RESPIRONICS

OEM Capnography business

Respironics Novametrix Capnography

Helping clinicians make every second count



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Key takeaways

Making care decisions at a moment's notice

To avoid delays and deliver optimal patient care, clinicians need the ability to identify potential breathing problems immediately.

Respironics capnography is designed to provide fast, reliable readings across a wide range of patients and care environments.[1]



1. Internal data on file.

Respiration

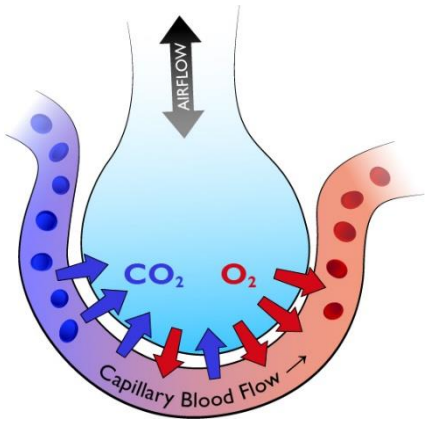
Ventilation vs. oxygenation

Ventilation

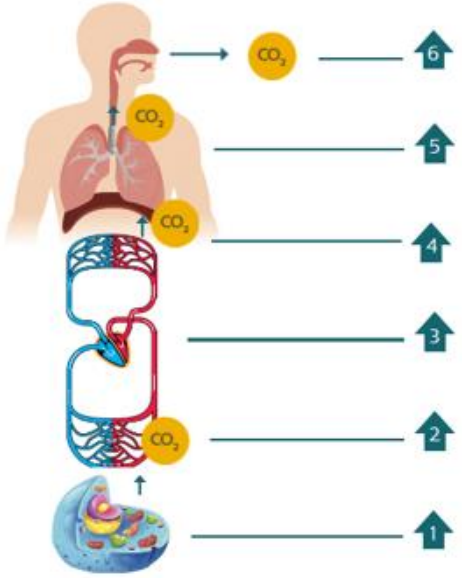
The exchange of gas between the lungs and the atmosphere so that oxygen from the air can be exchanged for carbon dioxide (CO_2) in the alveoli.

Oxygenation

The process by which concentrations of oxygen increase within the tissue as a result of ventilation.



How respiration occurs in the body



6. CO_2 expires out of the mouth and nose
5. CO_2 ventilates out of lungs
4. CO_2 diffuses into lungs
3. Blood carries CO_2 through circulation
2. CO_2 diffuses into venous system
1. Cells produce energy and CO_2

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Why measure $ETCO_2$?

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Why does CO_2 level matter?

- ✓ **Carbon dioxide** is the normal waste product from cellular metabolism
- ✓ **If CO_2 levels get too high**, it can cause cellular and organ damage

Capnography provides a rapid and reliable measurement that may detect life-threatening conditions earlier.[1,2]



1. Al-Aomar S, AlSamhori JF, Alzghoul H, Al-Ghraibeh H, Al-Majali G, Tarras S, Dolman H, Tyburski J, Mostafa G, Shahait AD. Evaluating the utility of end-tidal CO2 as a predictor of mortality in trauma victims: A systematic review and meta-analysis. Am J Surg. 2025 Feb;240:116130. doi:10.1016/j.amjsurg.2024.116130
2. Wollner EA, Nourian MM, Bertille KK, Wake PB, Lipnick MS, Whitaker DK. Capnography-An Essential Monitor, Everywhere: A Narrative Review. *Anesth Analg*. 2023;137(5):934-942. doi:10.1213/ANE.0000000000006689

It's best practice

CO_2 monitoring is rapidly becoming a standard of care for patient safety

American Heart Association.

"Continuous waveform capnography is recommended in addition to clinical assessment as the most reliable method of confirming and monitoring correct placement of an endotracheal tube."[1]

American Society of Anesthesiologists®

Continuous ETCO2 monitoring is the standard of care for patients receiving general anesthesia and is recommended for endotracheal tube placement.[2]

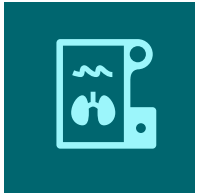
1. Panchal AR, Bartos JA, Cabañas JG, Donnino MW, Drennan IR, Hirsch KG, Kudenchuk PJ, Kurz MC, Lavonas EJ, Morley PT, O'Neil BJ, Peberdy MA, Rittenberger JC, Rodriguez AJ, Sawyer KN, Berg KM; Adult Basic and Advanced Life Support Writing Group. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020 Oct 20;142(16_suppl_2):S366-S468.
2. American Society of Anesthesiologists. Committee on Practice Parameters. Standards for Basic Anesthetic Monitoring. Last Amended October 15, 2025. Available at: https://www.asahq.org.

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Professional society recommendations across applications



Airway Management
Resuscitation Transport



Ventilator Management



Procedural Sedation
Pain Management

Best practice and recommendations

- The American Society of Anesthesiologists
- American Association for Respiratory Care
- American Hospital Association
- American College of Emergency Physicians
- The Association of Anaesthetists of Great Britain and Ireland
- Academy of Medical Royal Colleges
- Intensive Care Society
- Royal College of Anesthesia
- National Institute for Health and Care Excellence
- Canadian Anesthesiologists' Society
- European Section and Board of Anaesthesiology
- Emergency Nurses Association
- American Society of Peri Anesthesia Nurses
- College of Intensive Care Medicine of Australia and New Zealand
- Indian Society of Anesthesiologists

Advantages of Capnography



Clinical Advantage

- Rapid, real-time measurement for detecting respiratory problems[1,2]
- Advantages beyond pulse oximetry:
  - Decreased incidence of hypoxia and O_2 desaturation during sedation[3]
  - Significantly greater detection of respiratory depression compared with pulse oximetry and respiratory rate assessment[4]
  - Improved safety during pain management[5]



Clinical Flexibility

- Airway placement and patency
- Respiratory status in non-intubated patient
- Assess effectiveness of chest compressions during CPR
- Assess severity and inform treatment of small airway disease[6,7]



Cost Savings

- Potential to minimize costly adverse respiratory events[8,9]

1. Canadian Agency for Drugs and Technologies in Health (CADTH). Capnography for Monitoring EndTidal CO_2 in Hospital and Pre-hospital Settings: A Health Technology Assessment. Ottawa, ON: CADTH; March 2016. (CADTH Health Technology Assessment; no. 142).
2. Internal data on file.
3. Beitz A, Riphaus A, Meining A, et al. Capnographic monitoring reduces the incidence of arterial oxygen desaturation and hypoxemia during propofol sedation for colonoscopy: a randomized, controlled study (ColoCap study). Am J Gastroenterol. 2012;107(8):1205-1212.
4. Hutchison R, Rodriguez L. Capnography and respiratory depression. Am J Nurs. 2008;108(2):3539. doi:10.1097/01.NAJ.0000310329.55432.9f.
5. Maddox RR, Oglesby H, Williams CK, Fields M, Danello S. Continuous respiratory monitoring and a "smart" infusion system improve safety of patient-controlled analgesia in the postoperative period. In: Henriksen K, Battles JB, Keyes MA, Grady ML, eds. Advances in Patient Safety: New Directions and Alternative Approaches. Vol 4: Technology and Medication Safety. Rockville, MD: Agency for Healthcare Research and Quality (US); August 2008.
6. Farshid S, Buckland BC, Shanmuganathan S, Low GK. End-tidal carbon dioxide, a point-of-care biomarker to assess severity in acute asthma: a systematic review. Respir Med. 2025;236:107891.
7. Pertzov B, Ronen M, Rosengarten D, et al. Use of capnography for prediction of obstruction severity in non-intubated COPD and asthma patients. Respir Res. 2021;22(1):154.
8. Khanna AK, Jungquist CR, Buhre W, et al; PRediction of Opioid-induced respiratory Depression In patients monitored by capnoGraphY (PRODIGY) Group Investigators. Modeling the cost savings of continuous pulse oximetry and capnography monitoring of United States general care floor patients receiving opioids based on the PRODIGY trial. Adv Ther. 2021;38(7):3745-3759. doi:10.1007/s12325-021-01779-7.
9. Saunders R, Erslon M, Vargo J. Modeling the costs and benefits of capnography monitoring during procedural sedation for gastrointestinal endoscopy. Endosc Int Open. 2016;4:E340-E351. doi:10.1055/s-0042-100719.

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It's faster and more reliable than SpO_2

- ✓ $ETCO_2$ is measured breath-by-breath – earlier detection of respiratory events[1]
- ✓ Capnography readings are reliable, enhancing patient safety[2,3]



1. Burton JH et al. Acad Emerg Med. 2006;13(5):500-4. doi: 10.1197/j.aem.2005.12.017.
2. Aguilar AS et al. J Emerg Med. 2012; 42(4):424-8. doi: 10.1016/j.jemermed.2011.06.127.
3. McCarter T et al. Am Health Drug Benefits. 2008;1(5):28-35.

When and where $ETCO_2$ can be used

- ✓ Ventilator management
- ✓ Airway management resuscitation
- ✓ Procedural sedation
- ✓ Pain management
- ✓ Patient monitors
- ✓ Defibrillators
- ✓ Ventilators
- ✓ Anesthesia machines



Because when it comes to patient respiration, **every second counts**.

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Capnography basics

What is capnography?

Measure the efficiency of respiration by **analyzing the patient's ETCO2**

$ETCO_2$ monitoring provides an accurate waveform to measure and monitor:

- Airway patency
- Efficacy of ventilation
- Metabolic activity
- Relationship between ventilation and perfusion



1. Kerslake I, Kelly F. Uses of capnography in the critical care unit. *BJA Education*. 2016;17(5):178-183. doi:10.1093/bjaed/mkw062
2. Panchal AR, Bartos JA, et al. Adult Basic and Advanced Life Support Writing Group. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020 Oct 20;142(16_suppl_2):S366-S468. 20;142(16_suppl_2):S366-S468.

Components of a capnogram

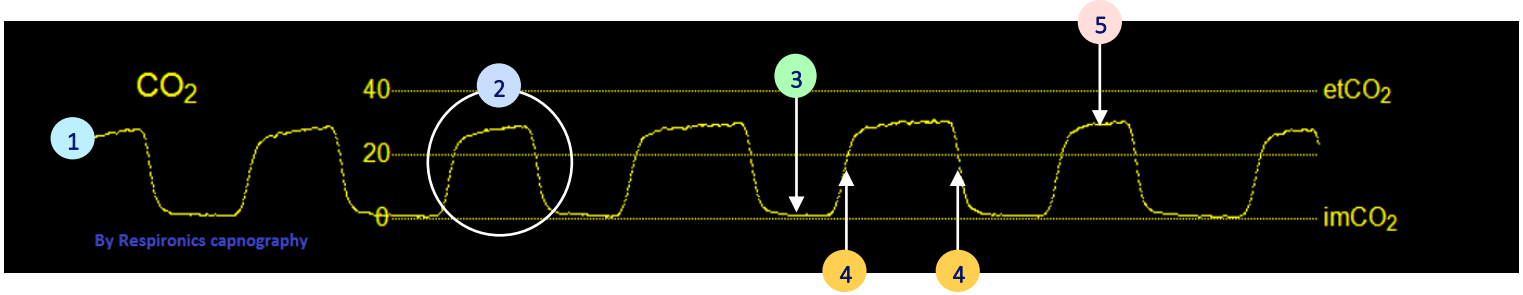
1 **Is there a waveform present?**
The presence of a waveform verifies the presence of a patent airway and that the patient is ventilating.

2 **Is the shape generally square?**
If not, there is a ventilation or mechanical issue.

3 **Does the waveform start and end at "zero" baseline along the horizontal axis?**
A continuous rise from the horizontal baseline indicates rebreathing of expired CO_2.

4 **Is there a notable vertical upstroke and downstroke?**
Decreasing expiratory upstroke and inspiratory downstroke are reflective of decreasing ETCO2 levels, indicating metabolic, perfusion, ventilation, or mechanical issue.

5 **Is there an alveolar plateau?**
Loss of the alveolar plateau means there is ineffective ventilation, because CO_2 is not clearing the airway, usually due to shallow breathing, partial obstruction, or low tidal volume.



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Types of capnography

Mainstream

- ✓ Uses infrared absorption spectroscopy
- ✓ Measures ETCO2 directly at the patient's airway
- ✓ Most common for ETCO2 monitoring of mechanically ventilated intubated patients



Advantages of mainstream capnography

- ✓ Fast response time (less than 60 ms)
- ✓ Does not divert or remove gas from tidal volume for CO_2 sampling
- ✓ No need for water traps or filters
- ✓ Real time recording of CO_2 concentration
- ✓ Useful in verifying tracheal intubation



Sidestream Capnography

- ✓ Uses infrared absorption spectroscopy
- ✓ Continuous sample is taken from patient's airway and analyzed inside the module
- ✓ Can be used on intubated and non-intubated patients
- ✓ Can be used in conjunction with oxygen delivery masks
- ✓ No sensor on the airway



Considerations for sidestream capnography

- ✓ Delayed waveform, typically 2-3 seconds
- ✓ Performs well with dehumidification tubing in humid environments
- ✓ Removes a portion of tidal volume (50 mL/min) for CO_2 sampling

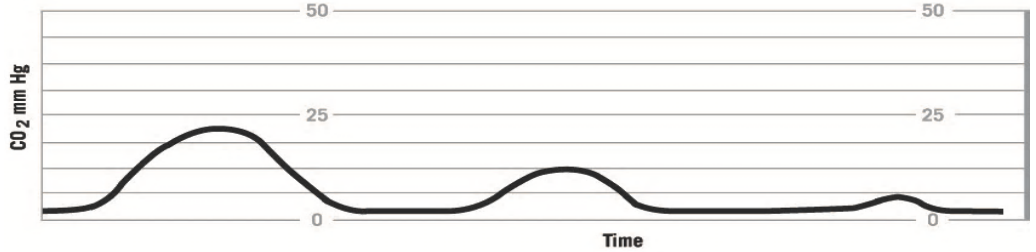


Recognizing respiratory distress with capnography

Cardiac and respiratory arrest

Waveform capnography provides:

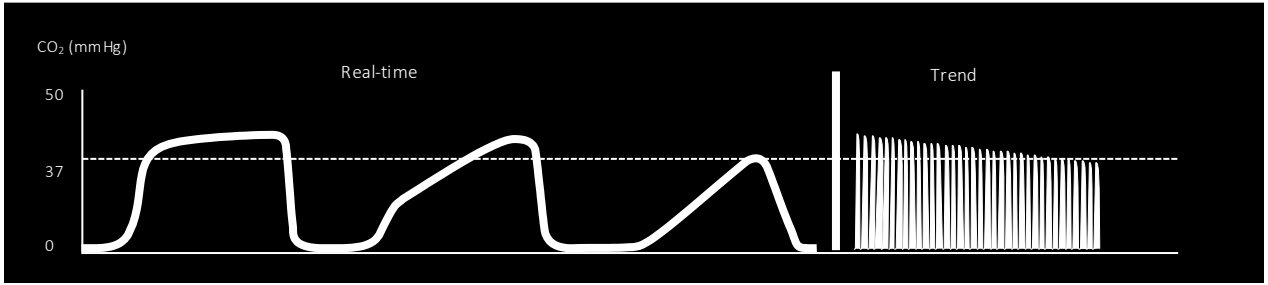
Confirmation of endotracheal tube (ETT) placement (failure to see and maintain normal waveforms shows the ETT is not in the bronchus)	Confirmation of airway patency



Obstruction in airway or breathing circuit

Causes for the “shark fin”:

Bronchospasm	Presence of foreign body in the airway	Partially kinked or narrowed ETT obstruction in expiratory limb or circuit breathing

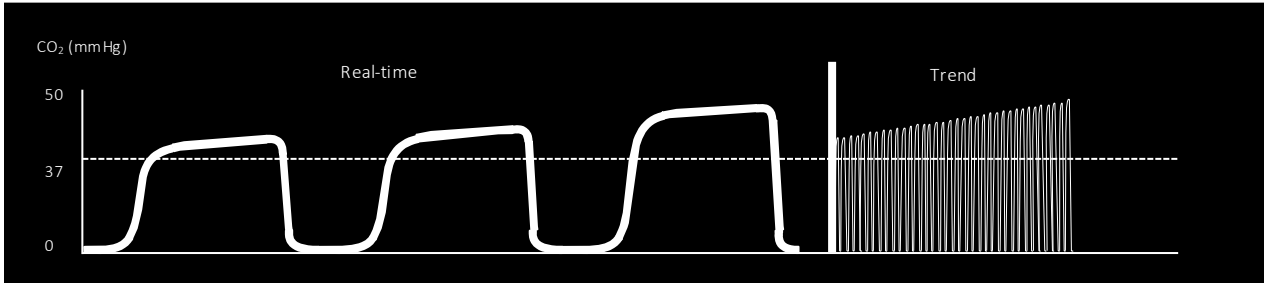


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Hypoventilation (increase in ETCO2)

Causes for the “up the staircase”:

Decrease in respiratory rate, decrease in tidal volume	Rapid rise in body temperature	Increase in metabolic rate



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Hypoventilation (decrease in $ETCO_2$)

Causes for the “down the staircase”:

Increase in respiratory rate, increase in tidal volume	Fall in body temperature	Decrease in metabolic rate

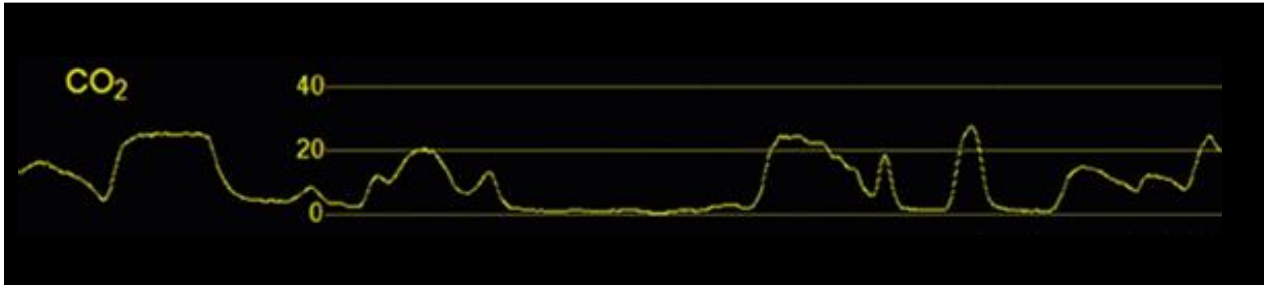


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Erratic waveform

Characteristics and possible cause for erratic waveform:

Characteristic loss of alveolar plateau and irregular waveform shape	Partial obstruction	Talking and mouth breathing with a nasal cannula



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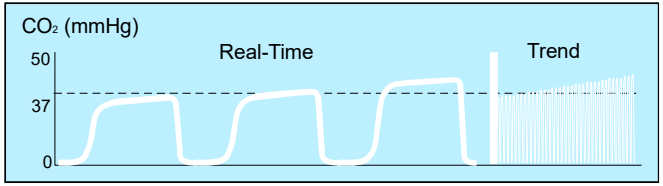
Use Cases

Capnography adds clinical value to ventilation platforms

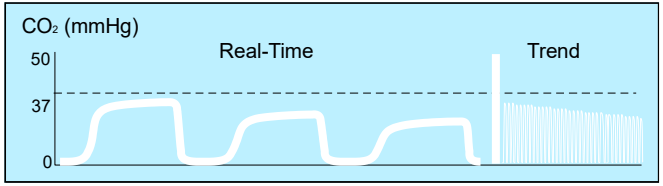
Capnography use cases during ventilation:

- ✓ Determining when to intubate or extubate
- ✓ Verifying ETT placement
- ✓ Alerting if accidental extubation occurs
- ✓ Monitoring ongoing airway management
- ✓ Ventilator weaning
- ✓ Detecting ventilator disconnects
- ✓ Determining hypo- and hyperventilation
- ✓ Determining dead space ($PaCO_2$ gradient)

Hypoventilation - Increase in ETCO2



Hyperventilation - Decrease in ETCO2



1. Kerslake I, Kelly F. Uses of capnography in the critical care unit. *BJA Education*. 2016;17(5):178-183. doi:10.1093/bjaed/mkw062

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Capnography adds clinical value to patient monitoring platforms

$ETCO_2$ monitoring is a rapid and reliable[1,2] method to:

- ✓ Monitor repeated or continuous measurement of patient parameters, such as ETCO2 and respiratory rate
- ✓ Guard against undetected respiratory depression
- ✓ Watch for - and warn against - serious or life-threatening events in critically ill patients
- ✓ Collect and display physiological data



1. Al-Aomar S, AlSamhori JF, Alzghoul H, Al-Ghraibeh H, Al-Majali G, Tarras S, Dolman H, Tyburski J, Mostafa G, Shahait AD. Evaluating the utility of end-tidal CO2 as a predictor of mortality in trauma victims: A systematic review and meta-analysis. Am J Surg. 2025 Feb;240:116130.
2. Wollner EA, Nourian MM, Bertille KK, Wake PB, Lipnick MS, Whitaker DK. Capnography-An Essential Monitor, Everywhere: A Narrative Review. *Anesth Analg*. 2023;137(5):934-942. doi:10.1213/ANE.0000000000006689

Capnography adds clinical value to patient monitoring platforms

Monitoring and diagnostic use cases – $ETCO_2$ monitoring assists in:

- ✓ Appropriate utilization of blood gases
- ✓ Effectiveness in chest compressions
- ✓ Analyzing waveforms – breathing pattern assessment
- ✓ Visualizing changes in ventilatory pattern
- ✓ Assessing patient / ventilation synchrony
- ✓ Monitoring over-sedation
- ✓ Verifying target $PaCO_2$ in head trauma patients
- ✓ Assisting in determining loss of airway control
- ✓ Assessing neuromuscular blockage drugs
- ✓ Evaluating bronchodilator therapy
- ✓ Managing asthma, especially in emergency department
- ✓ Verifying ventilation during transport

1. Donnelly Hellings J, Fuller J, Maillie S. End-tidal CO_2 monitoring. Am Nurse J. 2024; 19(9):6-12. doi:10.51256/anj092406.
2. Richardson M, Moulton K, Rabb D, et al. Capnography for Monitoring End-Tidal CO_2 in Hospital and Pre-hospital Settings: A Health Technology Assessment [Internet]. Ottawa (ON): Canadian Agency for Drugs and Technologies in Health; 2016 Mar. CADTH Health Technology Assessment, No. 142. Available from: https://www.ncbi.nlm.nih.gov/books/NBK362376/



Respironics capnography solutions

Respironics mainstream and sidestream solutions:



Interchangeable capnography sensing technologies

provide the right tool for all capnography monitoring applications throughout the hospital environment and across the care continuum.

Flexibility

to select the right tool to match best practice, clinical, environment, and patient needs.

Advanced engineering design

drives product performance and reliability.[1]

Advanced parameters

support the most critical patients.

OEM expertise

in technology integration, clinical implementation and clinical application to support partners.

1. Internal data on file.

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CAPNOSTAT 5
Mainstream Sensor

The technology of choice in tough environments

- ✓ **External sensor** – typically used with intubated patients with measurement made at patient's airway
- ✓ **No calibration required**, enabling fast action
- ✓ **Crisp CO_2 waveforms and rapid readings** give clinicians the information they need without delay
- ✓ **Provides fast readings across a wide range of patients** – including neonates[1]

- Durable design can **withstand drops of up to 6 feet** in a typical clinical environment[1]
- **High reliability –** near-zero failure rate[1]
- **Single-patient-use and reusable** airway adapters available
- **No water traps or tubing needed**



1. Internal data on file.

LoFlo Sidestream CO_2 Module

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Versatility across application

- ✓ 24,000-hour pump life[1]
- ✓ Full LoFlo accessory offering includes options for adults, neonates, and everyone in between
- ✓ Minimal dead space, even in neonates
- ✓ Intubated and non-intubated options
- ✓ Integrated sample cell and filter protects the LoFlo module from contamination
- ✓ No water trap required
- ✓ No calibration required

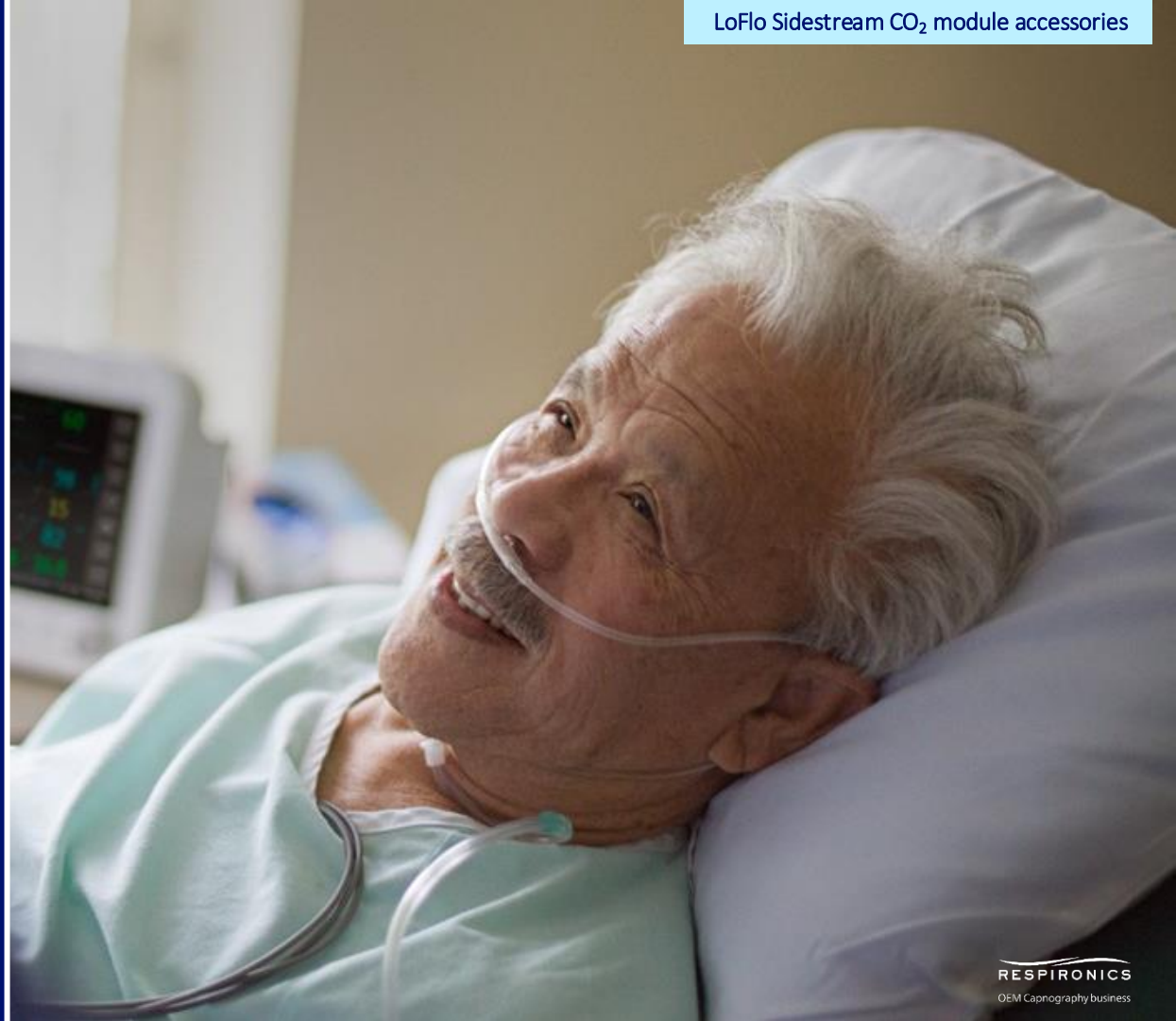


1. Internal data on file

LoFlo Sidestream CO_2 module accessories

Flexible solutions for a customizable approach

- ✓ Low deadspace adapter (neonatal), less than 1 mL
- ✓ Nasal and oral nasal cannula kits, with and without O_2 delivery

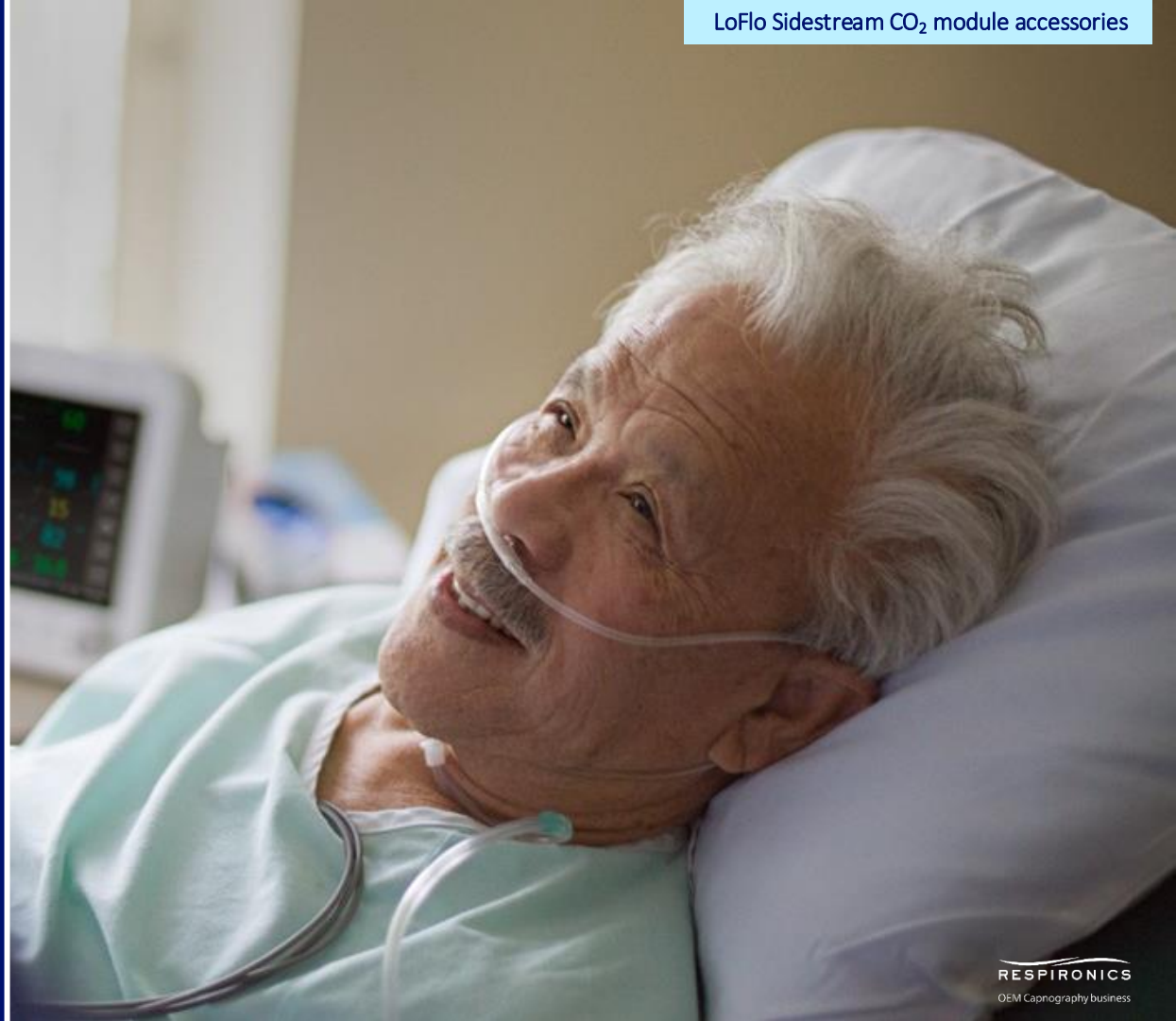


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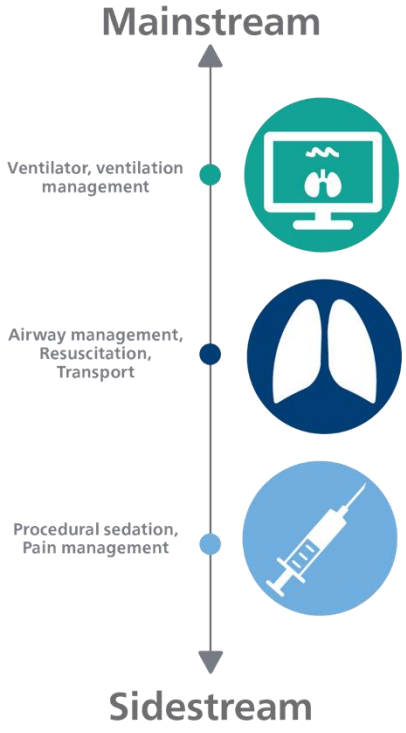
The LoFlo Advantage

- ✓ Removable, disposable external sample cell and filter provides up to 120 hours of protection against occlusions of the internal sensor[1]
- ✓ Airway adapter kits for weaning patients off ventilator
- ✓ Sampling lines for anesthesia and ventilator circuits with integrated adapter
- ✓ High reliability - near-zero failure rate[1]

1. Internal data on file.



Choose the right accessories
for your patient needs

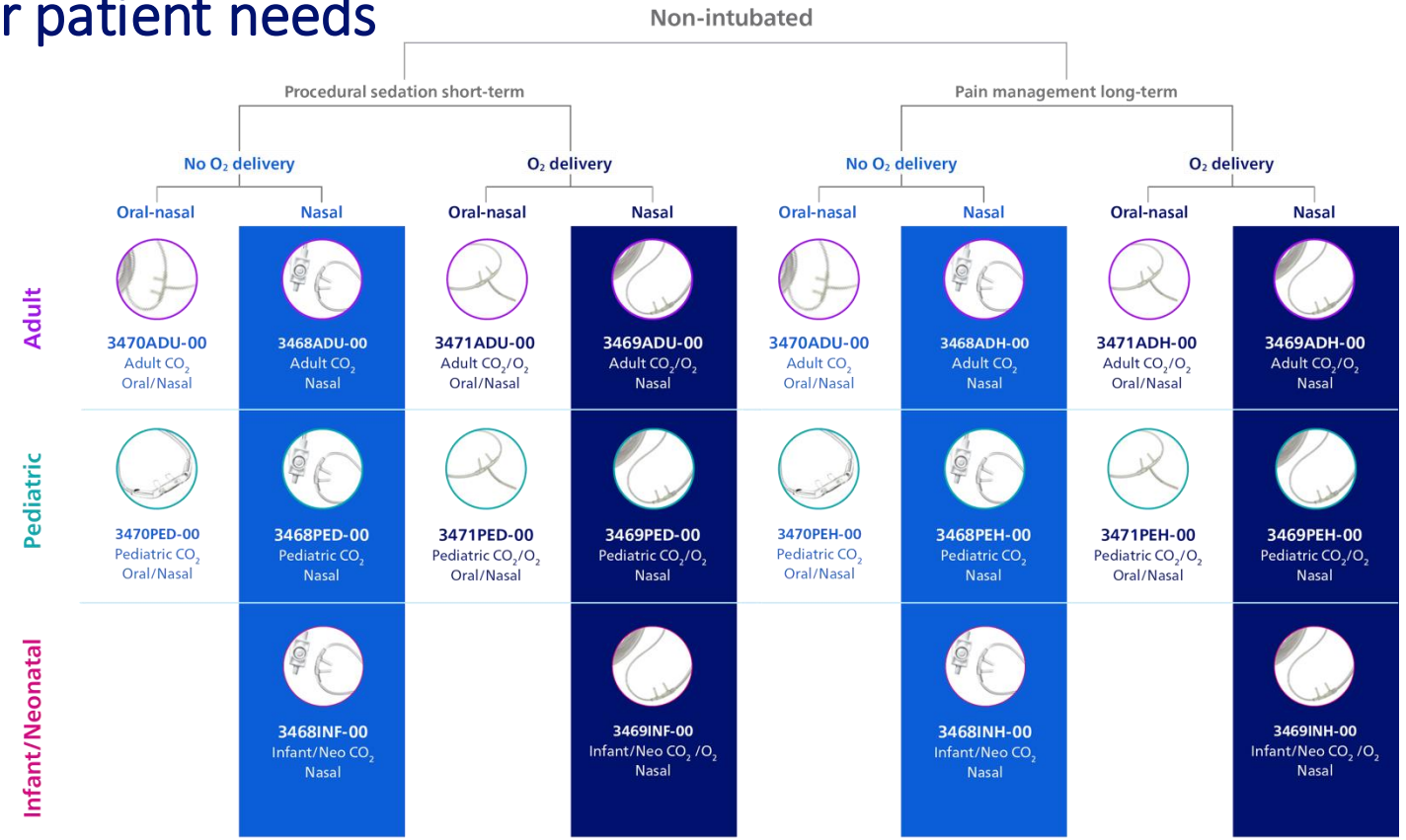


Intubated

	Mainstream		Sidestream	
	Mainstream single-patient use airway adapters	Mainstream reusable airway adapters	Sidestream short-term airway adapters	Sidestream long-term airway adapters with humidity management
Adult	6063-00	7007-01	3472ADU-00 Airway Adapter Set (ET Tube >4.0 mm)	3473ADU-00 Airway Adapter Set H (ET Tube >4.0 mm)
Pediatric	6063-00	7007-01	3472ADU-00 Airway Adapter Set (ET Tube >4.0 mm)	3473ADU-00 Airway Adapter Set H (ET Tube >4.0 mm)
Infant/Neonatal	6312-00	7053-01	3472INF-00 Airway Adapter Set H (ET Tube +/-4.0 mm)	3473INF-00 Airway Adapter Set H (ET Tube +/-4.0 mm)

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Choose the right accessories for your patient needs



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Key takeaways

Respironics capnography solutions: **trusted when every second counts**

Capnography: Critical to care

✓ Best practice – and enables clinicians to identify a breathing problem immediately

Respironics: Speed across a wide range of patients and care environments

✓ With mainstream or sidestream technology

Respironics: Enable continuous monitoring patient respiration without delay

✓ Switch seamlessly from mainstream to sidestream

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