

Promoting the Use of Capnography in Acute Care Settings: An Evidence-Based Practice Project

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Opioid-induced respiratory depression (OIRD) is a life-threatening complication of opioid analgesia. End-tidal carbon dioxide monitoring (capnography) has been shown to detect early signs of OIRD earlier than other commonly used monitoring methods. The goal of this evidence-based practice project was to promote the standardized use of capnography to reduce the incidence of OIRD. The project included an updated nursing protocol, an electronic order trigger; improved access to capnography monitors, and staff education about OIRD risk assessment and the use of capnography. A survey of registered nurses was also conducted to gather their perceptions on the ease of use and effectiveness of capnography. Twelve months after introducing the intervention there was an increase in monitoring frequency, with 2.56 times more patients at high risk for OIRD being monitored with capnography than at baseline. Of the 171 registered nurses surveyed during this project, 99% perceived the portable capnography monitors as easy to use and interpret. However, 71% reported systems issues in obtaining the monitoring equipment, and 65% reported problems with patient adherence. The intervention succeeded in increasing the number of high-risk patients being monitored with capnography and reducing the number of cases of OIRD.

Keywords: capnography, respiratory depression, opioid-induced respiratory depression, respiratory monitoring, mechanical monitoring.

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CAPNOGRAPHY IS THE MEASUREMENT of carbon dioxide (CO₂) partial pressure during expiration (end-tidal CO₂, hereafter EtCO₂) and is widely recognized as a valuable tool for detecting early signs of opioid-induced respiratory depression (OIRD). Multiple professional medical and nursing associations have published clinical prac-

tice guidelines endorsing capnography in a variety of acute care settings.¹⁻³ Once limited to the operating room, continuous capnography is now commonly used in critical care units, postanesthesia care units (PACUs), procedural sedation areas, emergency departments, and increasingly, general medical-surgical units. Numerous expert clinicians regularly advocate for broader use of capnography in hospitals.⁴⁻⁶ Recognition of the superiority of capnography for detecting early signs of respiratory depression is also growing internationally.⁷ Even the general public is becoming more aware of the benefits of this method of patient monitoring.^{8,9}

The Problem of OIRD

OIRD, a life-threatening, yet preventable, adverse effect of opioid analgesia, increases hospital costs

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and length of stay.^{10,11} The incidence of OIRD reported in the literature is highly variable because of the lack of consensus on its definition, differences in study designs, diverse patient populations, and different opioid regimens.^{2,12} Nonetheless, the Institute for Safe Medication Practices reports that OIRD has been increasing as a result of more aggressive pain treatment based on The Joint Commission's 15-year-old suggestion that pain should be treated as the fifth vital sign.¹³ Rates of OIRD are likely to continue to increase because of demographic trends resulting in a higher number of patients with key risk factors such as obesity, obstructive sleep apnea (OSA), and advanced age.^{2,14-16} In 2012, The Joint Commission issued a sentinel event alert urging hospitals to take action to increase opioid safety and reduce opioid-related sentinel events, citing that 29% of opioid-related adverse drug events were related to improper patient monitoring.¹⁷ Improved monitoring practices are one of the most important strategies in preventing opioid-related sentinel events in the perioperative setting.¹⁶

Evidence-Based Recommendations for Monitoring

Continuous capnography detects signs of compromised ventilation earlier and more effectively than either visual respiratory assessments or pulse oximetry.^{2,6} Pulse oximetry measures oxygenation, not ventilation, and as such provides a relatively late indication of respiratory decline.^{2,16,18} Capnography is likely to catch hypercarbia before it progresses to respiratory depression and arrest, for example, before the administration of naloxone is required.⁵ In patients receiving supplemental oxygen, capnography is clearly the better choice. Pulse oximetry yields artificially high oxygen saturation readings and can provide a false sense of security that the patient receiving supplemental oxygen is ventilating sufficiently.^{2,16,18}

In September 2011, the American Society for Pain Management Nursing (ASPMN) recommended the use of capnography for monitoring EtCO₂ in patients determined to be at high risk of OIRD.² Similarly, the American Society of PeriAnesthesia Nurses recommended that the need for technology-supported monitoring be based on

individual and iatrogenic risk factors, suggesting that capnography can be a useful indicator of respiratory depression in high-risk patients.³

Performance Gap

Even with clear guidelines for the use of capnography, research shows a large gap between evidence and practice. A 2013 national survey of monitoring practices used by registered nurses (RNs) (n = 99) to prevent OIRD revealed that pulse oximetry, but not capnography, was widely used.¹⁹ Of the 23 respondents who used continuous capnography, 22 found it useful in detecting OIRD (95%).¹⁹ No facilities routinely used capnography for high-risk patients; 75% of nurse respondents said that they did not have continuous capnography devices available at their facilities.¹⁹ A 2012 convenience poll of American Society of PeriAnesthesia Nurses' members showed diverse responses ranging from use in all phase I PACU patients to a complete lack of access to capnography.²⁰ A 2014 study of 10 hospital nursing units showed that three (two critical care units and one emergency department) reported little or no use of capnography, whereas the other seven had some degree of use that varied widely based on provider preference and availability of equipment.²¹ Such inconsistencies in patient monitoring practices may be contributing to a failure to detect impending OIRD expeditiously.

The University of Arizona Medical Center Evidence-Based Practice Project

The University of Arizona Medical Center (UAMC), a 489-bed, magnet-designated, level 1, trauma center located in Tucson, Arizona, developed an innovative campaign to promote the standardized use of capnography over a 1-year period.¹⁴ In late 2011, two sentinel events resulting in respiratory arrests in patients receiving opioid therapy prompted hospital leadership to investigate ways to identify patients at high risk for respiratory depression and improve monitoring practices for those patients. The ASPMN guidelines on monitoring for respiratory depression had been recently published and served as a basis for implementing evidence-based recommendations for clinical practice.² Hospital administrators asked the author, an acute pain service nurse practitioner (NP) with responsibilities for quality and safety (hereafter referred to as the

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