Moderate Sedation

HOW TO RECEIVE CREDIT

- Read the enclosed course.
- Complete the questions at the end of the course.
- Return your completed Answer Sheet to NetCE by mail or fax, or complete online at www.NetCE.com. Your postmark or facsimile date will be used as your completion date.
- Receive your Certificate(s) of Completion by mail, fax, or email.

Faculty

Lori L. Alexander, MTPW, ELS, MWC, is President of Editorial Rx, Inc., which provides medical writing and editing services on a wide variety of clinical topics and in a range of media. A medical writer and editor for more than 30 years, Ms. Alexander has written for both professional and lay audiences, with a focus on continuing education materials, medical meeting coverage, and educational resources for patients. She is the Editor Emeritus of the American Medical Writers Association (AMWA) Journal, the peer-review journal representing the largest association of medical communicators in the United States. Ms. Alexander earned a Master's degree in technical and professional writing, with a concentration in medical writing, at Northeastern University, Boston. She has also earned certification as a life sciences editor and as a medical writer.

Faculty Disclosure

Contributing faculty, Lori L. Alexander, MTPW, ELS, MWC, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Division Planners

John M. Leonard, MD
Ronald Runciman, MD

Director of Development and Academic Affairs

Sarah Campbell

Division Planners/Director Disclosure

The division planners and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for physicians in a variety of settings, including private practice, emergency department, radiology department, cardiac catheterization lab, and ambulatory surgery centers. The course is also of benefit to private practice physicians in family medicine and virtually all specialty areas.

Accreditations & Approvals

JOINTLY ACCREDITED PROVIDER™ INTERPROFESSIONAL CONTINUING EDUCATION

In support of improving patient care, NetCE is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

Designations of Credit

NetCE designates this enduring material for a maximum of 5 *AMA PRA Category 1 Credit(s)™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Successful completion of this CME activity, which includes participation in the evaluation component, enables the participant to earn up to 5 MOC points in the American Board of Internal Medicine's (ABIM) Maintenance of Certification (MOC) program. Participants will earn MOC points equivalent to the amount of CME credits claimed for the activity. It is the CME activity provider's responsibility to submit participant completion information to ACCME for the purpose of granting ABIM MOC credit. Completion of this course constitutes permission to share the completion data with ACCME.

Successful completion of this CME activity, which includes participation in the evaluation component, enables the learner to earn credit toward the CME and Self-Assessment requirements of the American Board

A complete Works Cited list begins on page 39.

Mention of commercial products does not indicate endorsement.

of Surgery's Continuous Certification program. It is the CME activity provider's responsibility to submit learner completion information to ACCME for the purpose of granting ABS credit.

This activity has been approved for the American Board of Anesthesiology's® (ABA) requirements for Part II: Lifelong Learning and Self-Assessment of the American Board of Anesthesiology's (ABA) redesigned Maintenance of Certification in Anesthesiology Program® (MOCA®), known as MOCA 2.0®. Please consult the ABA website, www.theABA.org, for a list of all MOCA 2.0 requirements. Maintenance of Certification in Anesthesiology Program® and MOCA® are registered certification marks of the American Board of Anesthesiology®. MOCA 2.0® is a trademark of the American Board of Anesthesiology®.

Successful completion of this CME activity, which includes participation in the activity with individual assessments of the participant and feedback to the participant, enables the participant to earn 5 MOC points in the American Board of Pediatrics' (ABP) Maintenance of Certification (MOC) program. It is the CME activity provider's responsibility to submit participant completion information to ACCME for the purpose of granting ABP MOC credit.

Successful completion of this CME activity, which includes participation in the evaluation component, earns credit toward the Lifelong Learning requirement(s) for the American Board of Ophthalmology's Continuing Certification program. It is the CME activity provider's responsibility to submit learner completion information to ACCME for the purpose of granting credit.

Through an agreement between the Accreditation Council for Continuing Medical Education and the Royal College of Physicians and Surgeons of Canada, medical practitioners participating in the Royal College MOC Program may record completion of accredited activities registered under the ACCME's "CME in Support of MOC" program in Section 3 of the Royal College's MOC Program.

Special Approvals

This activity is designed to comply with the requirements of California Assembly Bill 1195, Cultural and Linguistic Competency.

About the Sponsor

The purpose of NetCE is to provide challenging curricula to assist healthcare professionals to raise their levels of expertise while fulfilling their continuing education requirements, thereby improving the quality of healthcare.

Our contributing faculty members have taken care to ensure that the information and recommendations are accurate and compatible with the standards generally accepted at the time of publication. The publisher disclaims any liability, loss or damage incurred as a consequence, directly or indirectly, of the use and application of any of the contents. Participants are cautioned about the potential risk of using limited knowledge when integrating new techniques into practice.

Disclosure Statement

It is the policy of NetCE not to accept commercial support. Furthermore, commercial interests are prohibited from distributing or providing access to this activity to learners.

Course Objective

The purpose of the course is to provide physicians with the information necessary to perform moderate sedation safely and according to existing guidelines in order to facilitate better patient care.

Learning Objectives

Upon completion of this course, you should be able to:

1. Define moderate sedation, including its goals and objectives.
2. Adhere to guidelines for moderate sedation, especially those developed for one's particular specialty/setting.
3. Describe the necessary patient assessment and monitoring before, during, and after a procedure requiring sedation.
4. List the most commonly used pharmacologic agents used for moderate sedation and their advantages and disadvantages.
5. Select the optimal moderate sedation agent(s) based on patient characteristics and the setting.
6. Discuss the most common complications occurring during or after moderate sedation and their appropriate management.
7. Discuss risk management issues related to moderate sedation.

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

The use of moderate sedation for therapeutic and diagnostic procedures has increased substantially over the past few decades, primarily because of changes in healthcare delivery and advances in technology that have moved many surgical procedures out of the traditional operating room. A report on healthcare utilization showed that the rates of some inpatient procedures remained the same over time, while the rates of many ambulatory surgeries increased significantly [1]. Between 2010 and 2019, the rate of outpatient surgeries occurring in ambulatory surgery centers increased from 48% to 60% [2]. The number of minor procedures done in physicians' offices increased to about 10 million in 2005, and it has been estimated that approximately 17% to 24% of all elective ambulatory procedures are now done in an office-based setting [3; 4; 5]. The expansion of surgery beyond the operating room has implications for patient safety, with the safe and effective administration of anesthesia—comparable to that in a hospital—a paramount concern.

Moderate sedation is the preferred anesthesia for many procedures performed outside of the operating room and is also routinely provided as part of emergency care [6; 7]. This level of sedation has the main advantage of a more rapid return to the patient's presedation status compared with other, deeper levels of sedation/anesthesia [6]. In addition, there are few side effects and complications [6]. For these reasons, as well as for patient comfort and convenience, moderate sedation is used for a wide variety of diagnostic and therapeutic procedures in diverse specialty areas and settings. This widespread use calls for education for physicians in a broad array of specialties.

This course focuses primarily on moderate sedation in the endoscopy and emergency settings. The course provides minimal information on moderate sedation in the office-based setting and does not address moderate sedation for critically ill patients in an intensive care unit or in dental practices.

OVERVIEW OF MODERATE SEDATION

DEFINITION OF MODERATE SEDATION

The terminology used to describe achieving a moderate level of anesthesia has evolved since the mid-1980s. "Conscious sedation" was once the primary term used to define the act of giving patients sedatives and analgesia. The term was first used in the dental setting to describe a lightly sedated patient [8]. The term began to be used in other settings but was used to describe various levels of sedation, making the phrase confusing, as well as oxymoronic [9]. In 1998, the American College of Emergency Physicians (ACEP) published a policy statement on the use of "procedural sedation and analgesia," which it defined as "a technique of administering sedatives, analgesics, and/or dissociative agents to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function;" the policy has been updated several times [7; 10]. In 2001, the Joint Commission replaced "conscious sedation" with "moderate sedation/analgesia" [9]. Emergency department physicians continue to use the phrase "procedural sedation and analgesia" when referring to general instances of using sedation for procedures and have been encouraged to use "moderate sedation" for describing specific practices [9].

The level of sedation defined by the ACEP is "moderate" on the American Society of Anesthesiologists' (ASA's) continuum of anesthesia, which ranges from minimal (anxiolysis) to general anesthesia (***Table 1***) [11]. As defined by the ASA, moderate sedation describes a person who can respond purposefully to verbal or tactile stimulation (with reflex withdrawal from a painful stimulus not considered to be a purposeful response) [11]. No interventions are needed to maintain a patent airway, spontaneous ventilation is adequate, and cardiovascular function is usually maintained [11]. For consistency, the term "moderate sedation" is used throughout this course.

DEFINITION OF GENERAL ANESTHESIA AND LEVELS OF SEDATION/ANALGESIA				
Parameter	**Level of Sedation/Analgesia**			
	Minimal (Anxiolysis)	**Moderate**	**Deep**	**General Anesthesia**
Responsiveness	Normal response to verbal stimulation	Purposeful[a] response to verbal or tactile stimulation	Purposeful[a] response after repeated or painful stimulation	Unarousable, even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired
[a]Reflex withdrawal from a painful stimulus is not considered a purposeful response.				
Source: Reprinted with permission from American Society of Anesthesiologists. Practice guidelines for moderate procedural sedation and analgesia 2018: a report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. Anesthesiology. 2018;128(3):437-479. *Table 1*				

The ASA emphasizes that moderate sedation is distinct from monitored anesthesia care (MAC), which "allows for the safe administration of a maximal depth of sedation in excess of that provided during moderate sedation" [12]. According to the ASA, the following are essential components of MAC [12]:

- Anesthesia assessment and management of a patient's actual or anticipated physiological derangements or medical problems that may occur during a diagnostic or therapeutic procedure
- A clinician prepared and qualified to convert to general anesthesia when necessary
- A clinician qualified to intervene to rescue a patient's airway from any sedation-induced compromise

In contrast, moderate sedation is not expected to induce sedation deep enough to impair the patient's respiratory function or ability to maintain the integrity of his or her airway [12].

Across clinical settings, the goals of moderate sedation are to relieve anxiety, discomfort, or pain in order to allow patients to tolerate an unpleasant diagnostic or therapeutic procedure, to facilitate the successful performance of such a procedure, and to ensure the patient's return to a state safe for discharge [7; 11; 13].

SETTINGS FOR MODERATE SEDATION

As noted, the emergency department is one of the primary settings for the administration of moderate sedation. Within this setting, relocation of joints, fracture care, wound management, removal of foreign objects, cardioversion, and repair of facial lacerations have been the procedures most commonly performed with moderate sedation for both adults and children [14; 15]. With advances in technology and the introduction of new sedative drugs, the use of moderate sedation has expanded. Moderate sedation is now used to perform a range of therapeutic and diagnostic procedures in ambulatory care centers, other outpatient settings, radiology suites, and physician offices. Moderate sedation has become the preference for procedures

EXAMPLES OF PROCEDURES FOR WHICH MODERATE SEDATION IS COMMONLY USED
Ambulatory spinal surgery
Angiography
Breast biopsy
Bronchoscopy
Cardiac catheterization
Cardioversion
Cystoscopy
Diagnostic radiography
Dressing changes
Gastrointestinal endoscopy
Gynecologic procedures
Interventional radiography
Joint/fracture reduction
Laceration repair
Lumbar puncture
Plastic surgery
Removal of a foreign body
Removal of pins, wires, or screws
Wound management
Source: [6; 14; 15; 16; 19; 20; 21] *Table 2*

that were once done with no sedation as well as for procedures that were once done with a general anesthetic. It is sometimes used to supplement local or regional anesthesia, as in the treatment of wounds or the injection of local anesthetics in a painful area [7; 16].

In large part, the use of moderate sedation has increased in response to the demands of patients who want procedures to be pain-free yet do not want the life disruption caused by the use of a general anesthetic. As a result, moderate sedation is now used for a wide variety of procedures (***Table 2***) [6; 14; 15; 16; 19; 20; 21].

Among the diagnostic procedures for which moderate sedation is most commonly used are routine endoscopic examinations, the number of which has escalated because of their value in colorectal cancer screening [23]. According to a 2006 survey of American Society for Gastrointestinal Endoscopy (ASGE) members, 45% of the 724 respondents did not routinely offer unsedated endoscopic procedures and more than 70% said they would choose to be sedated for a routine endoscopic procedure [23]. In a more recent survey of American College of Gastroenterology (ACG) physician members, more than 98% of 1,353 respondents said they used sedation during their endoscopic procedures [24]. People scheduled for endoscopic procedures have come to expect sedation; in the ASGE survey, lack of patient acceptance was the most common reason given for not offering unsedated endoscopy [23].

PATIENT AND CLINICIAN SATISFACTION WITH MODERATE SEDATION

Rates of patient satisfaction after procedures with moderate sedation have been high. A systematic review of randomized trials in which moderate sedation was compared with no sedation (or placebo) for endoscopic procedures (36 studies; 3,918 patients) demonstrated that sedation improved patient satisfaction and willingness to have the procedure repeated [25]. In a study of moderate sedation for endobronchial ultrasound-guided transbronchial needle aspiration, which has typically been done with a general anesthetic, 98% of patients were satisfied with the procedure [19]. In another study, more than 98% of women who had moderate sedation for an office-based operative hysteroscopic procedure were satisfied [26]. It is important to note that patient satisfaction has varied according to the drug used, as will be discussed later in this course.

Clinician satisfaction with the use of moderate sedation has been studied less than patient satisfaction. However, physician satisfaction with moderate sedation can be inferred from the overwhelming percentage (more than 98%) of endoscopists who use moderate sedation rather than no sedation [24]. In addition, one systematic review (36 studies) showed a high level of physician satisfaction with moderate sedation for endoscopic procedures [25]. In the emergency department setting, clinician satisfaction has been evaluated with regard to specific drugs for sedation.

AMERICAN MEDICAL ASSOCIATION OFFICE-BASED SURGERY CORE PRINCIPLES
1. Guidelines or regulations for office-based surgery should be developed by states according to levels of anesthesia defined by the American Society of Anesthesiologists (ASA), excluding local anesthesia or minimal sedation.
2. Physicians should select patients for office-based surgery using moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia by criteria including the ASA Physical Status Classification System, and so document.
3. Physicians who perform office-based surgery with moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia should have their facilities accredited by the Joint Commission, Accreditation Association for Ambulatory Health Care (AAAHC), American Association for Accreditation of Ambulatory Surgical Facilities (AAAASF), American Osteopathic Association (AOA), or by a state recognized entity, such as the Institute for Medical Quality (IMQ), or be state licensed and/or Medicare certified.
4. Physicians performing office-based surgery with moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia must have admitting privileges at a nearby hospital, or a transfer agreement with another physician who has admitting privileges at a nearby hospital, or maintain an emergency transfer agreement with a nearby hospital.
5. States should follow the guidelines outlined by the Federation of State Medical Boards (FSMB) regarding informed consent.
6. For office surgery with moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia, states should consider legally privileged adverse incident reporting requirements as recommended by the FSMB and accompanied by periodic peer review and a program of continuous quality improvement.
7. Physicians performing office-based surgery using moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia must obtain and maintain board certification by one of the boards recognized by the American Board of Medical Specialties, AOA, or a board with equivalent standards approved by the state medical board within five years of completing an approved residency training program. The procedure must be one that is generally recognized by that certifying board as falling within the scope of training and practice of the physician providing the care.
8. Physicians performing office-based surgery with moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia may show competency by maintaining core privileges at an accredited or licensed hospital or ambulatory surgical center for the procedures they perform in the office setting. Alternatively, the governing body of the office facility is responsible for a peer review process for privileging physicians based on nationally recognized credentialing standards.
9. For office-based surgery with moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia, at least one physician who is currently credentialed in advanced resuscitative techniques must be present or immediately available with age- and size-appropriate resuscitative equipment until the patient has met the criteria for discharge from the facility. In addition, other medical personnel with direct patient contact should at a minimum be trained in Basic Life Support (BLS).
10. Physicians administering or supervising moderate sedation/analgesia, deep sedation/analgesia, or general anesthesia should have appropriate education and training.
Source: Modified, with permission from American Medical Association. Patient Safety Principles for Office-Based Surgery. Available at https://www.facs.org/education/patient-education/patient-safety/office-based-surgery. *Table 3*

GUIDELINES FOR MODERATE SEDATION

The ASA has established comprehensive guidelines for the safe and effective use of moderate sedation by practitioners who are not specialists in anesthesia [11]. These guidelines include recommendations for preparation of the patient before the procedure, patient monitoring during the procedure, and patient care after the procedure. The American Medical Association (in collaboration with the American College of Surgeons) has addressed the use of moderate sedation broadly in its core principles for office-based surgery, which state a goal of promoting "consistency in the safety and quality" of office procedures that involve the use of all levels of anesthesia, including moderate sedation (***Table 3***) [27].

The increasing use of moderate sedation in a wide variety of settings has prompted some specialty organizations to develop guidelines specific to a setting. For example, the American Gastroenterological Association (AGA) Institute and the ASGE have established guidelines on the use of sedation during endoscopic procedures, the ACEP has published guidelines on procedural sedation in the emergency department for adults and children, and the American Academy of Pediatrics (AAP) has addressed issues particular to sedation for children and adolescents [7; 13; 28; 29; 30; 31]. These targeted guidelines all echo the ASA recommendations.

ROLES OF HEALTHCARE PROFESSIONALS IN ADMINISTERING MODERATE SEDATION

The ASA has described the qualifications necessary for healthcare professionals to administer moderate sedation. In addition, guidelines developed by the AGA Institute, ASGE, and ACEP include recommendations for the role of non-anesthesiologists in administering sedation within the settings of endoscopy and the emergency department, respectively [7; 28; 31].

The ASA states that moderate sedation may be administered by any licensed physician (including dentists and podiatrists) who has been specifically trained to personally administer or supervise the administration of moderate sedation (referred to as a non-anesthesiologist sedation practitioner) [32]. A physician who administers moderate sedation must not be the one who is performing the diagnostic or therapeutic procedure for which the sedation is being given [32]. Moderate sedation may also be administered by a licensed registered nurse, an advanced practice nurse, or a physician assistant who has been trained to give medications and monitor patients during moderate sedation; in such cases, these healthcare professionals must be under the direct supervision of a non-anesthesiologist sedation practitioner or an anesthesiologist [32]. The ASA states that the practitioner administering moderate sedation "may assist with other minor, interruptible tasks once the patient's level of sedation/analgesia and vital signs have stabilized, provided that adequate monitoring for the patient's level of sedation is maintained" [11].

The ASA notes that a non-anesthesiologist physician must have satisfactorily completed a formal training program in the safe administration of drugs to achieve a level of moderate sedation and in the recognition and rescue of patients in whom the level of sedation becomes deeper than intended [32]. Non-anesthesiologist physicians should be familiar with ASA documents pertaining to moderate sedation (i.e., "Practice Guidelines for Sedation and Analgesia by Non-Anesthesiologists" and "Continuum of Depth of Sedation: Definition of General Anesthesia and Levels of Sedation/Analgesia") and demonstrate several other defined skills and knowledge (***Table 4***) [32]. The ASA also states that advanced life support skills (Advanced Cardiac Life Support certification) are necessary in settings in which an individual with such skills is more than one to five minutes away [32]. Lastly, the ASA notes that practitioners who plan to administer moderate sedation to children should have advanced life support skills, such as those required for certification in Pediatric Advanced Life Support, and demonstrated knowledge of the drugs and monitoring specific to the pediatric setting [32]. For all practitioners who administer moderate sedation, processes should be in place to evaluate a practitioner's performance as well as patient care outcomes at regular intervals [32].

In their guidelines on moderate sedation for endoscopy, the AGA Institute and the ASGE follow the ASA guidelines and recommend that the use of an anesthesia professional be strongly considered for patients classified as having ASA physical status IV or V [28; 31]. In addition, several other patient-related and procedure-related factors are "possible indications" for an anesthesia specialist, including a history of alcohol or substance abuse, morbid obesity, neurologic disorders, and complex therapeutic

SPECIFIC KNOWLEDGE AND SKILLS NEEDED TO ADMINISTER OR SUPERVISE THE USE OF MODERATE SEDATION
A physician or other healthcare professional[a] must be able to:
Follow the appropriate methods to obtain informed consent.
Assess a patient's risk and comorbidities (through history-taking and physical examination) and recognize patients for whom an anesthesia professional should provide sedation.
Assess a patient's risk for aspiration of gastric contents (as described in the "ASA Practice Guidelines for Preoperative Fasting").
Describe the pharmacologic profile of all sedative and analgesic drugs used to achieve a level of moderate sedation and the pharmacologic antagonists to these sedative and analgesic drugs, as well as vasoactive drugs and antiarrhythmics.
Describe the benefits and risks of supplemental oxygen.
Demonstrate proficiency in airway management with facemask and positive pressure ventilation.
Monitor physiologic variables (such as blood pressure, respiratory rate, oxygen saturation by pulse oximetry, electrocardiographic monitoring [including recognition of the most common arrhythmias], depth of sedation, and capnography).
Understand the importance of continuous use of appropriately set audible alarms on physiologic monitoring equipment.
Document the drugs administered, the patient's physiologic condition, and the depth of sedation at regular intervals throughout the period of sedation and analgesia, using a graphical, tabular, or automated record.
[a]A licensed registered nurse, an advanced practice nurse, or a physician assistant who has been trained to give medications and monitor patients during moderate sedation
Source: [32] *Table 4*

procedures [28; 31]. The ACEP guidelines note that there are no specific level A or B recommendations regarding personnel requirements needed to provide procedural sedation and analgesia in the emergency department. However, the guidelines state that a "nurse or other qualified individual" should be present during procedural sedation and analgesia for continuous monitoring of the patient in addition to the provider performing the procedure (level C recommendation) [7]. The guidelines also state that emergency physicians working or consulting in the emergency department should coordinate procedures that require administration of procedural sedation and analgesia [7]. All clinicians providing moderate sedation must be trained to administer drugs to achieve a desired level of sedation, monitor patients and maintain a desired level of sedation, and manage complications [7]. In 2011, the ACEP published comprehensive recommendations for physician credentialing, privileging, and practice; the ACEP also strongly supports the administration of propofol, ketamine, and other sedatives by qualified emergency department nurses under the direct supervision of a privileged emergency physician [7; 33]. The AAP guidelines note similar requirements for training and add that clinicians must have training in how to oxygenate a child in whom airway obstruction or apnea develops and in advanced pediatric airway skills [13].

Much controversy has surrounded the administration of one sedation drug—propofol—by nonanesthesiologist physicians. When propofol was first approved, a black box warning was required on its label noting that use of the drug was limited to clinicians trained in general anesthesia [34].

RECOMMENDATIONS FOR NON-ANESTHESIOLOGIST ADMINISTRATION OF PROPOFOL FOR SEDATION DURING GASTROINTESTINAL ENDOSCOPY

Safety

The safety profile of non-anesthesiologist-administered propofol sedation is equivalent to that of standard sedation with respect to the risks of hypoxemia, hypotension, and bradycardia for upper endoscopy and colonoscopy (grade 1B).

The safety profile of non-anesthesiologist-administered propofol sedation during endoscopic retrograde cholangiopancreatography and endoscopic ultrasound appears to be equivalent to that of standard sedation. However, the worldwide experience with non-anesthesiologist-administered propofol sedation during these procedures is insufficient to draw definitive conclusions about its use in these settings (grade 1C).

Efficacy

For esophagogastroduodenoscopy, colonoscopy, endoscopic retrograde cholangiopancreatography, and endoscopic ultrasound, the time for sedation induction is shorter with non-anesthesiologist-administered propofol sedation than with standard sedation (grade 1A).

When non-anesthesiologist-administered propofol sedation is used for esophagogastroduodenoscopy, colonoscopy, endoscopic retrograde cholangiopancreatography, or endoscopic ultrasound, the recovery time is shorter than when standard sedation with a narcotic and a benzodiazepine is used (grade 1A).

Patient satisfaction with non-anesthesiologist-administered propofol sedation is equivalent or slightly superior to that with standard sedation (grade 1A).

Cost-Effectiveness

For endoscopic retrograde cholangiopancreatography and endoscopic ultrasound, non-anesthesiologist-administered propofol sedation is more cost-effective than standard sedation (grade 1B).

Non-anesthesiologist-administered propofol sedation improves practice efficiency compared with standard sedation (grade 2C).

The use of anesthesiologist-administered propofol sedation for healthy, low-risk patients undergoing routine gastrointestinal endoscopy results in higher costs with no proven benefit with respect to patient safety or procedural efficacy (grade 2C).

Training

Non-anesthesiologist-administered propofol sedation requires the acquisition of skills and abilities that are distinct from those necessary for standard sedation. The training program should provide both didactic and practical, hands-on learning experiences (grade 1C).

Individuals administering propofol should be proficient in the management of upper and lower airway complications, including manual techniques for re-establishing airway patency, use of oral and nasal airway devices, and proper bag-mask ventilation. Basic life support or advanced cardiac life support certification is required. Training with life-size manikins and/or human simulators improves the acquisition of these skills (grade 2A).

Preceptorship is an important element of training for physicians and nursing personnel acquiring the skills to administer propofol (grade 2C).

Capnography reduces the occurrence of apnea and hypoxemia during endoscopic retrograde cholangiopancreatography and endoscopic ultrasound (grade 2B) and upper endoscopy/colonoscopy (grade 2C).

Grade 1A: Strong recommendation; can be applied to most clinical settings (randomized trials without important limitations); clear benefit.

Grade 1B: Strong recommendation; likely to apply to most clinical settings (randomized trials with important limitations); clear benefit.

Grade 1C: Intermediate strength recommendation (observational studies); recommendation may change when stronger evidence is available; clear benefit.

Grade 2A: Intermediate strength recommendation (randomized trials without important limitations); best action may differ depending on circumstances or patients' societal values; unclear benefit.

Grade 2B: Weak recommendation (randomized trials with important limitations); alternative approaches likely to be better under some circumstances; unclear benefit.

Grade 2C: Very weak recommendation (observational studies); alternative approaches likely to be better under some circumstances; unclear benefit.

Source: Reprinted from Vargo J, Cohen LB, Rex DK, Kwo PY. Position statement: nonanesthesiologist administration of propofol for GI endoscopy. Am J Gastroenterol. 2009;104(12):2886-2892 with permission from Elsevier. *Table 5*

However, clinicians discovered that propofol was effective for moderate sedation in the endoscopy setting, and several studies showed that the drug could be administered safely by non-anesthesia clinicians (including specially trained nurses) [35; 36]. The ACG petitioned the U.S. Food and Drug Administration (FDA) to remove the warning, but it was reaffirmed [34; 37]. In 2009, the Centers for Medicare and Medicaid Services (CMS) issued guidelines that followed the lines of the FDA warning, noting that the use of propofol constituted deep sedation and thus should be administered only by a clinician qualified to administer general anesthesia [34; 38]. After appeals from the American Academy of Emergency Medicine and the emergency medicine community, CMS changed its ruling in 2011, allowing healthcare institutions to specify the qualifications for clinicians who administer sedation, with the policies based on nationally recognized guidelines [39]. The ACEP followed up by stating that sedation drugs may be given by a registered nurse or other qualified staff with "established competency for sedative administration" under direct physician supervision [33]. The ACEP recommends that patients who are given propofol should receive care consistent with that required for deep sedation, even if moderate sedation is the intention [40]. Additionally, a dedicated practitioner (preferably an anesthesiologist) should monitor the patient throughout the procedure when propofol is given.

The ASGE, the American Association for the Study of Liver Diseases (AASLD), the ACG, and the AGA issued a joint position statement on the use of propofol by non-anesthesiologists for gastrointestinal endoscopy [41]. The position statement includes recommendations regarding the safety, efficacy, and cost-effectiveness of endoscopist-directed sedation with propofol, as well as guidelines for training (***Table 5***) [41].

PATIENT ASSESSMENT AND MONITORING

The use of moderate sedation requires careful patient assessment before sedation is administered, continuous monitoring while the patient is sedated, and close evaluation after the procedure. For elective procedures, the preprocedure assessment may be done days or weeks in advance; early assessment is essential for allowing time to make any necessary changes, such as the discontinuation of certain medications. Even when an early assessment has been done, all information should be confirmed during the routine assessment immediately prior to the procedure. Many guideline recommendations for the monitoring of patients before, during, and after a procedure with moderate sedation are based on expert consensus because level I and II evidence is lacking [7; 11; 28; 30; 31].

BEFORE SEDATION

Before moderate sedation is given, the clinician administering the sedation or another healthcare professional involved with the procedure must obtain the patient's medical history and perform a physical examination. The clinician should focus on how the history and physical findings affect the choice of medications for sedation and the potential for complications (***Table 6***) [6; 7; 11; 28; 31].

History

The history should elicit the following information [7; 11; 28]:

- Abnormalities of major organ systems
- Previous adverse experiences with any type of sedation and/or analgesia (including regional and general anesthesia)
- Allergies
- Medication history
- Smoking history
- Pregnancy status

USING THE HISTORY TO HELP IDENTIFY PATIENTS AT RISK FOR COMPLICATIONS	
Question	**Relevance to Moderate Sedation**
Is there a history of cardiovascular problems?	The patient may be at increased risk for complications and may require special monitoring.
Is there a history of respiratory problems (emphysema, asthma)?	Risk of complications is greater for patients with emphysema or asthma due to potential respiratory depression.
Is there a history of seizure disorders?	If disorder is treated with benzodiazepines, a benzodiazepine antagonist cannot be used as a reversal agent.
Is there a history of liver disease?	Liver damage may prolong and/or heighten sedative effects of drugs metabolized in the liver.
Is there a history of renal disease?	Potential for problems for patients with renal insufficiency if the sedation drugs used are ones that are excreted in the urine (such as benzodiazepines and opioids).
Is there a history of thyroid disease?	Altered rates of metabolism affect the effective doses of sedation drugs.
Is there a history of substance abuse?	A back-up plan should be made with an anesthesia professional in case the patient becomes combative or uncooperative or if sedation drugs have little effect.
Are there any piercings?	Piercings may need to be removed, depending on location.
What current medications are taken?	Many prescription medications and herbal supplements may increase the risk for complications related to sedation/analgesia and/or an invasive procedure.
Source: [6]	*Table 6*

- History of substance abuse (alcohol and/or drugs)
- History of stridor, snoring, or sleep apnea
- Presence and location of any piercings
- Time and nature of last oral intake (immediately prior to the procedure)
- Relevant previous hospitalizations
- History of sedation
- Family history, particularly related to anesthesia

Abnormalities of Major Organ Systems

Because most medications used for sedation/analgesia may result in respiratory depression, the risk for sedation-related complications may be increased for patients with a history of pulmonary disease, such as emphysema or asthma [6]. A history of cardiovascular disease may also increase the risk of complications [6]. In addition, determining if there is a history of liver disease is important, as most sedation/analgesia medications are hepatically metabolized [6]. Patients with renal disease may require further evaluation to determine the safety of administering some drugs that are excreted in the urine (e.g., benzodiazepines, opioid metabolites) [6]. Patients who have a history of seizure disorders treated with benzodiazepines should be identified, as a reversal agent may invoke a seizure [6]. Lastly, thyroid disease can affect the medication dose needed for adequate sedation [6].

History of Substance Abuse

The use of sedation/analgesia medications is typically safe for people with a history of substance abuse [6]. However, in some instances, the medication may have little effect and a patient may become combative or uncooperative during sedation [6]. The physician performing the procedure should be alerted to a history of substance abuse so a plan can be developed to address these issues, should they occur [6].

POTENTIAL COMPLICATIONS ASSOCIATED WITH PRESCRIBED MEDICATIONS, OVER-THE-COUNTER DRUGS, AND HERBAL SUPPLEMENTS		
Medication or Supplement	**Potential Complication(s)**	**Action Needed**
Prescribed and OTC Drugs		
Angiotensin-converting enzyme (ACE) inhibitors	Hypotension, bradycardia, intolerance to hypovolemia	Maintain hydration, give moderate doses of vasopressor
Diuretics	Hypokalemia, hypovolemia	Maintain hydration, check serum potassium level
Hypoglycemic agents (insulin and oral agents)	Hyperglycemia, hypoglycemia	Withhold or reduce dose on morning of procedure
Monoamine oxidase (MAO) inhibitors	Hypertension, excitatory state (meperidine), depressive reaction (opioids)	Stop older, nonselective MAO inhibitors two to three weeks before procedure; withhold new MAO inhibitors on morning of procedure
Nonsteroidal anti-inflammatory drugs	Altered renal function, gastrointestinal bleeding, impaired platelet function	—
Warfarin	Increased hemorrhage	Discontinue three to five days before procedure and check prothrombin time
Herbal Supplements		
Black cohosh	Hypotension, bradycardia	Discontinue two weeks before procedure
Ephedra	Hypertension, dysrhythmias	Discontinue seven days before procedure
Feverfew	Prolonged bleeding time	Discontinue two weeks before procedure
Garlic	Anticoagulant effects	Discontinue two weeks before procedure
Ginger	Prolonged bleeding time	Discontinue two weeks before procedure
Ginkgo biloba	Prolonged bleeding time	Discontinue two weeks before procedure
Ginseng	Hypoglycemia, hypertension, tachycardia	Discontinue two weeks before procedure
Kava	Interaction with barbiturates and benzodiazepines, anticoagulant effects	Discontinue 24 hours before procedure
St. John's wort	Prolonged sedative effects of anesthetics	Discontinue seven days before procedure
Valerian	Increased sedative effect of anesthetics or sedatives	Discontinue seven days before procedure
Source: [6]		*Table 7*

History of Stridor, Snoring, or Sleep Apnea

A history of stridor, snoring, or sleep apnea may make airway management difficult, as sedatives and analgesics alter normal respiratory responses to obstruction and apnea [42]. The ASA no longer recommends general anesthesia rather than moderate sedation for patients with obstructive sleep apnea who have a procedure involving the upper airway (such as upper endoscopy or bronchoscopy) [42]. If moderate sedation is used, capnography is recommended for monitoring during moderate sedation due to the risk of undetected airway obstruction. If deeper sedation is necessary for patients with obstructive sleep apnea, general anesthesia is recommended. Despite the presumed higher risk of cardiorespiratory complications, studies have shown that, in people who have endoscopy with moderate sedation, the rate of such complications does not differ between patients with or at high risk for obstructive sleep apnea and patients without or at low risk for sleep apnea [43; 44; 45].

Presence and Location of Any Piercings

Some piercings may need to be removed if it is thought that they will compromise patient safety. For example, a tongue piercing can become dislodged in the oral cavity, a piercing close to the procedure site may be a source of infection, or a piercing may be at risk for snagging on a surgical drape or monitoring leads [6].

Medication History

A clinician should document all medications—prescription and over-the-counter—that the patient currently takes. Many medications have the potential to interact with drugs used for sedation/analgesia or pose risks during invasive procedures (***Table 7***) [6]. Herbal and dietary supplements may also increase the risk for sedation-related or procedure-related risks, making it necessary to ask patients specifically about the use of such supplements. The use of herbal and dietary supplements is relatively common, with more than 55 million people taking them; however, less than half (about 45%) disclose the use of supplements to their healthcare provider [46]. The use of supplements is common before ambulatory surgery. In one study, nearly 43% of patients took a complementary or alternative medication in the two weeks preceding an ambulatory surgical procedure; approximately 20% of the patients took a supplement that inhibited coagulation, 14% took one that had cardiac effects, and 8% took one that had sedative effects [47]. This use is of particular concern because most supplements should be discontinued for one to two weeks before moderate sedation because of potential implications, including anticoagulation, cardiovascular, and sedative effects [6].

Time and Nature of Last Oral Intake

The ASA Committee on Standards and Practice Parameters notes that fasting before administration of moderate sedation decreases risks during sedation and recommends that patients who are to have sedation/analgesia for an elective procedure should not drink clear fluids for at least two hours or eat solid foods (a light meal) for at least six hours before the procedure [48]. However, meeting fasting requirements in the emergency department is difficult; one study showed that 70% of patients who had sedation in the emergency department had not been fasting [49]. Guidelines note that when urgent or emergent procedures must be done, recent food intake is not a contraindication for administering procedural sedation/analgesia in adults or children [7; 11; 13; 30]. The potential risks of sedation without fasting (e.g., aspiration) must be weighed against the benefit of performing the procedure promptly [7; 13]. In addition, the potential for aspiration must be considered in determining the target level of sedation, whether the procedure should be delayed, and whether intubation should be done to protect the trachea [7; 11]. The ACEP states that sedation may be safely given to children and adolescents who have not fasted (level B recommendation) [7; 30].

Physical Examination

The focus of the physical examination should be on vital signs, auscultation of the heart and lungs, baseline level of consciousness, and evaluation of the airway, with attention paid to anatomic features that may affect administration of sedation [11]. For example, substantial obesity (especially involving the neck and face), limited neck extension, cervical spine disease or trauma, mouth opening of less than 3 cm in an adult, and malocclusion of the jaw are all factors that may be associated with difficulty in airway management in the event of respiratory compromise during the procedure [11]. In addition, the patient's overall health should be classified according to the ASA physical status classification (***Table 8***) [50].

Identification of High-Risk Patients

The prevention and management of complications requires that physicians be able to accurately identify patients at high risk [6]. The primary patient-related factors associated with complications include obesity, chronic obstructive pulmonary disease, coronary artery disease, chronic renal failure, drug addiction, and age (children and individuals older than 65 years), and measures should be carried out to prevent complications in patients with these factors (***Table 9***) [6; 13].

PHYSICAL STATUS CLASSIFICATION OF THE AMERICAN SOCIETY OF ANESTHESIOLOGISTS	
Physical Status[a]	**Definition**
1	Normal, healthy patient
2	Patient with mild systemic disease
3	Patient with severe systemic disease
4	Patient with severe systemic disease that is a constant threat to life
5	Moribund patient who is not expected to survive without the operation
6	Declared brain-dead patient whose organs are being removed for donor purposes
[a]This number may be followed by an "E" if the surgery is considered an emergency (defined as cases in which delay in treatment would significantly increase the threat to the patient's life or body part).	
Source: Reprinted, with permission from American Society of Anesthesiologists. ASA Physical Status Classification System. Available at https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system.	*Table 8*

HIGH-RISK FACTORS DURING MODERATE SEDATION AND MEASURES TO PREVENT COMPLICATIONS		
Risk Factor	**Possible Complication**	**Preventive Measures**
Obesity	Gastroesophageal reflux Upper airway obstruction Oversedation	Consider treatment with an oral H2 antagonist and metoclopramide before the procedure. Administer small incremental doses and allow time for onset of action before additional dosing.
Chronic obstructive pulmonary disease	Respiratory depression	Administer all prescribed bronchodilators before sedation is initiated. Administer supplemental oxygen. Titrate drugs in small incremental doses and monitor closely. Consider local anesthesia as supplement for pain control.
Coronary artery disease	Undersedation Oversedation	Have patient take all routine cardiac medications on the day of the procedure. Take care to balance use of sedation. Administer supplemental oxygen.
Chronic renal failure	Overdose or prolonged effect of drug Exaggerated reaction to benzodiazepines	Avoid use of longer-acting opioids, such as meperidine (although fentanyl is thought to be safe). Use smaller doses of benzodiazepines with incremental dosing.
Drug addiction	Unknown drug requirements	Have patient take prescribed replacement drug (e.g., methadone) on day of procedure. Use local anesthesia as supplement to reduce amount of parenteral sedative needed. Use short-acting benzodiazepines with incremental dosing. Avoid reversal agents.
Children	Respiratory depression Airway obstruction	Consult with subspecialists and/or an anesthesiologist for children with special needs or with anatomic airway abnormalities or extreme tonsillar hypertrophy.
Older individuals (≥65 years)	Comorbidities Age-related changes in drug metabolism	Use lower doses of sedative agents. Follow conservative incremental dosing.
Source: [6; 7]		*Table 9*

ASA physical status is also a high-risk factor. As noted, the AGA Institute and the ASGE state that the use of an anesthesia professional should be "strongly considered" for endoscopy on patients who have an ASA physical status of IV or V [28; 31]. The AAP encourages clinicians to consult with an anesthesiologist for children with an ASA class of III or IV and for children with special needs, anatomic airway abnormalities, or moderate-to-severe tonsillar hypertrophy [13].

Routine Diagnostic Testing

The guidelines agree that routine laboratory or other diagnostic testing is not needed before moderate sedation [7; 11; 31]. However, if the results of testing may affect the management of sedation, such testing should be done before the patient is sedated [7; 11; 31].

Informed Consent

The ASA and AGA Institute guidelines note that the risks, benefits, and limitations of moderate sedation, as well as possible alternatives (no sedation), should be discussed with patients, enabling them to make an informed decision [11; 28]. For patients who are minors or legally incompetent adults, informed consent should be provided by a legal guardian [11]. The informed consent discussion should include risks after the procedure (e.g., related to vigorous exercise, use of alcohol, operation of heavy equipment) and should also confirm the availability of a competent adult to take the patient home after the procedure [28].

The AGA Institute notes that the endoscopist should discuss sedation as a distinct topic, in addition to the procedure, with separate documentation. The ASA also advocates for separate documentation of informed consent for sedation [28]. Ideally, sedation should be initially discussed at some point before the day of the endoscopic procedure to provide the patient with the best options and more flexibility in declining sedation [28].

The ACEP notes that verbal or written informed consent should be obtained in the emergency department [51]. Use of moderate sedation in the emergency department is often used for patients who have a limited ability to understand risks and benefits of treatment options because of age, pain, anxiety, or altered mental status; thus, implied consent may be appropriate according to institutional and departmental guidelines.

Documentation

The results of all elements of the preprocedure assessment should be clearly documented before sedation is started. Vital signs (i.e., blood pressure, heart rate, temperature) should also be recorded as baseline measures, and the patient's level of consciousness should be evaluated and documented before the initiation of sedation [7; 13; 28; 51]. In addition, the patient's name, birth date, and procedure should be confirmed prior to initiating sedation [11; 13; 51].

Importance of Effective Communication

Because the history and informed consent are vital components of the preprocedure process and integral to patient safety and satisfaction, effective communication is key. This can be challenging with patients who have low literacy, low health literacy, and/or a native language and cultural context different from that of the clinician. According to the National Assessment of Health Literacy, 14% of individuals in the United States have "below basic" health literacy, which means they lack the ability to understand health information and make informed healthcare decisions [52; 53]. Earlier studies indicated that as many as 26% of patients have inadequate health literacy, with an additional 20% having marginal health literacy [52; 53; 54].

More recently, two studies of patients in urban emergency departments showed that nearly 16% to 25% of patients had limited health literacy [55; 56]. Health literacy varies widely according to race/ethnicity, level of education, and gender, and clinicians are often unaware of the literacy level of patients and their families [55; 56; 57; 58]. Only 12% of American adults have a health literacy considered "proficient," while more than 33% (more than 80 million people) have difficulty with simple health tasks, such as following the directions of a prescription and adhering to a standardized childhood immunization schedule chart [52]. Ensuring that patients understand is essential, as limited health literacy has been associated with poor health outcomes [59].

Given these data, among the most important factors for effective communication are knowledge of the language preference of the patient; an awareness of the patient's health literacy level; and an understanding of and respect for the patient's and family's cultural values, beliefs, and practices (referred to as cultural competency) [57]. These issues are significant, given the growing percentages of racial/ethnic populations. According to U.S. Census Bureau data, 21.5% of the American population speak a language other than English, and of those, 39.0% speak English less than "very well" [60]. The clinician taking the history or discussing the procedure for informed consent should ask the patient what language is spoken at home and what language he or she prefers for medical care information, as some patients prefer their native language even though they have said they can understand and discuss medical information in English [61]. When the healthcare professional and the patient speak different languages, the use of family members and/or friends as interpreters should be avoided if possible, as the patient may not be as forthcoming with information and the family member or friend may not remain objective [62]. Studies have demonstrated that the use of professional interpreters rather than "ad hoc" interpreters (e.g., untrained staff members, family members, friends) facilitates a broader understanding, leads to better outcomes, and is better aligned with patient preferences [63; 64; 65]. Clinicians should also check with their state's health officials about the use of ad hoc interpreters, as several states have laws about who can interpret medical information for a patient [62].

Several instruments are available to test the health literacy level, and they vary in the amount of time needed to administer and the reliability in identifying low literacy. Among these is the Newest Vital Sign (NVS), an instrument named to promote the assessment of health literacy as part of the overall routine patient evaluation [66]. The NVS takes fewer than three minutes to administer, has correlated well with more extensive literacy tests, and has performed moderately well at identifying limited literacy [57; 58]. Two questions have also been found to perform moderately well in identifying patients with inadequate or marginal literacy: "How confident are you in filling out medical forms by yourself?" and "How often do you have someone help you read health information?" [57]. Clinicians should adapt their discussions and educational resources to the patient's and family's identified health literacy level and degree of language proficiency and should also provide culturally appropriate and translated educational materials when possible.

DURING SEDATION

Patient monitoring during sedation is essential for detecting changes in the patient's status as early as possible and for identifying trends in parameters that may signal the development of complications [11]. Monitoring consists of both clinical observation and the use of devices to measure physiologic parameters [7; 11; 28; 51]. Despite guidelines on appropriate monitoring, studies have demonstrated variation in practice patterns [24; 67; 68].

MODIFIED OBSERVER'S ASSESSMENT OF ALERTNESS/SEDATION SCALE	
Responsiveness	**Score**
Agitated	6
Responds readily to name spoken in normal tone ("alert")	5
Lethargic response to name spoken in normal tone	4
Responds only after name is called loudly and/or repeatedly	3
Responds only after mild prodding or shaking	2
Does not respond to mild prodding or shaking	1
Does not respond to deep stimulus	0

Source: Reprinted from Cohen L, Delegge MH, Aisenberg J, et al. AGA Institute review of endoscopic sedation. Gastroenterology. 2007;133(2):676-701 with permission from Elsevier. *Table 10*

Monitoring should include periodic assessment of the patient's level of consciousness, ventilator and oxygenation status, and hemodynamics [7; 11; 28; 51]. These parameters should be evaluated and documented at regular intervals that are defined by the type of medication, the dose, the length of the procedure, and the patient's general condition [11]. Parameters may be monitored manually or automatically; most devices in use today automatically record data. Automatic recording offers the benefit of alarms that can be set to go off when a parameter is outside of acceptable limits [11; 28]. Several new monitoring devices have been developed, but evidence of their effect on patient outcomes is lacking and more studies are needed before their routine use can be recommended [11].

Level of Consciousness

The patient's level of consciousness should be evaluated and documented throughout the procedure to ensure that the patient is able to control his or her airway to take deep breaths if necessary [7; 11; 13]. Although several scales and scoring systems have been developed to describe the level of consciousness, none is ideal. One recommended tool is the Modified Observer's Assessment of Alertness/Sedation Scale (***Table 10***) [28; 69]. The patient's response to verbal commands should be monitored routinely, except for patients who are unable to respond (e.g., very young children, mentally impaired individuals) or during procedures in which the lack of patient movement is essential [7; 11]. For situations in which a verbal response is not possible (such as upper endoscopy), the patient and the clinician who is monitoring should determine hand signals before sedation is administered.

A noninvasive method of assessing the level of consciousness is bispectral index (BIS) monitoring, which has been used since the mid-1990s in the setting of general anesthesia. BIS records electroencephalographic (EEG) waveforms from a probe adhered to the forehead, and the EEG recording is analyzed with an algorithm to generate a score on a scale of 0 to 100. EEG activity is a sensitive measure of sedation, with a low-amplitude, high-frequency signal representing the awake state and a high-amplitude, low-frequency signal representing sedation. BIS monitoring is helpful in ensuring that patients are not oversedated or undersedated, and research has shown that BIS results correlate with validated sedation scales. The ASA guideline does not mention BIS explicitly and notes that although monitoring of the level of consciousness reduces the risk of deep sedation, no data have shown that such monitoring improves outcomes [11]. The ACEP and the ASGE found insufficient or poor evidence to recommend the routine use of BIS [31; 69]. The AAP recommends against the routine use of BIS monitoring in children [13].

Ventilatory Function and Oxygenation Status

The patient's respiratory effort (ventilatory function) should be monitored with direct observation and/or auscultation [11]. This assessment may be supplemented by the use of pulse oximetry to continuously measure arterial hemoglobin oxygen saturation and heart rate. The value of measuring oxygen saturation is unclear. Although several studies have shown that pulse oximetry accurately detects desaturation during procedural sedation, the clinical significance of transient desaturation is uncertain [11]. In addition, oxygen saturation is relatively insensitive to early signs of hypoventilation, and studies have not shown that the use of oximetry reduces the incidence of cardiopulmonary complications. Oximetry is not able to detect an adequate signal during hypothermia, low cardiac output, and motion (such as a tremor) [11].

Despite these drawbacks, the ASA recommends pulse oximetry for all patients undergoing sedation/analgesia, and the AGA Institute and the ASGE recommend this monitoring tool as well [11; 28; 31]. A survey of endoscopists indicated that most (98.6%) routinely use pulse oximetry [24]. The ACEP recommends the use of pulse oximetry for patients at increased risk of hypoxemia, such as those with substantial comorbidity or when high doses of drugs or multiple drugs are used (level B recommendation) [7]. The ACEP notes that pulse oximetry may not be necessary when the patient's level of consciousness is minimally depressed and verbal communication can be continually monitored (level C recommendation) [7]. The AAP supports the use of newer pulse oximeters (e.g., less susceptible to motion artifacts, change in audible tone with changes in hemoglobin saturation) during pediatric sedation, and data on sedation practices among the Pediatric Sedation Research Consortium (PSRC) for 114,855 children showed 95% overall use of oximetry [13; 67]. However, the PSRC data also demonstrated much lower use (33%) among radiologists [67].

Recommendations about noninvasive monitoring of end-tidal carbon dioxide with capnography have evolved. At the time of their guidelines on monitoring during moderate sedation, the ASA and the AGA Institute found insufficient evidence to recommend the routine use of capnography, and the ASA only recommended capnography during moderate sedation when ventilation could not be directly observed. The ACEP noted only that procedural monitoring "may include" capnography, and the ASGE stated that capnography may improve patient safety [7; 11; 28; 31]. However, since the publication of those guidelines, several studies have demonstrated that capnography readings are a more sensitive measure of ventilatory function, detecting hypoventilation earlier than changes in vital signs, clinical observations, or pulse oximetry [70; 71; 72; 73]. In a study in the emergency department setting, capnography had a sensitivity of 100% (and specificity of 64%) in detecting hypoxia before onset [72]. In addition, a meta-analysis (five studies) demonstrated that respiratory depression was more than 17 times more likely to be detected during procedural sedation when capnography was used than when it was not used [73]. In 2010, the ASA issued standards for anesthetic monitoring (reaffirmed in 2020) stating that monitoring for the presence of exhaled carbon dioxide should be carried out during moderate (or deep) sedation. This is supported in the 2018 ASGE guidelines [31; 74]. In 2018, the ASA issued updated guidelines for moderate procedural sedation that include a new recommendation for continual monitoring with capnography to supplement observation and pulse oximetry [11]. Use of capnography during sedation is also recommended by the Emergency Nurses Association, and, in a joint position statement, the ASGE, the AASLD, the ACG, and the AGA Institute acknowledge that capnography reduces the occurrence of apnea and hypoxemia during gastrointestinal endoscopy with propofol sedation [41; 75]. A multisociety-developed curriculum on sedation during gastrointestinal endoscopy notes that proper training should include interpretation of capnography readings [69].

Guidelines from the AAP/American Academy of Pediatric Dentistry support the use of capnography (preferred) during pediatric sedation. However, it was used by less than half (45%) of practitioners in a large study of high-functioning pediatric sedation systems [13; 67].

The routine use of supplemental oxygen has also been debated. The ASA and ASGE guidelines note that supplemental oxygen should be considered for moderate sedation, and the ASGE states that supplemental oxygen can reduce the magnitude of oxygen desaturation during sedated endoscopy [11; 31]. The ASGE additionally states that supplemental oxygen should be administered if hypoxemia is anticipated or develops [31]. However, the AGA Institute asserts that there is little evidence to indicate that the use of supplemental oxygen reduces the incidence of significant cardiopulmonary complications in patients monitored with pulse oximetry [28]. In addition, the results of several studies have shown that supplemental oxygen may actually increase the rate of complications associated with sedation, as its use may delay recognition of hypoxemia and apnea [76; 77]. As a result, the AGA Institute recommends the use of supplemental oxygen during endoscopy only for older individuals and people with significant comorbid disease (ASA class IV and V) [28]. According to one survey, approximately 73% of endoscopists routinely use supplemental oxygen [24].

EVIDENCE-BASED PRACTICE RECOMMENDATION

American Society for Gastrointestinal Endoscopy recommends standard monitoring procedures in the elderly during moderate sedation with heightened awareness of this population's increased response to sedatives.

(https://www.giejournal.org/article/S0016-5107(13)01777-X/pdf. Last accessed September 26, 2022.)

Level of Evidence: +++O (Moderate quality evidence. Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.)

Hemodynamic Parameters

Heart rate and blood pressure should be monitored throughout the procedure. Although there is no evidence base for the intervals for this monitoring, three- to five-minute intervals have been suggested [11; 28]. Tachycardia and hypertension may be a sign of inadequate sedation, whereas bradycardia and hypotension may be an early sign of oversedation. The AAP recommends documentation of heart rate and blood pressure at a minimum of every 10 minutes throughout the procedure for children, and 87% of practitioners in the PSRC study monitored blood pressure [13; 67].

Electrocardiography

There is no evidence to indicate that continuous electrocardiography (ECG) monitoring is of benefit during moderate sedation, especially for patients who have no underlying cardiopulmonary disease [7]. Guidelines from the ASA, the AGA Institute, and the ASGE all note that ECG monitoring is not needed for low-risk patients [11; 28; 31]. The ASA guidelines suggest ECG monitoring to decrease risks for patients who have significant cardiovascular disease or dysrhythmia, and the AGA Institute and the ASGE state that ECG monitoring should be considered for high-risk patients, such as patients with a history of significant cardiac or pulmonary disease [11; 28; 31]. The AAP recommends that an ECG monitor and defibrillator be readily available [13].

AFTER SEDATION

Patient monitoring should continue during the recovery period after the procedure. The ASA recommends that monitoring continue until the patient is near the baseline level of consciousness and is no longer at increased risk of cardiorespiratory depression [11]. Monitoring should consist of documenting the same parameters measured during sedation, again at regular intervals. Other guidelines support this practice [7; 11; 13; 28; 31].

EVIDENCE-BASED PRACTICE RECOMMENDATION

After sedation/analgesia, the American Society of Anesthesiologists, the American Association of Oral and Maxillofacial Surgeons, the American College of Radiology, the American Dental Association, the American Society of Dentist Anesthesiologists, and the Society of Interventional Radiology recommend observing and monitoring patients in an appropriately staffed and equipped area until they are near their baseline level of consciousness and are no longer at increased risk for cardiorespiratory depression.

(https://pubs.asahq.org/anesthesiology/article/128/3/437/18818. Last accessed September 26, 2022.)

Level of Evidence: Expert Opinion/Consensus Statement

Scoring systems for anesthesia recovery are available, but no evidence has established standard discharge criteria; healthcare facilities should establish their own standardized criteria [11; 13; 28; 31]. In general, the following parameters are used to indicate that a patient can be discharged: stable vital signs, alert and oriented status, patent airway, good skin color and condition, minimal nausea and vomiting, adequate pain control, ability to walk without dizziness, and ability to dress independently [11; 28]. Many facilities have eliminated criteria related to the ability to eat or drink or void before discharge [28; 78]. If a reversal agent has been used, the patient should be observed for two hours after the agent was given to ensure that he or she will not become re-sedated after the effects of the reversal agent wear off [11].

Discharge criteria must also include the availability of a responsible adult to escort the patient home [11; 28]. The AAP suggests that at least two adults be available to take home a child who still uses a car seat [13]. Parents should be told that the child is at risk for airway obstruction if his or her head falls forward while in the car seat [11].

Oral and written discharge instructions should be given to all patients or parents [11; 13; 28; 31]. These instructions should provide information on diet, activity restrictions, medications to be taken or to be avoided, care of the procedure site (if applicable), possible side effects and complications, and a telephone number to call to report complications.

MOST COMMONLY USED DRUGS FOR MODERATE SEDATION

In order to administer moderate sedation medications, clinicians are required to have an understanding of the drugs used, including their pharmacologic properties, especially time to peak effect, potential drug-drug interactions, and the most common adverse events and side effects [11; 33; 69]. The choice of sedation drug(s) is clinician-dependent, and the primary factors to consider are the patient's history, the procedure (type and length), maximization of patient comfort, and minimization of risk [28; 31]. Specialty guidelines for moderate sedation provide evidence-based information on sedation drugs for specific settings [7; 28; 30; 31; 69].

The primary drug classes used for moderate sedation are sedative hypnotics (including benzodiazepines), opioids, and dissociatives, although other drugs are also used (***Table 11***) [6; 28; 69; 79; 80; 81; 82; 83; 84; 85]. Most drugs for moderate sedation are given intravenously and should be administered in small, incremental doses that are titrated to achieve the desired level of sedation [11]. When drugs are administered by different routes (e.g., oral, intramuscular), enough time must be given to allow for the drug to be absorbed before supplemental agents are considered [11]. Repeat doses of oral agents as supplemental sedation are not recommended because their absorption can be unpredictable [11].

PHARMACOLOGIC PROFILES OF MOST COMMON DRUGS USED FOR MODERATE SEDATION[a]					
Drug	**Typical Initial Dose**	**Time to Onset of Action (min)**	**Time to Peak Effect (min)**	**Duration of Effect (min)**	**Notes**
Sedative Hypnotics					
Midazolam	Adult: 1–2 mg Pediatric: 0.05 mg/kg	1–2	3–4	15–80	For patients older than 60 years or who have an ASA physical status of 3 or higher, reduce the dose by 20% to 30%.
Diazepam	Adult: 5–10 mg Pediatric: 0.2–0.5 mg/kg	2–3	3–5	360	Use lower doses in older or debilitated patients.
Lorazepam	Adult: 0.044 mg/kg (IV), 2–4 mg (IM) Pediatric: 0.05 mg/kg (PO)	1–2 (IV) 15–30 (IM)	15–30 (IV) 60–90 (IM)	360–480	Use with caution in patients with limited pulmonary reserve.
Propofol	Adult: 10–40 mg (endoscopy), 1.0 mg/kg (ED) Pediatric: 1–2 mg/kg	<1	1–2	4–8	Patients with ASA physical status III or IV are at higher risk for propofol-associated hypotension.
Etomidate	Adult: 0.2–0.6 mg/kg Pediatric: 0.2–0.6 mg/kg	<1	1	5–15	Respiratory depression is more common among patients older than 55 years.
Opioids					
Meperidine	Adult: 25–50 mg Pediatric: 0.5–1 mg/kg (IM, IV), 2–4 mg/kg (PO)	3–6	5–7	60–180	Contraindicated for patients taking an MAO inhibitor.
Fentanyl	Adult: 50–100 mcg (endoscopy) Pediatric: 0.5–2 mcg/kg	1–2	3–5	30–60	For patients older than 65 years of age, reduce by at least 50%.
Dissociative					
Ketamine	Adult: 0.5 mg/kg IV (endoscopy), 1–2 mg/kg IV (ED), 4–5 mg/kg (IM) Pediatric: 1–3 mg/kg IV, 5–10 mg/kg (IM)	<1	1	10–20	Emergence reactions are common among adults.

Table 11 continues on next page.

PHARMACOLOGIC PROFILES OF MOST COMMON DRUGS USED FOR MODERATE SEDATION[a] *(Continued)*					
Drug	**Typical Initial Dose**	**Time to Onset of Action (min)**	**Time to Peak Effect (min)**	**Duration of Effect (min)**	**Notes**
Other Drugs (Used as Adjuncts)					
Diphenhydramine	Adult: 25–50 mg	2–3	60–90	>240	—
Promethazine	Adult: 25–50 mg	2–5	Unknown	>120	—
Droperidol	Adult: 1.25–2.5 mg	3–10	30	120–240	—
Methohexital	Pediatric: 0.5–1.5 mg/kg (IV), 20–35 mg/kg (PR)	1 (IV) 5–15 (PR)	—	7–10 (IV) 60–90 (PR)	—
Pentobarbital	Pediatric: 1–3 mg/kg (IV), 2–6 mg/kg (IM)	3–5	—	15–45 (IV) 60–120 (IM)	Used primarily for children. Use has generally been replaced by other agents.
Chloral hydrate	Pediatric: 8–25 mg/kg	10–20	30–60	240–480	Used primarily for children, but rarely. Not approved in the United States.
Nitrous oxide	Inhaled and titrated to effect	2–3	Dose dependent	15–30	Used primarily for children.
Dexmedetomidine	1 mcg/kg	5–10	15–30	60–120	—

[a]The typical initial doses given here should be used as guidelines only. Drug dosing should be done on an individual basis with each patient, with consideration of the patient's age, condition, likelihood of complications, and length and complexity of the procedure. Pediatric doses are given only for those drugs recommended for use in children.
ED = emergency department, IM = intramuscular, IV = intravenous, MAO = monoamine oxidase, PR = rectal.

Source: [6; 28; 31; 69; 79; 80; 81; 82; 83; 84; 85; 86; 87] *Table 11*

In general, the dose of moderate sedation drugs should be reduced for patients older than 65 years of age because of physiologic changes that occur with age [6]. Slow titration of drugs is also essential in this population to avoid oversedation and complications [6]. When moderate sedation is used for children, the age and weight must be known for accurate calculation of the appropriate dose [6].

SEDATIVE HYPNOTICS

The class of sedative hypnotics comprises many drugs, including benzodiazepines and barbiturates. In addition, two ultrashort-acting agents in this class—propofol and etomidate—are used for moderate sedation. The use of barbiturates in moderate sedation has decreased considerably because of the availability of more effective agents (such as benzodiazepines).

Benzodiazepines

Benzodiazepines have anxiolytic, muscle relaxant, sedative, and amnesic effects [31; 68]. They have a high therapeutic index, meaning the serum drug level needed for effect is significantly lower than that which produces adverse effects [79]. In healthy people, the effect of benzodiazepines on the cardiovascular and respiratory systems is minimal when the dose is titrated appropriately [6]. Care must be taken, however, when opioids are used in conjunction with benzodiazepines, as the synergy of the drugs increases the potential for respiratory depression [6].

The three benzodiazepines most often used for moderate sedation are midazolam (Versed), diazepam (Valium), and lorazepam (Ativan).

Midazolam

Since its introduction in the mid-1980s, midazolam has replaced diazepam as the sedative of choice for moderate sedation because of its greater potency, more rapid onset of action, slightly shorter duration of action, and greater amnesic effect [28; 79]. The drug has no analgesic effect [31].

Pharmacokinetics. The time of onset is one to two minutes for intravenous midazolam, with the peak effect within three to four minutes [69]. The duration of the drug's effect is 15 to 80 minutes [69].

Dosage. In adults, the usual starting dose of intravenous midazolam is 1–2 mg given slowly over one to two minutes while observing for sedation or slurred speech [28; 69]. The drug should be titrated slowly and never administered by a rapid or single bolus [6]. If the initial dosage is insufficient to achieve or maintain the desired level of sedation, additional 0.5- to 1-mg doses may be given at two-minute intervals, to a maximum total dose of 6 mg (although a dose of 5 mg or greater is rarely needed) [69; 86]. The pediatric dose is 0.05 mg/kg [86]. Because of the drug's synergistic effect with opioids, the dose of midazolam should be reduced by approximately 30% when the patient has also received an opioid [6; 28].

Contraindications and Precautions. Midazolam should be administered with caution in the elderly and in patients with congestive heart failure, renal impairment, pulmonary disease, or hepatic dysfunction [6]. Fluctuations in vital signs (e.g., blood pressure, pulse), decreases in respiratory rate, and apnea have been reported after IV administration of midazolam [6].

Potential Adverse Events and Side Effects. The rates of side effects are low (1% to 4%) and include (in order of frequency) hiccups, nausea, vomiting, cough, headache, and drowsiness [6]. As with all benzodiazepines, disinhibition reactions such as rage, hostility, and aggression may occur [69].

Special Populations. The dose of midazolam should be reduced by about 20% to 30% for patients older than 60 years of age or who have an ASA physical status of III or higher [28; 69]. The risk of hypoventilation or apnea is increased among older patients and those with chronic disease; the drug should be titrated at smaller increments and at a slower rate [6].

Diazepam

Diazepam is among the oldest of the benzodiazepines and has been useful as a premedication for surgical and diagnostic procedures [28].

Pharmacokinetics. The time to onset of diazepam is two to three minutes when given intravenously. Its peak is at three to five minutes, and its duration is approximately six hours [69]. This long length of action may preclude its use for short-term moderate sedation.

Dosage. The target dose of intravenous diazepam is typically 5–10 mg, administered slowly in 2.5- to 5-mg increments at one- to two-minute intervals while observing carefully for signs of sedation (e.g., slurred speech) and avoiding respiratory depression. The required dose usually does not exceed 10 mg, although up to 20 mg may be needed to achieve a moderate level of sedation if no premedication has been given [6; 69].

Contraindications and Precautions. Diazepam should not be given to individuals with acute narrow-angle glaucoma (unless the condition is medically managed) [6]. The drug should be used cautiously in patients with compromised hepatic or renal function. The central nervous system (CNS) effects of diazepam may be potentiated by other CNS-depressant drugs, such as opioids, barbiturates, monoamine oxidase (MAO) inhibitors, and other psychotropic drugs [6].

Potential Adverse Events and Side Effects. Respiratory depression is a potential adverse event and is dose dependent; it is more likely to occur in patients with respiratory disease or who receive diazepam with an opioid [69]. The primary side effects are coughing and dyspnea, and pain at the injection site may also occur [28; 69].

Special Populations. Lower doses should be used in older or debilitated patients [69].

Lorazepam

Lorazepam has anxiolytic, sedative, and amnesic properties, but the time to peak effect and duration of action are long, making other benzodiazepines the preferred choice [79]. The drug is sometimes used for procedures that are expected to last longer than two hours [6].

Pharmacokinetics. The time of onset of lorazepam is 1 to 2 minutes when given intravenously, with a peak effect at 15 to 30 minutes [79]. When the drug is given intramuscularly, the time of onset is 15 to 30 minutes with a peak effect at 60 to 90 minutes [6]. The drug's duration of action is six to eight hours [6].

Dosage. As a premedication, lorazepam is given intramuscularly at a dose of 2–4 mg (0.05 mg/kg) two hours before the procedure or intravenously at a dose of 0.044 mg/kg, 15 to 20 minutes before the procedure [6; 86; 87]. The maximum dose (regardless of route) is 4 mg (or 2 mg for patients older than 50 years of age) [28; 87].

Contraindications and Precautions. Lorazepam is associated with a risk of underventilation and apnea, so should be given with caution to people who are very ill or who have limited pulmonary reserve [6].

Potential Adverse Events and Side Effects. Among the most common side effects are hallucinations, dizziness, change in blood pressure, blurred vision, nausea and vomiting, and tinnitus [6].

Ultrashort-Acting Agents

Propofol

Propofol is a sedative hypnotic that is being used more frequently for moderate sedation across settings, especially as its availability has increased. The drug offers very short action, with the patient awakening very rapidly after administration of the drug is stopped. Propofol offers the effects of sedation, amnesia, and antiemesis but has no analgesic properties [69; 80]. The therapeutic index is narrow, and the risk for deep sedation is high [11]. Therefore, the ASA recommends that patients who receive propofol (by any route) should receive care that is consistent with that required for deep sedation [11]. The ASA also notes that clinicians who administer propofol should be qualified to rescue patients from any level of sedation, including general anesthesia [11]. Propofol has no antagonist.

The American College of Emergency Physicians asserts that propofol can be safely administered to children and adults for procedural sedation and analgesia in the emergency department.

(https://www.acep.org/patient-care/clinical-policies/procedural-sedation-and-analgesia. Last accessed September 26, 2022.)

Strength of Recommendation: A (Generally accepted principles for patient care that reflect a high degree of clinical certainty)

Pharmacokinetics. The onset of action is less than one minute (typically 30 to 45 seconds), the peak effect occurs within one to two minutes, and the duration of effect is four to eight minutes [69; 80].

Dosage and Administration. Propofol is administered as a continuous IV infusion. For endoscopic procedures, the initial dose is typically 10–40 mg, with a maximum dose of 400 mg [28]. In the emergency department setting, the most common starting dose is 1.0 mg/kg given as a slow bolus infusion, followed by 0.5 mg/kg given every three minutes as needed [80]. The sedative effect of propofol is more pronounced in the elderly; therefore, in patients older than 55 years of age, it is recommended that the dose be reduced by 20% and the initial injection given more slowly (over three to five minutes). Pain at the injection site has been reported by up to 20% of patients [80]. Lidocaine (0.5 mg/kg), given either before administration or in combination with the propofol bolus, may help to decrease the risk of injection site pain [80]. The pediatric dose is 1–2 mg/kg, given as a bolus over 30 seconds [87].

Propofol is not an antimicrobially preserved product under U.S. Pharmacopeia Convention standards, and because of this, the FDA makes several recommendations regarding administration [88]:

- Use the vial or the prefilled syringe formulation on only one patient.
- Visually inspect propofol for the presence of particulate matter, discoloration, and separation of the phases of the emulsion.
- Disinfect the vial rubber stopper with 70% isopropyl alcohol.
- Administer the drug immediately after the vial or syringe has been opened.
- Complete administration from a single vial or syringe within six hours after opening.
- Discard unused drug within the time limit noted.

Contraindications and Precautions. Because the formulation of propofol includes soybean oil (10%) and purified egg phophatide (1.2%), there was some concern that it might induce an allergic reaction in patients with allergy to egg or soy [69; 80]. However, allergic reactions are to proteins (not fats), and these patients can receive propofol without any special precautions.

Potential Adverse Events and Side Effects. Respiratory depression and cardiovascular instability are the major potential adverse events associated with propofol [69]. The drug produces negative inotropic effects on the cardiovascular system, which can result in a substantial decrease in blood pressure after administration [80]. However, these effects tend to resolve rapidly because of the drug's short duration of action. Hiccups, wheezing, and coughing may occur as a result of the respiratory effects of the drug. Other side effects that have been reported include headache, confusion, and euphoria [6]. Many patients have also described sexually explicit dreams during sedation with the drug [89].

Special Populations. Patients with an ASA physical status of III or IV are at higher risk for propofol-associated hypotension [80].

Etomidate

Like propofol, etomidate (Amidate) is an ultra-short-acting sedative hypnotic. It has been traditionally used as induction for general anesthesia and for rapid sequence intubation in the emergency department [90; 91]. An advantage of etomidate is an absence of any effect on cardiovascular stability. The drug is used for sedation for short procedures, primarily in the emergency department setting; it is not routinely used in the endoscopy setting. Etomidate has no antagonist.

Pharmacokinetics. The onset of action of etomidate is less than one minute, with the peak effect reached within one minute. The duration of effect is 5 to 15 minutes [81; 82]. Full recovery is achieved in approximately 13 to 30 minutes [83; 84].

Dosage and Administration. The usual initial dose of etomidate (for both adults and children) is 0.2–0.6 mg/kg given IV over 30 to 60 seconds [86]. This may be repeated at three- to five-minute intervals, as needed, to a total of three doses given [82; 83; 85].

Contraindications and Precautions. Etomidate is contraindicated in patients with hypersensitivity to the drug [82].

Potential Adverse Events and Side Effects. Respiratory depression may occur, but myoclonus is the most common side effect, reported in 20% to 45% of patients during procedural sedation. In one small study, myoclonus occurred in 72% of patients receiving etomidate [81; 90; 92; 93]. There are protocols for minimizing myoclonus, including pretreatment with a fraction dose of etomidate or a small dose of a short-acting benzodiazepine. Pain at the injection site has also been common, occurring in up to 40% of patients [81]. Nausea and vomiting during emergence have also been reported at low rates [83; 90].

Special Populations. Respiratory depression may be more common in older patients (older than 55 years of age), especially at higher-than-average doses [84]. Among older patients, no significant differences in the rate of complications or length of stay in the emergency department have been found compared with younger patients [94].

OPIOIDS

Opioid drugs are distinct because of their analgesic properties and are typically given to provide the patient with some level of pain relief during a procedure. As noted, care should be taken when an opioid is given in combination with a benzodiazepine, as a synergistic effect increases the risk of respiratory depression [69]. The opioids most often used for moderate sedation are meperidine and fentanyl, both of which provide analgesia as well as sedation [28].

Meperidine

Meperidine (Demerol) provides good control of substantial pain, but other opioids provide better and safer sedation [79].

Pharmacokinetics

The time to onset of action is three to six minutes, with the peak effect at five to seven minutes [69]. The effect of the drug lasts one to three hours [69].

Dosage

The typical starting dose of meperidine is 25–50 mg [69]. Additional doses of 25 mg may be given every two to five minutes, up to a maximum dose of 150 mg [28].

Contraindications and Precautions

Meperidine is contraindicated for patients taking an MAO inhibitor, as life-threatening complications may develop from the interaction of these two drugs [28]. The drug should be used with caution in patients with renal disease because the accumulation of normeperidine can lead to a neurotoxic reaction [69].

Potential Adverse Events and Side Effects

Respiratory depression is a potential adverse event; cardiovascular instability has also been noted, but to a lesser extent [69]. The most common side effects are pruritus and vomiting [69; 79].

FENTANYL

Fentanyl (Sublimaze) is a synthetic opioid that is structurally related to meperidine and is 100 times more potent than morphine [69]. Fentanyl is frequently used as the analgesic component of moderate sedation because of its short length of action. The drug can be administered intravenously, intramuscularly, or transmucosal; for moderate sedation, the IV route is used most often.

Pharmacokinetics

The time of onset of action is within one to two minutes, with the peak effect occurring at three to five minutes [69].

Dosage and Administration

In the endoscopy setting, the usual initial dose for moderate sedation in adults is 50–100 mcg given by slow IV injection [69]. The dose can be titrated to effect using incremental doses of 25 mcg every two minutes, up to a maximum of 200 mcg [28]. The pediatric dose is 0.5–2 mcg/kg, with a maximum dose of 5 mcg/kg [87].

Contraindications and Precautions

Fentanyl should be administered with caution to patients with respiratory disease (e.g., asthma, chronic obstructive pulmonary disease), as a major adverse event associated with the drug is respiratory depression [69]. The drug should be used cautiously with other CNS depressants, such as barbiturates, as they will have an additive or potentiating effect [6]. Caution should be used when prescribing fentanyl with benzodiazepines or other CNS depressants [86].

Potential Adverse Events and Side Effects

Respiratory depression and chest wall rigidity are potential adverse events [69]. Chest wall rigidity is rare but is more likely with rapid infusion of the drug or high doses [95]. Nausea and vomiting may occur [6; 28].

Special Populations

The dose of fentanyl should be reduced by at least 50% in patients older than 65 years of age [28; 87].

DISSOCIATIVES

Ketamine

Ketamine (Ketalar) is a dissociative drug, or one that "dissociates" the thalamus from the limbic system. Ketamine provides both analgesia and amnesia; as such, it is one of the few drugs other than opioids that provide pain relief with moderate sedation. Another benefit is its minimal effect on the cardiovascular and respiratory systems [69]. Ketamine produces a cataleptic state, and the onset of sedation is marked by the development of nystagmus and an open-eye gaze. Once dissociation occurs, patients are unable to respond to external stimuli, making the level of sedation inconsistent with the definition of moderate sedation [96]. Dissociation may also cause random body movements, which means the drug is not appropriate for procedures that require the patient to be motionless (such as imaging studies) [96]. The drug has a bronchodilation effect, making it useful for patients with asthma [79]. Ketamine is often used in combination with propofol (known as "ketofol").

Pharmacokinetics

Ketamine has an onset of action of less than one minute, with the peak effect occurring at one minute. The duration of the drug's effect is 10 to 20 minutes [69].

Dosage and Administration

In the endoscopy setting, the typical initial dose of IV ketamine is 0.5 mg/kg, and the dose is titrated to effect [28]. In the emergency department setting, IV administration is preferred for adults because of the ease of repeated doses and association with less vomiting [96]. The initial dose for adults is 1.0 mg/kg, given over 30 to 60 seconds, with repeat doses (0.5 mg/kg) given every 5 to 15 minutes as needed [96]. For children, the initial dose is 1.5–2.0 mg/kg, with repeat doses of 0.5–1.0 mg/kg given every 5 to 15 minutes [96]. The initial dose of intramuscular ketamine is 4–5 mg/kg for adults and children, with 2–4 mg/kg given 10 minutes after the initial dose if sedation is not adequate [96].

Contraindications and Precautions

Absolute contraindications for ketamine include an age younger than 3 months (because of the high risk of airway-related complications) and known or suspected schizophrenia [79; 96]. Relative contraindications include major procedures that stimulate the posterior pharynx; a history of airway instability; active pulmonary infection or disease; significant cardiac arrhythmia, coronary artery disease, or hypertension; CNS abnormalities; glaucoma or acute globe injury; and thyroid disorders [96]. Head trauma, minor oropharyngeal procedures, and an age of 3 to 12 months are no longer contraindications [96].

Potential Adverse Events and Side Effects

Emergence reactions have occurred in approximately 10% to 30% of adults who receive ketamine [69]. These reactions range from vivid dreams to hallucinations and delirium [69]. Because of the risk for emergence reactions, ketamine is not usually used alone in adults [97]. The concomitant use of midazolam may help reduce this risk [69]. Vomiting occurs in approximately 5% to 15% of adults and less commonly in children and adolescents; it is more likely when the drug is given intramuscularly [96]. Airway or respiratory complications have occurred in approximately 4% of children [96].

Prophylactic anticholinergics were once recommended for adults to reduce the risk of airway-related adverse events (by preventing oral secretions), but studies showed no benefit to this prophylaxis [96]. Benzodiazepines were once recommended to combat emergence reactions in children but these reactions are rare in children and this prophylaxis is no longer recommended [96].

OTHER DRUGS

Several other drugs have been used for moderate sedation, though some have been largely replaced by drugs with greater benefit and lower risks [6; 69].

Diphenhydramine (Benadryl) and promethazine (Phenergan) are antihistamines that may be used as adjuncts for sedation for endoscopy or minor surgical procedures. When given as an adjunct to meperidine and midazolam for colonoscopy, diphenhydramine increased patient scores for overall sedation (compared with placebo) and decreased the amount of meperidine and midazolam needed [69]. Promethazine, an antiemetic, has been used as an adjunct to opioids or benzodiazepines for endoscopy, and its antiemetic effect may be beneficial for some patients [31; 69; 79]. Antihistamines are less effective than benzodiazepines in terms of anxiolysis and sedation [79].

Droperidol (Inapsine) has been used as an adjunct to opioids and benzodiazepines for complex endoscopic procedures or for patients who are difficult to sedate (such as patients with a history of alcohol or drug abuse) [98]. However, droperidol is associated with serious side effects, including hypotension, prolongation of the QTc interval, and extrapyramidal signs [69]. The drug is contraindicated in patients with a prolonged QTc interval, and the FDA added a black box warning to the drug's label in 2001 to highlight the potential for sudden cardiac death at high doses in psychiatric patients [69; 86].

Barbiturates have many disadvantages as moderate sedation drugs, including no substantial anxiolytic or amnestic effect, cumulative effects that may cause deep sedation when used with another drug, and substantial effects on the cardiovascular and respiratory systems [79]. In addition, painful stimuli may cause delirium and agitation [79]. Two barbiturates are still in some use for moderate sedation: methohexital and pentobarbital. The ACEP notes that both are options for the sedation of children who are to have painless procedures [29; 30].

Chloral hydrate has been used for sedation, but it is used rarely now because of its unpredictable cardiac toxicity, little to no analgesic or amnesic effects, and the availability of other sedation medications that offer greater benefit, including midazolam [79; 95]. The drug is still an option for children who require sedation for a painless diagnostic procedure, and it can be given orally or rectally (for infants) [30]. It is more effective for children younger than 4 years of age than older children [30]. Although the drug may be used safely and effectively in properly monitored children who have congenital cardiac anomalies, it should not be used for children with neurodevelopmental disorders because of an increased incidence of adverse effects and decreased efficacy compared with healthy children [30]. The disadvantages of chloral hydrate are increased risks of respiratory depression, hypoxia and resedation, with the potential for residual effects up to 24 hours after the drug has been given [30].

Nitrous oxide is an option for children and may be used with a local anesthetic for safe and effective sedation for healthy children undergoing a painful procedure [30]. Other sedative analgesic drugs may be used in combination with nitrous oxide, but the combination increases the risk for deeper sedation, respiratory depression, and other adverse events; careful monitoring is needed [30]. Nitrous oxide may be less effective in reducing procedure-related distress in younger children compared with older children [30].

Dexmedetomidine (Precedex) is an effective sedative for selected procedures and is currently FDA-approved for procedural sedation and short-term mechanically ventilated adults in an intensive care unit [86; 99]. The drug provides sedation, anxiolysis, analgesia, and hypnosis; its analgesic effects are small, and the use of another analgesic may be necessary for more painful procedures [99]. Advantages include a rapid onset of action, minimal effects on the respiratory and cardiovascular systems, and few side effects [99].

ANTAGONISTS (REVERSAL AGENTS)

The ASA recommends that, whenever possible, antagonists should be on hand during the use of moderate sedation [11]. Antagonists are available to reverse the effects of opioids and benzodiazepines, but as yet no antagonist agents exist for propofol, etomidate, or barbiturates [69]. Naloxone hydrochloride can be used to reverse the effect of opioids, and flumazenil (Romazicon) can reverse the effects of benzodiazepines (***Table 12***) [28; 69].

MODERATE SEDATION REVERSAL AGENTS					
Drug	**Dose**	**Time to Onset of Action (min)**	**Time to Peak Effect (min)**	**Duration of Effect (min)**	**Comments**
Naloxone (opioids)	0.4–2 mg IV at 2-minute intervals until desired effect	1–2	5	30–45	Use repeat boluses or a continuous infusion to maintain adequate blood levels until the opioid agonist is eliminated.
Flumazenil (benzodiazepines)	0.2 mg IV at 15-second intervals Maximum dose: 1 mg	1–2	3	60	—

Source: [28; 69; 86] *Table 12*

The ASA guidelines note that other steps should be taken before or concomitantly with pharmacologic reversal in patients who become hypoxemic or apneic during sedation, including [11]:

- Encouragement or stimulation of deep breathing
- Supplemental oxygen
- Positive pressure ventilation if spontaneous ventilation is inadequate

The ASA also recommends that patients be closely monitored after pharmacologic reversal to ensure that sedation and cardiorespiratory depression do not recur [11].

COMPARISON OF MODERATE SEDATION DRUGS IN SPECIFIC SETTINGS

The choice of drug or drug combination for moderate sedation varies in relation to the clinical setting, type and duration of the procedure, need for analgesia, and patient characteristics. For example, the duration of sedative effect required for endoscopy procedures is often considerably longer than procedures in the emergency department setting. Several agents are available for moderate sedation in each setting, and studies have compared their efficacy, safety, and efficiency. Most clinical research on specific agents has focused on the endoscopy and emergency department setting, with few data available on comparison of drugs in an office-based setting.

ENDOSCOPY

Adults

For adults in the endoscopy setting, the combination of a benzodiazepine and an opioid is used most often for moderate sedation. A national survey showed that approximately 74% of endoscopists were using this approach, typically combining midazolam and fentanyl [24]. Propofol was used by approximately 26%; this rate may reflect restrictive guidance on the use of propofol and may have increased since the time of the survey [24].

As noted, the safety of propofol and the restrictions regarding the professionals qualified to administer it have been the subject of intense debate. However, several studies have shown that propofol is safe when administered by non-anesthesia personnel in the endoscopy setting. In a report involving nearly 650,000 cases worldwide of endoscopist-directed sedation with propofol, 11 patients required endotracheal intubations, no patient had permanent neurologic injury, and four patients died [35]. The four people who died included two with pancreatic cancer, one with severe mental retardation, and one with severe cardiomyopathy [35]. The authors

estimated that, if anesthesia specialists had been used in all these cases (and had prevented the four deaths), the estimated cost per life-year saved would be $5.3 million [35].

In a subsequent literature review, propofol administered by non-anesthesia clinicians (including specially trained nurses) for sedation during endoscopy was safe, with minor adverse events in less than 1% of patients [36]. There were no deaths and no patients who required endotracheal intubation [36].

When compared with traditional drugs for sedation during colonoscopy, propofol has been as safe as benzodiazepines and/or opioids, with a faster onset of action and a deeper level of sedation. A systematic review demonstrated that procedure time, pain control, and rate of complications were similar for propofol and traditional drugs, but propofol was associated with shorter recovery and discharge times and higher rates of patient satisfaction [100]. These benefits have been observed in other studies, along with lower rates of memory and recall of pain and gagging during the procedure among patients who received propofol [25; 101; 102]. Clinician satisfaction has also been reported to be significantly higher for propofol than conventional sedation [24]. Shorter recovery and discharge times also help to enhance the efficiency in endoscopy suites [103].

A meta-analysis (22 trials, 1,798 adults) demonstrated that propofol for gastrointestinal endoscopy was comparable to traditional sedative agents in terms of safety [104]. The rates of cardiopulmonary complications (i.e., hypoxia, hypotension, arrhythmia, and apnea) were similar for patients who received propofol and those who received traditional sedative agents, even among high-risk patients [104]. Lastly, a 2013 study and statistical analysis (200 patients) found that deep sedation during endoscopy occurred more frequently and recovery times were shorter with propofol/fentanyl than with midazolam/fentanyl [102].

Propofol offers an additional benefit in that it has increased the completion rate for complicated procedures. For example, endoscopic retrograde cholangiopancreatography (ERCP) with traditional sedation is poorly tolerated by patients, and in many cases, the procedure must be interrupted before satisfactory images have been obtained, necessitating additional interventions with associated risks and added cost. In a study of 252 patients who had ERCP, propofol significantly decreased the rate of incomplete procedures compared with sedation using a benzodiazepine (4% vs. 11%) [105]. The median hospital stay was similar for the two agents, as were the rates of mild sedation-related complications and mild procedural complications.

Children and Adolescents

Data on sedation for children and adolescents undergoing endoscopy are limited. The authors of a systematic review published in 2012 (11 randomized and 15 nonrandomized controlled trials) targeted studies involving children and adolescents younger than 18 years of age [106]. Few of the trials compared different drugs, but the review demonstrated that propofol-based sedation had a safety profile similar to that of an opioid and benzodiazepine [106]. Data on midazolam- and ketamine-based sedation were too limited to draw conclusions. Sedation was most effective with propofol; the authors noted that adding midazolam, fentanyl, or ketamine to propofol may enhance the effectiveness without increasing adverse events [106].

The evidence for the safety of propofol among children includes data collected by the PSRC (which included gastrointestinal procedures as well as radiographic studies, hematology/oncology procedures, and others) regarding propofol sedation/anesthesia at 27 locations within the United States. Overall, the rate of pulmonary complications was 235 per 10,000 sedations; the rate of unintended deep sedation was low (0.9 per 10,000), as was use of a reversal agent (0.4 per 10,000) [107]. No patient died, and two patients required cardiopulmonary resuscitation.

AMERICAN COLLEGE OF EMERGENCY PHYSICIANS RECOMMENDATIONS FOR DRUGS USED FOR MODERATE SEDATION IN ADULTS DURING PROCEDURES IN THE EMERGENCY DEPARTMENT		
Drug	**Recommended Use**	**Level of Recommendation[a]**
Propofol (alone)	Can be safely administered for procedural sedation and analgesia	A
Ketamine and propofol	Can be safely administered for procedural sedation and analgesia	B
Etomidate	Can be safely administered for procedural sedation and analgesia	B
Ketamine (alone)	Can be safely administered for procedural sedation and analgesia	C
[a]Level A: Based on evidence from one or more Class I or multiple Class II (observational) studies. These are generally accepted principles for patient care that reflect a high degree of clinical certainty. Level B: Based on strength of evidence Class II (observational) studies that directly address the issue, decision analysis that directly addresses the issue, or strong consensus of strength of evidence Class III (cross-sectional, case series/reports, or consensus) studies. Level C: Based on preliminary, inconclusive, or conflicting evidence, or in the absence of any published literature, panel consensus.		
Source: [7]		*Table 13*

EMERGENCY DEPARTMENT

The ideal drug for moderate sedation in the emergency department would be easily titrated; have a rapid onset of action, short duration of effect, and rapid recovery; provide sufficient anxiolysis, sedation, analgesia, amnesia, and motor control; and be associated with minimal side effects and cardiorespiratory depression [108; 109; 110]. Although many agents have been tried, no single drug fits this profile, especially given the range of procedures done in the emergency department setting.

Adults

In its clinical policy on procedural sedation and analgesia in the emergency department, the ACEP provided evidence-based recommendations regarding etomidate, "ketofol," and propofol (***Table 13***) [7; 80]. Ketamine alone was also recommended for children (Level A recommendation) and adults (Level C recommendation) in the ACEP clinical policy. The ACEP suggests that when using any opioid and benzodiazepine, as with fentanyl and midazolam, the opioid should be given first, as it presents the greater risk of respiratory depression; the dose of the benzodiazepine should then be titrated [7].

Etomidate has many advantages for use in the emergency department, including a rapid onset of action, short duration of action, stable hemodynamic profile, and favorable side effect profile [81; 83; 90]. It is used for short procedures, such as joint relocations, fracture care, cardioversion, removal of foreign bodies, and repair of lacerations, and rates of procedure completion and patient satisfaction have been high [14; 15; 83; 84; 92]. The ACEP notes that the drug can be safely used for procedural sedation and analgesia (level B recommendation), but careful dosing and monitoring must be carried out, as the drug can quickly induce deep sedation [7; 90].

The use of propofol has increased as the safety and efficacy of the drug has been demonstrated and the drug has become more accessible [111; 112]. The drug has been found to have many benefits, with similar or lower rates of adverse events compared with traditional drugs used for moderate sedation (***Table 14***) [92; 111; 113; 114; 115; 116; 117].

COMPARISON OF EFFICACY AND SAFETY OF PROPOFOL WITH TRADITIONAL MODERATE SEDATION DRUGS IN THE EMERGENCY DEPARTMENT SETTING		
Comparative Drug	**Efficacy**	**Safety**
Several alternatives	Significantly higher number of cases in which a single agent was sufficient for sedation Significantly lower rate of sedation with propofol	Significantly lower rate of complications
Midazolam	Higher rate of procedural success with propofol Shorter recovery time and length of stay	No significant difference in safety profiles
Etomidate	Higher rate of procedural success with propofol	Comparable rates of adverse events[a]
Ketamine	Significantly shorter time to regaining of baseline mental status Similar procedure times, number of successful procedures, pain, and recall of the procedure	Significantly lower rate of subclinical respiratory depression Similar rates of clinical interventions related to respiratory depression Less frequent recovery agitation
Methohexital	Equally effective, with no differences in the rates of patient satisfaction, patient recall, or procedure-related pain	Equally safe
[a]The rate of myoclonus was higher among patients who received etomidate (20% vs 2%).		
Source: [80; 111; 112; 113; 114; 115; 116; 117]		*Table 14*

Propofol has also been found to be more cost-effective than traditional drugs, primarily because of decreased staff time and shorter lengths of stay [115; 118]. One study showed an approximate savings of $597 per successful sedation with propofol [119].

Propofol has also been evaluated in combination with a low dose of ketamine. The rationale for this combination is that using lower doses of each agent may reduce the undesirable adverse effects of both agents while maintaining optimal sedation during procedures [120; 121]. The two drugs can either be drawn up in the same syringe or be given in two syringes. When given separately, an IV bolus of ketamine is given first, followed by a bolus of propofol, with additional boluses of propofol given to maintain sedation [97]. A 1:1 ratio is typically used when given in the same syringe, but the ratio of propofol to ketamine has varied among trials (range: 10:1 to 2:1), and the optimum dose of the agents in combination is unclear [97; 120].

In a study of 114 procedural sedation and analgesia events (primarily orthopedic procedures), the combination (a 1:1 mixture of ketamine 10 mg/mL and propofol 10 mg/mL) was associated with few adverse events, which were either self-limited or responded to minimal interventions [122]. No patient had hypotension or vomiting or received endotracheal intubation. The procedure was successfully performed without the need for other sedatives in approximately 97% of patients. The median recovery time was 15 minutes (range: 5 to 45 minutes), and both clinician and patient satisfaction was high, with median scores of 10 on a scale of 1 to 10 [122].

An early review of studies in which the propofol/ketamine combination was compared with propofol alone provided insufficient evidence to recommend its use [109]. Significant hemodynamic and respiratory compromise occurred in fewer patients who received the combination, but the need for active interventions did not differ between the combination and propofol alone [109]. In addi-

tion, higher doses of ketamine were associated with increased rates of nausea, vomiting, and emergence reactions following the procedure [109]. The findings of a subsequent systematic review (eight trials) confirmed these results, with no superior clinical efficacy for the combination compared with propofol alone, conflicting data on reduced hemodynamic and respiratory complications with the combination, and an increased rate of adverse events with higher doses of ketamine [120].

Later studies have shown benefit in both efficacy and safety. In a small study comparing ketamine and propofol with propofol alone, the effectiveness was similar, but the combination was associated with better quality of sedation, enhanced patient comfort, and higher rates of clinician satisfaction, as well as a smaller decline in systolic blood pressure [108]. In another study (in adults and children), the combination was associated with a trend toward better quality of sedation, lower doses of propofol, and greater staff satisfaction; the rate of respiratory depression was similar [123]. The findings of a 2011 review of 10 trials also suggested that the combination was associated with a lower rate of hypotension and respiratory depression [97]. Results of a study published in 2015 found that the combination resulted in a lower frequency of adverse respiratory events compared with propofol alone [124].

Children and Adolescents

When considering drugs for moderate sedation for children and adolescents in the emergency department, clinicians should choose a drug with the highest therapeutic index and administer the lowest possible dose [13]. Analgesics should be used for painful procedures, and sedative/hypnotics should be used for nonpainful procedures (such as imaging studies) [13]. Either a single agent or a combination of drugs may be used when both sedation and analgesia are desired. Deep or dissociative sedation is often required for children who are to undergo a painful procedure [30].

The ACEP has outlined the evidence base for the safety of sedation drugs for children undergoing procedures in the emergency department (***Table 15***) [10]. Options for painful procedures include but are not limited to opioids, benzodiazepines, and barbiturates, and specific agents such as ketamine, propofol, remifentanil, dexmedetomidine, etomidate, and nitrous oxide [29]. In an effort to best achieve the goals of sedation in children, many studies have evaluated combinations of these drugs. The ACEP no longer makes specific recommendations for the use of a single agent or combination of agents for patients or sedation procedures [29]. A 2011 ACEP policy statement acknowledges that emergency department physicians are highly skilled in selecting and performing sedation and note that the relative needs of analgesia and sedation should be weighed against the potential risks, benefits, and alternatives when individualizing their plan for patient sedation.

When ketamine and midazolam was compared with etomidate and fentanyl in a small study (23 children), ketamine and midazolam was more effective at reducing pain and distress (as scored on the Observational Scale of Behavioral Distress-Revised) during sedation for a procedure (orthopedic reduction) [125]. However, etomidate and fentanyl may be suitable for short, simple procedures, as the combination was associated with significantly shorter total sedation times (approximately 50 minutes vs. 78 minutes) and recovery times (approximately 25 minutes vs. 61 minutes) [125]. The adverse effect profiles of the two drug combinations differed; dysphoric emergence reaction and vomiting occurred among children who received ketamine and midazolam, and vomiting, injection-site pain, and myoclonus occurred in children who received etomidate and fentanyl [125].

Etomidate and fentanyl was found to be safe and effective in children in another study, in which an initial dose of 0.2 mg/kg IV was associated with adequate sedation in 60% to 67% of children, depending on the procedure [85]. The procedure was successfully completed in all but one child, and no significant adverse respiratory events occurred [85].

AMERICAN COLLEGE OF EMERGENCY PHYSICIANS RECOMMENDATIONS FOR DRUGS USED FOR MODERATE SEDATION IN CHILDREN DURING PROCEDURES IN THE EMERGENCY DEPARTMENT		
Drug	**Recommended Use**	**Level of Recommendation[a]**
Ketamine (alone)	Can be safely administered for procedural sedation and analgesia	A
Propofol (alone)	Can be safely administered for procedural sedation and analgesia	A
Ketamine and propofol	Can be safely administered for procedural sedation and analgesia	B
Etomidate	Can be safely administered for procedural sedation and analgesia	C

[a]Level A: Based on evidence from one or more Class I (randomized, controlled) or multiple Class II (observational) studies. These are generally accepted principles for patient care that reflect a high degree of clinical certainty.
Level B: Based on strength of evidence Class II studies that directly address the issue, decision analysis that directly addresses the issue, or strong consensus of strength of evidence Class III (cross-sectional, case series/reports, or consensus) studies.
Level C: Based on preliminary, inconclusive, or conflicting evidence, or in the absence of any published literature, panel consensus.

Source: [7] *Table 15*

The combination of ketamine and propofol has also been evaluated in children. In one study, the combination (median dose: 0.8 mg/kg of each drug) was effective in 219 young individuals (1 to 20 years of age) having a procedure in the emergency department [126]. Sedation was effective in all patients, with a median recovery time of 14 minutes (range: 3 to 41 minutes). The rate of adverse events was low; three patients (1.4%) experienced an airway event requiring intervention (with positive pressure ventilation needed in one patient) and two patients (0.9%) had emergence reactions requiring treatment [126].

MANAGEMENT OF COMPLICATIONS

Knowledge and skill in managing potential complications of moderate sedation is essential. Most complications occur because of sedation becoming deeper than intended (rather than not reaching adequate sedation) [11]. This is especially important for children, as studies have indicated that children often reach a level of sedation that is deeper than intended [13]. Clinicians who administer moderate sedation must be qualified to rescue patients who reach a deep level of sedation [11].

Overall, the risk of sedation-related complications is low. A retrospective review of the Clinical Outcomes Research Initiative database demonstrated that the rate of cardiopulmonary unplanned events was 1.4% of 324,737 endoscopic procedures [127]. Patient age, higher ASA class, and routine use of supplemental oxygen were associated with a higher incidence of events [127]. A 2016 systematic review and meta-analysis of 9,652 procedural sedations in adults in the emergency department found that the rate of severe adverse events was approximately 4% for hypoxia, 1.6% for emesis, 1.5% for hypotension, and 1.2% for apnea [128].

An important factor in the rate of complications is the drug or drugs used for sedation. In one meta-analysis, the lowest rates of complications were associated with ketamine/propofol and the highest rates were associated with midazolam, midazolam/opiate, and ketamine (alone) [128]. Ketamine alone or in combination with propofol is associated with high rates of agitation (16% and 5%, respectively). Among children, midazolam and fentanyl has been associated with the highest rate of respiratory adverse events at 19.3%, compared with 10% for ketamine and midazolam, 6.1% for ketamine alone, and 5.8% for midazolam alone [129]. In a later study, the rate of pulmonary

MANAGEMENT OF COMMON SERIOUS COMPLICATIONS DURING MODERATE SEDATION		
Complication	**Clinical Signs**	**Interventions[a]**
Respiratory depression/ soft tissue obstruction	Decreased, shallow, or labored respirations Rocking motion of chest Weak cough, high-pitched noise during inspiration (partial obstruction) No movement of air (complete obstruction) Decreased oxygen saturation	Put patient in supine position Stimulate patient (call name or gently shake) Administer supplemental oxygen Perform head tilt-chin lift or jaw-thrust maneuver Insert artificial airway (nasopharyngeal or oropharyngeal) Administer positive pressure ventilation with bag-valve-mask device Insert endotracheal tube Administer reversal agent
Laryngospasm	Loud crowing sound (partial spasm) Lack of air exchange (complete)	Administer supplemental oxygen Provide calming measures Ask patient to breathe slowly and deeply and to cough Administer low dose of midazolam or lidocaine Administer positive pressure ventilation with 100% oxygen and suction Administer low dose of succinyl choline Insert endotracheal tube
Bronchospasm	Mild wheezing heard only on auscultation (only smaller bronchioles affected) Audible wheezing, tachypnea, dyspnea, decreased lung compliance, decreased oxygen saturation, restlessness (greater area of lung affected)	Administer bronchodilator Administer humidified oxygen
Hypotension	>20% decrease in blood pressure for more than two minutes	Place patient in Trendelenburg position Perform ABC assessment Confirm appropriate ECG rate and rhythm: treat arrhythmia or notify cardiologist if signs of MI or ischemia are present Consider hypovolemia: administer rapid IV bolus of 0.9% saline (in the absence of contraindications) Consider other causes: if drug effect, administer reversal agent; if decreased vascular resistance, administer vasopressor
[a]In general, interventions should be carried out in order of simple to aggressive, but more aggressive measures may be needed immediately depending on the patient's condition. ABC = airway, breathing, circulation, ECG = electrocardiogram, MI = myocardial infarction.		
Source: [6; 132]		*Table 16*

EMERGENCY EQUIPMENT FOR SETTINGS IN WHICH MODERATE SEDATION WILL BE ADMINISTERED[a]	
Standard equipment	Basic airway management equipment Blood pressure monitoring system Cardiac defibrillator Cardiac monitoring system Intravenous access equipment (tubing, catheters, fluids) Oxygen supply and delivery system (adult and pediatric nasal cannulas and face masks) Pulse oximeter
Emergency airway supplies	Advanced airway management equipment Bag-mask ventilation device Blades (Miller, MacIntosh) Endotracheal tubes (cuffed and uncuffed) and stylets (adult and pediatric) Laryngeal mask airways (adult and pediatric) Laryngoscope blades and handles Light bulbs Magill forceps (adult, pediatric) Nasopharyngeal and oropharyngeal airways (appropriate sizes) Sterile lubricant Suction equipment (source, catheters) Tongue blades Yankauer suction catheters
Support supplies	Alcohol wipes Adhesive tape Gloves Needles (assorted) for drug aspiration, intramuscular injection [Intraosseous bone marrow needle] Sterile gauze pads Syringes (assorted sizes) Tourniquets
Emergency medications	Atropine Amiodarone Diazepam or midazolam Diphenhydramine Ephedrine Epinephrine (1:1,000 and/or 1:10,000) Glucose 50% [10% or 20%] Hydrocortisone, methylprednisolone, or dexamethasone Lidocaine Nitroglycerin (tablets or spray) Sodium bicarbonate Vasopressin
Pharmacologic antagonists	Flumazenil Naloxone
[a]This list should be used as a guide, depending on the setting. Equipment noted in brackets is recommended in settings where sedation may be used for infants or children.	
Source: [7; 11; 13; 28]	*Table 17*

complications among children who had received propofol was 2.4%, with the most common complications being laryngospasm, airway obstruction, and oxygen desaturation of less than 90% for more than 30 seconds [107].

Age has also been reported to be a factor for complications. However, in a study in the emergency department setting, the rate of complications was not higher for patients 65 years of age and older than for younger patients [130]. With regard to children, serious complications occur more often among children younger than 2 years of age [107]. Such complications are also more common among children who have underlying disease and who receive multiple sedatives [107].

The most common complications during moderate sedation are respiratory depression, airway obstruction, laryngospasm, bronchospasm, and hypotension [6; 11; 69; 107; 131]. Immediate identification of these complications and prompt interventions are needed (***Table 16***) [6].

In settings in which moderate sedation is used, all essential emergency equipment and qualified personnel must be readily available and standards of care and policies must be established [6; 11]. Guidelines recommend appropriate emergency equipment and supplies (***Table 17***) [11; 28]. Patients who receive IV medication should have vascular access maintained throughout the procedure, and personnel with skills to establish IV access should be immediately available [11].

LEGAL/RISK MANAGEMENT ISSUES

Determining the number of malpractice claims related to the use of moderate sedation is difficult. It has been estimated that approximately one in every 500 malpractice claims involves complications related to endoscopic sedation [28]. (Data on claims related to sedation in the emergency department setting are not available.) Potential legal issues related to moderate sedation are associated with a failure to administer sedation according to the standard of care, failure to obtain appropriate informed consent, and the patient's discharge status [28; 133]. In addition, patient expectation of pain-free procedures may increase the risk of malpractice claims for two reasons: patients' claims of inadequate sedation, and oversedation as a way to ensure a pain-free status [28]. Some key measures can help clinicians reduce their risk of malpractice related to moderate sedation (***Table 18***) [134]. All clinicians should discuss the possibility that the patient may have pain or discomfort despite appropriate sedation [28]. The discussion about sedation should also note that the patient may not remember the procedure and postprocedure discussion and that there is a risk for allergic drug reactions and local reactions at the IV site [28]. The discussion of these points should be carefully documented to provide proof in the event of legal action. The preprocedure discussion should also address informed consent, as outlined previously.

The primary goal of informed consent is to protect patients by requiring that physicians provide a balanced discussion of a proposed procedure/treatment, as well as of the alternative options, so patients can make informed medical decisions [135]. Inadequate communication with patients and/or family, including informed consent, is an underlying cause of approximately 21% of malpractice claims [136]. Proof of a complete informed consent process is the best defense against a malpractice claim [28]. Thus, practitioners should use strategies that help to ensure that patients understand the informed consent discussion.

In all situations, the informed consent discussion should focus on the expected benefits, the risks involved with the procedure/treatment, and the feasible alternatives [18]. In settings involving the use of moderate sedation, the risks, benefits, side effects, and alternatives of the particular drugs used for sedation must be included in the informed consent discussion. Ideally, this discussion should be led by the healthcare professional who will be administering the sedative [28].

STEPS TO REDUCE THE RISK OF MALPRACTICE RELATED TO MODERATE SEDATION
Perform and document a thorough evaluation before the procedure.
Document the American Society of Anesthesiologists class in the preprocedure evaluation.
Give the patient clearly written instructions before the procedure.
Follow patient safety guidelines.
Engage in education to ensure knowledge of the pharmacology of sedation drugs.
Ensure that alarms on monitoring equipment are on and are loud enough.
Warn patients about the risks of driving and require proof of a driver before sedation is administered.
Source: [28; 134] *Table 18*

The adequacy of the disclosure of risks is defined differently among states. In most states, a "professional standard" is applied, which means that adequate disclosure is defined as what a reasonable medical practitioner would disclose in a similar situation. In other states, a "lay standard" is applied, with adequate disclosure defined as what a reasonably prudent individual would want to know before consenting to the particular procedure/treatment [18]. In general, physicians must disclose all severe risks, such as death, paralysis, and loss of an extremity, regardless of the likelihood of the event. Less severe events should be disclosed if they are frequent, whereas nominal risks do not need to be disclosed if they are not frequent [135].

It may be legally argued that an informed consent process that takes place directly before a procedure constitutes obtaining consent under duress. For example, a person about to have endoscopy may have a difficult time saying no to sedation after he or she has prepared for a test [28]. When possible, it is helpful to provide written information about the risks and benefits of the proposed sedation in advance of the procedure. The informed consent for sedation may be incorporated within the body of the consent form for the related procedure or may be a separate document; however, the ASA strongly advises a separate document [19; 23].

CONCLUSION

The use of moderate sedation for therapeutic and diagnostic procedures has increased substantially over the past few decades, bringing the delivery of potent sedatives outside the operating room. This shift in the administration of sedatives by non-anesthesia healthcare professionals calls for enhanced knowledge of the pharmacologic profiles of drugs used for moderate sedation. In addition, clinicians should follow the most recent guidelines for patient assessment before the procedure and monitoring during the procedure. The preprocedure assessment should focus on the history and physical examination, with careful attention to identifying patients at high risk for complications. Procedural monitoring involves close observation and objective data. The drug or drugs for moderate sedation should be selected according to the specifics of an individual patient, with consideration of the patient's history, the risks and benefits of the drug, and the length and complexity of the procedure.

Works Cited

1. Freid V, Bernstein AB. *Health Care Utilization Among Adults Aged 55-64 Years: How Has It Changed Over the Past 10 Years?* Hyattsville, MD: National Center for Health Statistics; 2010.
2. McDermott KW, Liang L. *Overview of Major Ambulatory Surgeries Performed in Hospital-Owned Facilities, 2019*. HCUP Statistical Brief #287. Rockville, MD: Agency for Healthcare Research and Quality; 2021.
3. Fortune Business Insights. U.S. Ambulatory Surgical Centers Market Size, Share, and COVID-19 Impact. Available at https://www.fortunebusinessinsights.com/u-s-ambulatory-surgical-centers-market-106323. Last accessed September 9, 2022.
4. Chavez M, Maker VK. Common office procedures. In: Rakel RE, Rakel DP (eds). *Textbook of Family Medicine*. 9th ed. Philadelphia, PA: Saunders Elsevier; 2015.
5. Kurrek M, Twersky RS. Office-based anesthesia. *Can J Anaesth*. 2010;57(3):256-272.
6. Odom-Forren J, Watson D. *Practical Guide to Moderate Sedation/Analgesia*. 2nd ed. St Louis, MO: Mosby Elsevier; 2005.
7. Godwin SA, Burton JH, Gerardo CJ, et al. Clinical policy: procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2014;62(3):247-258.
8. National Institutes of Health. Consensus conference: anesthesia and sedation in the dental office. *JAMA*. 1985;254(8):1073-1076.
9. Green S. Procedural sedation terminology: moving beyond "conscious sedation." *Ann Emerg Med*. 2002;39(4):433-435.
10. American College of Emergency Physicians. Clinical policy for procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 1998;31(5):663-677.
11. American Society of Anesthesiologists. Practice guidelines for moderate procedural sedation and analgesia 2018: a report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. *Anesthesiology*. 2018;128(3):437-479.
12. American Society of Anesthesiologists. Distinguishing Monitored Anesthesia Care ("MAC") from Moderate Sedation/Analgesia (Conscious Sedation). Available at http://www.asahq.org/~/media/sites/asahq/files/public/resources/standards-guidelines/distinguishing-monitored-anesthesia-care-from-moderate-sedation-analgesia.pdf. Last accessed September 9, 2022.
13. Coté CJ, Wilson S; American Academy of Pediatrics; American Academy of Pediatric Dentistry. Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures. *Pediatr Dent*. 2019;41(4):E26-E52.
14. Sacchetti A, Senula G, Strickland J, Dubin R. Procedural sedation in the community emergency department: initial results of the ProSCED registry. *Acad Emerg Med*. 2007;14(1):41-46.
15. Sacchetti A, Stander E, Ferguson N, Maniar G, Valko P. Pediatric procedural sedation in the community emergency department: results from the ProSCED registry. *Pediatr Emerg Care*. 2010;23(4):218-222.
16. Crystal C, McArthur TJ, Harrison B. Anesthetic and procedural sedation techniques for wound management. *Emerg Med Clin North Am*. 2007;25:41-71.
17. Schaufele M, Marin DR, Tate JL, Simmons AC. Adverse events of conscious sedation in ambulatory spine procedures. *Spine J*. 2011;11(12):1093-1100.
18. Nepps M. The basics of medical malpractice: a primer on navigating the system. *Chest*. 2008;134(5):1051-1055.
19. Domino K. Professional liability: should separate written consent for anesthesia be adopted? *ASA Newsletter*. 2006;70(7):10.
20. Toledano R, Kodali B-S, Camann WR. Anesthesia drugs in the obstetric and gynecologic practice. *Rev Obstet Gynecol*. 2009;2(2):93-100.
21. Failey C, Aburto J, de la Portilla HG, et al. Office-based outpatient plastic surgery utilizing total intravenous anesthesia. *Anesth Surg J*. 2013;33(2):270-274.
22. Bayat A, Ramaiah R, Bhananker SM. Analgesia and sedation for children undergoing burn wound care. *Expert Rev Neurother*. 2010;10(11):1747-1759.
23. Sanford S. Informed consent: the verdict is in. *ASA Newsletter*. 2006;70(7):15-16.
24. Cohen L, Wecsler JS, Gaetano JN, et al. Endoscopic sedation in the United States: results from a nationwide survey. *Am J Gastroenterol*. 2006;101(5):967-974.
25. McQuaid K, Laine L. A systematic review and meta-analysis of randomized, controlled trials of moderate sedation for routine endoscopic procedures. *Gastrointest Endosc*. 2008;67(6):910-923.
26. Wortman M, Daggett A, Ball C. Operative hysteroscopy in an office-based surgical setting: review of patient safety and satisfaction in 414 cases. *J Minim Invasive Gynecol*. 2013;20(1):56-63.
27. American Medical Association, American College of Surgeons. Patient Safety Principles for Office-Based Surgery. Available at https://www.facs.org/for-patients/patient-resources/patient-safety/office-based-surgery. Last accessed September 9, 2022.
28. Cohen L, Delegge MH, Aisenberg J, et al. AGA Institute review of endoscopic sedation. *Gastroenterology*. 2007;133(2):676-701.

29. American College of Emergency Physicians. ACEP Policy Statement: Sedation in the Emergency Department. Available at https://www.acep.org/globalassets/new-pdfs/policy-statements/procedural.sedation.in.the.ed.pdf. Last accessed September 9, 2022.
30. Mace S, Brown LA, Francis L, et al. Clinical policy: critical issues in the sedation of pediatric patients in the emergency department. *Ann Emerg Med*. 2008;51(4):378-399.
31. Early DS, Lightdale JR, Vargo JJ II, et al. Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy. Guidelines for sedation and anesthesia in GI endoscopy. *Gastrointest Endosc*. 2018;87(2):327-337.
32. American Society of Anesthesiologists. Statement of Granting Privileges for Administration of Moderate Sedation to Practitioners (Amended 2021). Available at https://www.asahq.org/standards-and-guidelines/statement-of-granting-privileges-for-administration-of-moderate-sedation-to-practitioners. Last accessed September 17, 2022.
33. O'Connor R, Sama A, Burton JH, et al. Procedural sedation and analgesia in the emergency department: recommendations for physician credentialing, privileging, and practice. *Ann Emerg Med*. 2011;58(4):365-370.
34. Vargo J. Update on endoscopist-administered propofol sedation for endoscopic procedures. *Gastroenterol Hepatol (NY)*. 2011;7(3):189-197.
35. Rex D, Deenadayalu VP, Eid E, et al. Endoscopist-directed administration of propofol: a worldwide safety experience. *Gastroenterology*. 2009;137(4):1229-1237.
36. Ellett M. A literature review of the safety and efficacy of using propofol for sedation in endoscopy. *Gastroenterol Nurs*. 2010;33(2):111-117.
37. American Society of Anesthesiologists. FDA Upholds ASA Stance on Safe Use of Propofol. Available at https://www.asahq.org/about-asa/newsroom/news-releases/2010/08/fda-upholds-asa-stance-on-safe-use-of-propofol. Last accessed September 17, 2022.
38. Rex D. Effect of the Centers for Medicare & Medicaid Services policy about deep sedation on use of propofol. *Ann Intern Med*. 2011;154(9):622-626.
39. Centers for Medicare and Medicaid Services. State Operations Provider Certification. Available at https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/downloads/SCLetter11_10.pdf. Last accessed September 17, 2022.
40. American Society of Anesthesiologists. Statement on Safe Use of Propofol. Available at http://www.asahq.org/~/media/Sites/ASAHQ/Files/Public/Resources/standards-guidelines/statement-on-safe-use-of-propofol.pdf. Last accessed September 17, 2022.
41. Vargo J, Cohen LB, Rex DK, Kwo PY. Position statement: nonanesthesiologist administration of propofol for GI endoscopy. *Am J Gastroenterol*. 2009;104(12):2886-2892.
42. American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea. *Anesthesiology*. 2014;120(2):268-286.
43. Gill J, Vidyarthi G, Kulkarni P, et al. Safety of conscious sedation in patients with sleep apnea in a veteran population. *South Med J*. 2011;104(3):185-188.
44. Adler D, Kawa C, Hilden K, Fang J. Nurse-administered propofol sedation is safe for patients with obstructive sleep apnea undergoing routine endoscopy: a pilot study. *Dig Dis Sci*. 2011;56(9):2666-2671.
45. Mador M, Nadler J, Mreyoud A, et al. Do patients at risk of sleep apnea have an increased risk of cardio-respiratory complications during endoscopy procedures? *Sleep Breath*. 2012;16(3):609-615.
46. Wu C, Wang CC, Kennedy J. Changes in herb and dietary supplement use in the U.S. adult population: a comparison of the 2002 and 2007 National Health Interview Surveys. *Clin Ther*. 2011;33(11):1749-1758.
47. Wren K, Kimbrall S, Norred CL. Use of complementary and alternative medications by surgical patients. *J PeriAnesthes Nurs*. 2002;17:170-177.
48. American Society of Anesthesiologists Committee on Standards and Practice Parameters. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: an updated report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration. *Anesthesiology*. 2017;126(3): 376-393.
49. Bell A, Treston G, McNabb C, Monypenny K, Cardwell R. Profiling adverse respiratory events and vomiting when using propofol for emergency department procedural sedation. *Emerg Med Australas*. 2007;19(5):405-410.
50. American Society of Anesthesiologists. ASA Physical Status Classification System. Available at https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system. Last accessed September 18, 2022.
51. American College of Emergency Physicians. Procedural Sedation and Analgesia in the Emergency Department: Recommendations for Physician Credentialing, Privileging and Practice. Available at https://www.acep.org/globalassets/uploads/uploaded-files/acep/clinical-and-practice-management/resources/sedation/acep-sedation-position.pdf. Last accessed September 18, 2022.
52. Kutner M, Greenberg E, Jin Y, Paulsen C. *The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy*. Washington, DC: National Center for Education Statistics; 2006.

53. Committee on Health Literacy Board on Neuroscience and Behavioral Health. *Health Literacy. A Prescription to End Confusion*. Washington, DC: The National Academies Press; 2004.
54. Paasche-Orlow M, Parker RM, Gasmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. *J Gen Intern Med*. 2005;20(2):175-184.
55. Ginde A, Weiner SG, Pallin DJ, Camargo CA Jr. Multicenter study of limited health literacy in emergency department patients. *Acad Emerg Med*. 2008;15(6):577-580.
56. Olives T, Patel R, Patel S, Hottinger J, Miner JR. Health literacy of adults presenting to an urban ED. *Am J Emerg Med*. 2011;29(8):875-882.
57. Powers B, Trinh JV, Bosworth HB. Can this patient read and understand written health information? *JAMA*. 2010;304(1):76-84.
58. Shah L, West P, Bremmeyr K, Savoy-Moore RT. Health literacy instrument in family medicine: the "newest vital sign" ease of use and correlates. *J Am Board Fam Med*. 2010;23(2):195-203.
59. Berkman N, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med*. 2011;155(2):97-107.
60. U.S. Census Bureau. Language Spoken at Home: American Community Survey (ACS) 1-Year Estimates. Available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_1YR_S1601&prodType=table. Last accessed September 18, 2022.
61. Karliner L, Napoles-Springer AM, Schillinger D, Bibbins-Domingo K, Pérez-Stable EJ. Identification of limited English proficient patients in clinical care. *J Gen Intern Med*. 2008;23(10):1555-1560.
62. Sevilla Matir J, Willis DR. Using bilingual staff members as interpreters. *Fam Pract Manage*. 2004;11(7):34-36.
63. Flores G. The impact of medical interpreter services on the quality of health care: a systematic review. *Med Care Res Rev*. 2005;62(3):255-299.
64. Karliner L, Jacobs EA, Chen AH, Mutha S. Do professional interpreters improve clinical care for patients with limited English proficiency? A systematic review of the literature. *Health Serv Res*. 2007;42(2):727-754.
65. Ngo-Metzger Q, Massagli MP, Clarridge BR, et al. Linguistic and cultural barriers to care: perspectives of Chinese and Vietnamese immigrants. *J Gen Intern Med*. 2003;18(1):44-52.
66. Weiss B, Mays MZ, Martz W, et al. Quick assessment of literacy in primary care: the newest vital sign. *Am Fam Med*. 2005;3(6):514-522.
67. Langhan M, Mallory M, Hertzog J, et al. Physiologic monitoring practices during pediatric procedural sedation: a report from the Pediatric Sedation Research Consortium. *Arch Pediatr Adolesc Med*. 2012;166(11):990-998.
68. Triantafillidis J, Merikas E, Nikolakis D, Papalois AE. Sedation in gastrointestinal endoscopy: current issues. *World J Gastrenterol*. 2013;19(4):463-481.
69. American Society for Gastrointestinal Endoscopy, American Association for the Study of Liver Diseases, American College of Gastroenterology, American Gastroenterological Association Institute, Society for Gastroenterology Nurses and Associates. Multisociety sedation curriculum for gastrointestinal endoscopy. *Gastrointest Endosc*. 2012;76(1):e1-e25.
70. Krauss B, Hess D. Capnography for procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2007;50(2):172-181.
71. Pino R. The nature of anesthesia and procedural sedation outside of the operating room. *Curr Opin Anaesthesiol*. 2007;20(4):347-351.
72. Deitch K, Miner J, Chudnofsky CR, Dominici P, Latta D. Does end tidal CO2 monitoring during emergency department procedural sedation and analgesia with propofol decrease the incidence of hypoxic events? A randomized, controlled trial. *Ann Emerg Med*. 2010;55(3):258-264.
73. Waugh J, Epps CA, Khodneva YA. Capnography enhances surveillance of respiratory events during procedural sedation: a meta-analysis. *J Clin Anesth*. 2011;23(3):189-196.
74. American Society of Anesthesiologists. Standards for Basic Anesthetic Monitoring. Available at http://www.asahq.org/~/media/sites/asahq/files/public/resources/standards-guidelines/standards-for-basic-anesthetic-monitoring.pdf. Last accessed September 18, 2022.
75. Provinse JF, Stuart P, Killian M, et al. Clinical Practice Guideline: Capnography during Procedural Sedation/Analgesia. Available at https://www.ena.org/shop/catalog/resources/clinical-practice/the-use-of-capnography-during-procedural-sedationanalgesia/c-23/c-106/p-389. Last accessed September 18, 2022.
76. Downs J. Has oxygen administration delayed appropriate respiratory care? Fallacies regarding oxygen therapy. *Respir Care*. 2003;48(6):611-620.
77. Fu E, Downs JB, Schweiger JW, Miguel RV, Smith RA. Supplemental oxygen impairs detection of hypoventilation by pulse oximetry. *Chest*. 2004;126:1552-1558.
78. Chung F, Lermitte J. Discharge process. In: Twersky R, Philip BK (eds). *The Ambulatory Anesthesia Handbook*. 2nd ed. St. Louis, MO: Mosby; 2008: 354-370.

79. Becker D. Pharmacodynamic considerations for moderate and deep sedation. *Anesth Prog*. 2012;59(1):28-42.
80. Miner J, Burton JH. Clinical practice advisory: emergency department procedural sedation with propofol. *Ann Emerg Med*. 2007;50(2):182-187.
81. Falk J, Zed PJ. Etomidate for procedural sedation in the emergency department. *Ann Pharmacother*. 2004;38(7):1272-1277.
82. Brown T, Lovato LM, Parker D. Procedural sedation in the acute care setting. *Am Fam Physician*. 2005;71(1):85-90.
83. Ruth W, Burton JH, Bock AJ. Intravenous etomidate for procedural sedation in emergency department patients. *Acad Emerg Med*. 2001;8(1):13-18.
84. Vinson D, Bradbury DR. Etomidate for procedural sedation in emergency medicine. *Ann Emerg Med*. 2002;39(6):592-598.
85. Mandt M, Roback MG, Bajaj L, Galinkin JL, Gao D, Wathen JE. Etomidate for short pediatric procedures in the emergency department. *Pediatr Emerg Care*. 2012;28(9):898-904.
86. LexiComp Online. Available at https://online.lexi.com. Last accessed September 19, 2022.
87. Society of Gastroenterology Nurses and Associates. Medications. Available at https://www.sgna.org/Practice-Resources/GI-Nurse-Sedation/Medications. Last accessed September 19, 2022.
88. Meyer T. The Propofol Safety Review. Available at https://www.apsf.org/newsletters/html/2007/summer/04_propofol.htm. Last accessed September 19, 2022.
89. Brandner B, Blagrove M, McCallum G, Bromley LM. Dreams, images and emotions associated with propofol anaesthesia. *Anaesthesia*. 1997;52(8):750-755.
90. Bahn E, Holt KR. Procedural sedation and analgesia: a review and new concepts. *Emerg Med Clin North Am*. 2005;23(2):503-517.
91. Bergen J, Smith DC. A review of etomidate for rapid sequence intubation in the emergency department. *J Emerg Med*. 1997;15(2):221-230.
92. Miner J, Danahy M, Moch A, Biros M. Randomized clinical trial of etomidate versus propofol for procedural sedation in the emergency department. *Ann Emerg Med*. 2007;49(1):15-22.
93. Yates A, Wolfson AB, Shum L, Kehrl T. A descriptive study of myoclonus associated with etomidate procedural sedation in the ED. *Am J Emerg Med*. 2013;31(5):852-854.
94. Cicero M, Graneto J. Etomidate for procedural sedation in the elderly: a retrospective comparison between age groups. *Am J Emerg Med*. 2011;29(9):1111-1116.
95. Miller M, Levy P, Patel MM. Procedural sedation and analgesia in the emergency department: what are the risks? *Emerg Med Clin North Am*. 2005;23(2):551-572.
96. Green S, Roback MG, Kennedy RM, Krauss B. Clinical practice guideline for emergency department ketamine dissociative sedation: 2011 update. *Ann Emerg Med*. 2011;57(5):449-461.
97. Thomas M, Jennett-Reznek AM, Patanwala AE. Combination of ketamine and propofol versus either agent alone for procedural sedation in the emergency department. *Am J Health Syst Pharm*. 2011;68(23):2248-2256.
98. Cohen J, Haber GB, Dorais JA, et al. A randomized, double-blind study of the use of droperidol for conscious sedation during therapeutic endoscopy in difficult to sedate patients. *Gastrointest Endosc*. 2000;51(5):546-551.
99. Gerlach A, Murphy CV, Dasta JF. An updated focused review of dexmedetomidine in adults. *Ann Pharmacother*. 2009;43(12):2064-2074.
100. Singh H, Poluha W, Cheung M, Choptain N, Baron KI, Taback SP. Propofol for sedation during colonoscopy. *Cochrane Database Syst Rev*. 2008;(4):CD006268.
101. Levitzky B, Lopez R, Dumot JA, Vargo JJ. Moderate sedation for elective upper endoscopy with balanced propofol versus fentanyl and midazolam alone: a randomized clinical trial. *Endoscopy*. 2012;44(1):13-20.
102. Lera dos Santos ME, Maluf-Filho F, Chaves DM, et al. Deep sedation during gastrointestinal endoscopy: propofol-fentanyl and midazolam-fentanyl regimens. *World J Gastroenterol*. 2013;19(22):3439-3446.
103. Wilcox C. Efficiency issues in sedation and monitoring. *Gastrointest Endosc Clin N Am*. 2004;14(4):647-656.
104. Wang D, Chen C, Chen J, et al. The use of propofol as a sedative agent in gastrointestinal endoscopy: a meta-analysis. *PLoS One*. 2013;8(1):e53311.
105. Lordan J, Woods J, Keeling P, Paterson IM. A retrospective analysis of benzodiazepine sedation vs. propofol anaesthesia in 252 patients undergoing endoscopic retrograde cholangiopancreatography. *HPB (Oxford)*. 2011;13(3):174-177.
106. van Beek E, Leroy PL. Safe and effective procedural sedation for gastrointestinal endoscopy in children. *J Pediatr Gastroenterol Nutr*. 2012;54(2):171-185.
107. Cravero J, Beach ML, Blike GT, Gallagher SM, Hertzog JH. The incidence and nature of adverse events during pediatric sedation/anesthesia with propofol for procedures outside the operating room: a report from the Pediatric Sedation Research Consortium. *Anesth Analg*. 2009;108(3):795-804.
108. Phillips W, Anderson A, Rosengreen M, Johnson J, Halpin J. Propofol versus propofol/ketamine for brief painful procedures in the emergency department: clinical and bispectral index scale comparison. *J Pain Palliat Care Pharmacother*. 2010;24(4):349-355.

109. Loh G, Dalen D. Low-dose ketamine in addition to propofol for procedural sedation and analgesia in the emergency department. *Ann Pharmacother*. 2007;41(3):485-492.

110. Symington L, Thakore S. A review of the use of propofol for procedural sedation in the emergency department. *Emerg Med J*. 2006;23(2):89-93.

111. Senula G, Sacchetti A, Moore S, Cortese T. Impact of addition of propofol to ED formulary. *Am J Emerg Med*. 2010;28(8):880-883.

112. Miller KA, Andolfatto G, Miner JR, Burton JH, Krauss BS. Clinical practice guideline for emergency department procedural sedation with propofol: 2018 update. *Ann Emerg Med*. 2019;73(5):470-480.

113. Black E, Campbell SG, Magee K, Zed PJ. Propofol for procedural sedation in the emergency department: a qualitative systematic review. *Ann Pharmacother*. 2013;47(6):856-868.

114. Hohl C, Sadatsafavi M, Nosyk B, Anis AH. Safety and clinical effectiveness of midazolam versus propofol for procedural sedation in the emergency department: a systematic review. *Acad Emerg Med*. 2008;15(1):1-8.

115. Reynolds J, Abraham MK, Barrueto FF Jr, et al. Propofol for procedural sedation and analgesia reduced dedicated emergency nursing time while maintaining safety in a community emergency department. *J Emerg Med*. 2013;39(5):502-507.

116. Miner J, Gray RO, Bahr J, Patel R, McGill JW. Randomized clinical trial of propofol versus ketamine for procedural sedation in the emergency department. *Acad Emerg Med*. 2010;17(6):604-611.

117. Miner J, Biros M, Krieg S, Johnson C, Heegaard W, Plummer D. Randomized clinical trial of propofol versus methohexital for procedural sedation during fracture and dislocation reduction in the emergency department. *Acad Emerg Med*. 2003;10(9):931-937.

118. Rahman N, Hashim A. The use of propofol for procedural sedation and analgesia in the emergency department: a comparison with midazolam. *Emerg Med J*. 2011;28(10):861-865.

119. Hohl C, Nosyk B, Sadatsafavi M, Anis AH. A cost-effectiveness analysis of propofol versus midazolam for procedural sedation in the emergency department. *Acad Emerg Med*. 2008;15(1):32-39.

120. Slavik V, Zed PJ. Combination ketamine and propofol for procedural sedation and analgesia. *Pharmacotherapy*. 2007;27(11): 1588-1598.

121. Ghojazadeh M, Sanaie S, Paknezhad SP, Faghih SS, Soleimanpour H. Using ketamine and propofol for procedural sedation of adults in the emergency department: a systematic review and meta-analysis. *Adv Pharm Bull*. 2019;9(1):5-11.

122. Willman E, Andolfatto G. A prospective evaluation of "ketofol" (ketamine/propofol combination) for procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2007;49(1):23-30.

123. David H, Shipp J. A randomized controlled trial of ketamine/propofol versus propofol alone for emergency department procedural sedation. *Ann Emerg Med*. 2011;57(5):435-441.

124. Yan JW, McLeod SL, Iansavitchene A. Ketamine-propofol versus propofol alone for procedural sedation in the emergency department: a systematic review and meta-analysis. *Acad Emerg Med*. 2015;22(9):1003-1013.

125. Lee-Jayaram J, Green A, Siembieda J, et al. Ketamine/midazolam versus etomidate/fentanyl: procedural sedation for pediatric orthopedic reductions. *Pediatr Emerg Care*. 2010;26(6):408-412.

126. Andolfatto G, Willman E. A prospective case series of pediatric procedural sedation and analgesia in the emergency department using single-syringe ketamine-propofol combination (ketofol). *Acad Emerg Med*. 2010;17(2):194-201.

127. Sharma V, Nguyen CC, Crowell MD, et al. A national study of cardiopulmonary unplanned events after GI endoscopy. *Gastrointest Endosc*. 2007;66(1):27-34.

128. Bellolio MF, Gilani WI, Barrionuevo P, et al. Incidence of adverse events in adults undergoing procedural sedation in the emergency department: a systematic review and meta-analysis. *Acad Emerg Med*. 2016;23(2):119-134.

129. Roback M, Walthen JE, Bajai L, Bothner JP. Adverse events associated with procedural sedation and analgesia in a pediatric emergency department: a comparison of common parenteral drugs. *Acad Emerg Med*. 2005;12(6):508-513.

130. Weaver C, Terrell KM, Bassett R, et al. ED procedural sedation of elderly patients: is it safe? *Am J Emerg Med*. 2010;29(5):541-544.

131. Cote G, Hovis RM, Ansstas MA, et al. Incidence of sedation-related complications with propofol use during advanced endoscopic procedures. *Clin Gastroenterol Hepatol*. 2010;8(2):137-142.

132. Becker DE, Haas DA. Recognition and management of complications during moderate and deep sedation part 1: respiratory considerations. *Anesth Prog*. 2011;58(2):82-92.

133. Petrini D, Petrini JL. Risk assessment and management for endoscopists in an ambulatory surgery center. *Gastrointest Endosc Clin N Am*. 2006;16(4):801-815.

134. Shepard S. Conscious Sedation in the Office. Available at https://www.thedoctors.com/articles/moderate-or-conscious-sedation-in-the-office-setting. Last accessed September 20, 2022.

135. Paterick T, Carson GV, Allen MC, Paterick TE. Medical informed consent: general considerations for physicians. *Mayo Clin Proc*. 2008;83(3):313-319.

136. Diamond R. Internal Medicine Malpractice Claims Study Reveals Most Common Claims. Available at https://forum.ashrm.org/2016/09/23/internal-medicine-malpractice-claims-study-reveal-most-common-claims/. Last accessed September 20, 2022.

Evidence-Based Practice Recommendations Citations

ASGE Standards of Practice Committee, Early DS, Acosta RD, et al. Modifications in endoscopic practice for the elderly. *Gastrointest Endosc*. 2013;78(1):1-7. Available at https://www.giejournal.org/article/S0016-5107(13)01777-X/pdf. Last accessed September 26, 2022.

American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, Society of Interventional Radiology. Practice guidelines for moderate procedural sedation and analgesia 2018: a report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. *Anesthesiology*. 2018;128(3):437-479. Available at https://pubs.asahq.org/anesthesiology/article/128/3/437/18818. Last accessed September 26, 2022.

Godwin SA, Burton JH, Gerardo CJ, et al. Clinical policy: procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2014;63(2):247-58. Available at https://www.acep.org/patient-care/clinical-policies/procedural-sedation-and-analgesia. Last accessed September 26, 2022.