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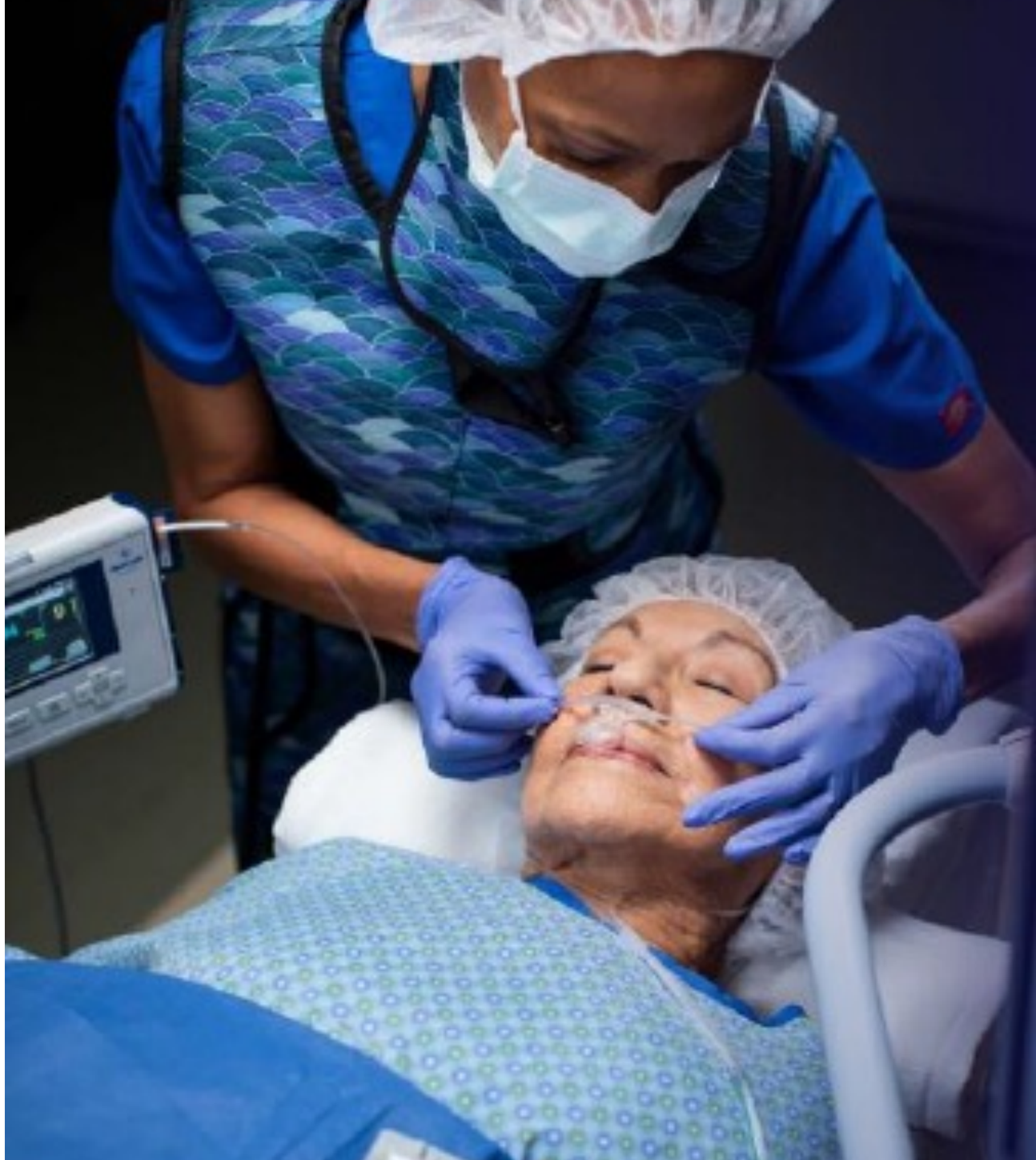
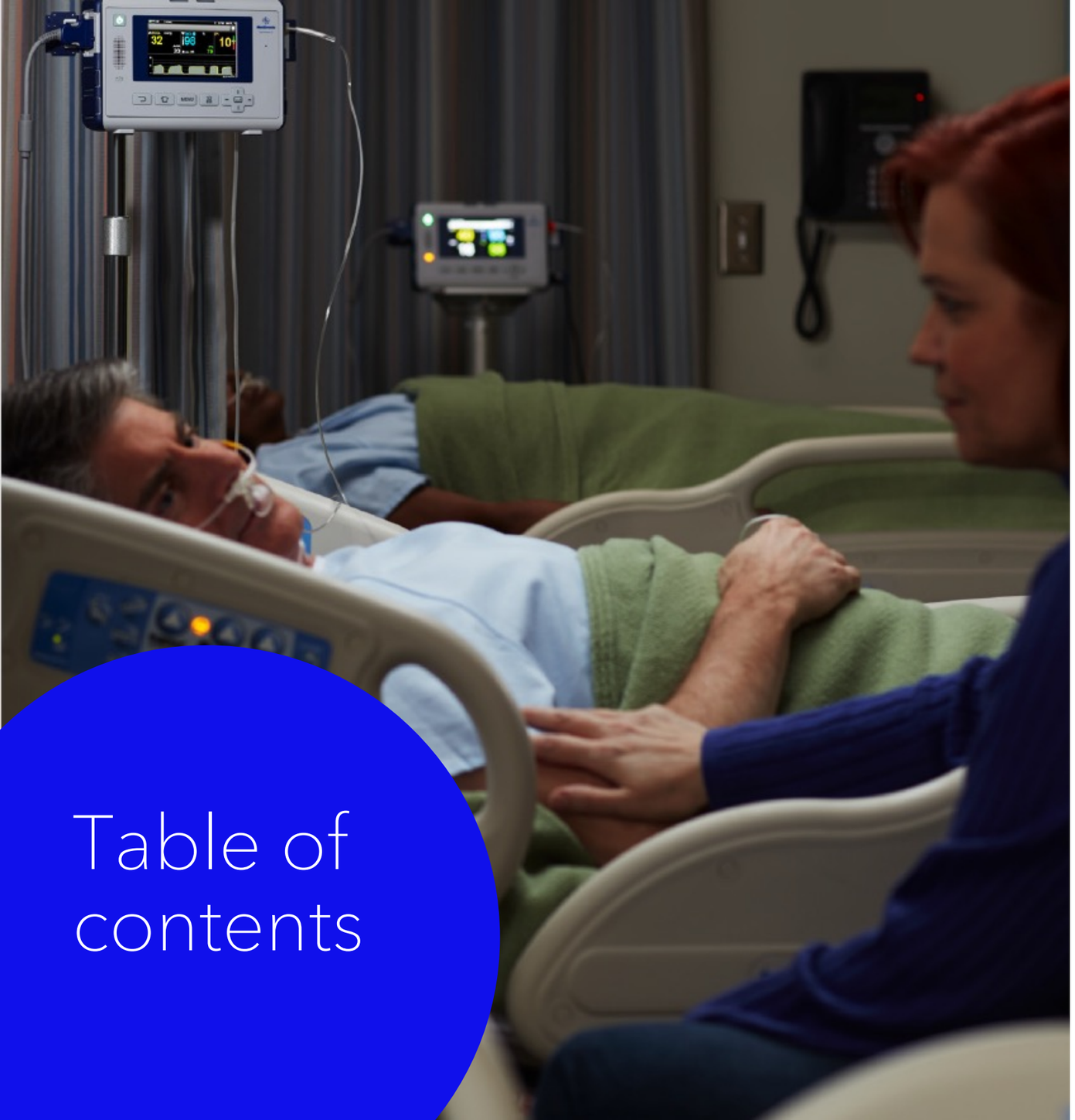
Engineering the extraordinary

Clinical Society Guidelines

Capnography monitoring





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Respiratory compromise – incidents of respiratory insufficiency, failure, and arrest – can strike subtly and suddenly.[1] Continuous capnography monitoring can help detect such threats to improve patient outcomes.

A growing wave of clinical societies recommend continuous capnography monitoring, along with pulse oximetry, to alert you to changes in oxygenation and ventilation – two key factors in identifying respiratory compromise in its early stages.

Recommendations

While society guidelines and recommendations vary by application and area of care, most support using waveform capnography:

- During administration of opioids for pain management[2-6]
- For patients under moderate to deep sedation[7-14]
- During CPR[15-18]
- When transporting mechanically ventilated patients[7,15]
- To ensure the proper placement of endotracheal tubes[7,15,17-19]
- For patients receiving supplemental oxygen[2-5,10]

Access a clinical evidence bibliography on capnography monitoring

Visit the respiratory medical education curriculum

Check out Medtronic Patient Monitoring and Respiratory Interventions Webinar Wednesdays

Visit Medtronic HCP Resources

Click here for societies recommending capnography monitoring

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Society profiles and capnography guidelines

AAGBI

Who they are
The Association of Anesthetists of Great Britain and Ireland set out to advance and improve patient care and safety in the field of anesthesia and disciplines allied to anesthesia.

Capnography standards[7]
In 2021, AAGBI recommended capnography for procedural sedation whenever there is a loss of response to verbal contact, if an airway device is in place, during intrahospital transport, and to determine correct tracheal intubation. It is also advised during lighter levels of sedation to aid in respiratory and airway patency monitoring.

AANA

Who they are
The American Association of Nurse Anesthesiology is the professional association for Certified Registered Nurse Anesthetists (CRNAs) dedicated to advancing its members' profession and anesthesia patient safety through advocacy, evidence-based practice standards, professional development, and commitment to innovation, collaboration and diverse ideas, experiences, and beliefs.

Capnography standards[9]
In 2019, AANA's Standards for Practice declared ventilation should be continuously monitored by clinical observation and confirmation of expired carbon dioxide during moderate sedation, deep sedation or general anesthesia. Additionally, tracheal intubation or placement of other artificial airway devices should be verified by auscultation, chest excursion, and the confirmation of expired carbon dioxide. Ventilatory monitors such as capnography should be used as indicated to measure expired carbon dioxide.

AARC

Who they are
The American Association for Respiratory Care works to advance the science and practice of respiratory care by fostering and promoting professional excellence for respiratory care professionals and advocating for patients and their families.

Capnography guidelines[15]
In 2011, AARC issued clinical practice guidelines recommending capnography/capnometry to:

- Verify the correct placement of endotracheal tubes and artificial airways
- Assist in the assessment of pulmonary circulation and respiratory status
- Optimize mechanical ventilation
- Ensure airway integrity for mechanically ventilated patients during transport

AHA

Who they are
The American Heart Association is a voluntary organization dedicated to building healthier lives, free of cardiovascular diseases and stroke.

Capnography guidelines[16-18]
In 2010, AHA issued Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care indicating waveform capnography monitoring can:

- Help clinicians monitor quality of chest compressions
- Confirm endotracheal tube placement
- Act as an early indicator of return of spontaneous circulation (ROSC)

In 2015 and 2020, AHA updated and strengthened its guidelines to include additional clinical utility for capnography monitoring to:

- Act as a potential indicator to help guide end-of-life resuscitative efforts in adults
- Assess CPR quality in patients to help avoid risk of exposure to hypocapnia or hypercapnia

APSF

Who they are
The Anesthesia Patient Safety Foundation (APSF) strives to improve patient safety during anesthesia care by encouraging national and international collaboration safety research and education, and patient safety initiatives.

Capnography guidelines[2]
In 2011, APSF recommended continuous monitoring of oxygenation and ventilation to help reduce the likelihood of unrecognized, clinically significant opioid-induced respiratory depression. Although structured assessments of the patient's level of consciousness and frequent spot checks are critical, they may not offer an indication of respiratory depression as quickly as continuous electronic monitoring of oxygenation and ventilation.

ARIN

Who they are
The Association for Radiologic and Imaging Nursing (ARIN) provides radiology nurses with the knowledge and resources to advance the standards of care for patients undergoing radiology procedures.

Capnography guidelines[10]
ARIN's Position Statement endorses the routine use of capnography for all patients who receive moderate sedation or analgesia during procedures in the imaging environment. Use of capnography monitoring will help clinicians detect respiratory depression, hypoventilation, and apnea, as capnography use is associated with improved patient outcomes. Capnography should always be used regardless of whether sedation is administered by an anesthesia provider or registered nurse credentialed to administer moderate sedation.

ASA

Who they are
The American Society of Anesthesiologists (ASA) is a professional organization of anesthesiologists dedicated to raising and maintaining the standards of the medical practice of anesthesiology and improving patient care.

Capnography standards[8,19]
ASA's Standards and Guidelines outline the following:

- Monitor oxygenation, ventilation, circulation, and temperature continuously during administration of all anesthetics
- Use both pulse oximetry and capnography, along with visual monitoring, for patients under moderate to deep sedation
- Use capnography for the confirmation of tracheal intubation in patients with difficult airways
- Use capnography to confirm adequate ventilation by any means (face mask, supraglottic airway, tracheal intubation) in difficult airways
- Use capnography when an endotracheal tube or laryngeal mask is in place

ASPMN

Who they are
The American Society of Pain Management Nursing (ASPMN) is a professional organization dedicated to advancing and promoting optimal nursing care for people affected by pain by promoting best nursing practices.

Capnography guidelines[3]
In 2020, ASPMN recommended that all patients at risk for opioid-induced unintended advancing sedation and opioid-induced respiratory depression be evaluated for continuous electronic monitoring including pulse oximetry, capnography, acoustic respiratory rate monitor, and/or minute ventilation monitor. Capnography is more effective in detecting respiratory depression events compared to intermittent pulse oximetry assessments.

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CIRSE

Who they are
The Cardiovascular and Interventional Radiological Society of Europe (CIRSE) is an educational and scientific association aiming to improve patient care through the support of teaching, science, research and clinical practice in the field of cardiovascular and interventional radiology.

Capnography standards[11]
In 2020, CIRSE Standards of Practice suggested capnography monitoring to assess ventilation during sedation for interventional radiology procedures. They state that monitoring carbon dioxide is a rapid method to assess ventilation.

ESAIC

Who they are
The European Society of Anaesthesiology and Intensive Care (ESAIC) works to improve the safety standards for the administration of anesthesia.

Capnography guidelines:[12]
ESAIC strongly recommends capnography for all patients undergoing procedural sedation. Continuous evaluation of ventilation and levels of carbon dioxide during sedation can be achieved through capnography. Pulse oximetry measures oxygenation but does not provide measurements for ventilation if supplemental oxygen is given to the patient, and therefore, additional monitoring should also be used to monitor appropriate respiratory function.

SGNA

Who they are
The Society of Gastroenterology Nurses and Associates, Inc. (SGNA) is committed to the safety and effectiveness of gastroenterology and endoscopy nursing by supporting professional development, education, research, advocacy and collaboration.

Capnography standards[13]
SGNA cites sedation-related complications are transient and easily treated with early detection and intervention by the procedural team. To help reduce these incidents, the SGNA recommends continuous monitoring of cardiovascular and respiratory systems including pulse oximetry and, in some cases, capnography.

SIR

Who they are
The Society of Interventional Radiology is an organization of practicing interventional radiologists, scientists, and other health professionals dedicated to delivering patient care with minimally invasive, image-guided therapy.

Capnography guidelines[14]
SIR recognizes that ASA standards are the basis for anesthesia administration credentials in most medical facilities. As a result, the SIR position statement concludes that interventional radiology professionals should become familiar with the changes to the standards set by ASA, as any significant change in the ASA standards for moderate and deep sedation will have a downstream impact on most interventional radiology practices. SIR also notes the American Heart Association (AHA) guidelines for capnography use during endotracheal tube assessment, cardiac and respiratory arrest care, and cardiopulmonary resuscitation.

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TJC

Who they are

The mission of The Joint Commission (TJC) is to evaluate health care organizations and inspire them to continuously improve healthcare with safe, effective, high-quality care. The Joint Commission accredits and certifies more than 22,000 healthcare organizations in the United States, reflecting their commitment to quality and performance standards.

Capnography guidelines[4-6]

The Joint Commission Sentinel Event Alert #49 outlines steps to help hospitals better manage unintended consequences of opioid-induced respiratory depression, including protocols and policies for continuous patient monitoring in patients receiving opioid analgesia. Specifically, The Joint Commission advised using both pulse oximetry and waveform capnography because pulse oximetry alone may still indicate adequate oxygenation even when the patient's ventilation is compromised. The recommendations emphasized the use of ventilation monitoring when a patient is at higher risk of respiratory depression and supplemental oxygen is in use.

In their 2018 R3 Report, The Joint Commission identified safe opioid prescribing for pain management as an organizational priority for hospitals.

Additionally, The Joint Commission specifies that hospital leadership and clinicians identify and acquire patient monitoring technology for use with patients at high risk for adverse events as a result of treatment with prescribed opioids. The Joint Commission updated their R3 recommendation in 2021 stating hospitals must have protocols in place to identify, manage, and monitor patients at high risk for adverse outcomes due to opioid treatment. Additionally, clinicians may be asked to describe these protocols during the accreditation process.

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Capnography monitoring compliance

2

Pain management

APSF[2]

Continuous monitoring of oxygenation and ventilation help reduce the likelihood of unrecognized, clinically significant opioid-induced respiratory depression.

ASPMN[3]

All patients at risk for opioid-induced unintended advancing sedation and opioid-induced respiratory depression should be evaluated for continuous electronic monitoring.

The Joint Commission[4-6]

Hospitals must have protocols in place to identify, manage, and monitor patients at high risk for adverse outcomes due to opioid treatment. Clinicians may be asked to describe these protocols during the accreditation process.

- Develop and implement protocols for continuous monitoring for patients receiving opioid therapy with individualized assessments to measure the quality and adequacy of respiration and depth of sedation
- Hospital leadership and clinicians should identify and acquire patient monitoring technology for patients at high risk for adverse events as a result of treatment with prescribed opioids

APSF, ASPMN, and The Joint Commission, recommend capnography monitoring for patients receiving opioid analgesics for pain management.

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Procedural sedation

Anesthesia/all sedation procedures

AAGBI[7]

Waveform capnography monitoring should be used in procedural sedation whenever there is a loss of response to verbal contact or when using tracheal tubes and supraglottic airway devices. In lighter sedation, capnography is advised to aid monitoring of airway patency, respiratory rate, and pattern.

ASA[8]

For patients under moderate to deep sedation, both pulse oximetry and capnography monitoring, along with visual monitoring, are required.

AANA[9]

For patients undergoing moderate sedation, deep sedation, or general anesthesia, ventilation should be continuously monitored by clinical observation and confirmation of expired carbon dioxide.

ESAIC[12]

Capnography is strongly recommended for all patients receiving procedural sedation.

Interventional radiology procedures under sedation

ARIN[10]

All radiologic and imaging nursing professionals should be familiar with the use of capnography and the information it provides as an objective evaluation of a patient's ventilatory status. Capnography should be used for all patients who receive moderate sedation while undergoing imaging procedures.

CIRSE[11]

Capnography monitoring is suggested to assess ventilation during sedation for interventional radiology procedures.

SIR[14]

Interventional radiologists using moderate sedation should understand the potential benefits of using capnography in addition to pulse oximetry monitoring, consider obtaining monitoring equipment, and incorporate it into clinical practice.

Gastrointestinal procedures under sedation

SGNA[13]

Continuous monitoring of cardiovascular and respiratory systems is recommended to provide timely information to clinicians. Capnography monitoring should be considered in patients at risk of deep sedation during prolonged endoscopic procedures.

AAGBI, ASA, AANA, ARIN, CIRSE, ESAIC, SGNA, and SIR advocate for capnography monitoring during moderate- to deep-procedural sedation.

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CPR

AARC[15]

Capnography should be used to optimize chest compressions, detect ROSC during chest compressions, or once a rhythm check reveals an organized rhythm.

AHA[17-19]

It is reasonable to consider quantitative waveform capnography:

- To improve CPR quality
- To optimize chest compression performance
- As an indication of ROSC

AARC and AHA recommend capnography monitoring during cardiopulmonary resuscitation.

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Transport

AAGBI[7]

The monitoring standard of care required during transport of an anesthetized or sedated patient is the same as what is required during the procedure. If an airway device is in place, capnography should be used during the transfer of patients within a healthcare facility, including from OR to the PACU.

AARC[15]

For patients being mechanically ventilated, capnography monitoring is one of the objective standards required for monitoring during transport to a healthcare facility.

AAGBI and AARC recommend capnography monitoring when a patient is transported by ambulance and within a healthcare facility.

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Intubation

AAGBI[7]

Capnography should be used routinely to:

- Monitor patients with endotracheal tubes or supraglottic airway devices in place
- Detect correct endotracheal intubation

AARC[15]

Capnography is recommended to:

- Confirm correct placement of endotracheal tubes
- Guide ventilator management
- Monitor mechanically ventilated patients during transport
- Monitor intubated patients for cardiopulmonary quality

AHA[17,18]

Capnography monitoring should be used to confirm placement of endotracheal tubes

ASA[8,19]

- End tidal CO_2 monitoring is required when an endotracheal tube or laryngeal mask is in place
- End tidal CO_2 monitoring should be used to confirm tracheal intubation in difficult airways

AAGBI, AARC, AHA, and ASA recommend capnography monitoring for intubated patients.

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Supplemental oxygen

APSF[2]
When supplemental oxygen is prescribed, capnography or other monitoring modalities are indicated to measure adequacy of ventilation.

ARIN[10]
The use of supplemental oxygen during procedural sedation may prolong the recognition of apnea. Capnography provides a real-time assessment of ventilation and is superior to pulse oximetry when assessing hypoventilation/apneic oxygenation.

The Joint Commission[4-6]
Patients receiving supplemental oxygen are considered higher risk for respiratory depression and should be monitored.

APSF, ARIN, and The Joint Commission recommend enhanced respiratory monitoring for patients receiving supplemental oxygen.

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Societies endorsing capnography

3

Societies

AAAHC IQI – Accreditation Association for Ambulatory Healthcare Institute for Quality Improvement (U.S.)
AAGBI – Association of Anaesthetists of Great Britain and Ireland
AANA – American Association of Nurse Anesthetists
AAOMS – American Association of Oral and Maxillo-facial Surgeons
AAP – American Academy of Pediatrics
AAPD – American Academy of Pediatric Dentistry
AARC – American Association for Respiratory Care
ACEM – Australasian College for Emergency Medicine
ACEP – American College of Emergency Physicians
ADA – American Dental Association
Aust DA – Australian Dental Association
AHA – American Heart Association
AHRQ – Agency for Healthcare Research and Quality (U.S.)
ANZCA - Australian and New Zealand College of Anaesthetists
ANZCOR - Australia/New Zealand Council of Resuscitation
AORN - Association of perioperative Registered Nurses (U.S.)
APS – American Pain Society
APSF – Anesthesia Patient Safety Foundation (U.S.)
ARIN - Association for Radiologic & Imaging Nursing (U.S.)
ARMC – Academy of Royal Medical Colleges (UK)
ASA – American Society for Anesthesiologists
ASDA – American Society of Dentist Anesthesiologists
ACEM – Australasian College for Emergency Medicine
ANZCA – Australia & New Zealand College of Anesthetists
BCS - British Cardiovascular Society
BHRS - British Heart Rhythm Society
BRCA – British Royal College of Anaesthetists
BSAR- APSAR - Belgian Professional Association of Specialists in Anesthesia and Resuscitation
BSG - British Society of Gastroenterology
CAS – Canadian Anesthesia Society
CCAS - Congenital Cardiac Anesthesia Society (US)
CDC – Centers for Disease Control (U.S.)
CEM – College of Emergency Medicine (UK)
CICM – College of Int Care Medicine of Australia & New Zealand
CIRSE - Cardiovascular and Interventional Radiological Society of Europe
CMQ - Le Collège des Médecins du Québec
CMS – Centers for Medicare and Medicaid Services (US)
CPS – Center for Patient Safety
CRSCCRHA - Cardiopulmonary Resuscitation Specialized Committee of Chinese Research Hospital Association
CSANZ - Cardiac Society of Australia and New Zealand
CSDE - Chinese Society of Digestive Endoscopy
CSA - Chinese Society of Anesthesiology
CSGNA – Canadian Society of Gastroenterology Nurses and Associates
DAS – Difficult Airway Society (UK)
EBA – European Board of Anesthesiology
ECRI – Emergency Care Research Institute (US)
ENA – Emergency Nurses Association (U.S.)
ERC – European Resuscitation Council
ESAIC - European Society of Anaesthesiology and Intensive Care
ESGE - European Society of Gastrointestinal Endoscopy
ESGENA - European Society of Gastroenterology and Endoscopy Nurses and Associates
HSFC – Heart & Stroke Foundation of Canada
ICS – Intensive Care Society (UK)
IHI – Institute for Healthcare Improvement (U.S.)
JGES - Japan Gastroenterological Endoscopy Society
JSA – Japanese Society of Anesthesia
NICE - National Institute for Health and Care Excellence (UK)
NHI - Netherlands Healthcare Inspectorate
NYSPFP - New York State Partners for Patients (CMS effort – U.S.)
NZDC – New Zealand Dental Council
OIIQ - l'Ordre des infirmières et infirmiers du Québec
OPIQ - l'Ordre Professionnel des inhalothérapeutes du Québec
RCEM – Royal College of Emergency Medicine (UK)
RCI – Respiratory Compromise Institute (U.S.)
SASA – South African Society of Anesthesiologists
SARB - Society for Anesthesia and Resuscitation of Belgium
SCAI - Society for Cardiovascular Angiography and Interventions (US)
SPA - Society for Pediatric Anesthesia (U.S.)
SFAI - Swedish Society For Anesthesia And Intensive Care
SGNA – Society of Gastroenterology Nurses and Association (U.S.)
SHM – Society of Hospital Medicine (U.S.)
SIR – Society of Interventional Radiology (US)
SPS – Society for Pediatric Sedation (U.S.)
TennCare - Tennessee's Medicaid (U.S.)
TJC – The Joint Commission (U.S.)
USAF – United States Air Force
VHA – Veteran's Health Administration (U.S.)

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Growing wave of capnography

- U.S./North American
- Europe
- Other

Opioids
Sedation

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
VHA Opioids	BRCA/DAS Airway	CAS Sedation	AANA Sedation	CDC Opioids	ASA X 2 Sedation	SPS Sedation	TennCare SNF Ventilation	ASA Task Force (ASA, AAOMS, ACR, ADA, ASDA, SIR) Sedation	CMS Airway	ASPMN Opioids	JGES Sedation	ASA Airway
AHA/ERC Resuscitation	BRCA/BSG Sedation	ICS ICU	CMS Opioids	USAF Sedation	CMQ/OPIQ/ OIIQ Sedation	ANZCOR Resuscitation	ECRI Tech Hazards Opioids		AANA Sedation	AHA Resuscitation	SASA Sedation	
NICE Sedation	AARC Mechanical Ventilation	NHI Sedation	ASA Airway	ACEP/ENA Sedation	CSGNA Sedation	AAGBI/EBA Anesthesia/ Sedation	ECRI Safety Concerns Opioids	ASGE Sedation		SARB & BSAR-APSAR Sedation	AAGBI Sedation	
WFSA Anesthesia	'96 minute Man' Resuscitation	IHI Sedation/ Narcotics	AAGBI X 2 Airway/PACU	NICE Sedation	ACR/SIR Sedation	AORN Sedation	EBA/ESAIC Sedation	AAAASF Sedation		SASA Sedation	TJC – R3 Report Update Opioids	
	AAGBI Sedation/ ICU	BRCA/CEM Sedation	AHA Resuscitation	EBA Sedation/PACU /Transfer	BCS/BHRS Sedation	ARIN Sedation	PPAHS Opioids	ECRI Opioids		CIRSE Sedation	SGNA Sedation	
	EBA Sedation/ICU	BRCEM Sedation	SIR Sedation	BRCA/CEM Sedation	BRCA Sedation/ICU/ ED	APS Opioids	NYS DOH Sedation	CPS Respiratory Compromise / Sedation				
	ASA Sedation	AAOMS Sedation	ARMC Sedation	TennCare SNF Ventilators	ESGE/ESGENA Sedation	ASA Opioids	AANA Opioids					
	APSF Opioids	TJC Opioids	ECRI Opioids	CMS Memo Opioids	CICMANZ/ ANZCA/ACEM Transport	RCEM Sedation	TJC- R3 Report Opioids					
		AAAHC IQI Sedation	CMS NYSPFP Opioids	CSANZ Sedation	RCI Respiratory Compromise	AAP/AAPD Sedation						
			SFAI Sedation	ECRI Opioids	SHM Opioids	SCAI/SPA/ CCAS Sedation						
				SGNA Sedation	DAS Airway	CRSCCRHA Resuscitation						
				ICS ICU	AHA/ERC Resuscitation	JSA Malignant Hyperthermia						
				CSDE/CSA Sedation	ICS Airway	ADA Sedation						
					JSA Sedation							

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Resource links

Association of Anaesthetists

American Association of Nurse Anesthesiology (AANA)

American Association for Respiratory Care (AARC)

American Heart Association & American Stroke Association

American Society of Anesthesiologists

Anesthesia Patient Safety Foundation

American Society for Pain Management Nursing

Cardiovascular and Interventional Radiological Society of Europe

European Society of Anesthesiology and Intensive Care

Association for Radiologic and Imaging Nursing

The Joint Commission

Society of Gastroenterology Nurses and Associates (SGNA)

Society of Interventional Radiology

Microstream™ capnography monitoring system should not be used as the sole basis for diagnosis or therapy and is intended only as an adjunct in patient assessment.

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