

Preventing Unnecessary Deaths with Capnography

by Greg Spratt, BS, RRT, CPFT

The HealthGrades “Patient Safety in American Hospitals Study” is an annual report that identifies the patient safety incident rates for nearly every hospital in the country. In addition to this analysis, HealthGrades creates a composite score of the results of the patient safety indicators and identifies the best-performing hospitals to establish a best-practice benchmark against which other hospitals can be evaluated. Their results are routinely published in national media such as *Forbes* and *Woman’s Day*. This data provides health care consumers with an important measure of quality in making health care choices (www.healthgrades.com).

In its fifth annual report, HealthGrades estimated that 1.12 million total patient safety incidents occurred during almost 41 million hospitalizations in the Medicare population, a nearly 3% incident rate.¹ These incidents were associated with almost \$8.8 billion of excess cost during 2004 through 2006. There were 270,491 actual in-hospital deaths that occurred among patients who developed one or more of the 16 patient safety incidents. Using previous research, they calculated that 238,337 were attributable to patient safety incidents and potentially preventable.

HealthGrades’ data also reveals that large disparities in risk of preventable death due to safety incidents exist between the “best” (5-star) and “worst” (1-star) rated hospitals.² Across all procedures and diagnoses studied, there was an approximate 70% lower chance of dying in a 5-star rated hospital compared to a 1-star rated hospital and approximately a 50% lower chance of dying in a 5-star rated hospital compared to the U.S. hospital average.

HealthGrades notes that while improvements were seen across the majority of patient safety indicators compared to previous years, four post-operative indicators (including post-operative respiratory failure) showed worsening with increased incidence rates when compared to 2004. This worsening was associated with higher attributable mortality rates and accounted for approximately 72% of all the potentially preventable deaths.

Preventing respiratory failure

Today it is the standard of care for hospitals to use capnography in the operating room. The American Society of Anesthesiologists’ (ASA) “Standards for Basic Anesthetic Monitoring” state that end tidal carbon dioxide (EtCO₂) monitoring should be employed to confirm endotracheal tube placement and throughout the procedure with initiation audible alarms until patient transfer to post-operative care.³

The ASA also recognized the value of EtCO₂ during sedation and analgesia administered by non-anesthesiologists for procedures outside the operating room.⁴ The ASA Task Force states, “the primary causes of morbidity associated with sedation/analgesia are drug-induced respiratory depression and airway obstruction” and agreed that EtCO₂ with audible alarms may reduce risk during moderate and deep sedation or whenever the patient is separated from caregivers, while cautioning practitioners that impedance plethysmography may fail to detect airway obstruction.

The Task Force emphasizes that, “because ventilation and oxygenation are separate though related physiologic processes, monitoring oxygenation by pulse oximetry is

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not a substitute for monitoring ventilatory function” (bold added for emphasis).

Procedural adverse events often involve respiratory depression and hypoxemia, which may lead to permanent neurologic impairment and death, even in children.^{5,6} Patients often are monitored visually and with pulse oximetry to alert clinicians to respiratory depression. However, evidence suggests this method may not be sensitive enough to prevent significant hypoxemia and hypercarbia prior to being alerted, especially with supplemental oxygen, which can mask hypoventilation in oximetry readings.^{7,8}

Lightdale et al found that endoscopy staff documented poor ventilation in only 3% of children during all procedures and no apnea using oximetry and visual monitoring.⁹ In reality, monitoring using capnography indicated alveolar hypoventilation was occurring during 56% of procedures and apnea during 24%.

Finally, capnography is useful in preventing adverse events post-operatively in patients receiving patient-controlled analgesia for pain management.¹⁰ McCarter et al found that capnography was more effective than pulse oximetry in providing early warning of respiratory depression in patients receiving supplemental

oxygen.¹¹ In all cases of respiratory depression with bradypnea (<6 breaths per minute), capnography, but not pulse oximetry, alerted the nurse to impending respiratory depression. The researchers state, “Capnography monitoring and automatic pausing of patient-controlled analgesia improved postoperative outcomes in situations that could have otherwise been **fatal**” (bold added for emphasis).

Patients at risk = a hospital at risk

The risk of postoperative respiratory failure puts hospital patients, and the hospital, at increasing risk. Respiratory depression from the administration of pain medication is a leading cause of preventable death in hospitals. In fact, postoperative respiratory failure is the third most common patient safety incident in hospitals each year, affecting an estimated 600,000 patients at a cost of \$1.5 billion.¹

Capnography completes picture of ventilation

The ASA has established new guidelines recommending that all patients sedated with neuraxial opioids be monitored for depth of respiration, not only pulse oximetry and respiratory rate.¹² Other researchers state:



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–Patient Safety in American Hospitals Study

- Relying on pulse oximetry alone is potentially dangerous as it reflects oxygenation status of the patient rather than effective ventilation.¹¹
- Because respiratory rate indicates only the number of breaths, and not whether enough oxygen is being taken in and enough CO₂ is being released, a patient can have a normal respiratory rate but could be on the verge of respiratory failure.¹³

Preventing unnecessary deaths and adverse events requires a concerted effort of clinicians and administrators. Capnography is an excellent tool during anesthesia, sedation, and post-operative management for monitoring for early signs of progressive respiratory failure. The lives of hospital patients and the reputation of health care facilities rely on the decisions made about patient safety. ■

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EDITOR'S NOTE

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