

European Society of Gastrointestinal Endoscopy, European Society of Gastroenterology and Endoscopy Nurses and Associates, and the European Society of Anaesthesiology Guideline: Non-anesthesiologist administration of propofol for GI endoscopy



Authors

J. M. Dumonceau^{1,1}, A. Riphaus^{2,1}, J. R. Aparicio³, U. Beilenhoff⁴, J. T. A. Knape⁵, M. Ortmann⁶, G. Paspatis⁷, C. Y. Ponsioen⁸, I. Racz⁹, F. Schreiber¹⁰, P. Vilmann¹¹, T. Wehrmann¹², C. Wientjes⁸, B. Walder¹³ and the NAAP Task Force Members²

Institutions

Institutions are listed at the end of article.

Bibliography

DOI <http://dx.doi.org/10.1055/s-0030-1255728>
Endoscopy 2010; 42:
960–974 © Georg Thieme
Verlag KG Stuttgart · New York
ISSN 0013-726X

Corresponding authors

J. M. Dumonceau, MD, PhD

Division of Gastroenterology
and Hepatology
Geneva University Hospitals
Micheli-du-Crest Street, 24
1205 Geneva
Switzerland
Fax: +41-22-3729366
jmdumonceau@hotmail.com

A. Riphaus, MD

Ruhr University Bochum
Department of Medicine
Knappschafts Krankenhaus
In der Schornau 23–25
44892 Bochum
Germany
Fax: +49-234-2993439
ariphaus@web.de

Propofol sedation by non-anesthesiologists is an upcoming sedation regimen in several countries throughout Europe. Numerous studies have shown the efficacy and safety of this sedation regimen in gastrointestinal endoscopy. Nevertheless, this issue remains highly controversial. The aim of this evidence- and consensus-based set of guideline is to provide non-anesthesiologists with a comprehensive framework for propofol sedation during digestive endoscopy. This guideline results from a collaborative effort from representatives of

the European Society of Gastrointestinal Endoscopy (ESGE), the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) and the European Society of Anaesthesiology (ESA). These three societies have endorsed the present guideline.

The guideline is published simultaneously in the Journals *Endoscopy* and *European Journal of Anaesthesiology*.

1 Introduction

Although esophagogastroduodenoscopy (EGD) and colonoscopy can be performed without sedation [1, 2], both procedures are better tolerated in terms of patient satisfaction and willingness to repeat the examination when sedation is administered [3]. More complex procedures are rarely performed without sedation. Benzodiazepines, either combined with opioids or not, have long been used for sedation (termed as “traditional sedation” in this guideline); however, the short-acting hypnotic agent propofol is increasingly being used [4–7]. Due to limited anesthesiology resources, propofol is being administered worldwide by trained nurses or endoscopists for endoscopic procedures in selected patients [5]. Administration of propofol by nurses or endoscopists is commonly referred to as non-anesthesiologist-administered propofol (NAAP).

The aim of this guideline is to provide medical doctors and nurses who participate in gastrointestinal endoscopy and are not anesthesiologists with a comprehensive framework on how to implement and practice NAAP. The guideline covers the care provided to any patient undergoing digestive endoscopy. They are not designed to be rigid and cannot replace clinical judgment; furthermore, their

implementation may be subject to domestic regulations or local policy and should only be used with the agreement of the relevant domestic regulatory authority or local policy maker.

2 Methods

The European Society of Gastrointestinal Endoscopy (ESGE) commissioned and funded this guideline, which was prepared by representatives from the ESGE, the European Society of Anaesthesiology (ESA), and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA). In this guideline, the word “caregiver” refers to nurses or physicians who take care of patients during endoscopy and are not anesthesiologists or nurses specialized in anesthesiology.

¹ Both authors collaborated equally to this work.

² NAAP Task Force Members: L. Aabakken, Rikshospitalet–Radiumhospitalet Medical Center, Oslo, Norway; A. Axon, The General Infirmary, Leeds, United Kingdom; A. Axon, Parlane Plowden, Leeds, United Kingdom; G. Costamagna, Policlinico A. Gemelli, Rome, Italy; E. Giostra, Geneva University Hospitals, Geneva, Switzerland; P. Hornslet, Gentofte Hospital, Copenhagen University, Hellerup, Denmark; S. Ladas, “Attikon” University General Hospital Medical School, Athens, Greece; T. Marek, Silesian Academy of Medicine, Katowice, Poland; M. Dinis-Ribeiro, Portuguese Oncology Center Porto, CINTESIS/Porto Faculty of Medicine, Portugal.

Table 1 Definitions of categories for evidence levels and recommendation grades used in this guideline [8].

Evidence level	
1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1–	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case-control or cohort studies; high quality case-control studies or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2–	Case-control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal
3	Nonanalytic studies, e. g. case reports, case series
4	Expert opinion
Recommendation grades	
A	At least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population or a systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+ directly applicable to the target population and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++ directly applicable to the target population and demonstrating overall consistency of results or extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+ directly applicable to the target population and demonstrating overall consistency of results or extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4 or extrapolated evidence from studies rated as 2+

RCT, randomized controlled trial

The guideline process included meetings, telephone conferences, and electronic-based discussions among subgroups and members of the entire committee during July 2009 and May 2010. Subgroups were formed, each charged with a series of clearly defined key questions (see **Appendix 1**). The committee chair worked with subgroup leaders to identify pertinent search terms that always included, as a minimum, “sedation” and “gastrointestinal endoscopy” as well as words pertinent to specific key questions. Search was performed on Medline (via Pubmed), Cochrane Library, Embase, and the internet. Articles were first selected by title; their relevance was then confirmed by review of the corresponding manuscript, and publications with content that was considered irrelevant were excluded. Additional articles were identified by manually searching the reference lists of retrieved papers. A central repository of selected literature was made available to all members of the guideline development group. Evidence tables were generated for each key question, based on meta-analyses or randomized controlled trials (RCTs) if these were available; otherwise, case-control studies, retrospective analyses, and case series were included. The number of articles retrieved and selected for each task force is indicated in the Evidence Table (see **Appendix 2**).

The study populations considered varied between clinical questions. At times evidence was not available from studies that included patients sedated using propofol, and it was therefore necessary to consider studies that used traditional sedation. Evidence such as this is indicated in the comments to recommendations. For important outcomes, articles were individually assessed by using the Method for Evaluating Research and Guideline Evidence (MERGE) checklists as amended by the Scottish Intercollegiate Guidelines Network [8]. Evidence levels and recommendation grades used in this guideline were those recommended by the amended Scottish Intercollegiate Guidelines Network (Table 1) [8].

Subgroups agreed electronically on draft proposals that were presented to the entire group for general discussion during a meeting held in 2009 during the 18th United European Gastroenterology Week (London, UK). During the meeting and following

discussion, competing proposals for wording of recommendations or assigning strength of evidence were resolved by formal voting. Where the guideline development group was unable to agree a unanimous recommendation, the difference of opinion was formally recorded and the reasons for dissent were noted. The results of that discussion were incorporated into the subsequent guideline version and again discussed using electronic mail. Searches were re-run in December 2009. Studies that were published after this date were not considered for inclusion. This time-point should be the starting point in the search for new evidence for future updates to this guideline. Recommendations were finalized during a meeting of subgroup leaders in 2010 during the 12th International Endoscopy Symposium (Düsseldorf, Germany).

The manuscript was edited for style by the corresponding authors and by a lawyer (Andrew Axon), with approval by subgroup leaders and then by all members of the guideline development group. In May 2010, the final draft was sent to all individual ESGE members. After incorporation of comments made by the individual ESGE members, the manuscript was endorsed by the ESGE Governing Board, the ESGENA, and the ESA. It was sent to the Editorial Boards of the journals *Endoscopy* and the *European Journal of Anaesthesiology*. It underwent international peer review and the final version was approved by all members of the guideline development group.

Evidence statements and recommendations are stated in italics, key evidence statements and recommendations are in bold. This guideline was issued in 2010 and will be considered for review in 2013, or sooner if new evidence becomes available. Any updates to the guideline in the interim period will be noted on the ESGE website: <http://www.esge.com/esge-guidelines.html>.

3 Summary of statements and recommendations



Compared with traditional sedation, propofol-based sedation presents similar rates of adverse effects, provides higher postprocedure patient satisfaction for most endoscopic procedures, decreases time

to sedation, and decreases recovery time (and may therefore decrease discharge time compared with traditional sedation). Propofol-based sedation may also increase the quality of endoscopic examination. There are no cost-effectiveness data directly comparing specifically NAAP with traditional sedation or monitored anesthesia care for gastrointestinal endoscopy. (Evidence level 1+.)

Specific knowledge and skills are necessary for endoscopists and nursing staff using NAAP to ensure patient comfort and safety; none of the NAAP reports published to date used self-training to achieve competency in this technique. NAAP performed by endoscopists and endoscopy nurses should not take place without appropriate training, and self-training in NAAP is strongly discouraged. (Evidence level 2++, Recommendation grade A.)

Digestive endoscopists and registered nurses are adequate candidates for NAAP training courses. Previous experience in intensive care medicine is desirable for the physician who is responsible for NAAP. We recommend that training courses for NAAP include a theoretical and a practical part, each part being followed by an examination to document successful training. NAAP training courses should teach techniques of basic life support (BLS) to all participants and advanced cardiac life support (ACLS) to caregivers who will practice in locations where an ACLS provider is not immediately available. (Evidence level 4, Recommendation grade D.)

Simulator training using a full-scale patient simulator as an adjunct to practical NAAP courses allows improvement of trainees' skill. We recommend the use of such simulators. (Evidence Level 2-, Recommendation grade D.)

The first human cases of NAAP performed by a caregiver require particular attention because complications are more frequent during this period. We recommend that the first human cases of NAAP performed by an individual be supervised by an anesthesiologist or another person with previous experience of > 300 NAAP cases (Evidence level 2-, Recommendation grade D). There was dissension in the audience, with some participants recommending preceptorship during the first cases of NAAP without defining "first cases", and others preferring to state a number of cases (evidence only available for n = 30).

Higher categories of the American Society of Anesthesiology (ASA) physical status classification system and some endoscopic procedures are associated with a higher incidence of complications after endoscopy. Higher Mallampati's classes are associated with more difficult airway management. We recommend that these risk factors are assessed before each NAAP procedure by reviewing patient past medical history, performing a focused physical examination, and assessing type and anticipated complexity of the endoscopic procedure. (Evidence level 2+, Recommendation grade C.)

In the presence of patient-related risk factors for complications, the primary involvement of an anesthesiologist during endoscopy is suggested. These factors include ASA category ≥ 3 , a Mallampati's class of 3 or other conditions at risk for airway obstruction (e.g. pharyngolaryngeal tumors), patients who chronically receive significant amounts of pain medications or in cases of anticipated long-lasting procedure. (Evidence level 4, Recommendation grade D.)

In the vast majority of NAAP studies, propofol was administered by a person who had patient sedation as his/her sole task (Evidence level 1++). It is recommended that patients be continuously monitored by a person dedicated to NAAP (Recommendation grade A).

There is no evidence that quick availability of a life support team is required for propofol administration. We do not recommend compulsory availability of a life support team if propofol is administered in the presence of a person trained in ACLS. (Evidence level 2+; Recommendation grade C.)

Intravenous access is required for sedation in gastrointestinal endoscopy and should be maintained using a catheter, not a winged steel needle, until full patient recovery (Evidence level 4, Recommendation grade D.)

Continuous supplemental oxygen is indicated during NAAP for endoscopy. (Evidence level 1+, Recommendation grade B.)

Patient monitoring is recommended in all patients using continuous pulse oximetry and automated noninvasive blood pressure measurement (at baseline and then at 3–5-minute intervals) during both NAAP and the recovery period; continuous electrocardiography is recommended in selected patients with a history of cardiac and/or pulmonary disease. Baseline, minimum and maximum heart rate/blood pressure, as well as baseline and minimum oxygen blood saturation should be recorded. (Evidence level 2++, Recommendation grade B.)

Visual assessment of respiratory activity during anticipated long endoscopy procedures is not a reliable method for detecting apnea. During NAAP, capnographic monitoring of respiratory activity may reduce episodes of hypoxemia during long endoscopic procedures or when visual assessment of patient breathing is impaired, but no clinical impact has been demonstrated. Therefore, capnography cannot be recommended as standard. (Evidence level 1+, Recommendation grade B.)

Electroencephalogram (EEG)-based monitoring may be used during NAAP to target a sedation level; it may help to reduce propofol consumption during complex endoscopic procedures with targeted deep sedation. No clinical impact of EEG-based monitoring has been demonstrated (Evidence level 1+), and no specific recommendation is made due to the paucity of data.

Simple endoscopic procedures can be performed with moderate sedation, maintaining a high degree of patient satisfaction. Prolonged or complex procedures (e.g. endoscopic ultrasonography [EUS] and endoscopic retrograde cholangiopancreatography [ERCP]) are frequently performed under deep sedation. (Evidence level 1++, Recommendation grade A.)

Combining propofol with an additional drug (benzodiazepine/opioid/ketamine) allows the dose of propofol administered to be decreased without reproducible effect on recovery time; there is no clear evidence that combining propofol with another drug leads to a decrease in adverse effects (Evidence level 1+). No recommendation is made about combination of propofol with other drugs.

Intermittent bolus administration of propofol is the current standard administration technique for NAAP. Data about propofol administration using perfusor systems during endoscopy are accumulating and show that these systems are as effective and safe as the standard technique. Patient-controlled sedation (PCS) is a valid administration technique but it is not applicable in a significant minority of patients. (Evidence level 1+.)

Listening to patient-selected music during colonoscopy allows the dose of propofol administered to be decreased; we recommend this for colonoscopy. (Evidence level 1-, Recommendation grade B.)

The role of pharyngeal anesthesia during propofol sedation for upper digestive endoscopy has not been assessed. No recommendation is made.

Variable stiffness colonoscopes allow the dose of propofol administered to be decreased during colonoscopy with no demonstrated clinical impact (Evidence level 1+). A single endoscope manufacturer currently offers such models and no recommendation is made.

Postendoscopy pain is lower when air is replaced by CO₂ for gut distension during long endoscopy procedures but there are no data on the doses of propofol administered (Evidence level 1+). No recommendation is made.

Propofol is contraindicated in patients with a known allergy to soy protein. Pain at the injection site is frequent and can be prevented by lidocaine (Evidence level 1++). Hypoxemia and hypotension are the most frequent adverse effects of propofol and develop during NAAP in 5%–10% of patients. Measures to be taken in case of complications should be established in a check-list that is updated and tested at regular intervals. If a patient proves difficult to sedate adequately for the examination purpose, endoscopy termination and referral to an anesthesiologist should be considered (Evidence level 4, Recommendation grade D).

A small minority of sedation-related adverse effects occur after, as opposed to during, the procedure. We recommend patient observation until discharge by a person who is aware of the adverse effects of the drugs administered. (Evidence level 2+, Recommendation grade C.)

Minimum discharge criteria are useful for discharging patients after sedation for digestive endoscopy. We recommend using a standardized discharge scoring form. (Evidence level 2+, Recommendation grade C.)

Minimum discharge criteria should be fulfilled before discharging a patient. However, psychomotor functions remain significantly impaired when standard discharge criteria are met. Upon discharge, patients should be accompanied by a responsible person and refrain from driving, operating heavy machinery or engaging in legally binding decisions for at least 12 hours if sedation with propofol alone was administered (24 hours in cases of a combined regimen). Advice should be provided verbally and in written form, including a 24-hour contact phone number. (Evidence level 1+, Recommendation grade A.)

Documentation should be maintained throughout all phases of patient management, including:

- ▶ vital signs assessed at regular intervals (oxygen saturation, heart rate, and blood pressure)
- ▶ drugs (name, dosage), IV fluids (type, quantity), and oxygen (flow rate) administered
- ▶ sedation-associated complications and their management
- ▶ fulfillment of discharge criteria.

A minority of the audience thought that it should be recommended to record, in addition to this, the level of consciousness at regular intervals. Maintaining documentation in an electronic database may help to monitor quality and will provide a record in the event of medicolegal investigation. (Evidence level 4, Recommendation grade D.)

The endoscopist bears the ultimate medicolegal responsibility to ensure proper personal training of the endoscopy staff involved in NAAP. (Evidence level 4.)

Informed consent for NAAP should be obtained from the patient or his/her legal representative according to domestic laws and regulations in a way similar to that of other endoscopy procedures. It is generally obtained during a face-to-face discussion between a physician familiar with the procedure and the patient, with information given in lay language to the patient and the opportunity for him/her to ask questions prior to the procedure. The informed consent regarding sedation issues may be incorporated into the main body of the endoscopy consent form. The procedure of informed consent should be documented. (Evidence level 4, Recommendation grade D.)

4 Propofol-based vs. traditional sedation



Compared with traditional sedation, propofol-based sedation presents similar rates of adverse effects, provides higher postprocedure patient satisfaction for most endoscopic procedures, decreases time to sedation, and decreases recovery time (and may therefore decrease discharge time compared with traditional sedation). Propofol-based sedation may also increase the quality of endoscopic examination. There are no cost-effectiveness data directly comparing specifically NAAP with traditional sedation or monitored anaesthesia care for gastrointestinal endoscopy. (Evidence level 1+.)

Higher postprocedure patient satisfaction is achieved with propofol vs. traditional sedation for colonoscopy [3], EUS [9], ERCP [10, 11], but not EGD [3]. Examination quality may also be higher with propofol vs. traditional sedation, at least for EGD and ERCP [10, 12]. Time to sedation and recovery time are shorter with propofol vs. traditional sedation [3, 13].

With regard to adverse effects, propofol may cause hypoventilation, hypotension, and bradycardia relatively frequently, but severe adverse effects are extremely rare [5]. Therefore, the parameters “hypoxemia” and “hypotension” are most often used as surrogate markers of clinical complications; these were used for comparing propofol with traditional sedation in RCTs that were reviewed in three meta-analyses (▶ Table 2) [3, 13, 14].

Sedation was performed by a gastroenterologist in most trials and by a registered nurse or an anesthesiologist in the remaining ones. No significant differences between propofol-based and tra-

Table 2 Meta-analyses of randomized controlled trials that reported safety of propofol vs. traditional agents for sedation during endoscopy.

Reference*	N	Procedure	Hypoxemia, % (95% CI)		Hypotension, % (95% CI)		OR for complications, % (95% CI)	
			Propofol	Trad. agents	Propofol	Trad. agents	Hypoxemia	Hypotension
Qadeer et al. 2005 [14]	1161	EGD, colonoscopy, ERCP, EUS	8.8 (NA)	9.9 (NA)	2.8 (NA)	3.0 (NA)	0.76 (0.43–1.35)	1.06 (0.53–2.09)
McQuaid & Laine 2008 [3]	3918	EGD, colonoscopy	11 (7–16)	18 (12–26); 6 (4–7) [†]	5 (2–10)	7 (5–10)	1.11 (0.71–1.74)	1.28 (0.51–3.26)
Singh et al. 2008 [13]	1181 [‡]	Colonoscopy	5.4 (NA)	6.9 (NA)	12.5 (NA)	13.5 (NA)	0.73 (0.44–1.22)	0.84 (0.42–1.69)

* Propofol was used as a single agent or combined with other drugs; traditional agents consisted of a benzodiazepine plus an opioid in most trials.

[†] Proportions stated separately for midazolam alone (18%) or midazolam associated with a narcotic (6%).

[‡] The outcome “hypotension” was analyzed in 321 patients.

CI, confidence interval; EGD, esogastroduodenoscopy; ERCP, endoscopic retrograde cholangio-pancreatography; EUS, endoscopic ultrasonography; NA, not available; OR, odds ratio; RCT, randomized controlled trial.

ditional sedation were detected for hypoxemia or hypotension in these meta-analyses, except for fewer cardiopulmonary complications with propofol sedation during colonoscopy vs. traditional sedation [14].

With regard to cost, indirect calculations found that propofol was at least as cost-effective as traditional sedation for colonoscopy and EUS (due to quicker postprocedure recovery and, hence, higher daily number of procedures) [9, 15]. However, these conclusions are not applicable in most settings because these calculations did not take into account the additional cost of a supplementary nurse dedicated to propofol sedation, although such a nurse exists in most studies.

5 Training in NAAP

Specific knowledge and skills are necessary for endoscopists and nursing staff using NAAP to ensure patient comfort and safety; none of the NAAP reports published to date used self-training to achieve competency in this technique. NAAP performed by endoscopists and endoscopy nurses should not take place without appropriate training, and self-training in NAAP is strongly discouraged. (Evidence level 2++, Recommendation grade A.)

Digestive endoscopists and registered nurses are adequate candidates for NAAP training courses. Previous experience in intensive care medicine is desirable for the physician who is responsible for NAAP. We recommend that training courses for NAAP include a theoretical and a practical part, each part being followed by an examination to document successful training. NAAP training courses should teach techniques of BLS to all participants and ACLS to caregivers who will practice in locations where an ACLS provider is not immediately available. (Evidence level 4, Recommendation grade D.)

NAAP providers should be able to manage the typical adverse effects of propofol and be trained in life support techniques [5, 16–20]. In multicenter retrospective and prospective studies, all nurses and endoscopists performing NAAP were trained in ACLS [5, 21–25]. The European Board of Anaesthesiology recommends that NAAP endoscopists performing patient sedation should be trained in ACLS, including endotracheal intubation, and that training of nurses should be similar to the training of medical staff but focused on BLS [18]. Our panel did not recommend training in endotracheal intubation based on the extremely low frequency of events requiring this intervention and difficulties in maintaining endotracheal intubation skills in such conditions. However, personnel providing NAAP should be familiar with an alternative method to free the airways and maintain them patent (e.g. using a laryngeal tube) while waiting for support.

Many guidelines, including those issued by the European Board of Anaesthesiologists, recommend periodic participation in structured education curricula for NAAP [16–20]. Such courses are organized in various European countries and a typical program is summarized in **Table 3** [26].

Simulator training using a full-scale patient simulator as an adjunct to practical NAAP courses allows improvement of trainees' skill. We recommend the use of such simulators. (Evidence Level 2-, Recommendation grade D.)

Simulator-based education is being increasingly used in endoscopy after it has become standard practice in anesthesiology [27]. It allows training on dosing, drug effects in different types of patients, management of drops in oxygen saturation, blood pressure or heart rate, cardiac arrhythmias, and apnea. A study per-

Table 3 Typical program of a training course for non-anesthesiologist administration of propofol (NAAP).

Theoretical part
– Pharmacology, pharmacokinetics, and interactions of sedatives, analgesics, and respective antidotes
– Principles of sedation and monitoring patients including analysis of ECG monitoring
– Different sedation concepts
– Pre-, intra- and postendoscopy patient care concerning sedation, monitoring, recovery, discharge criteria, management of complications and documentation
– Legal aspects (e.g. delegation, informed consent)
Practical part
– Basic airway management (e.g. freeing of airways, jaw thrust, bag-valve mask ventilation)
– Use of different tubes for airway ventilation (e.g. Guedel tube, laryngeal tube)
– Treatment of acute respiratory problems
– BLS and ACLS, including the use of defibrillators
ACLS, advanced cardiac life support; BLS, basic life support; ECG, electrocardiogram

formed during a training course for sedation during endoscopy showed a significant improvement in the examination test scores of attendees after 3 hours of training that included hands-on management on a full-scale patient simulator compared with before training [27].

The first human cases of NAAP performed by a caregiver require particular attention because complications are more frequent during this period. We recommend that the first human cases of NAAP performed by an individual be supervised by an anesthesiologist or another person with previous experience of > 300 NAAP cases (Evidence level 2-, Recommendation grade D). There was dissension in the audience, with some participants recommending preceptorship during the first cases of NAAP without defining "first cases", and others preferring to state a number of cases (evidence only available for n = 30).

Programs that pioneered NAAP involved a board-certified anesthesiologist who was personally present during the initiation period [28, 29]. However, the exact role of the anesthesiologist was not reported in these studies and, more recently, fewer details have been given in the literature about the first human cases of NAAP performed by individuals. In a retrospective study, sedation-related complication rates were significantly lower with advanced experience-level nurses (≥ 100 NAAP procedures) compared with the least-experienced nurses (≤ 30 NAAP procedures) [23].

6 Practice of NAAP

6.1 Pre-procedure patient selection

Higher categories of the ASA physical status classification system and some endoscopic procedures are associated with a higher incidence of complications after endoscopy. Higher Mallampati's classes are associated with more difficult airway management. We recommend that these risk factors are assessed before each NAAP procedure by reviewing patient past medical history, performing a focused physical examination, and assessing type and anticipated complexity of the endoscopic procedure. (Evidence level 2+, Recommendation grade C.)

Adequate patient selection for NAAP is important because a significant proportion of complications observed after endoscopy are related to sedation and some of these may be preventable [30–32]. Impaired physical status, procedure type, older age, and possibly obesity are risk factors for the development of cardiopulmonary complications and mortality [30, 32, 33]. These factors should be assessed together with other useful elements (e.g. risk factors for sleep apnea, abnormal head and neck features, chronic obstructive pulmonary disease of stage 3–4, cardiac failure of stage 3–4, history of bronchoaspiration, trouble with previous anesthesia or sedation, allergies, current medications, tobacco, alcohol, and drug consumption) using a combination of standardized questionnaires and nurse-based or physician-based assessment [34]. After physical examination including vital signs, heart and lung auscultation, as well as throat examination, the patient is classified according to the ASA physical status scale and Mallampati's class [35, 36].

In the presence of patient-related risk factors for complications, the primary involvement of an anesthesiologist during endoscopy is suggested. These factors include ASA category ≥ 3 , a Mallampati's class of 3 or other conditions at risk for airway obstruction (e.g. pharyngolaryngeal tumors), patients who chronically receive significant amounts of pain medications or in cases of anticipated long-lasting procedure. (Evidence level 4, Recommendation grade D.)

The presence of some patient-related risk factors may trigger the consideration of the primary involvement of an anesthesiologist during endoscopy [37]. Such factors are, for example: a history of stridor, snoring or sleep apnea; patients with dysmorphic facial features (e.g. Pierre Robin syndrome, trisomy 21) or oral abnormalities such as small opening (<3 cm in an adult), high arched palate, macroglossia, tonsillar hypertrophy, or a nonvisible uvula; patients with neck abnormalities, such as obesity involving the neck and facial structures, short neck, limited neck extension, neck mass, cervical spine disease or trauma, tracheal deviation, or advanced rheumatoid arthritis; patients with jaw abnormalities, such as micrognathia, retrognathia, trismus, or significant malocclusion; patients receiving significant amounts of pain medication chronically or who for other reasons may be tolerant to agents used during sedation and analgesia.

6.2 Performance of sedation

6.2.1 Personnel

In the vast majority of NAAP studies, propofol was administered by a person who had patient sedation as his/her sole task (Evidence level 1++). It is recommended that patients be continuously monitored by a person dedicated to NAAP (Recommendation grade A).

Recent guidelines from the USA and Germany recommend that NAAP be performed by a person who has NAAP as their sole task [16, 17]. These recommendations are mostly based on expert opinions and they have recently been challenged by reports suggesting that propofol administration in the presence of the endoscopist and a single nurse is safe [29, 38, 39]. These reports included > 28 000 endoscopic procedures (mostly EGD and colonoscopy, 500 upper digestive EUS); no severe complications were reported except for requirement for bag mask ventilation in six patients (0.02%). However, blood pressure was not monitored in a majority of these patients, and it is therefore unclear how often patients might have presented critical hypotension.

There is no evidence that quick availability of a life support team is required for propofol administration. We do not recommend compulsory availability of a life support team if propofol is admin-

istered in the presence of a person trained in ACLS. (Evidence level 2+; Recommendation grade C.)

6.2.2 Patient preparation and monitoring

Intravenous access is required for sedation in gastrointestinal endoscopy and should be maintained using a catheter, not a winged steel needle until full patient recovery. (Evidence level 4, Recommendation grade D.)

Permanent intravenous access is required for most protocols of NAAP (EGD after a single bolus injection of propofol has been reported) [40]; Teflon cannulas are as easy to insert as winged steel needles and provide more reliable intravenous access [41].

Continuous supplemental oxygen is indicated during NAAP for endoscopy. (Evidence level 1+, Recommendation grade B.)

Administration of oxygen is widely recommended because RCTs have shown that oxygen desaturation is frequent during endoscopy if the patient breathes room air, and that this may be prevented by supplemental oxygen administration during endoscopy under traditional sedation [42–50]. However, the potential benefit of routine prophylactic oxygen supplementation in terms of decreased cardiopulmonary complications is unclear [51].

Patient monitoring is recommended in all patients using continuous pulse oximetry and automated noninvasive blood pressure measurement (at baseline and then at 3–5-minute intervals) during both NAAP and the recovery period; continuous electrocardiography is recommended in selected patients with a history of cardiac and/or pulmonary disease. Baseline, minimum and maximum heart rate/blood pressure, as well as baseline and minimum oxygen blood saturation should be recorded. (Evidence level 2++, Recommendation grade B.)

Most studies that have established the safety of NAAP have used patient monitoring as stated above [5]. Clinical utility of these measures has not been demonstrated but oximeters, electrocardiographs, and devices that automatically monitor blood pressure at regular intervals are widely available, relatively reliable, cheap, and easy to use. For example, pulse oximetry was found to be used during colonoscopy in 77% of > 6000 patients investigated in 11 European countries between 2000 and 2002 and in 97% of all gastroscopies and colonoscopies as shown in a recent nationwide survey in Germany [7, 52]. For NAAP, such monitoring has become a de facto standard.

- ▶ The utility of blood pressure monitoring during NAAP has not been studied but it is intuitively important to monitor because a decrease in blood pressure is one of the most frequent side effects of propofol, and it may require intervention.
- ▶ The utility of continuous electrocardiographic monitoring during NAAP has not been studied.
- ▶ Pulse oximetry is a noninvasive technique that allows S_pO_2 measurement, i.e. the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen. It provides an early warning of hypoxemia but it is not an early indicator of decreased ventilation.

Visual assessment of respiratory activity during anticipated long endoscopy procedures is not a reliable method of detecting apnea. During NAAP, capnographic monitoring of respiratory activity may reduce episodes of hypoxemia during long endoscopic procedures or when visual assessment of patient breathing is impaired, but no clinical impact has been demonstrated. Therefore, capnography cannot be recommended as standard. (Evidence level 1+, Recommendation grade B.)

Most episodes of apnea and disordered respiration remain undetected by visual assessment of respiratory activity during antici-

Table 4 Stages of sedation modified according to the American Society of Anesthesiologists [60].

	Minimal (anxiolysis)	Moderate	Deep	Anesthesia
Reaction being addressed	Patient reaction is adequate to verbal commands	Somnolence, reaction to louder commands, if needed with additional tactile stimulation	Somnolence, hard to wake, targeted reaction to repeated tactile stimulation and pain stimulus	Patient cannot be woken, not even in response to pain stimuli
Spontaneous breathing	Not influenced	Adequate	Respiratory function mildly restricted	Inadequate, orotracheal intubation or larynx mask necessary

pated long endoscopy procedures [53]. Two RCTs with a total of 426 patients have compared rapid vs. delayed signaling of respiratory abnormalities, as detected by capnography monitor, to the endoscopy team during sedation for endoscopy in adults and children [54,55]. Hypoxemia developed significantly more frequently in the capnography-blinded group vs. capnography-aware group in both studies, but no difference in clinically relevant outcomes (e.g. complication rate) was found in either study. Furthermore, in one of these RCTs, capnography erroneously displayed a flat line for at least 50 seconds in 13% of patients [54]. Clinical usefulness of capnography should be assessed in patients considered to be at high-risk for morbidity from hypoxemia (e.g. severe cardiovascular disease).

EEG-based monitoring may be used during NAAP to target a sedation level; it may help to reduce propofol consumption during complex endoscopic procedures with targeted deep sedation. No clinical impact of EEG-based monitoring has been demonstrated (Evidence level 1+), and no specific recommendation is made due to the paucity of data.

The bispectral index (BIS) is a variable derived from the EEG that allows the quantification of the hypnotic effects of anesthetic drugs on the central nervous system. Four RCTs assessing the usefulness of BIS during propofol sedation for endoscopy have been identified [56–59]. In these RCTs, the administration of propofol was controlled based on BIS vs. clinical parameters. Two RCTs that included patients with colonoscopy or gastric endoscopic submucosal dissection found no difference between randomization groups, in particular with regard to propofol consumption or recovery time (one study found better patient and [unblinded] endoscopist satisfaction with BIS) [56,57]. The two other RCTs included patients subjected to ERCP; both RCTs found that the propofol dose was significantly lower and the recovery time shorter in patients randomized to BIS compared with those randomized to clinical parameters for the monitoring of propofol administration [58,59]. In one of these RCTs [58], propofol was administered by an anesthesiologist; no side effect was attributed to the use of BIS.

6.2.3 Level of sedation

Simple endoscopic procedures can be performed with moderate sedation, maintaining a high degree of patient satisfaction. Prolonged or complex procedures (e.g. EUS and ERCP) are frequently performed under deep sedation. (Evidence level 1++, Recommendation grade A.)

The level of sedation can be assessed using different scales; an example is given in [Table 4](#) [60–62].

For EGD and colonoscopy, moderate sedation provides a high level of physician and patient satisfaction and a low risk of serious adverse events with all currently available agents [3]. For more

complex procedures such as EUS and ERCP, a deep sedation level has been targeted in a majority of studies, mostly to avoid involuntary patient movements [9–11,39,63–65].

6.2.4 Protocols of propofol-based sedation

6.2.4.1 Propofol alone or combined with other drugs

Combining propofol with an additional drug (benzodiazepine/opioid/ketamine) allows the dose of propofol administered to be decreased without reproducible effect on recovery time; there is no clear evidence that combining propofol with another drug leads to a decrease in adverse effects (Evidence level 1+). No recommendation is made about combination of propofol with other drugs.

Seven RCTs compared sedation with propofol administered alone vs. combined with midazolam and/or fentanyl or with a cocktail of various drugs ([Table 5](#)).

Different endoscopic procedures were analyzed and two RCTs were performed in children [66,67]. Most trials found that the doses of propofol were lower with combined vs. monotherapy regimens but results in terms of recovery times were contradictory. Complications were significantly less frequent with combined regimens in two RCTs that used midazolam [64,66], and were more frequent when propofol was combined with a “cocktail” including midazolam, ketamine, and pentazocine [65]. Endoscopy was rated as easier with combined regimens vs. propofol monotherapy in two RCTs [66,68]. Patient satisfaction was similar with propofol monotherapy vs. combined regimens, except for more late pain recall with a combined regimen in one trial [69].

6.2.4.2 Propofol administration techniques

Intermittent bolus administration of propofol is the current standard administration technique for NAAP. Data about propofol administration using perfusor systems during endoscopy are accumulating and show that these systems are as effective and safe as the standard technique. PCS is a valid administration technique but it is not applicable in a significant minority of patients. (Evidence level 1+.)

Propofol may be administered intravenously as repeated bolus injections, continuous infusion or a mixture of both techniques. Most trials dealing with propofol for digestive endoscopy have used repeat bolus injections by a caregiver or continuous infusion at a fixed rate; other techniques include PCS, target-controlled infusion (TCI) and, mostly for clinical research, “computer-assisted personalized sedation” (CAPS).

Standard techniques

An initial bolus of propofol (dose adapted to patient weight, age or comorbidity) is administered intravenously, followed by repeated boli according to patient condition or by a continuous propofol infusion (infusion rate is chosen according to the desired

Table 5 Main outcomes in randomized controlled trials comparing propofol used in monotherapy or in combination with other sedative drugs.

Study	N	Drugs combined	Procedure	Mean propofol dose		Mean recovery time, minutes		Complications	
				Monotherapy	Combined regimen	Monotherapy	Combined regimen	Monotherapy	Combined regimen
Disma et al. 2005 [66]	240	M or F	EGD	3.5 mg/kg	3.2 mg/kg	51.5	54	19%*	5 – 6%
Paspatis et al. 2006 [67]	54	M	EGD	2.9 mg/kg**	1.8 mg/kg	7.7**	25.9	O ₂ < 92%: 15.3% ΔMBP > 10 mmHg: 0	21.4% 3.5%
VanNatta & Rex 2006 [69]	200	M, or F, or M+F	Colonoscopy	215 mg**	82.5 – 140 mg	18.1**	13.9 – 14.7	ND	ND
Fanti et al. 2007 [70]	270	M	Upper EUS	364 mg	394 mg	39	38	0	0
Ong et al. 2007 [65]	199	M+P+K	ERCP	192 mg***	131 mg	NA	NA	4.8%**	15.8%
Paspatis et al. 2008 [64]	91	M	ERCP	512 mg***	331 mg	30.6**	35.5	O ₂ < 90%: 24.4%* SBP < 90 mmHg: 4.4%	6.5% 6.5%
Padmanabhan et al. 2009 [68]	200	M, or F, or M+F	Colonoscopy	285 mg***	200 mg	66	64	ND	ND

EGD, esophagogastroduodenoscopy; ERCP, endoscopic retrograde cholangio-pancreatography; EUS, endoscopic ultrasonography. F, fentanyl; K, ketamine; M, midazolam; P, pentazocine. NA, not available; ND, no difference between groups without more precision in the original article; ΔMBP, change in mean arterial blood pressure; SBP, systolic blood pressure. *P < 0.05; **P < 0.01; ***P < 0.001.



sedation depth and the patient risk profile, with additional boli administered as needed). These are the best documented and the most often used administration techniques for propofol.

Patient-controlled sedation

In PCS, a computerized pump is programed to deliver intravenously a predetermined amount of sedative and/or opioid when the patient presses a button. This technique has mostly been used for colonoscopy. A Cochrane meta-analysis of RCTs comparing propofol with traditional sedation for colonoscopy has shown that, with PCS, complication rates were similar, pain control was inferior (even in studies that used propofol combined with an analgesic) but patient satisfaction was higher than with traditional agents [13]. This discordance between pain and patient satisfaction likely reflects the fact that patients appreciate deciding about their appropriate sedation level.

Three RCTs have randomized patients scheduled to colonoscopy for the administration of propofol (alone or in combined regimen) via PCS vs. via continuous infusion or repeat bolus administrations by a trained nurse. Of note, 34% of the 453 patients eligible for randomization in these trials refused inclusion. In terms of patient safety, no clinically significant difference between the administration techniques was detected. The doses of propofol were similar between randomization groups in two RCTs and lower in the PCS group in one study [71]. Patient satisfaction was significantly higher with PCS in one of three trials [72]; willingness to repeat the examination was evaluated in two trials and it was significantly higher with the PCS in one of them [71]. The advantage of PCS in terms of cost (no dedicated nurse) may be offset by the cost of different propofol formulations used for PCS [73].

Target-controlled infusion and computer-assisted personalized sedation

With these techniques, the infusion rate is adjusted by a computer, either in an “open-loop” system based on fixed parameters (e.g. body weight) or in a “closed-loop” system that uses feedback from a real-time measure of drug effect (e.g. patient reaction to tactile stimuli or BIS) [74,75]. These systems are called TCI and CAPS, respectively. Too few data have been reported in the endoscopy field to draw conclusions with these systems but, for TCI in adult surgical patients, no clinically significant differences were demonstrated in terms of quality of anesthesia or adverse events with TCI vs. manually controlled infusion of propofol (Cochrane meta-analysis) [76].

6.2.5 Non-pharmacological measures available to reduce doses of propofol

6.2.5.1 Listening to music

Listening to patient-selected music during colonoscopy allows the dose of propofol administered to be decreased; we recommend this for colonoscopy. (Evidence level 1–, Recommendation grade B.)

Three meta-analyses have reported the effect of listening to music on sedative drug consumption during colonoscopy [77–79]. Differences in the amounts of drugs used between the intervention and control groups were not statistically significant in two meta-analyses [77,78], and they were marginally significant in the third one due to the inclusion of one additional RCT that used propofol for sedation (midazolam was used in the RCTs included in the two other meta-analyses) [79]. In the additional RCT [80], propofol mixed with alfentanil was self-administered via PCS in the intervention and control groups; patients with

headphones and a choice of different music types (intervention group) self-injected less drug than control patients. One meta-analysis also included patients undergoing EGD and sigmoidoscopy; listening to music may also be beneficial for these interventions [78].

6.2.5.2 Pharyngeal anesthesia

The role of pharyngeal anesthesia during propofol sedation for upper digestive endoscopy has not been assessed. No recommendation is made.

Pharyngeal anesthesia decreases patient discomfort during upper digestive endoscopy under traditional sedation but it has not been investigated for endoscopy under propofol sedation [81]. Impact on consumption of traditional agents and on recovery was not reported in available trials.

6.2.5.3 Special endoscopes

Variable stiffness colonoscopes allow the dose of propofol administered to be decreased during colonoscopy with no demonstrated clinical impact (Evidence level 1+). A single endoscope manufacturer currently offers such models and no recommendation is made.

A meta-analysis of seven RCTs showed that sedative drugs were used in significantly lower amounts and that cecal intubation rate was higher when colonoscopy was performed using a variable stiffness colonoscope vs. a standard colonoscope [82]. One of these seven RCTs used propofol for sedation; it found that patients self-administered (via PCS) significantly lower amounts of propofol when a variable stiffness colonoscope was used but no impact on sedation-related complications (hypotension, oxygen desaturation) or recovery time was found [83].

6.2.5.4 Use of CO₂ as air replacement for gut distension

Postendoscopy pain is lower when air is replaced by CO₂ for gut distension during long endoscopy procedures but there are no data on the doses of propofol administered (Evidence level 1+). No recommendation is made.

Two RCTs compared CO₂ vs. air for gut distension during ERCP and colonoscopy performed under propofol sedation [84,85]. Impact on the dose of propofol administered was not reported and recovery time was similar with both gases in one study [84]. Postendoscopy pain was significantly lower with CO₂ vs. air.

6.2.6 Precautions and management of complications

Propofol is contraindicated in patients with a known allergy to soy protein. Pain at the injection site is frequent and can be prevented by lidocaine (Evidence level 1++). Hypoxemia and hypotension are the most frequent adverse effects of propofol and develop during NAAP in 5%–10% of patients. Measures to be taken in case of complications should be established in a check-list that is updated and tested at regular intervals. If a patient proves difficult to sedate adequately for the examination purpose, endoscopy termination and referral to an anesthesiologist should be considered (Evidence level 4, Recommendation grade D).

Strict aseptic conditions, including the use of separate propofol vials for each patient, should be maintained during manipulation of propofol, as bacterial and viral (hepatitis C) contaminations have been reported [86,87]. Recommendations about allergies to some components (e.g. eggs, peanuts, sulfites) vary depending on the propofol formulation and this should be checked according to recommendations by the manufacturer of the formulation used. A so-called “propofol infusion syndrome” (with rhabdomyolysis) has also been described (initially after long-term,

high-dose, administration of propofol in intensive care units but more recently with short administration of lower doses) [88]. Propofol is contraindicated in patients with a known allergy to soy protein. Propofol may cause pain at the injection site; this may be prevented in 60% of patients by intravenous administration of lidocaine (0.5 mg/kg) with a rubber tourniquet on the forearm [89].

Hypoxemia and hypotension, the most frequent adverse effects of propofol, are usually defined as hemoglobin oxygen saturation < 90% and systolic blood pressure < 90 mmHg, respectively. Their incidence during propofol-based sedation was, in a meta-analysis, 11% (95% confidence interval [CI], 7%–16%) and 5% (95% CI 2%–10%), respectively [3].

Measures that should be taken when hypoxemia develops include stopping the infusion of sedative drugs, increasing oxygen supply, maintaining the airway patent (by jaw-thrust maneuver, suctioning, and mask ventilation). Flumazenil/naloxone may be administered if benzodiazepines/opioids have been used. If the patient does not respond adequately to these measures, endoscopy should be stopped. If hypoxemia does not reverse, emergency call must be performed according to local protocols and ACLS must be initiated. In cases of arterial hypotension, an electrolyte solution should be administered, possibly associated with catecholamines. In cases of bradycardia, atropine should be administered intravenously.

6.3 Post-sedation care

6.3.1 Surveillance during recovery

A small minority of sedation-related adverse effects occur after, as opposed to during, the procedure. We recommend patient observation until discharge by a person who is aware of the adverse effects of the drugs administered. (Evidence level 2+, Recommendation grade C.)

A large prospective study showed that serious adverse effects may occur up to 30 minutes after the administration of benzodiazepines and opioids for sedation, but postprocedure adverse effects represented < 10% of per-procedure adverse effects [90]. Serious postprocedure adverse effects are less frequent with propofol compared with a combination of midazolam/meperidine [11]. During recovery, patients should be observed by a person who is aware of the side effects of the drugs administered using monitoring equipment similar to that used during the procedure. This person may perform minor interruptible tasks but should not leave the room. Although it is possible to observe patients in the examination room, we recommend a separate room for practical reasons.

6.3.2 Discharge

Minimum discharge criteria are useful for discharging patients after sedation for digestive endoscopy. We recommend using a standardized discharge scoring form (e.g. Table 6). (Evidence level 2+, Recommendation grade C.)

Various scoring systems devised for the assessment of postsurgical recovery have been used after sedation for endoscopy, the most popular systems being the modified Aldrete score (for early or phase I recovery) and the postanesthetic discharge scoring system (PADSS, for intermediate or phase II recovery) [91,92]. Despite limitations of PADSS inherent to its focus on surgical procedures (e.g. one of the five criteria in this system is “surgical bleeding”), it has been documented to allow safe discharge after digestive endoscopy in a relatively small prospective study [93]. A checklist (Table 6) is proposed to assess home-readiness of pa-

Table 6 Example of checklist for home discharge after digestive endoscopy under sedation.

Stable vital signs for at least 1 hour
Alert and oriented to time, place, and person (infants and patients whose mental status was initially abnormal should have returned to their baseline status)
No excessive pain, bleeding, or nausea
Ability to dress and walk with assistance
Discharged home with a responsible adult who will remain with the patient overnight to report any postprocedure complications
Written and verbal instructions outlining diet, activity, medications, follow-up appointments, and a phone number to be called in case of emergency
A contact person and circumstances that warrant seeking the assistance of a health care professional clearly outlined
Tolerating oral fluids not mandatory, unless specified by physician (i.e. patient is diabetic, frail, and/or elderly; not able to tolerate an extended period of NPO status)

Adapted from Ead [94].

tients after digestive endoscopy under sedation. At a minimum, criteria proposed by the ASA should be met [37]. Commonly used tests to evaluate psychomotor functions are coherent response to questions, ability to stand on one foot, and ability to walk in a straight line for 5 m without instability.

Minimum discharge criteria should be fulfilled before discharging a patient. However, psychomotor functions remain significantly impaired when standard discharge criteria are met. Upon discharge, patients should be accompanied by a responsible person and refrain from driving, operating heavy machinery or engaging in legally binding decisions for at least 12 hours if sedation with propofol alone was administered (24 hours in cases of combined regimen). Advice should be provided verbally and in written form, including a 24-hour contact phone number. (Evidence level 1+, Recommendation grade A.)

Psychomotor functions remain significantly impaired when standard discharge criteria are met [95]. Therefore, patients should be informed in advance of precautions to be taken after discharge; these instructions should be repeated at the time of discharge. Precautions include the presence of an escort to ensure safe return home in cases of outpatient procedures.

Psychomotor recovery is significantly more rapid with propofol vs. traditional sedation: in two RCTs that compared propofol with midazolam/pethidine for EGD/colonoscopy, patients who had received propofol had no impairment of psychomotor functions 2 hours after sedation as measured by a driving simulator test, in contrast to those who had received midazolam/pethidine [40,96]. However, both studies employed relatively low doses of propofol. In another study, 92% of 400 patients who received low-dose propofol for EGD wanted to drive when leaving the endoscopy unit, and all did so without incident [97]. Therefore, current recommendations from various professional associations to neither drive nor use public transport without an accompanying person, nor operate heavy machinery or engage in any legal decision making for 24 hours seem too strict if propofol is used in low-dose monotherapy.

6.4 Procedure documentation and medicolegal issues

Documentation should be maintained throughout all phases of patient management, including:

- ▶ vital signs assessed at regular intervals (oxygen saturation, heart rate, and blood pressure)

- ▶ drugs (name, dosage), IV fluids (type, quantity), and oxygen (flow rate) administered
- ▶ sedation-associated complications and their management
- ▶ fulfillment of discharge criteria.

A minority of the audience thought that it should be recommended to record, in addition to this, the level of consciousness at regular intervals. Maintaining documentation in an electronic database may help to monitor quality and will provide a record in the event of medicolegal investigation. (Evidence level 4, Recommendation grade D.)

A structured procedural sedation record is part of a quality process and may help to improve compliance with sedation guidelines [98].

The endoscopist bears the ultimate medicolegal responsibility to ensure proper personal training of the endoscopy staff involved in NAAP. (Evidence level 4.)

Medicolegal issues are important when considering NAAP because (1) up to half of complications after endoscopic procedures are related to sedation, and (2) in two surveys, a majority of endoscopists cited “medicolegal issues” as the main reason for not embracing NAAP [7,99]. The fact that the label accompanying propofol packages in many countries stipulates that “propofol should be administered only by persons trained in the administration of general anesthesia” means that, in some countries, during NAAP, propofol is used “off-label”. Off-label use of drugs is common in medical practice and it has been endorsed by various associations such as the Food and Drug Administration and the American Medical Association [100]. However, departure from label recommendations may in some courts shift the burden of proving that the method of use accords with recognized clinical practice to the defendant.

Informed consent for NAAP should be obtained from the patient or his/her legal representative according to domestic laws and regulations in a way similar to that of other endoscopy procedures. It is generally obtained during a face-to-face discussion between a physician familiar with the procedure and the patient, with information given in lay language to the patient and the opportunity for him/her to ask questions prior to the procedure. The informed consent regarding sedation issues may be incorporated into the main body of the endoscopy consent form. The procedure of informed consent should be documented. (Evidence level 4, Recommendation grade D.)

A significant proportion of complications after endoscopy are related to sedation [30,31]. In a series of 59 ERCP procedures for which malpractice was alleged, Cotton showed the importance of face-to-face communication between the endoscopist and the patient [101]. Information pertaining to sedation should be provided, including pros and cons of sedation with alternatives and the option for unsedated endoscopy, potential complications, postprocedure risks related to driving, operating equipment where psychomotor functions are essential, consuming alcohol and drugs, taking legally binding decisions, and the risk of amnesia.

Acknowledgements

We thank the Board and the Guidelines Committee of the ESA for their support and endorsement. The authors would also like to thank T. H. Baron for his review and valuable input to the guideline.

Competing interests: A. Riphaus has received speaker fees from Fresenius Kabi, Nycomed, Falk Foundation, Astra Zeneca and research support from Fresenius Kabi and Oridion. T. Wehrmann has received speaker fees from Fresenius Kabi, Falk Foundation, B. Braun-Melsungen, Nycomed and research support from Fresenius Kabi, Olympus, B. Braun-Melsungen and Paion.

Institutions

- ¹ Service of Gastroenterology and Hepatology, Geneva University Hospitals, Geneva, Switzerland
- ² Department of Medicine, Ruhr University Bochum, Bochum, Germany
- ³ Endoscopy Unit, Hospital General Universitario de Alicante, Pintor Baeza s/n, Alicante, Spain
- ⁴ President, European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA), Ulm, Germany
- ⁵ Past-President, European Society of Anaesthesiology, University Medical Center Utrecht, Utrecht, The Netherlands
- ⁶ Vice-President, ESGENA, Basel, Switzerland
- ⁷ Department of Gastroenterology, Benizelion General Hospital, L. Knossou, Heraklion, Crete, Greece
- ⁸ Department of Gastroenterology and Hepatology, Academic Medical Center, Amsterdam, The Netherlands
- ⁹ First Department of Internal Medicine and Gastroenterology, Petz Aladar Hospital, Gyor, Vasvari, Hungary
- ¹⁰ Department of Internal Medicine, Division of Gastroenterology and Hepatology, Medical University Graz, Austria
- ¹¹ Department of Surgical Gastroenterology, Herlev Hospital; Endoscopic Unit, Gentofte Hospital, Copenhagen University, Hellerup, Denmark
- ¹² Division of Gastroenterology, Deutsche Klinik für Diagnostik, Wiesbaden, Germany
- ¹³ Department of Anesthesiology, Geneva University Hospitals, Geneva, Switzerland

References

- 1 Baudet J-S, Borque P, Borja E et al. Use of sedation in gastrointestinal endoscopy: a nationwide survey in Spain. *Eur J Gastroenterol Hepatol* 2009; 21: 882–888
- 2 Radaelli F, Meucci G, Sgroi G, Minoli G and the Italian Association of Hospital Gastroenterologists (AIGO). Technical performance of colonoscopy: the key role of sedation/analgesia and other quality indicators. *Am J Gastroenterol* 2008; 103: 1122–1130
- 3 McQuaid KR, Laine L. A systematic review and meta-analysis of randomized, controlled trials of moderate sedation for routine endoscopic procedures. *Gastrointest Endosc* 2008; 67: 910–923
- 4 Heuss LT, Froehlich F, Beglinger C. Changing patterns of sedation and monitoring practice during endoscopy: results of a nationwide survey in Switzerland. *Endoscopy* 2005; 37: 161–166
- 5 Rex D, Deenadayalu V, Eid E et al. Endoscopist-directed administration of propofol: a worldwide safety experience. *Gastroenterology* 2009; 137: 1229–1237
- 6 Paspatis G, Manolaraki M, Tribonias G et al. Endoscopic sedation in Greece: results from a nationwide survey for the Hellenic Foundation of gastroenterology and nutrition. *Dig Liv Dis* 2009; 41: 807–811
- 7 Riphaus A, Rabofski M, Wehrmann T. Endoscopic sedation and monitoring practice in Germany: results from the first nationwide survey. *Zeitschrift für Gastroenterologie* 2010; 48: 392–397
- 8 Harbour R, Miller J. A new system for grading recommendations in evidence based guidelines. *BMJ* 2001; 323: 334–336
- 9 Dewitt J, McGreevy K, Sherman S, Imperiale TF. Nurse-administered propofol sedation compared with midazolam and meperidine for EUS: a prospective, randomized trial. *Gastrointest Endosc* 2008; 68: 499–509
- 10 Jung M, Hofmann C, Kiesslich R, Brackertz A. Improved sedation in diagnostic and therapeutic ERCP: propofol is an alternative to midazolam. *Endoscopy* 2000; 32: 233–238
- 11 Riphaus A, Stergiou N, Wehrmann T. Sedation with propofol for routine ERCP in high-risk octogenarians: a randomized, controlled study. *Am J Gastroenterol* 2005; 100: 1957–1963
- 12 Meining A, Semmler V, Kassem AM et al. The effect of sedation on the quality of upper gastrointestinal endoscopy: an investigator-blinded, randomized study comparing propofol with midazolam. *Endoscopy* 2007; 39: 345–349
- 13 Singh H, Poluha W, Cheung M et al. Propofol for sedation during colonoscopy. *Cochrane database of systematic reviews* 2008; CD006268

- 14 Qadeer MA, Vargo JJ, Khandwala F et al. Propofol versus traditional sedative agents for gastrointestinal endoscopy: a meta-analysis. *Clin Gastroenterol Hepatol* 2005; 3: 1049–1056
- 15 Vargo JJ, Bramley T, Meyer K, Nightengale B. Practice efficiency and economics: the case for rapid recovery sedation agents for colonoscopy in a screening population. *J Clin Gastroenterol* 2007; 41: 591–598
- 16 Riphaut A, Wehrmann T, Weber B et al. S3 Guideline: Sedation for gastrointestinal endoscopy 2008. *Endoscopy* 2009; 41: 787–815
- 17 Lichtenstein DR, Jagannath S, Baron TH et al. Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy. Sedation and anesthesia in GI endoscopy. *Gastrointest Endosc* 2008; 68: 815–826
- 18 Knape JTA, Adriaensen H, van Aken H et al. Guidelines for sedation and/or analgesia by non-anaesthesiology doctors. *Eur J Anaesth* 2007; 24: 563–567
- 19 Cohen LB, Delegge MH, Aisenberg J et al. AGA Institute review of endoscopic sedation. *Gastroenterology* 2007; 133: 675–701
- 20 Byrne MF, Chiba N, Singh H, Sadowski DC. *Clinical Affairs Committee of the Canadian Association of Gastroenterology*. Propofol use for sedation during endoscopy in adults: a Canadian Association of Gastroenterology position statement. *Can J Gastroenterol* 2008; 22: 457–459
- 21 Rex DK, Heuss LT, Walker JA, Qi R. Trained registered nurses/endoscopy teams can administer propofol safely for endoscopy. *Gastroenterology* 2005; 129: 1384–1391
- 22 Rex DK, Overley CA, Walker J. Registered nurse-administered propofol sedation for upper endoscopy and colonoscopy: Why? When? How? *Rev Gastroenterol Dis* 2003; 3: 70–80
- 23 Fatima H, Dewitt J, Leblanc J et al. Nurse-administered propofol sedation for upper endoscopic ultrasonography. *Am J Gastroenterol* 2008; 103: 1649–1656
- 24 Tohda G, Higashi S, Wakahara S et al. Propofol sedation during endoscopic procedures: safe and effective administration by registered nurses supervised by endoscopists. *Endoscopy* 2006; 38: 360–367
- 25 Maffei M, Dumortier J, Dumonceau JM. Self-training in unsedated transnasal EGD by endoscopists competent in standard peroral EGD: prospective assessment of the learning curve. *Gastrointest Endosc* 2008; 67: 410–418
- 26 Beilenhoff U, Engelke M, Kern-Wächter E et al. DEGEA-Curriculum Sedierung und Notfallmanagement in der Endoskopie für Endoskopiepflege-und-assistenzpersonal. www.degeade.de/typo3/fileadmin/Fachinformationen/Sedierung/DEGEA-Curriculum.pdf; Accessed on Nov 15, 2009
- 27 DeMaria S, Levine AI, Cohen LB. Human patient simulation and its role in endoscopic sedation training. *Gastrointest Endosc Clin N Am* 2008; 18: 801–813
- 28 Heuss LT, Schnieper P, Drewe J et al. Risk stratification and safe administration of propofol by registered nurses supervised by the gastroenterologist: a prospective observational study of more than 2000 cases. *Gastrointest Endosc* 2003; 57: 664–671
- 29 Cohen LB, Dubovsky AN, Aisenberg J, Miller KM. Propofol for endoscopic sedation: a protocol for safe and effective administration by the gastroenterologist. *Gastrointest Endosc* 2003; 58: 725–732
- 30 Eckardt VF, Kanzler G, Schmitt T et al. Complications and adverse effects of colonoscopy with selective sedation. *Gastrointest Endosc* 1999; 49: 560–565
- 31 Quine MA, Bell GD, McCloy RF et al. Prospective audit of upper gastrointestinal endoscopy in two regions of England: safety, staffing, and sedation methods. *Gut* 1995; 36: 462–467
- 32 Bhananker SM, Posner KL, Cheney FW et al. Injury and liability associated with monitored anesthesia care: a closed claims analysis. *Anesthesiology* 2006; 104: 228–234
- 33 Williams EJ, Taylor S, Fairclough P et al. Are we meeting the standards set for endoscopy? Results of a large-scale prospective survey of endoscopic retrograde cholangio-pancreatograph practice. *Gut* 2007; 56: 821–829
- 34 Gupta A. Preoperative screening and risk assessment in the ambulatory surgery patient. *Cur Opin Anaesth* 2009; 22: 705–711
- 35 ASA. Physical Status Classification System. www.asahq.org/clinical/physicalstatus.htm; Accessed on Apr 15, 2010
- 36 Mallampati SR, Gatt SP, Gugino LD et al. A clinical sign to predict difficult tracheal intubation: a prospective study. *Can Anaesth Soc J* 1985; 32: 429–434
- 37 Gross JB, Bailey PL, Connis RT et al. Practice guidelines for sedation and analgesia by non-anesthesiologists. *Anesthesiology* 2002; 96: 1004–1017
- 38 Külling D, Orlandi M, Inauen W. Propofol sedation during endoscopic procedures: how much staff and monitoring are necessary? *Gastrointest Endosc* 2007; 66: 443–449
- 39 Yusoff IF, Raymond G, Sahai AV. Endoscopist administered propofol for upper-GI EUS is safe and effective: a prospective study in 500 patients. *Gastrointest Endosc* 2004; 60: 356–360
- 40 Horiuchi A, Nakayama Y, Katsuyama Y et al. Safety and driving ability following low-dose propofol sedation. *Digestion* 2008; 78: 190–194
- 41 Smith MR, Bell GD, Fulton B et al. A comparison of winged steel needles and Teflon cannulas in maintaining intravenous access during gastrointestinal endoscopy. *Gastrointest Endosc* 1993; 39: 33–36
- 42 al-Qoraini A, Adu-Gyamfi Y, Larbi EB, al-Shedokhi F. The effect of supplemental oxygen in sedated and unsedated patients undergoing upper gastrointestinal endoscopy. *J Int Med Res* 1993; 21: 165–170
- 43 Bell GD, Quine A, Antrobus JH et al. Upper gastrointestinal endoscopy: a prospective randomized study comparing continuous supplemental oxygen via the nasal or oral route. *Gastrointest Endosc* 1992; 38: 319–325
- 44 Bowling TE, Hadjiminias CL, Polson RJ et al. Effects of supplemental oxygen on cardiac rhythm during upper gastrointestinal endoscopy: a randomized controlled double blind trial. *Gut* 1993; 34: 1492–1497
- 45 Crantock L, Cowen AE, Ward M, Roberts RK. Supplemental low flow oxygen prevents hypoxia during endoscopic cholangiopancreatography. *Gastrointest Endosc* 1992; 38: 418–420
- 46 Gross JB, Long WB. Nasal oxygen alleviates hypoxemia in colonoscopy patients sedated with midazolam and meperidine. *Gastrointest Endosc* 1990; 36: 26–29
- 47 Haines DJ, Bibbey D, Green JR. Does nasal oxygen reduce the cardiorespiratory problems experienced by elderly patients undergoing endoscopic retrograde cholangiopancreatography? *Gut* 1992; 33: 973–975
- 48 iwao T, Toyonaga A, Shigemori H et al. Supplemental oxygen during endoscopic variceal ligation: effects on arterial oxygenation and cardiac arrhythmia. *Am J Gastroenterol* 1995; 90: 2186–2190
- 49 Patterson KW, Noonan N, Keeling NW et al. Hypoxemia during outpatient gastrointestinal endoscopy: the effects of sedation and supplemental oxygen. *J Clin Anesth* 1995; 7: 136–140
- 50 Rozario L, Sloper D, Sheridan MJ. Supplemental oxygen during moderate sedation and the occurrence of clinically significant desaturation during endoscopic procedures. *Gastroenterol Nursing* 2008; 31: 281–285
- 51 Sharma VK, Nguyen CC, Crowell MD et al. A national study of cardiopulmonary unplanned events after GI endoscopy. *Gastrointest Endosc* 2007; 66: 27–34
- 52 Froehlich F, Harris JK, Wietlisbach V et al. Current sedation and monitoring practice for colonoscopy: an International Observational Study (EPAGE). *Endoscopy* 2006; 38: 461–469
- 53 Vargo JJ, Zuccaro G, Dumot JA et al. Automated graphic assessment of respiratory activity is superior to pulse oximetry and visual assessment for the detection of early respiratory depression during therapeutic upper endoscopy. *Gastrointest Endosc* 2002; 55: 826–831
- 54 Qadeer MA, Vargo JJ, Dumot JA et al. Capnographic monitoring of respiratory activity improves safety of sedation for endoscopic cholangiopancreatography and ultrasonography. *Gastroenterology* 2009; 136: 1568–1576; quiz 1819–1820
- 55 Lightdale JR, Goldmann DA, Feldman HA et al. Microstream capnography improves patient monitoring during moderate sedation: a randomized, controlled trial. *Pediatrics* 2006; 117: e1170–e1178
- 56 Drake LM, Chen SC, Rex DK. Efficacy of bispectral monitoring as an adjunct to nurse-administered propofol sedation for colonoscopy: a randomized controlled trial. *Am J Gastroenterol* 2006; 101: 2003–2007
- 57 Imagawa A, Fujiki S, Kawahara Y et al. Satisfaction with bispectral index monitoring of propofol-mediated sedation during endoscopic submucosal dissection: a prospective, randomized study. *Endoscopy* 2008; 40: 905–909
- 58 Paspatis GA, Chainaki I, Manolaraki MM et al. Efficacy of bispectral index monitoring as an adjunct to propofol deep sedation for ERCP: a randomized controlled trial. *Endoscopy* 2009; 41: 1046–1051
- 59 Wehrmann T, Grotkamp J, Stergiou N et al. Electroencephalogram monitoring facilitates sedation with propofol for routine ERCP: a randomized, controlled trial. *Gastrointest Endosc* 2002; 56: 817–824
- 60 American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and

- analgesia by non-anesthesiologists. *Anesthesiology* 2002; 96: 1004–1017
- 61 *American Society of Anesthesiologists Task Force on Preanesthesia Evaluation*. Practice advisory for preanesthesia evaluation: a report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology* 2002; 96: 485–496
 - 62 *Ely EW, Truman B, Shintani A et al*. Monitoring sedation status over time in ICU patients: reliability and validity of the Richmond Agitation-Sedation Scale (RASS). *JAMA* 2003; 289: 2983–2991
 - 63 *Muller S, Borowics SM, Fortis EAF et al*. Clinical efficacy of dexmedetomidine alone is less than propofol for conscious sedation during ERCP. *Gastrointest Endosc* 2008; 67: 651–659
 - 64 *Paspatis GA, Manolaraki MM, Vardas E et al*. Deep sedation for endoscopic retrograde cholangiopancreatography: intravenous propofol alone versus intravenous propofol with oral midazolam premedication. *Endoscopy* 2008; 40: 308–313
 - 65 *Ong WC, Santosh D, Lakhtakia S, Reddy DN*. A randomized controlled trial on use of propofol alone versus propofol with midazolam, ketamine, and pentazocine “sedato-analgesic cocktail” for sedation during ERCP. *Endoscopy* 2007; 39: 807–812
 - 66 *Disma N, Astuto M, Rizzo G et al*. Propofol sedation with fentanyl or midazolam during oesophagogastroduodenoscopy in children. *Eur J Anaesth* 2005; 22: 848–852
 - 67 *Paspatis GA, Charoniti I, Manolaraki M et al*. Synergistic sedation with oral midazolam as a premedication and intravenous propofol versus intravenous propofol alone in upper gastrointestinal endoscopies in children: a prospective, randomized study. *J Pediatr Gastroenterol Nutr* 2006; 43: 195–199
 - 68 *Padmanabhan U, Leslie K, Eer AS et al*. Early cognitive impairment after sedation for colonoscopy: the effect of adding midazolam and/or fentanyl to propofol. *Anesth Analg* 2009; 109: 1448–1455
 - 69 *VanNatta ME, Rex DK*. Propofol alone titrated to deep sedation versus propofol in combination with opioids and/or benzodiazepines and titrated to moderate sedation for colonoscopy. *Am J Gastroenterol* 2006; 101: 2209–2217
 - 70 *Fanti L, Agostoni M, Arcidiacono PG et al*. Target-controlled infusion during monitored anesthesia care in patients undergoing EUS: propofol alone versus midazolam plus propofol. A prospective double-blind randomized controlled trial. *Dig Liv Dis* 2007; 39: 81–86
 - 71 *Crepeau T, Poincloux L, Bonny C et al*. Significance of patient-controlled sedation during colonoscopy. Results from a prospective randomized controlled study. *Gastroenterol Clin Biol* 2005; 29: 1090–1096
 - 72 *Killing D, Fantin AC, Biro P et al*. Safer colonoscopy with patient-controlled analgesia and sedation with propofol and alfentanil. *Gastrointest Endosc* 2001; 54: 1–7
 - 73 *Heuss LT, Drewe J, Schmieper P et al*. Patient-controlled versus nurse-administered sedation with propofol during colonoscopy. A prospective randomized trial. *Am J Gastroenterol* 2004; 99: 511–518
 - 74 *Leslie K, Absalom A, Kenny GNC*. Closed loop control of sedation for colonoscopy using the Bispectral Index. *Anaesthesia* 2002; 57: 693–697
 - 75 *Pambianco DJ, Whitten CJ, Moerman A et al*. An assessment of computer-assisted personalized sedation: a sedation delivery system to administer propofol for gastrointestinal endoscopy. *Gastrointest Endosc* 2008; 68: 542–547
 - 76 *Leslie K, Clavisi O, Hargrove J*. Target-controlled infusion versus manually-controlled infusion of propofol for general anaesthesia or sedation in adults. *Cochrane database of systematic reviews* 2008; CD006059
 - 77 *Bechtold ML, Puli SR, Othman MO et al*. Effect of music on patients undergoing colonoscopy: a meta-analysis of randomized controlled trials. *Dig Dis Sci* 2009; 54: 19–24
 - 78 *Rudin D, Kiss A, Wetz RV, Sottile VM*. Music in the endoscopy suite: a meta-analysis of randomized controlled studies. *Endoscopy* 2007; 39: 507–510
 - 79 *Tam WWS, Wong ELY, Twinn SF*. Effect of music on procedure time and sedation during colonoscopy: a meta-analysis. *World J Gastroenterol* 2008; 14: 5336–5343
 - 80 *Lee DWH, Chan K-W, Poon C-M et al*. Relaxation music decreases the dose of patient-controlled sedation during colonoscopy: a prospective randomized controlled trial. *Gastrointest Endosc* 2002; 55: 33–36
 - 81 *Evans LT, Saberi S, Kim HM et al*. Pharyngeal anesthesia during sedated EGDs: is “the spray” beneficial? A meta-analysis and systematic review. *Gastrointest Endosc* 2006; 63: 761–766
 - 82 *Othman MO, Bradley AG, Choudhary A et al*. Variable stiffness colonoscope versus regular adult colonoscope: meta-analysis of randomized controlled trials. *Endoscopy* 2009; 41: 17–24
 - 83 *Lee DWH, Li ACN, Ko C-W et al*. Use of a variable-stiffness colonoscope decreases the dose of patient-controlled sedation during colonoscopy: a randomized comparison of 3 colonoscopes. *Gastrointest Endosc* 2007; 65: 424–429
 - 84 *Maple JT, Keswani RN, Hovis RM et al*. Carbon dioxide insufflation during ERCP for reduction of postprocedure pain: a randomized, double-blind, controlled trial. *Gastrointest Endosc* 2009; 70: 278–283
 - 85 *Riss S, Akan B, Mikola B et al*. CO₂ insufflation during colonoscopy decreases post-interventional pain in deeply sedated patients: a randomized controlled trial. *Wien Klin Wochenschr* 2009; 121: 464–468
 - 86 *Fukada T, Ozaki M*. Microbial growth in propofol formulations with disodium edetate and the influence of venous access system dead space. *Anaesthesia* 2007; 62: 575–580
 - 87 *Tallis GF, Ryan GM, Lambert SB et al*. Evidence of patient-to-patient transmission of hepatitis C virus through contaminated intravenous anaesthetic ampoules. *J Viral Hepat* 2003; 10: 234–239
 - 88 *Riker RR, Glisic EK, Fraser GL*. Propofol infusion syndrome: difficult to recognize, difficult to study. *Crit Care Med* 2009; 37: 3169–3170
 - 89 *Picard P, Tramèr MR*. Prevention of pain on injection with propofol: a quantitative systematic review. *Anesth Analg* 2000; 90: 963–969
 - 90 *Newman DH, Azer MM, Pitetti RD, Singh S*. When is a patient safe for discharge after procedural sedation? The timing of adverse effect events in 1367 pediatric procedural sedations. *Ann Emerg Med* 2003; 42: 627–635
 - 91 *Aldrete JA*. Modifications to the postanesthesia score for use in ambulatory surgery. *J Perianesth Nurs* 1998; 13: 148–155
 - 92 *Chung F, Chan VW, Ong D*. A post-anesthetic discharge scoring system for home readiness after ambulatory surgery. *J Clin Anesth* 1995; 7: 500–506
 - 93 *Amorniyotin S, Chalayonnavin W, Kongphlay S*. Recovery pattern and home-readiness after ambulatory gastrointestinal endoscopy. *J Med Assoc Thai* 2007; 90: 2352–2358
 - 94 *Ead H*. From Aldrete to PADSS: Reviewing discharge criteria after ambulatory surgery. *J Perianesth Nurs* 2006; 21: 259–267
 - 95 *Wiley J, Vargo JJ, Connor JT et al*. Quantitative assessment of psychomotor recovery after sedation and analgesia for outpatient EGD. *Gastrointest Endosc* 2002; 56: 810–816
 - 96 *Riphaus A, Gstettenbauer T, Frenz MB, Wehrmann T*. Quality of psychomotor recovery after propofol sedation for routine endoscopy: a randomized and controlled study. *Endoscopy* 2006; 38: 677–683
 - 97 *Horiuchi A, Nakayama Y, Hidaka N et al*. Low-dose propofol sedation for diagnostic esophagogastroduodenoscopy: results in 10,662 adults. *Am J Gastroenterol* 2009; 104: 1650–1655
 - 98 *Pitetti R, Davis PJ, Redlinger R et al*. Effect on hospital-wide sedation practices after implementation of the 2001 JCAHO procedural sedation and analgesia guidelines. *Arch Pediatric Adolesc Med* 2006; 160: 211–216
 - 99 *Cohen LB, Wechsler JS, Gaetano JN et al*. Endoscopic sedation in the United States: results from a nationwide survey. *Am J Gastroenterol* 2006; 101: 967–974
 - 100 *Aisenberg J, Cohen LB, Piorkowski JD*. Propofol use under the direction of trained gastroenterologists: an analysis of the medicolegal implications. *Am J Gastroenterol* 2007; 102: 707–713
 - 101 *Cotton PB*. Analysis of 59 ERCP lawsuits; mainly about indications. *Gastrointest Endosc* 2006; 63: 378–382; quiz 464