Most states regulate a dentist’s ability to perform sedation by the route of drug administration, but depth of sedation is really the bottom line.

Any route of drug administration may render the patient into planes where respiration is depressed, and most self-administered drug overdoses (suicides) are given via the oral route.
Someday, all states will assess didactic and psychomotor competency via standardized exams on patient simulators, analogous to passing a BLS exam.
Oral

+
- 

- Acceptance
- No special skills
- Low side effects
- No extra equipment
- Pt. Can take night before
- No extra state permit?

- Variable absorption
- First pass effect
- Need compliance
- ~ 1 hour to peak, therefore can’t easily titrate
- May actually reach maximum sedation after discharge!
Inhalational

+  
-  

- Rapid onset/peak effect  
- Can titrate  
- Quick elimination (Pt. can often drive self home)  
- No extra state permit?  

- Special equipment  
- Special skills  
- Need compliance  
- Waste gas
Hypothesis: The risk of sedating an anxious patient with nitrous oxide/oxygen alone is *less* than not sedating that same person.

- States should consider dropping any requirements for nitrous oxide permits and instead issue them to dentists who fail to recognize and treat (or refer) anxious patients.
I.M.

+ 
- 

- Least cooperation of all techniques
- No special skills
- Useful in emergencies
- Bypasses gut

- Titration Difficult
- Hurts
- Parenteral route, need advanced monitoring and possible “extra” state permit
A *Priori* logic would suggest that the IV route should be the safest.
Sedation of the Future?

“Patient-Controlled IV Sedation”

Milk of amnesia
How Deep is the Patient?

How Stable?
Monitor

- CNS
- Respiration/Ventilation
- Cardiovascular
- Temperature
Sedative drugs effect the CNS first, sensory nerves before motor.

For conscious sedation, the patient should be able to talk and respond appropriately to command.
University of Michigan Sedation Scale (UMSS)

0  Awake and alert

1  Minimally sedated: tired/sleepy, appropriate response to verbal conversation and/or sound

2  Moderately sedated: somnolent/sleeping, easily aroused with light tactile stimulation or a simple verbal command

3  Deeply sedated: deep sleep, arousable only with significant physical stimulation

4  Unarousable
# Responsiveness Scores of the Modified Observer’s Assessment of Alertness/Sedation Scale (OAA/S)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Responds readily to name spoken in normal tone (alert)</td>
</tr>
<tr>
<td>4</td>
<td>Responds lethargically to name spoken in normal tone</td>
</tr>
<tr>
<td>3</td>
<td>Responds only after name is called loudly and/or repeatedly</td>
</tr>
<tr>
<td>2</td>
<td>Responds only after mild prodding or shaking</td>
</tr>
<tr>
<td>1</td>
<td>Responds only after painful trapezius squeeze</td>
</tr>
<tr>
<td>0</td>
<td>Does not respond to painful trapezius squeeze</td>
</tr>
</tbody>
</table>
The American Academy of Pediatric Dentistry and American Academy of Pediatrics have stressed the importance of monitoring vital signs and level of consciousness during sedation to ensure patient safety. At present, there is no objective, universally accepted measure for level of sedation.

**Bispectral analysis (BIS)** monitoring is a relatively new, noninvasive technology used clinically to evaluate level of sedation. This technology is based on the principle that electroencephalogram wave forms change with the level of alertness. In general, when an individual is awake, electroencephalogram waveforms are high frequency and low amplitude. When the individual is deeply sedated, the frequency decreases and amplitude increases, and there are changes in relationships among different frequencies.
Using these principles, an algorithm for digital signal processing was developed that produces a numeric value known as the BIS index, ranging from 0 to 100. The manufacturer’s guidelines are as follows: a BIS index of 70 to 90 represents light to moderate sedation, 60 to 70 deep sedation, 40 to 60 general anesthesia, and less than 40 a deep hypnotic state. A BIS score of 0 represents no brain activity and is seen in coma and death.
Anesthesiologists should be aware that the BIS monitor may not be sensitive enough to provide an adequate measure of the depth of sedation and hypnosis when using N₂O alone for sedation. It may be better to monitor sedation clinically (e.g., with the OAA/S scale) to determine the dose requirement and the adequacy of depth of sedation and hypnosis.
Respiration

- Morbidity/Mortality from outpatient sedations most often are due to respiratory arrest.
- Sedative drugs depress respiratory rate and tidal volume before the cardiovascular system.
- Pulse oximetry is the standard of care for assessing respiration and thus oxygenation.
- Also assess color of blood, breath sounds and respiratory rate.
- Capnography (CO$_2$ monitoring) useful for GA.
Pulse Oximetry

- Non-invasively, measures percent oxygenation of hemoglobin in capillary blood
- Also measures heart rate
- Should maintain above 90%
Cardiovascular

- Blood Pressure
- EKG
- Heart Rate
Type and Frequency of Monitoring Depends on Depth of Sedation

- **Local Anesthesia**: Pre-op B.P. and pulse
- **Nitrous Oxide and Conscious Sedation via oral route**: Continuous talking to patient, and Pre, Intra and Post-op B.P. and Resp. rate. If patient driving self home (Nitrous Only), then Pre/Post-op Trieger Test
- **Parenteral Conscious/Deep Sedation**: Continuous pulse oximetry, q5 min. B.P.
- **G.A.**: Continuous pulse oximetry, Capnography, EKG, Temperature, q5 min B.P., BIS monitor?
NITROUS OXIDE/SEDATION RECORD

Student Name ___________________________ Date __________________
Faculty Name ___________________________ Assistant __________________
MED History (circle): Pregnancy        URI        Recent Retinal Surgery        Psych      Other ________________
Drug Allergies (List) ______________________________

PreOP Vitals: BP _____ Pulse _____ Resp _____ Consent Prior to Sedation?  Yes      No
Oral Sedation Time _____ Drug ___________________________ Dose _____

PreOP Trieger Test

IntraOP volumes: Nitrous _____LPM   O2 _____LPM
IntraOP vitals: BP _____ Pulse _____ Resp _____
Nitrous Initiated (Time) __________________________

PostOP 100% O2: _________ minutes
PostOP vitals: BP _____ Pulse _____ Resp _____

PostOP Trieger Test

PT Discharge Condition _____________   PT Discharge Time _____________
Discharged to (circle):   Self            Spouse            Parent            Other __________________________
### IV SEDATION RECORD

**Date** ____________  **Weight** ____________  **Age** ____________  **ASA Class** ____________  **Surgeon** ____________

**Anesth:** ____________  **Asst:** ____________  **MEDS History**

**Smoking** ____________  **Allergies:** ____________  **Pregnancy** ____________  **Relevant Current Diseases:**

**Present MEDS:**

**Previous Anesthetics:**

**Family History of Anesthesia Problems:**

**ETOH/Drug Abuse**

**Pre Op Vitals:**

<table>
<thead>
<tr>
<th>BP</th>
<th>Pulse</th>
<th>Resp</th>
<th>SpO₂</th>
</tr>
</thead>
</table>

**Consent:** ____________  **Hours NPO** ____________

**Compromised airway (obesity; limited opening, macroglossia, OSA)**  

☐ yes  ☐ no

**IV**

<table>
<thead>
<tr>
<th>Temp</th>
<th>Reversal Agents</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>BP Cuff</th>
<th>Pulse Ox</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>O₂ check</th>
<th>EKG</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Total</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>O₂ (lpm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Versed</td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td></td>
</tr>
<tr>
<td>Demerol</td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td></td>
</tr>
<tr>
<td>Benadryl</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td></td>
</tr>
<tr>
<td>Decadron</td>
<td></td>
</tr>
</tbody>
</table>

**IVF: D,W**

<table>
<thead>
<tr>
<th>Other</th>
<th>2% Lido epi</th>
<th>1:100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2% Arti epi</td>
<td>1:100,000</td>
<td></td>
</tr>
<tr>
<td>3% Mepi plain</td>
<td>1:200,000</td>
<td></td>
</tr>
<tr>
<td>5% Bup epi</td>
<td>1:200,000</td>
<td></td>
</tr>
</tbody>
</table>

**Discharge criteria met (CHECK)**

☐ BP ± 20 mm of baseline  ☐ Fully awake or easily arousable

☐ SpO₂ > 92% on room air  ☐ Steady gait, no dizziness

☐ Breathes deeply and coughs freely  ☐ Escorted to parking lot / car

**Post OP Vitals:**

<table>
<thead>
<tr>
<th>BP</th>
<th>Pulse</th>
<th>Resp</th>
<th>SpO₂</th>
</tr>
</thead>
</table>

**Written D/C instructions given** ____________

**Patient D/C to: Spouse ____________  Parent ____________  Friend ____________  Other ____________**
B.P./O₂ Sat. + Printer
Emergency Equipment
(Crash Cart)

- B.L.S. most important, with the ability to breath for someone who isn’t... mouth-to-mouth, mouth-to-mask, bag/valve/mask, intubation
- Reversal Drugs
- Supplemental O₂
- AED
Automatic External Defibrillator
The Ideal Anxiolytic

- Not antigenic
- Cheap
- Effective via any route
- Rapidly absorbed if given P.O.
- Tastes good (like chicken)
- Reversible — has an antidote
- Makes patient happy, motionless, possibly amnesic
The Ideal Anxiolytic

- Favorable **Therapeutic Index** (safe)...
  The perfect anxiolytic acts only on the emotion center of the CNS, not influencing the respiratory or cardiovascular systems.

- Quickly and completely metabolized (no active by-products) without help form the patient’s kidneys, liver, etc.

- Non-addicting
Oral Agents

- ETOH
- Barbiturates
- Benzodiazepines
- Antihistamines
- Narcotics
- Others
Benzodiazepines

😊 Less respiratory depression and hangover effects compared to barbiturates., work on limbic system in “GABAnergic” way, favorable T.I., schedule 4 agents, older agents cheap, antidote (Romazicon)

😢 Teratogenic, paradoxical excitement in some kids, psychologically addicting, newer agents $

Differences between drugs in this class are mostly due to their duration of action.....short being good for dentistry.
Benzodiazepines: The Big 3

- **Diazepam** (Valium) long half-life (~24 hr.) with active metabolite, cheap
- **Triazolam** (Halcion) popular sleeping pill, short half-life (~3 hours)
- **Midazolam elixir** (Versed) “Approved” for use in children. New and relatively expensive, rapid absorption via oral route, PDR urges caution RE respiratory depression.
Other Benzodiazepines

- Lorazepam (Ativan)
- Alprazolam (Xanax)
- Oxazepam (Serax)
- Temazepam (Restoril)
- Flurazepam (Dalmane)
Triazolam

U.S. Brand Names: Halcion
Generic Available: Yes

Children <18 years: Dosage not established.

Adults maximum dose: 0.5 mg/day

Sedation for dental procedure: 0.25 mg taken the evening before oral surgery; and/or 0.25 mg 1 hour before procedure

(Sublingual administration results in a 28 percent greater bioavailability compared with oral administration, in turn resulting in higher plasma concentrations at one to two hours after the drug is administered Sublingual administration of triazolam should produce a faster onset and enhance titration ability by reducing some of the variables associated with oral administration)
Metabolic Subplots

- CYP3A enzymes in the intestines and the liver metabolize triazolam. Antiretroviral agents inhibit CYP3A, resulting in a two-fold increase in plasma concentrations.

- Other CYP3A4 inhibitors include azole antifungals, ciprofloxacin, clarithromycin, diclofenac, doxycycline, erythromycin, imatinib, isoniazid, nefazodone, nicardipine, propofol, protease inhibitors, quinidine, and verapamil.
Midazolam

U.S. Brand Names: Versed

Dosage needs to be individualized based on the patient’s age, underlying diseases, and concurrent medications. Decrease dose (by ~30%) if narcotics or other CNS depressants are administered concomitantly. Children <6 years may require higher doses and closer monitoring than older children; calculate dose on ideal body weight. Personnel and equipment needed for standard respiratory resuscitation should be immediately available during administration.

**Children:** Conscious sedation for procedures or preoperative sedation:

**Oral:** 0.25-0.5 mg/kg as a single dose preprocedure, up to a maximum of 20 mg; administer 30-45 minutes prior to procedure. Children <6 years and uncooperative patients may require as much as 1 mg/kg as a single dose; 0.25 mg/kg may suffice for children 6-16 years of age.
Reversal Agent (Antidote)

ROMAZICON is indicated for the complete or partial reversal of the sedative effects of benzodiazepines in cases where general anesthesia has been induced and/or maintained with benzodiazepines, where sedation has been produced with benzodiazepines for diagnostic and therapeutic procedures, and for the management of benzodiazepine overdose.

ROMAZICON® (flumazenil)

INJECTION

The use of Romazicon has been associated with the occurrence of seizures. These are most frequent in patients who have been on benzodiazepines for long-term sedation or in overdose cases where patients are showing signs of serious cyclic antidepressant overdose. Practitioners should individualize the dosage of Romazicon and be prepared to manage seizures.
The intramuscular, subcutaneous and sublingual routes of flumazenil injection have been studied in dogs. Although reversal of midazolam-induced respiratory depression was successful with all injection methods, the mean reversal time was significantly shorter with intravenous administration (120 versus 262 seconds with sublingual administration).

For the reversal of the sedative effects of benzodiazepines administered for conscious sedation, the recommended initial dose of ROMAZICON is 0.2 mg (2 mL) administered intravenously over 15 seconds. If the desired level of consciousness is not obtained after waiting an additional 45 seconds, a second dose of 0.2 mg (2 mL) can be injected and repeated at 60-second intervals where necessary (up to a maximum of 4 additional times) to a maximum total dose of 1 mg (10 mL).

The intramuscular, subcutaneous and sublingual routes of flumazenil injection have been studied in dogs. Although reversal of midazolam-induced respiratory depression was successful with all injection methods, the mean reversal time was significantly shorter with intravenous administration (120 versus 262 seconds with sublingual administration).

The treatment of fearful or anxious patients presents a myriad of problems for the dentist. In-office sedation using oral (enteral) medications is an effective means of increasing patient tolerance of invasive dental procedures. The incremental oral administration technique is a protocol that can be utilized to treat fearful or anxious patients. A case is presented in which this technique was used as an adjunct to the rehabilitation of a debilitated mouth.
ADA/AAOMS Position: 2003

- Titration of oral medications for the purpose of sedation is unpredictable
- Can produce alteration in the state of consciousness beyond the intent of the provider.
- Combination inhalational – enteral sedation raise the risk of oversedation
- Should not exceed manufacturer’s recommended dosage

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