

Guide to Waveform Capnography during intubation

Continuous Waveform Capnography is the gold standard for exhaled CO₂ detection in adults and children and technological improvements mean this equipment may become more widely used in neonatology over time. This is a short guide for any units starting to use this technology during intubation.

Wave capnography has two roles at intubation:

- monitoring successful or unsuccessful placement in the airway (showing tracheal placement)
- confirming the lungs are being ventilated (showing alveolar ventilation).

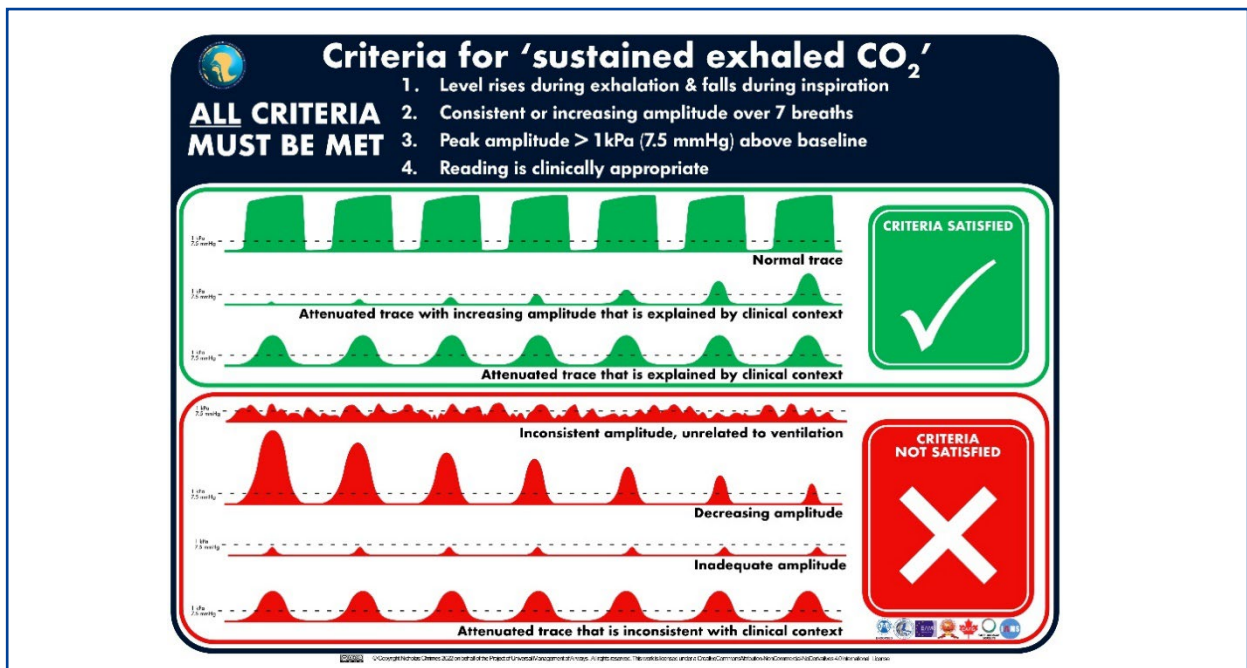
It is therefore primarily an AIRWAY monitor at this time.

At the point of intubation the key components are that:

1. the waveform should rise and fall with expiration and inspiration
2. the wave form should be sustained (ie not decreasing)
3. should be above 1 kPa in the absence of a large leak
4. should be clinically appropriate.

Together these 4 factors are 'sustained exhaled carbon dioxide'.

Figure 1: Criteria for 'sustained exhaled CO₂'.



Large airway leaks

Large leaks will mean the waveform trace is abnormal. This will be more common in neonates than adults in whom a cuffed tube is used. However the complete absence of exhaled CO₂ trace still indicates the lungs are not being ventilated and requires correction.

Low cardiac output

In low cardiac output states the amount of CO₂ exhaled is reduced but is not zero. This is true even soon after cardiac arrest. Waveform capnography will detect these low levels of CO₂ and produce an attenuated CO₂ trace. A colour change capnometer device may be insensitive and give a false negative result in these situations.

Flat capnograph

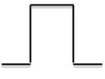



A flat capnograph or the absence of ‘sustained exhaled carbon dioxide’ indicates the lungs are not being ventilated. The cause must be found and addressed. It is essential to actively rule out oesophageal intubation; “no trace, wrong place”. If oxygen desaturation occurs before oesophageal intubation has been actively excluded (eg. by videolaryngoscopy) the default option should be to remove the tube (unless this is considered actively dangerous) and ventilate by other means.

Capnography as an airway or respiratory monitor

The traditional approach of considering the capnograph as a respiratory monitor and the focus on the phases of the waveform is a distraction at intubation. Remember its role is to identify whether you have placed the tube in the trachea and are providing ventilation of the lungs.

A simplified approach to learning the capnograph traces is shown in Figure 2.

Figure 2: Simplified capnograph traces

Good	Bad
 Top hat – good Indicates – clear unobstructed airway	 Dunce hat – bad Indicates – significant leak
 Ascot hat – OK Indicates – bronchospasm - partially obstructed airway	 No hat – very bad Indicates – dislodged/displaced tracheal tube or tracheostomy - oesophageal intubation - lack of ventilation

References

1. Cook TM, Kelly FE, Goswami A. ‘Hats and caps’ capnography training on intensive care. *Anaesthesia*. 2013; 68: 421
2. Chrimes N, Higgs A, Baker PA et al. Prevention of unrecognised oesophageal intubation: consensus guideline – from the Project for Universal Management of Airways and international airway societies. *Anaesthesia* 2022; 77: 1395-1415

Further reading

Owen Hibberd, Niamh Beirne, Dani Hall. A beginners guide to capnography.
<https://doi.org/10.31440/DFTB.50639>