


neoResus
The Victorian Newborn Resuscitation Project

Pedi-Cap™ CO₂ detector

Presentation redeveloped for this program by Rosemarie Boland
from an original presentation by Johnston, Adams & Stewart, (2006)
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Background

- Clinical methods of assessing endotracheal tube placement have not been systematically evaluated in neonates
- End tidal CO₂ detectors identify oesophageal intubation faster than clinical assessment (Mean 8.1 seconds versus 39.7 seconds)

(Garey, et al., 2008)

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Clinical verification of ETT position

Tracheal intubation is likely if:

- The ETT is visualized passing through the vocal cords
- The heart rate rises above 100 bpm soon after intubation & commencing positive pressure ventilation
- Breath sounds are auscultated in both axillae
- Condensation is seen on the inside of the endotracheal tube during expiration
- The infant's chest rises and falls with each inflation

(Australian Resuscitation Council, 2006)

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ARC recommendation

“An end tidal CO₂ detector attached to the outside end of the endotracheal tube is recommended for verification of correct tube placement”


(Australian Resuscitation Council, 2006, Guideline 13.5)

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Benefits of using a Pedi-Cap™

- Quick confirmation of correct ETT placement in the trachea
- Easy to use
- Inserts quickly into the circuit
- Inexpensive
- Portable
- Risk management strategy



Pedi-Cap®
Patient size:
1-15 kg

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How does the Pedi-Cap™ work?

- The Pedi-Cap™ is a semi-quantitative, non invasive colorimetric end tidal CO₂ (ETCO₂) detector
- The device starts at a base line colour when minimal CO₂ is present and undergoes gradual colour change as the concentration of exhaled CO₂ increases with each positive pressure inflation delivered to the infant
- ETCO₂ is a reflection of ventilation, cardiac output, pulmonary blood flow and metabolism

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The effect of pulmonary perfusion on ETCO₂



- If perfusion is adequate, ETCO₂ represents the partial pressure of CO₂ in circulating blood. This will be demonstrated inflation-to-inflation on the Pedi-Cap™ after successful intubation
- Inadequate cardiac output & decreased pulmonary perfusion (e.g. during cardiac-respiratory arrest) will lead to negligible ETCO₂ detection as CO₂ is not being delivered to the lungs

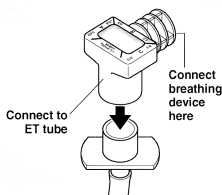
(Garey, et al., 2008)

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Connecting the Pedi-Cap™



- The Pedi-Cap™ is inserted between the outer end of the endotracheal tube and the manual ventilation device (e.g. Neopuff™ or self inflating bag)



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Interpreting the results



- After 6 effective positive pressure inflations, evaluate the colour of the window on expiration
- Successful tracheal intubation is confirmed if the Pedi-Cap™ window changes from purple (on inspiration) to yellow (on expiration) with every positive pressure inflation delivered to the infant

The following slides describe all the colour changes that may be seen and their meaning

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Successful tracheal intubation

Adequate Perfusion Spontaneous Heartbeat

Inhalation Exhalation
(Adequate Perfusion)

The Pedi-Cap™ window changes colour on expiration from purple to gold or mustard yellow

2% to < 5% EtCO_2 *; 15 to 38 mmHg

ET tube in trachea

Secure tube

Continue to observe color change

* at sea level

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Poor perfusion or insufficient tidal volume (V_T) is being delivered

Poor Perfusion or CPR

Inhalation Exhalation
(Poor Perfusion)

The Pedi-Cap™ window changes colour on expiration to light or dark tan if perfusion is poor or insufficient V_T is being delivered

0.5% to < 2% EtCO_2 ; 4 to < 15 mmHg

Retained CO_2 in esophagus or low perfusion

Deliver six more breaths

Color remains tan

ET tube in trachea with low perfusion

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No perfusion, cardiac arrest or oesophageal intubation

No Perfusion Cardiac Arrest

Inhalation Exhalation
(No Perfusion)

The Pedi-Cap™ window stays purple or dark grey on expiration if there is no perfusion or the ET tube is in the oesophagus

.03% to < 0.5% EtCO_2 ; < 4 mmHg

ET tube not in trachea or inadequate perfusion (Ineffective CPR)


Check if ET tube is through vocal cords

| | |
|--|---|
| <p>YES</p> <p>ET tube in trachea with inadequate perfusion</p> <p>Take appropriate clinical action</p> | <p>NO</p> <p>ET tube not in trachea</p> <p>Reinsert tube Recheck with Easy Cap II or Pedi-Cap</p> |
|--|---|

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Damaged Pedi-Cap™

Damaged Pedi-Cap



Inhalation Exhalation

The Pedi-Cap™ window stays yellow on both inspiration & expiration, indicating a damaged Pedi-Cap™

Reasons for damage

- Contamination with Adrenaline
- Contamination with surfactant
- Exposure to gastric juices
- Prolonged exposure to high humidity

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Caution when using a Pedi-Cap™

- Despite being correctly placed in the trachea, there are circumstances in which the Pedi-Cap™ may not change colour. This may occur when:
 - Insufficient inflations are delivered
 - Insufficient tidal volume is delivered
 - There is significant air leak around the endotracheal tube
 - The infant is in full circulatory arrest


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Management during cardiac arrest

- In cardiac arrest, re-establishment of cardiac output and pulmonary perfusion by adequate CPR is necessary to increase end tidal CO₂ to a level detectable by the Pedi-Cap™
- Actions:
 - Continue ECC & positive pressure ventilation at 3:1
 - Check that the ETT can be visualized passing through the vocal cords: re-intubate if it is not
 - If the ETT is through the vocal cords, increase the PIP to ensure a sufficient tidal volume is being delivered


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The very low birth weight infant

- The Pedi-Cap™ CO₂ detector is labeled for use in infants > 1 kg birth weight
- Research has shown that the tidal volume of a viable (400 gram) infant is above the tidal volume threshold for the Pedi-Cap™ device, suggesting that a Pedi-Cap™ is appropriate for use on any size neonate to confirm intubation
(Garey, et al., 2008)


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Limitations of the Pedi-Cap™

- A positive colour change will occur when the endotracheal tube is in **any** portion of the respiratory tree, such as the right main bronchus or oropharynx
- A chest X-ray remains the gold standard to confirm correct endotracheal tube position in any infant who requires intubation

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Conclusion

- The Pedi-Cap™ can quickly verify endotracheal tube placement in the trachea
- It is easy to use
- It is easy to learn to use
- Caution is required in certain situations
- A Pedi-Cap™ should be standard equipment on newborn resuscitation cots


(Australian Resuscitation Council, 2006)

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Pedi-Cap™ product details

- Weighs < 5 grams
- Dead space: 3 mL
- Resistance: 2.5 cm H₂O (+/- 0.5 cm) at 10 L/min flow
- Single patient use, but can be used intermittently or continuously on an infant for two hours



Pedi-Cap®
Patient size:
1-15 kg


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Supplier

Tyco Healthcare Pty Ltd
Telephone: 1800 252 467
Pedi-Cap™ Pediatric CO₂ Detector
Box of 6


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References

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Disclaimer

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