

Capnography Monitoring in Procedural Sedation: A Hospital-Wide Cost-Avoidance Model

Presenting Author: Michael Jopling MD, Mount Carmel St. Ann's Hospital

Co-Authors: David Trost MD, Weill Cornell Medical Center; Timothy Kofol, MBA, S2N Health; Erin Warner, S2N Health

Introduction: The American Society of Anesthesiology (ASA) developed guidelines supporting the routine use of capnography to assess ventilatory status during all moderate or deep sedation procedures attended by an anesthesiologist. Other professional societies and many hospitals have yet to develop or implement similar guidelines citing cost concerns. Capnography has been shown to increase the detection of respiratory depression by a factor of 17.6 times, giving providers an early indication of potential problems with respiration or airway obstruction enabling an immediate intervention [Vaugh, et al, 2011]. We developed a hospital cost-avoidance model to assess the net economic impact of capnography monitoring during sedation procedures for a typical hospital.

Methods: The model used data from a 500-bed example hospital to estimate the annual number of sedation procedures which is then used to calculate the capnography monitoring equipment and disposables required for each sedation area of care. Rates of adverse respiratory events and the cost associated with these events, shown in Figure 1, were derived from 11 investigations that had enrolled more than 1.1M procedural cases across a wide variety of sedation settings. The model utilized a Monte Carlo analysis to estimate potential hospital savings with routine capnography monitoring assuming that capnography could prevent 50% of adverse respiratory events because of early detection and intervention enabled by capnography monitoring. The cost of routine capnography monitoring assumed an average hospital cost of \$3,000 for the monitoring device and \$12 for per-procedure disposables. The Monte Carlo analysis used 10,000 simulations varying the number of events, cost of events and the capnography success rate using a triangle distribution (min = 30%, most likely = 50%, max = 60%).

Results: For the example hospital, the total median predicted annual cost of adverse respiratory events related to procedural sedation in the Interventional Radiology, Gastroenterology, Interventional Cardiology and the Emergency Department was estimated to be \$1,920,000. The same adverse event rate was assumed across departments. The annual cost of routine capnography monitoring of all sedation procedures across departments was modeled to be \$208,000. Based upon this estimate, capnography monitoring yielded a median annual cost-avoidance of \$785,000 per year for a calculated median annual hospital savings of \$883,000 (Figure 2). The model estimated that the majority of savings would be from the Gastroenterology (49%) and Interventional Radiology departments (39%).

Discussion: While the clinical basis for routine capnography monitoring in sedation procedures is well reflected in the ASA guidelines and others, the cost of deploying and utilizing capnography consistently throughout a hospital may be a barrier to adoption of this safety technology. The hospital-cost avoidance model presented here shows that capnography monitoring in procedural sedation may both improve patient care and simultaneously decrease overall hospital costs.

Figure 1: Rate of Events & Associated Costs

	Published Rate per 10,000	Est. Cost Per Occurrence	Est. Standard Deviation of Cost
Major adverse event (death, cardiac arrest & aspiration)	3.4	\$278,327	\$500,000
Unplanned admission to the hospital or ICU because of sedation related complications	5.6	\$21,183	\$27,500
Unplanned treatments (Incremental care including intubation, fluids, bag mask ventilation, oxygen supplementation)	275.4	\$50.44	\$5

Figure 2: Savings Breakdown by Department

