Historical Selection: Anderson JA. Respiratory monitoring for anesthesia and sedation. *Anesth Prog*. 1987;34: 228–231.

The kind words and thoughts that prompted my Heidbrink award are deeply appreciated. The opportunity to stand on Dr Heidbrink's shoulders as we improve the quality and safety of dental anesthesiology is truly a great honor. With this honor comes the charge of selecting a currently relevant, historical "landmark" article for commentary. As our current *Anesthesia Progress* (AP) website populates only back to 2005, I had to look deeper—a lot deeper. Hours of scouring the AP archives were eventually rewarded with the re-discovery of Dr Jay Anderson's seminal and prognostic 1987 manuscript on respiratory monitoring, reprinted in this issue of AP. Rather than being historical (antiquated), I would opine that his concepts were way, way ahead of their time—another example of "What's old is new!" We must be able to learn from the past in order to invent our sound future. Please permit me to expand on 5 statements from this article to showcase its current relevance.

1. "…the respiratory system is perhaps the area where vigilance in monitoring is most needed."

It is generally understood that most readers of AP sedate their patients in the office setting to target and maintain a moderate or deep level of sedation (depending on training and licensure), the latter with occasional excursions into general anesthesia, while maintaining an open (guarded) airway and spontaneous ventilation. This area is depicted by the circle in Figure 1, which otherwise showcases diagnostic criteria and adverse consequences at various levels on the continuum of the depth of sedation. It is clear that airway patency is usually the first and, therefore, the most frequent physiologic/anatomic situation to decline as the depth of sedation increases, followed by decreases in ventilation and finally blood pressure. Additionally, we are aware that most morbidity and mortality associated with sedation arise from problems related to the airway—"It's always the airway." The primary concern during sedation, therefore, is to ensure that the patient is adequately exchanging air (open airway + ventilation).

I wish to highlight several important concepts that can be overlooked when interpreting the table in Figure 1. The depth of sedation is determined primarily by your patient's level or degree of responsiveness: their ability to respond to voice, light touch, or painful stimuli. As the level of sedation deepens, the need for airway intervention, ventilatory support, and finally hemodynamic support will increase. Stated another way, risk increases with the depth of anesthesia. One might say we become victims of our own "success." An important monitoring milestone, then, will be the ability of a patient to give an appropriate verbal response or a purposeful "thumbs-up" after repeated or painful stimulation. If your patient cannot do this, there will be an increased risk of upper airway collapse, ventilatory depression, or hypotension. In addition, the ability for self-rescue, that is the possibility for arousal or the ability to follow commands to take a deep breath, will be lost.

Achieving and maintaining an appropriate level of sedation can be challenging due to the wide and sometimes unpredictable, stochastic variability of patient responses to drugs during sedation—both dose and rate of injection. These divisions (ie, levels of sedation; Figure 1) are arbitrary and should be viewed as a continuum as patients may not exactly fit into this scheme. Movement between levels of sedation can be rapid and unexpected. Patients might even skip a level of sedation despite the use of lower sedative drug doses (slippery slope). Though sedation is divided into 3 categories, this categorization does not reflect the reality of the lack of readily identifiable stop points in the movement of a patient from one level to the next. The lack of a dividing line is significant because the safety of your patient lies in the balance. Deepening the sedation is associated with declining physiological self-protections, primarily within the airway. The sedated patient may not be competent in protecting their airway.

2. "…vigilant monitoring be carried out continuously* to allow the prompt recognition of a deleterious trend or an acute problem, as well as the evaluation of responses to therapeutic interventions."

Dr Anderson selected the term "continuously," which has been subsequently differentiated from continually by the American Society of Anesthesiologists Standards for Basic Anesthetic Monitoring as footnoted. Interestingly, this highlights the fact that airway patency and ventilatory adequacy can change rapidly and might well be missed with intermittent observations, regardless of frequency. As will be addressed later, a philosophical shift has been occurring in patient monitoring,[2] with emphasis now placed on the importance of detecting adverse physiology immediately, triggering proactive interventions, and moving away from a reactive stance. During sedation, the team must be "airway ready," highly attuned to the possibility of obstruction at any given moment.

*The term continual is defined as "repeated regularly and frequently in steady rapid succession," whereas continuous means "prolonged without any interruption at any time" (see Standards for Basic Anesthetic Monitoring, American Society of Anesthesiologists. Approved by the ASA House of Delegates, October 21, 1986, and last amended October 28, 2015. Accessed October 24, 2023.

Anesth Prog 70:202–205 2023 | DOI 10.2344/155994

Figure 1. The Sedation Continuum

	Procedural Sedation			
Level of sedation	Minimal (anxiolysis)	Moderate (conscious)	Deep	General anesthesia
Responsiveness	Normal response to voice	Purposeful response to voice or touch	Purposeful response after repeated or painful stimulation	Unarousable
Is airway intervention needed?	No	No	Maybe	Yes
Is spontaneous ventilation adequate?	Yes	Yes	Maybe	Usually not
Is blood pressure and heart rate adequate?	Yes	Usually	Usually	Maybe not

Circular area depicts the depth typically targeted for most in-office sedations. Lack of a purposeful response (i.e., no "thumbs up") to repeated or painful stimuli increases the risk of sedation-related complications. Adapted from Practice Guidelines, Anesthesiology, 2018.[1]

http://www.asahq.org/quality-and-practice-management/practice-guidance-resourcedocuments/standards-for-basic-anesthetic-monitoring).

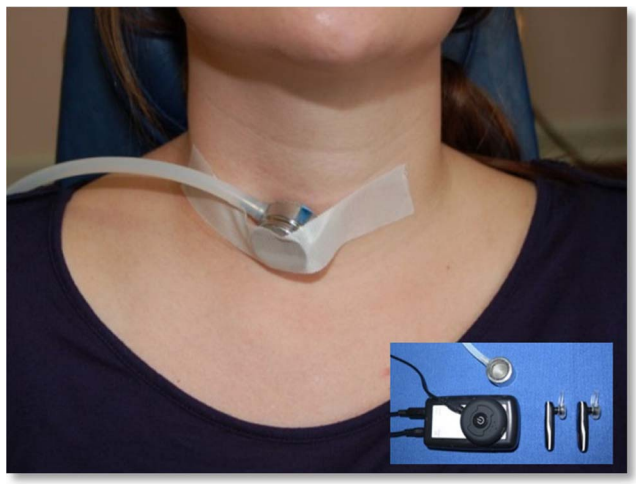
3. ". . .the primary and most crucial monitor for any anesthetic is the vigilant senses of a well-trained anesthesiologist. . .look at the patient."

Some 40 years and a lifetime ago, I was the person that Dr Ganzberg referenced in his Heidbrink award commentary,[3] administering methohexital as a sole anesthetic agent, monitoring with vision (eyes), hearing (ears), feel (touch), and few, if any, other devices that would have required an electric wall outlet. That is all we had at that time and place. But I learned early and learned well how to look and listen to my patients to assess whether adequate respiratory function was occurring. With my ear close to the patient's mouth and nose, I could hear snoring, stridor, wheezing, or the silence of apnea and/or obstruction; I could hear the hissing of 4 L/min of oxygen flowing through the nasal hood (we'll get back to hearing in a moment). With each breath, I could see smooth, rhythmic, coordinated chest and abdominal wall movement (even with a dental bib). I could watch the creases on the anesthetic bag vanish and reappear. I could observe patient color, sternal retraction, and condensation on a full-face mask. I could feel warm air on my hand (there were no gloves back then). I could sense the compliance of the anesthetic bag and estimate a heart rate from more than a few locations on a fully clothed patient. Of course, this would never happen nowadays, but what wonderful set of skills to have kept in my back pocket, used over a full lifetime career. Just think, back then, if we could have added our usual horde of technological monitors to the mix, not only would we have improved monitoring, but more importantly we would have amplified patient safety. If I only knew then what I know now!

4. "The 'standard' methods used routinely to monitor the respiratory system continuously have been the use of a precordial or esophageal stethoscope and visual assessment of chest wall movement and patient appearance. . ."

Drumroll, please! Once again, say "hello" to the lowly (Bluetooth) stethoscope (Figure 2), often hidden in plain

Figure 2. Bluetooth Pretracheal Stethoscope



Bluetooth stethoscope placed pretracheally to the lateral of the Adam's apple. The inset image shows 2 Bluetooth earpieces along with the Bluetooth receiver unit and stethoscope.

sight, affixed to one side of the Adam's apple, so elegant in its simplicity. It will reduce the lag time of apnea detection from the capnographic 6 seconds to 0 seconds (it is instantaneous; your canary in the coal mine). It will warn of impending obstruction with the onset of sonorous noise, and it will detect transmitted wheezing, snoring, stridor, or simply normal air passage sounds in mouth breathers. In some cases, my assistants (who listen right along with me) can even identify an occasional A2P2 split of the transmitted second heart sound (S2). Pretracheal auscultation with a Bluetooth stethoscope is a perfect dance partner to capnography. The pulse oximeter is still used of course, but mostly as a dust collector at least as it pertains to a ventilatory monitor. By the time the patient's oxygen saturation plummets, the train has already left the station, and the inaccurate, low register "banjo tones" add nothing but anxiety and the urgency of time to high stakes events. No reason to wait for that.

Interestingly, back in the early '80s a similar but rudimentary radio stethoscope was available. We would tune our FM radios to an unused frequency to listen. I similarly recall a customized earpiece attached to a rubber tube for direct listening. Neither worked all that well, but it was a start.

5. "At this time the most ideal monitoring system for ventilation would... be the combination of the pulse oximeter and capnography. These monitors, combined with a precordial... stethoscope and observation, should answer the two primary questions of 'is the patient exchanging air?' and 'is gas exchange adequate?'."

There is no downside to continuous pretracheal auscultation and capnography. As Dr Kramer[4] indicates, both monitors can be considered "belt and suspenders"—both trousers and oxygen saturation will stay up. So here we are, what's old is new. It took most states and professional organizations only 35 years or so to formally endorse capnography, in some instances requiring more than a little cajoling to do so, or so I am told. It leaves one wondering if they will ever support pretracheal auscultation for open airway sedation and general anesthesia. It all seems to make perfect sense to me. In order to effectively and efficiently manage the airway, one must monitor it. Early warning blunts time urgency and decreases the duration, severity, and physiologic impact of hypoxia, especially for those patients least able to tolerate such insults. Regardless, patient monitoring will continue to evolve, in spite of the lack of clear, but unnecessary evidence of improved patient outcomes.

The risk of sedation is greater than the risk of the dental procedure it facilitates. Unfortunately, the threshold of this risk is seldom appreciated until after it has been crossed. A colleague once compared sedation to "walking through a mine field with clown shoes on."

If you haven't tried pretracheal auscultation, no explanation will suffice. If you have tried it, no explanation is necessary. Airway management is and will remain the cornerstone of patient safety.[5] If my pretracheal stethoscope is not available, the case gets cancelled. It's just that simple. In 1987, these thoughts and writings were an important contribution to the advancement of the quality and safety of office-based sedation. They continue to be so to this day.

Respectfully,

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I have unsuccessfully reached out to Dr Anderson via phone and email. Should he become aware of this selection, I would be honored to share more of his insights.

REFERENCES

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Continuing Education Questions

This continuing education (CE) program is designed for dentists who desire to advance their understanding of pain and anxiety control in clinical practice. After reading the designated article, the participant should be able to evaluate and use the information appropriately in providing patient care.

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1. Which monitor will detect apnea the earliest?

   A. Capnography
   B. Electrocardiogram
   C. Pretracheal stethoscope
   D. Pulse oximeter

2. Which monitor can detect tachycardia?

   A. Electrocardiogram
   B. Pretracheal stethoscope
   C. Pulse oximeter
   D. All of the above [Database]

3. Controlled, randomized, prospective trials are necessary to prove the effectiveness of any given monitor prior to its acceptance and endorsement.

   A. True
   B. False

4. Chest wall movement is a guarantee that adequate air exchange is occurring.

   A. True
   B. False