03825835220).

Sotiropoulos et al, Neonatology, 2022

Change 8: Peak Inflation Pressure

Initial Peak Inflation Pressure (PIP) Settings

Neonatal Resuscitation Program®

8th Edition

Start with a **PIP of 20 to 25 cm H_2O.**

9th Edition

The suggested **initial PIP is 25 cm H_2O.**

Weeks' gestation	Acceptable range
≥32 weeks	25-30 cm H_2O
< 32 weeks	20-25 cm H_2O

Why the PIP was altered?

- Because **lung compliance, volume, and vulnerability to injury differ with gestational age**, the **PIP** required to achieve effective ventilation also differs.
- Evidence shows that both **too low pressures** (ineffective aeration) and **too high pressures** (Volutrauma, IVH) are harmful.
- **PIP must be individualized — guided by gestation, lung compliance, chest rise, and heart rate response.**

Klingenberg C et al., **Arch Dis Child Fetal Neonatal Ed**, 2018
Lista G et al., **Pediatrics**, 2005
Finer NN et al., **J Pediatr**, 2019

Change 9: Ventilation rate

Ventilation Rate

Neonatal Resuscitation Program®

8th Edition	9th Edition
The ventilation rate is **40-60 breaths per minute**.	The ventilation rate is **30-60 breaths per minute**.

Why the ventilation rate was altered?

Rationale: Supported by physiologic data and observed clinical effectiveness.

- NRP recommends **30–60 breaths/min** because this range

✓Best mimics natural newborn respiration

✓Achieves effective ventilation and HR rise

✓Minimizes air trapping

✓Supported by physiologic and clinical data

✓Moreover, during the chest compression, the ventilation rate is 30

Colin P.F. O'Donnell, *Resuscitation*, 2019.
Colin O.F. Kamlin, *Resuscitation*, 2006.
Katherine S. Sobotka, *Journal of Applied Physiology*, 2015.
Stuart B. Hooper, *Clinical and Experimental Pharmacology and Physiology*, 2013.

Change 10: Ventilation Correction steps

Ventilation Corrective Steps

Neonatal Resuscitation Program®

8th Edition

- If the heart rate is not increasing within the **first 15 seconds** of PPV and you do not observe chest movement, start the ventilation corrective steps.
- You will **perform the corrective steps sequentially** until you achieve chest movement with assisted breaths.

9th Edition

- If the heart rate is not increasing within **15 to 30 seconds** of starting ventilation and you do not observe chest movement, start the ventilation corrective steps.
- Based on your assessment of the infant and clinical situation, you **may choose the steps that are most likely to be helpful and prioritize the order in which you perform them.**

Change 11: LMA- a primary device

A laryngeal mask may now be used as a **primary device** for ventilation instead of as an alternative airway when face mask and intubation are unsuccessful.	If the baby **cannot be successfully ventilated** with a face mask and intubation is unfeasible or unsuccessful, **a laryngeal mask may provide a successful rescue airway.**	In most cases, **ventilation is initiated** with a **face mask or laryngeal mask.**

Rationale for the change

- **Evidence / Rationale:** Manikin trials, observational studies and some clinical trials demonstrate high success rates for LMA insertion and effective ventilation, faster establishment of ventilation than failed intubation attempts, and feasibility with brief training. Data are limited in very preterm/ELBW infants.

Rationale for the change

- **Meta-analysis of 6 RCTs (n = 1823; ≥34⁰⁄₇ weeks GA):**
  - Use of **LMA** reduced **failure of initial ventilation** compared with face mask.
  - **Lower rate of endotracheal intubation** in the delivery room.
  - **Shorter duration of ventilation** and **faster heart rate recovery (>100/min).**
  - Studies showed heterogeneity in provider experience with face mask ventilation.
- **Additional quasi-randomized trial (n = 67; >36 weeks GA):**
  - LM group had **shorter ventilation time** and **less need for intubation** vs face mask.

Change 12: Size of ET tube to be used

Endotracheal Tube Size

Neonatal Resuscitation Program®

8th Edition

Weight (kilograms)	Gestational Age (weeks)	Endotracheal Tube Size (mm ID)
<1kg	<28	2.5
1-2kg	28-34	3.0
>2	>34	3.5

9th Edition

Weight (kilograms)	Gestational Age (weeks)	Endotracheal Tube Size (mm ID)
<800	22-25	2.5*
800-1,200	26-28	2.5
1,201-2,200	29-34	3.0
>2,200	>34	3.5

*A 2.0 mm ID endotracheal tube (optional) may be considered.

Evidence-to-Decision (E-t-D) framework:

- **Foglia EE et al.**, *Video laryngoscopy for neonatal intubation* (RCTs and registry data)
- **Davis PG et al.**, *Airway injury and tube leak in preterm infants*
- **Lee HC et al.**, *National Neonatal Research Database analyses of intubation success and complications by tube size*
- Collectively demonstrate:

1. **Improved success and less trauma** with better visualization → allows safe use of smaller tubes
2. **Updated anthropometric studies** of preterm tracheal diameter shows previous sizing tables over-estimated airway calibre
3. **Registry data** linking oversized tubes to post-extubation stridor/subglottic stenosis

Change 12: Tip-to-gum instead of Tip-to lip

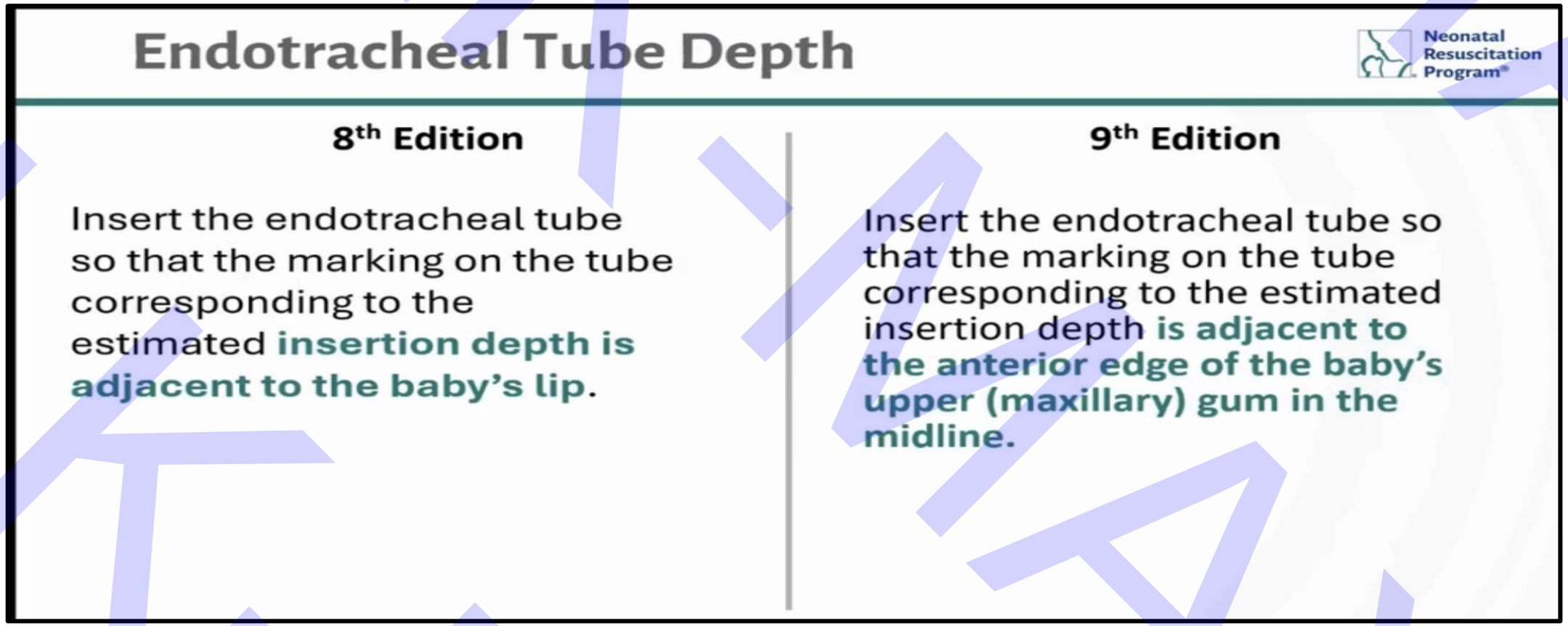


Figure 5.25. Note the marking adjacent to the infant's upper (maxillary) gum at the midline.

Why this change???

Old method	New method	Reason for change
Tip-to-Lip	Tip-to-Gum (maxillary alveolus)	**Lip position variable; gum is a fixed skeletal landmark**
Based on external facial length	Based on intraoral, anatomically constant landmark	**Improves reproducibility across gestational ages**
±1 cm depth variability on X-ray	Closer correlation with optimal tracheal position (T1–T2)	Reduces right-mainstem intubation & extubation risk
Harder to standardize in open-mouth neonate	Easily visible under laryngoscopy	Matches training with video laryngoscopy tools

Key findings referenced there (Foglia EE 2023; Lee HC 2024; Davis PG 2023) showed that:

1.Lip landmarks are inconsistent.

1. The **distance from the lip to the vocal cords** varies widely with facial shape, gestational age, and race/ethnicity.
2. Premature infants often have **shorter philtrum-to-glottis distance**, causing over-insertion if lip markings are used.

2.Radiographic correlation is more reliable when depth is measured from the gum line.

1. The *maxillary gum* (upper alveolar ridge) is **fixed to the skull** and doesn't vary with mouth opening, tongue position, or swelling.
2. Studies using radiographs & manikin measurements found "tip-to-lip" placement can overshoot by **0.5–1 cm**, whereas "tip-to-gum" correlates with ETT tips lying correctly at **T1–T2** on X-ray.

3.Improved standardization for all GA.

As extremely preterm and VLBW infants requires accurate depth estimation—1 cm error can lead to mainstem intubation.

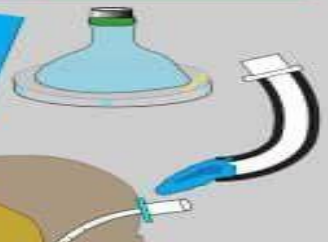
4.Better reproducibility during team training and video laryngoscopy.

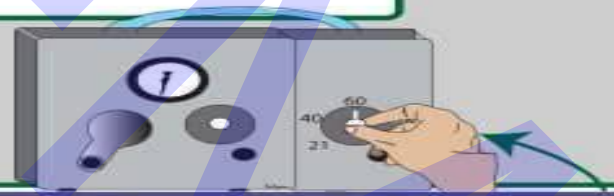
Overview of NRP 9th Edition Practice Changes*

Dry, position and gentle, tactile stimulation if breathing is ineffective; Clear airway if needed.

Ventilation corrective-steps need not be performed sequentially; Prioritize the order by choosing the steps most likely to be helpful.

Ventilation can be initiated with a face mask or supra-glottic airway



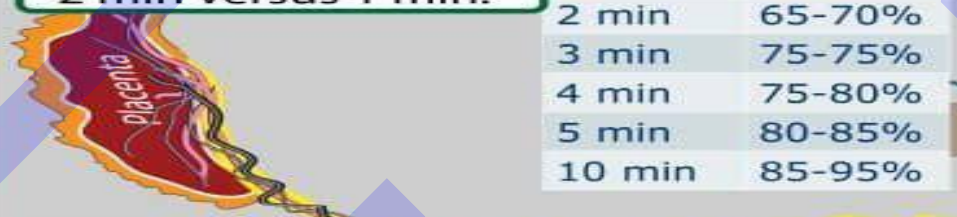


Initial FiO_2	
≥35 wk	0.21
32-34 wk	0.21 – 0.3
<32 wk	≥0.3

Ventilation: 30-60 /min	
Initial PIP: 25 cmH_2O	
≥32 wk	25-30 cmH_2O
<32 wk	20-25 cmH_2O

Target O_2 saturation (SpO_2) table starts at 2 min versus 1 min.

Target Oxygen Saturation Table	
~~1 min~~	~~60-65%~~
2 min	65-70%
3 min	75-75%
4 min	75-80%
5 min	80-85%
10 min	85-95%



After chest compressions, if reliable pulse oximeter signal is achieved, adjust FiO_2 to target SpO_2

Umbilical cord management: DCC ≥ 60 s; iUCM not recommended for < 28 wk; iUCM in non-vigorous 35-42 wk; Non-vigorous 28-34 wk - not enough evidence to recommend iUCM

ETT insertion depth is measured to the anterior edge of the upper (maxillary) gum instead of the lip (tip-to-gum instead of tip-to-lip)

Endotracheal tube size or internal diameter

Weight (g)	GA (wk)	ETT size
< 800	22-25	2.5 (or 2.0)
800-1200	26-28	2.5
1201-2200	29-34	3.0
> 2200	> 34	3.5

*this infographic is a personal creation of Dr. Satyan Lakshminrusimha and does not represent the official position of or endorsed by the American Academy of Pediatrics and the Neonatal Resuscitation Program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danke
謝謝
teşekkür ederim
спасибо
dank je
tapadh leat
thank you
gracias
bedankt
hvala
mauruuru
mochchakkeram
dziękuję
go raibh maith agat
sukriya
kop khun krap
sagolun
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