

Pharmacologic Behavior Guidance

Pharmacology and Other Considerations

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Questions - Objectives

- ◆ Who should we sedate?
- ◆ How should we recover and discharge the patient?
- ◆ What medications can we use and how can we administer them?
- ◆ How should we accomplish the sedation?
- ❖ Define levels of sedation
- ❖ Describe indications for sedation
- ❖ Categorize patients who are candidates for sedation
- ❖ Compare the risks and benefits of the sedative medications
- ❖ Describe the parenteral routes
- ❖ Describe pre-operative assessment of the patient
- ❖ List the required monitoring equipment
- ❖ Explain discharge criteria

Background

- ◆ In 1983 Goodson and Moore publish:

J Am Dent Assoc. 1983 Aug;107(2):239-45.

Life-threatening reactions after pedodontic sedation: an assessment of narcotic, local anesthetic, and antiemetic drug interaction.

Goodson JM, Moore PA.

- ◆ This article spurs the AAPD to write the very first guidelines on procedural sedation in 1985
- ◆ It is estimated that 100,000-250,000 sedations involving children and dentistry are done annually (Wilson, 2004)

ADA News

FDA warns on repeated, lengthy use of general anesthesia drugs

January 12, 2017

The U.S. Food and Drug Administration issued a warning in December 2016 that repeated or lengthy use of general anesthetic and sedation drugs during surgeries or procedures in children younger than 3 years or in pregnant women during their third trimester may affect the development of children's brains.

The FDA is requiring warnings to be added to the labels of general anesthetics and sedation drugs. The agency will also continue to monitor the use of these drugs in children and pregnant women and will update the public if additional information becomes available, according to an FDA news release.

Anesthetic and sedation drugs are necessary for infants, children and pregnant women who require surgery or other painful and stressful procedures, helping to ensure their health, safety and comfort of patients and families. Studies suggest that a single, relatively short exposure to general anesthetic and sedation drugs is unlikely to have negative effects on behavior or learning, according to the FDA. However, further research is needed to fully characterize how early life anesthetic exposure affects children's brain development.

A Conscious Decision

A review of the use of general anaesthesia and conscious sedation in primary dental care

Report by a Group chaired by the Chief Medical Officer and Chief Dental Officer

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy
of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures: Update 2016

Charles J. Coté, MD, FAAP Stephen Wilson, DMD, MA, PhD, AMERICAN ACADEMY OF PEDIATRICS, AMERICAN ACADEMY OF PEDIATRIC DENTISTRY

High Points

1. Codeine should be avoided as a post-procedure analgesic
2. A specific query regarding sleep disordered breathing may be helpful
3. Before a sedation, a "time out" should be performed
4. Time of discharge and condition of the patient should be documented
5. For moderate sedation, the individual who assists with tasks should be trained in PALS and shall have specific assignments in the event of an emergency
6. Precordial stethoscope is strongly recommended and required if bidirectional communication is not possible

Available: http://www.aapd.org/media/Policies_Guidelines/G_Sedation1.pdf

Who gets sedation?



Complex Decision-Making

- | | |
|---|---|
| <ul style="list-style-type: none"> ◆ Risks of pharmacologic management ◆ Safety record of pharmacologic management ◆ Extent of dental needs ◆ Practitioner training and experience (ability to "rescue") ◆ Extent of professional investment and support for the technique ◆ Monitoring | <ul style="list-style-type: none"> ◆ Cost and third party payers ◆ Venue issues (office vs. surgery center vs. OR) ◆ Parental expectations and societal changes ◆ Nature of child's cognitive and emotional needs ◆ Integration of these factors into an acceptable modus operandi embraced by the dental profession |
|---|---|

Behavioral Considerations/Indications

- Limited cooperation
- Young age (24 months* and up)
- Anxiety
- Extent of dental treatment
- Some individuals with special needs
- Tenuous social situation

*Select cases

Techniques to Delay Invasive Treatment

- ◆ "Active Surveillance"
- ◆ Fluoride varnish
- ◆ Silver Diamine Fluoride



Silver Diamine Fluoride

- ◆ Topical application arrest active open carious lesions in a single treatment
- ◆ Can be repeated 2-3X/yr
- ◆ Reduces future decay in other teeth by 50%.
- Twice as effective as varnish



Technique

- Cavitated lesion; DRY tooth; some level of cooperation from child
- Dosing:
 - ◊ 10kg child = 4 teeth per visit (1 drop)
 - ❖ 1 drop per 10 kg
- Must repeat at least 2x/yr for the first 2 years for arresting caries
- Has been used in conjunction with ART



Rosenblatt et al. J Dent Res 2009; 88:116-125

Checklist: Who to Sedate?

- ✓ Sedation is indicated
- ✓ Patient above Age/Weight limits
- ✓ Airway is not complex
 - Tonsils 40% or less (grades 0, 1, or 2)
- ✓ ASA I or II
- ✓ No upper respiratory infection (URI) within the last 2 weeks



Understanding the Drugs

Pharmacokinetics and routes of administration



Absorption

- Inhalational - nitrous
- Enteral - Absorbed through the GI tract or oral mucosa
 - ◊ Oral, Sublingual, Rectal
- Parenteral – bypasses GI tract
- Intravenous, Intramuscular, Submucosal, Intranasal
 - None of these go through hepatic metabolism

Oral Route

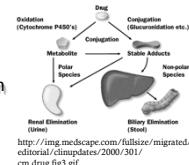
Principal site of absorption is small intestine due to large surface area

- Unpredictable due to:
 - ◊ pH of stomach/intestine
 - ◊ Gastric emptying
 - ◊ Altered physiologic states
 - Diabetes: delayed gastric emptying
 - ◊ Presence of food
 - ◊ First pass metabolism
 - ◊ Only free drug form can cross blood brain barrier and most of drug is bound to plasma proteins



Hepatic metabolism

- Oxidation by cytochrome P-450 system
 - ◊ Binds drug during metabolism
 - ◊ Large number of different enzymes
 - ❖ CYP-3A4
 - Metabolizes half of all available drugs (benzodiazepines, opioids)
 - Inhibited by many drugs – meaning more free drug available
 - SSRIs, some GI meds, some supplements



<http://img.medscape.com/fullsize/migrated/editorial/climpdates/2000/301/cm.drug.fg3.gif>

CYP-3A4 Inhibitors

- ◆ Antiarrhythmics
 - ◊ Amiodarone (Cardarone)
 - ◊ Quinine (Quinamm)
- ◆ Antifungals
 - ◊ Most "azoles" (Diflucan, Monistat-Derm, Nizoral)
- ◆ Antinefectives
 - ◊ Clarithromycin (Biaxin)
 - ◊ Erythromycin
 - ◊ Metronidazole (Flagyl)
 - ◊ Norfloxacin (Noroxin)
- ◆ Proton Pump Inhibitors
 - ◊ Omeprazole (Prilosec)
- ◆ Calcium Channel Blockers
 - ◊ Diltiazem (Cardizem)

- ◆ Amprenavir (Agenerase)
- ◊ Indinavir (Crixivan)
- ◊ Nevirapine (Viracept)
- ◊ Ritonavir (Norvir)
- ◆ SSRIs
 - ◊ Fluoxetine (Prozac)
 - ◊ Fluvoxamine (Luvox)
 - ◊ Sertraline (Zoloft)
- ◆ Misc
 - ◊ St. John's Wort
 - ◊ Ecstasy
 - ◊ Cannabinoids
 - ◊ Cimetidine (Tagamet)
 - ◊ Grapefruit Juice



Pharmacokinetics to Pay Attention To When Selecting a Drug

- ◆ Onset
 - ◊ What is the latency time before sedation is achieved?
- ◆ Presence of active metabolites
 - ◊ Drug-drug interactions which could result in excessive sedation
- ◆ Half-life
 - ◊ The shorter the half-life, the less possibility of residual next day effects from prolonged sedation

The Drugs



Chloral hydrate



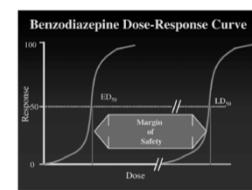
- Used for decades for pediatric sedation both in medicine and dentistry
- Commercially available version discontinued in 2012
- Sedative hypnotic with no analgesic properties
- Metabolized by liver and kidneys to trichloroethanol
- Long half-life of metabolites, no reversal
- Dose: 10–50 mg/kg orally to 1 g maximum
- Produces GI irritation (vomiting frequently reported in studies)
- Concerns for carcinogenicity

Benzodiazepines

- Sedative hypnotics; CNS depressants
- Potential respiratory depressants; however, at therapeutic oral doses in healthy patients – no clinically significant respiratory depression and do not potentiate depressant effects of opiates (Ashkenazi, Ped Dent, 20:5; 1998)
- Can result in "disinhibition" and a paradoxical effect

Safety

- ◆ Most widely used drugs for anxiolysis due to their efficacy and safety profile
- ◆ Wide margin of safety between therapeutic and toxic doses
- ◆ Schedule IV



Donaldson et al, Oral sedation: a primer on anxiolysis for the adult patient. Anesth Prog 2007 54:118-129.

Benzodiazepines

- Biotransformation in liver results in pharmacologically active metabolites (except triazolam and lorazepam)
 - ❖ Lorazepam can be used in patients with hepatic dysfunction because it is glucuronidated rather than oxidized (P_{450})
- Contraindications: acute narrow angle glaucoma; pregnancy
- All benzodiazepines can be reversed with flumazenil

	Generic Name	Trade Name	Available As
Short-Acting	Midazolam	Versed	Oral: 2mg/mL Injectable: 1mg/mL 5mg/mL
	Triazolam	Halcion	0.125mg and 0.25mg tabs
Long-Acting	Diazepam	Valium	2, 5, and 10 mg tabs 1mg/mL solution
	Lorazepam	Ativan	0.5 mg, 1mg, and 2mg tabs (oral and sublingual)

Midazolam



- Brand name: Versed®
- Available as oral syrup (2mg/mL) or as IV formulation
 - IV formulation can be used orally (Salem et al, Int J Pediatr. 2015; Srivastava et al, Int J Clin Pediatr Dent, 2014)
- Oral dosages range from 0.25 to 1mg/kg
- Intranasal dosages range from 0.2-0.5mg/kg
- Max single dose: 20mg

Properties

- Onset: 15-20 minutes
- Metabolites: active metabolites (hepatic metabolism)
- Half-life: 1.5-2.5 hours
- Dose-dependent effects: ataxia, blurred vision, amnestic effect

Does it work?

- Studies not standardized
 - Various dose ranges; however, most studies find midazolam to be effective in the 0.5 to 0.75mg/kg range
- It is the only sedative medicine to receive any support (even though weak) from a Cochrane Review
- Oral effectiveness ranges from: 65-90%
- Intranasal effectiveness ranges from: 35-75%

Johnson et al, 2010; Shapira et al, 1996; Shapira et al, 2004; Soenri et al, 2012; Salem et al, 2015; Peretz et al, 2014; Al-Zahrani et al, 2009



What do we like about it?

- ◆ Short onset (15-30 minutes)
- ◆ Short half-life (1.5-2.5 hours in adults)
- ◆ Amnestic effect
- ◆ Reversible: Flumazenil
- ◆ DEA Schedule IV

What do we not like about it?

- ◆ Short working time
- ◆ Paradoxical reaction
- ◆ Oral syrup is bitter and can be a lot of volume



Diazepam

- Anxiolytic/mild sedation
- Wide margin of safety
- Less "potent" than midazolam but gives a longer working time
- Very little pediatric dentistry literature on its effectiveness
 - Effectiveness: 63-83%



Houpt, 1996; Kantovitz et al, 2007; Tyagi, 2013; Pisalchayoung et al, 2005

Diazepam Doses

- Adult dose:** 5-10 mg 1 hr before treatment (half the dose for the elderly or debilitated)
- Pediatric dose***: 0.15-0.5mg/kg
 - Pediatric dental patients: several studies suggest approximately **0.3mg/kg** for successful sedation
 - Maximum single dose: 10 mg

* Creedon RL, Dock M. Pharmacologic management of patient behavior. In: McDonald RE, Avery DR, eds. *Dentistry for the Child and Adolescent*. St. Louis, Mo: Mosby; 2000:297-324.

Properties

- Onset: 60-90 minutes
- Metabolites: active
- Half-life: 20-70 hours



Case Selection

- Disclaimer: Not evidence-based; clinical experience
- Older child (7 and up)
- Anxious (not defiant)
- Quality of sedation: mild
- Adverse effect: weepy



Triazolam

- Most prescribed psychoactive drug marketed in the U.S.
- Off-label use in dentistry
- Anterograde amnesia: "Traveler's amnesia"
 - FDA re-evaluated the drug 2x (1991, 1992) and determined it to be safe and effective



Triazolam Properties

- Onset:** 30-60 mins
- Metabolites:** no active metabolites*
- Half-life:** 1.5 to 5.5 hours
- Amnestic properties**
 - Dose-dependent



Triazolam in Children

- **Safety:**
 - Safe in dose ranges studied
- **Effectiveness:**
 - At least as effective as chloral hydrate/hydroxyzine combination
- **Adverse effects:**
 - Higher dosing = ataxia, double vision, paradoxical reaction is possible

(Coldwell et al, 1999; Raadal et al, 1999; Karl et al, 1997; Meyer, 1990; Quarnstrom et al, 1992)

Triazolam and Children

- ◆ No published guidelines/recommendations
- ◆ **Age:** Usually used for older children/adolescents
 - ◊ Literature includes children as young as 21 months (21-81 months)
 - ◊ Usually reserve triazolam for older children because for younger patients (ie. 2-5 yr olds), we have other sedation regimens with much more literature to support using them
- ◆ **Dose:** 0.005-0.03mg/kg ranges
 - ◊ Harder to dose in mg/kg because only available in tablets

Dosing

- ◆ **Children:**
 - ◊ 0.015-0.03mg/kg for **sedation** up to 0.5 mg* as a maximum dose
 - ◊ Half the dose for **anxiolysis/mild sedation**
- ◆ **Adults:** 0.25 for anxiolysis; 0.5 for sedation
 - ◊ The 0.25mg may not have any amnestic effect in adults (Berthold et al, 1997, OOOE)
 - ◊ Max single dose: 0.5mg
 - ◊ In two head to head comparisons with diazepam, triazolam was found to be the more effective anxiolytic agent (Erich et al, J Endod 1997; Penttila et al, Can J Anaesth 1995)



What do we like about it?

- ◆ Short onset (effects usually seen at 30 minutes)
- ◆ Short half-life
- ◆ Amnestic effect
- ◆ Reversible: Flumazenil
- ◆ Longer working time than midazolam
- ◆ DEA Schedule IV

What do we not like about it?

- ◆ Paradoxical reaction
- ◆ Harder to dose in mg/kg because only comes as tablets (0.125mg and 0.25mg)



Case Selection

- Disclaimer: From clinical experience
- Late school-aged child or adolescent
- May be successful for a slightly defiant child
- Asthmatic
- Younger child that you'd like to give a benzodiazepine but need a little longer working time than midazolam can give you
- In an older, more cooperative child, you can administer via the sublingual route (SL)

Lorazepam



- **Action And Clinical Pharmacology:**
 - ◊ Only benzodiazepine with consistent, complete rapid IM absorption and is an anticonvulsant
 - ◊ **Onset:** 60 minutes
 - Sublingual administration decreases the onset to 30-45 mins
 - ◊ **Metabolites:** conjugated and does not involve the cytochrome P450 system; No active metabolites
 - Few drug-drug interactions
 - ◊ **Half life:** 12-15 hours; duration of effect 8-10 hours

Lorazepam Dosing

- Adult Dose: 1-4mg
 - ❖ Usually 2-3mg dose is sufficient
- Oral Tablets: 0.5 mg, 1mg, and 2mg tablets
 - All oral tabs are white
- Sublingual Tablets: 0.5 mg, 1mg, 2mg
 - 0.5 mg and 2 mg are colored tabs (green and blue respectively)

Meperidine (Demerol)

- Synthetic opioid with approx 1/10 potency of morphine
- Causes euphoria and analgesia
- Contraindications:
 - Asthma – it can cause histamine release
 - Intracranial lesions (hydrocephaly & VP shunt) because it can elevate cerebral spinal fluid pressure
 - Hepatic and renal disease
 - Epileptogenic at high levels



Properties

- **Onset:** 45-60 minutes
- **Metabolites:** active
- **Half-life:** 15-40 hours
- Adverse effects:
 - Respiratory depression
 - Nausea/vomiting

Meperidine

- Dosage: 1-2.2mg/kg (usually 25-50 mg)
- Maximum single dose is 50 mg
- Available: 50mg/5mL (10mg/mL) oral solution
- Effectiveness: 58-81%
- Concomitant local anesthesia dose consideration is very important (lidocaine dosage = 4.4mg/kg)

Sams et al, 1993; Haney et al 1993; Sams et al, 1992; Roberts et al, 1992; Cathers et al, 2005; Lenahan, 2015



What do we like about it?

- ◆ Long working time (45-60 minutes)
- ◆ Analgesia and euphoria
- ◆ Reversible: Naloxone
- ◆ No paradoxical reaction
- ◆ Oral formulation is easy to administer – low volume



What do we not like about it?

- ◆ Respiratory depression
- ◆ Nausea/vomiting
- ◆ Long onset (45-60 min latency)
- ◆ Histamine release
- ◆ Schedule II (more involved to comply with DEA regulations)

Anti-Histamines

- **Diphenhydramine** (Benadryl)
 - Relatively safe
 - Little to no respiratory depression
- **Dose**
 - ❖ Under 5 yo, consider 12.5-25 mg
 - ❖ Over 5 yo, consider 25-50 mg
 - ❖ Adult: 25-50 mg
- **Onset** – 30 to 60 minutes
- **Disadvantages:**
 - Can cause paradoxical excitation
 - Has not been studied for effectiveness for dental sedation



Anti-histamines

Potentiate CNS depressant effects of opioids and benzodiazepines.

Hydroxyzine

- Also an antiemetic
- Onset: 30 mins
- Historically given as 25mg regardless of weight but newer literature doses: 0.6mg-2mg/kg
- Max: 50 mg when in combination

Promethazine

- Also an antiemetic
- Onset: 20 mins
- Historically given as 25mg regardless of weight but weight doses range 1-2mg/kg
- Max: 25 mg when in combination



Hydroxyzine as a Single Agent

- As single agent can dose at 3.7mg/kg and maximum dose is 100 mg
 - Kupietzky and Blumenstyk, J Dent Child, 1998
- 3.7mg/kg as a single agent is as effective as 0.2mg/kg intranasal midazolam
 - Shapira et al, J Dent Child, 1996
- Case selection: asthmatic, anxious child but shows some cooperation; you want a short onset and slightly longer working time

Combinations

- Classic Combos
 - Chloral Hydrate and Hydroxyzine
 - "Triple" Combo – Chloral Hydrate, Meperidine, and Hydroxyzine
 - Meperidine and Hydroxyzine
- As midazolam has come to the forefront as a suitable agent, newer combinations have been tried
 - Midazolam and Meperidine
 - Midazolam and Hydroxyzine
 - "Reversible" Triple – Midazolam, Meperidine, Hydroxyzine

Combinations Success Ranges

- Midazolam + Hydroxyzine: 75%
 - Dose: 0.5mg/kg Mid + 25mg of H
 - Dose: 0.3mg/kg of Mid + 3.7mg/kg of H
- Midazolam + Meperidine: 60-100%
 - Dose: 0.5-0.7mg/kg Mid + 1-1.5mg/kg Mep
- Midazolam + Meperidine + Hydroxyzine: 80-90%
 - Dose: 1 mg/kg Mid + 1mg/kg Mep + 25mg H (Sheroan et al, 2006)
 - Dose: 1mg/kg Mid + 2mg/kg Mep + 2mg/kg H (McCormack 2014)

Medications and Dosages

Drug	Dose (mg/kg)	Max Dose	Onset (min)	Duration (mins)	Reversal
Midazolam	0.5-1	20 mg	15-20	15-20	Flumazenil
1. Demerol	1.1-2	1. 50 mg 2. 50 mg	45-60	45-60	Naloxone
2. Hydroxyzine	2. 1-2				
1. Midazolam	1. 0.5-1	1. 20 mg 2. 50 mg	15-20 45-60	25-35	1. Flumazenil 2. Naloxone
2. Demerol	2. 1				
1. Midazolam	1. 0.5-1	1. 20 mg 2. 50 mg	1. 15-20 2. 15-60	20-30	Flumazenil
2. Hydroxyzine	2. 1-2				
Hydroxyzine	1 - 3.7 mg/kg	100 mg	30	45	
Triazolam	0.015-0.03	0.5mg	30-60	45-60	Flumazenil
Diazepam	0.25-0.5	10 mg	60	45-60	Flumazenil

Other Medications



Nonbenzodiazepine Anxiolytics-Hypnotics ("Z" Drugs)

Chemically distinct from benzodiazepines but clinically they are indistinguishable from benzos.
Their effects can be reversed by flumazenil.

- Zolpidem (Ambien)
 - ❖ Onset: 30-45 mins
 - ❖ No active metabolites
 - ❖ Half-life: 1.5-4.5 hours
 - ❖ Dose: 0.4mg/kg
 - ❖ Maximum: 10 mg
 - ❖ Only 2 studies in children – both studies found it unsatisfactory for pediatric dental sedations
- Zaleplon (Sonata)
 - ❖ Onset: 20 mins
 - ❖ Half-life: 0.5-1hr
 - ❖ Dose: 5-20 mg (usual dose is 10 mg)
 - ❖ Only a few studies in dentistry (none in children) – in adults shows similar results to 0.5mg triazolam with faster recovery



Alternate Routes

Sublingual, Inhalational, Intranasal

Sublingual



- Technique: place tablet under tongue and allow tablet to dissolve before swallowing – approximately 2 minutes
- Triazolam:
 - ❖ SL administration decreases latency time to 20 minutes and increases blood concentration by 28% (enhanced bioavailability)
 - (Scavone et al; J Clin Pharmacol 26:208-10, 1986)
 - ❖ Studies suggest greater anxiolytic/sedative effect with SL route
- Lorazepam:
 - ❖ No difference in onset, anxiolytic effects or peak concentration for either oral/SL route
 - (van der Bijl et al, J Oral Maxillofac Surg, 1998)

Inhalational



- Nitrous Oxide
- Colorless and virtually odorless gas
- Causes minor depression in cardiac output while peripheral resistance is slightly increased, thereby maintaining blood pressure
- **Analgesic** and anxiolytic agent
 - ❖ CNS depression, euphoria, little effect on respiratory system
- Superior safety profile
 - ❖ When used at concentrations <50%

Nitrous Oxide Administration



- Flow rate of 5 to 6 L/min
 - ❖ Reservoir bag should be approx 2/3 full and decreases but does not completely collapse when child breathes in through nose
 - ❖ Adjust flow rate for each patient
- Titrated or Rapid induction techniques acceptable
- Typical patient requires 30-40% to achieve ideal sedation (tip: suggest to the patient that he/she will have an extraordinary and pleasant experience)
- Scavenging system

Monitoring and Recovery

- ◆ Continual visual monitoring of the patient's respiratory rate and level of consciousness must occur during treatment
 - ❖ Patients can experience unpleasant effects when the concentration is above 50% - reports of patients feel like they are falling; pt has a "hard stare"; pt may hallucinate or be unaware of surroundings
- ◆ Diffusion hypoxia can occur
 - ❖ Administer 100% oxygen for 5 minutes post-use
- ◆ Side effects = nausea/vomiting
 - ❖ Especially with fluctuations in concentrations

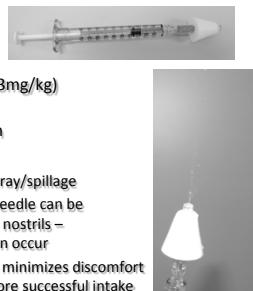
Contraindications to Nitrous Oxide

1. Chronic obstructive pulmonary diseases
2. Severe emotional disturbances or drug-related dependencies
3. First trimester of pregnancy
4. Treatment with bleomycin sulfate
5. Methylenetetrahydrofolate reductase deficiency
6. Cobalamin deficiency
7. If the patient can't breathe through the nose (ie. URI)
8. Otitis media/bowel obstruction

Nitrous Oxide + Sedative

- ◆ Nitrous oxide and sedatives work synergistically
- ◆ The addition of N₂O absolutely results in deeper sedation
- ◆ If your sedation is going well, turn down/off the nitrous

Intranasal



- ◆ Used for midazolam (dose: 0.2-0.3mg/kg)
- ◆ Studies have suggested it is a reliable way to deliver medication
- ◆ Techniques
 - ◊ Eyes should be protected from spray/spillage
 - ◊ Tuberculin syringes without the needle can be used to administer drops into the nostrils – some spillage from the nostrils can occur
 - ◊ An atomizer at the end of syringe minimizes discomfort and increases the likelihood of more successful intake

Pediatric Dentistry Sedation Trends

- ◆ Wilson & Houp, 2010 survey published in 2016, Ped Dent
- ◊ Roughly pediatric dentist sedate 59 pts in a 3 month period
- ◊ The practitioners who perform the largest amount of sedations are the oldest (practicing 20+ years) and the youngest (practicing <5 years) and from the Southeast
- ◊ Use of protective stabilization is declining
- ◊ The use of pulse oximetry and blood pressure monitoring increased (pulse ox to 97% for moderate sedation)
- ◊ Benzodiazepines are the leading drugs (diazepam, then midazolam)

Trends Continued . . .

Table 2a. FREQUENCY OF USE OF SEDATIVE AGENTS					
	1985	1991	1995	2000	2010
% of patients sedated only with N ₂ O*	39	18	18	15	6
0	24	26	23	19	11
1-5	12	13	12	13	11
6-10	12	14	15	16	18
11-25	11	12	12	15	20
26-50	11	12	12	15	20
>50	22	17	20	22	34
Total	100	100	100	100	100

Table 2b. PERCENT OF PATIENTS SEDATED WITH AGENTS OTHER THAN NITROUS OXIDE BY AGE AND DISABILITY					
	1985	1991	1995	2000	2010
% of patients sedated with agents other than N ₂ O who are age group only	81	34	27	17	13
3	34	38	39	33	25
4-5	16	19	22	28	25
6-10	6	6	7	12	23
>10	3	3	4	5	14

Table 3. CHANGES IN FREQUENCY OF USE OF SEDATIONS OVER THE PAST FIVE YEARS					
	1985 (n=1,043)	1991 (n=1,138)	1995 (n=1,280)	2000 (n=1,328)	2010 (n=1,312)
% of practitioners using sedation					
Increased	12	17	19	22	
Decreased	31	21	28	30	
No change	57	62	53	48	
Total	100	100	100	100	

What are Programs Teaching These Days?

Table 9. NUMBER OF PROGRAMS USING SEDATIVES AND THEIR COMBINATIONS ACCORDING TO PROGRAM DIRECTORS					
Drug† combinations	No. of programs	Valid %	No. of programs not responding	No. of programs using drug alone or in combination	
Chloral hydrate	14	47	8 (21)		
Chloral hydrate + benzodiazepine	12	41	9 (24)	Chloral hydrate	19
Chloral hydrate + morphine	9	35	13 (33)		
Diazepam alone	32	76	9 (24)	Diazepam	24
Diazepam + midazolam	6	23	12 (32)	Midazolam	32
Midazolam + hydroxyzine or promethazine	11	41	11 (29)	Hydroxyzine	11
Midazolam (oral)	31	94	3 (10)	Midazolam	31
Midazolam (inhalation)	42	100	3 (10)		
Midazolam + lorazepam	13	24	11 (29)	Lorazepam	32
Tetrazepam	6	22	11 (29)		
Lorazepam	5	12	12 (32)		
Alprazolam	5	8	12 (32)		
Fenfluramine	5	19	11 (29)		
Ketamine	6	22	11 (29)		
			None responsive		
			32		
			23		

* Ranges are across responses, not necessarily within responses.
† Oral, inhalation, and parenteral (intravenous, rectal, nasal, eye, etc.) forms of sedatives.

‡ Oral, inhalation, and parenteral (intravenous, rectal, nasal, eye, etc.) forms of sedatives.

§ Not based on weight.

Table 10. DRUGS, DOSE, AND AGE RANGE USED IN PROGRAMS REPORTED BY PROGRAM DIRECTORS*			
Drugs	Dose range (mg/kg)	Age range (yrs)	
Chloral hydrate	20-75	2-8	
Chloral hydrate + hydroxyzine or promethazine	25.75±0.2-5.2	2-8	
Chloral hydrate + meperidine	10.45±1.20±5.2	2-8	
Diazepam	0.2-0.5	3-17	
Diazepam + meperidine	1.0±1.0	-	
Midazolam + hydroxyzine or promethazine	0.25-1.25	2-8	
Midazolam (oral)	0.2-0.5	2-8	
Midazolam (inhalation)	0.25-1.0±0.2	2-8	
Midazolam + meperidine	0.25-1.25	2-8	
Lorazepam	1.2-2 mg	12-18	
Alprazolam	0.25-1.0	-	
Fenfluramine	0.125-0.625	-	
Ketamine	2.6 (intramuscular) 7.5 (oral)	-	

* Ranges are across responses, not necessarily within responses.
† Oral, inhalation, and parenteral (intravenous, rectal, nasal, eye, etc.) forms of sedatives.

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§ Not based on weight.

Getting Ready to Dispense Medications

DEA compliance and Prescriptions



Dosing

- Always aiming for “The Minimum Therapeutic Dose”
- Always dose based on weight
 - ◊ Easy calculation (divide pounds by 2.2 to get kilograms)
 - ◊ Pay attention to BMI
- The addition of nitrous oxide potentiates the sedation and can potentiate respiratory depression



<http://www.ncbi.nlm.nih.gov/medlineplus/magazine/issues/summer11/images/kid-height.jpg>

Importance of Weight

- Obesity imposes a restrictive ventilation defect
- Causes a drop in functional residual capacity (FRC)
- Drug absorption, distribution, metabolism, and excretion are all affected by an increase in BMI

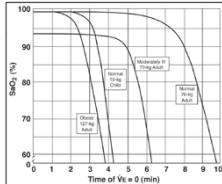


Figure 4. Oxygen saturation vs time of apnea for various types of patients. Figure adapted from Benumof JL, et al.²⁴

Baker, Obesity: A Complicating Factor for Sedation in Children, 2006

Calculating BMI

◆ <https://nccd.cdc.gov/dnpabmi/calculator.aspx>

BMI Calculator for Child and Teen

Information Entered

Age: 4 years
Sex: Boy
Birth Date: Wednesday, April 17, 2010
Date of Measurement: Tuesday, January 24, 2017
Height: 4 feet 6 inches
Weight: 40 pounds

Results

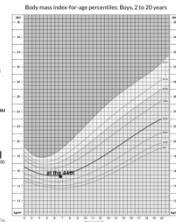
Based on the measurement, the BMI is 15.8, placing the child for age at the 4th percentile. This child has a healthy weight.

What does this mean?
What should you do?

At the 4th percentile:

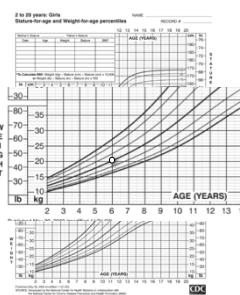
- Underweight, less than the 5th percentile
- Healthy weight, 5th percentile up to the 85th percentile
- Overweight, 85th percentile or greater
- At the 95th percentile

You can also view these results as a BMI for age Percentile Growth Chart.



What to Do?

- Obese? >95%
- Sedation is contraindicated
- Overweight? 85-95%
 - Use a growth chart and dose the patient at a weight that would be considered in the “normal” range for that individual



In-Office Storage



- Do you store them in your office?
 - Must be in compliance with DEA Compliance
- Security for practitioners is not well-defined:
 - ◊ Controlled substances listed in Schedules II, III, IV, and V shall be stored in a **securely locked, substantially constructed cabinet**
 - Reference: www.deadiversion.usdoj.gov/pubs/manuals/sec/general_sec.htm
- Can order from a compounding pharmacy or a supply house like Southern Anesthesia

Dispensing Medications

- Sedatives should be given by individuals licensed to give medications
 - Dentist
 - Nurse
- From 2016 Guidelines: "If sedation is being directed by a physician (dentist) who is not personally administering the medications, . . . the nurse administering the medication is to confirm the dose verbally before administration."



Prescriptions



- Do you write a prescription?
 - Signature should say: Do not take this medication at home
 - Never prescribe more than the maximum amount for that child's weight (ie. Should never prescribe more than 5 mL of demerol)
 - No refills: Patient should get a new Rx for each appointment
 - Don't store patient's medications without adhering to DEA security regulations

Behavioral Considerations and Parental Opinions

Settling, Stabilization, Sedation Effectiveness

Settling

- Once the child is placed in the chair, an effort should be made to "settle" the child
- Use nitrous oxide, attach the monitors, try to allow the child to become calm and let the nitrous enhance the sedative
- If the child is combative from the start, bypass this – in this instance, speed is your friend

Stabilization



- Requires a separate consent apart from the consent for the sedation and dentistry
- If using passive stabilization
 - Patient must be placed comfortably so joints/limbs are not unduly stressed
 - Patient should not be wrapped tightly preventing ventilation
- Shoulder roll should be used to open the airway

Protective Stabilization

When indicated, how acceptable is the use of protective stabilization (papoose, pedi-wrap) for the following types of patients in your practice?

Type of Appointment	Always acceptable	Sometimes acceptable	Rarely acceptable	Never acceptable	Total Responses
Emergency patients	25%	47%	19%	9%	302
Sedated patients	39%	31%	17%	13%	300
ISHCN Patients	16%	58%	15%	11%	301
Routine operative care	4%	20%	25%	51%	302

Parental Presence

- ◆ Research shows parents overwhelming prefer to be present in the operatory (Shroff, 2015)
- ◆ Parents prefer to be present for sedation (White, 2016)
- ◆ In the past decade, there's been a 10% increase in pediatric dentists allowing parents back for almost all procedures (Wells et al, 2014)
- ◆ Multiple studies show parental presence or absence does not seem to influence the child's behavior (Fenlon, 1993, Freeman, 1999, Cox, 2011, Vasiliiki, 2016)

Changes in Parental Preference of BGPs Over Time			
1984 (Murphy et al)	1991 (Lawerence et al)	2003 (Eaton et al)	2011 (Patel et al)
Most Acceptable Technique			
Tell Show Do	Tell Show Do	Tell Show Do	(Basic guidance techniques were not examined in this study)
Positive Reinforcement	Nitrous Oxide	Nitrous Oxide	
Mouth Prop	Voice Control	General Anesthesia	Sedation
Voice Control	Active Restraint	Oral Premedication	General Anesthesia
Physical Restraint	Hand-Over-Mouth	Voice Control	Active Restraint
Hand-Over-Mouth	Papoose Board	Passive Restraint	Passive Restraint
Sedation	Oral Premedication	Hand-Over-Mouth	
General Anesthesia	General Anesthesia		
Papoose Board			
Least Acceptable Technique			

Parental Views of Sedation

- ◆ White et al, 2016:
 - ❖ Parents believe sedation is safe
 - ❖ 72% of parents think their child will be asleep during sedation
 - ❖ 75% do not think a papoose should be needed
 - ❖ 64% of believe that one reason for sedation is to allow the dentist to restore all of the teeth in one visit
 - ❖ Parents aren't sure if "a shot will be needed to numb the teeth"
- ◆ Parents express more concern over slurred speech and ataxia than excessive sleep (McCormack et al, 2014)

Parental Acceptance of Various Sedation Experiences

Table 3. PARENTAL ACCEPTANCE OF SEDATION APPOINTMENT SCENARIOS		
Scenario	% parental acceptance	N=235
Child sleeps throughout	82.6	194
Child is awake but sleepy	73.2	172
Child cries and moves slightly, but the dentist is able to fix the teeth	54.5	128
Child cries and moves slightly, so the dentist stops fixing the teeth	43.4	102
Child cries, screams, and moves a lot, but the dentist is able to fix the teeth	18.3	43

◆ White et al, A Questionnaire of Parental Perceptions of Conscious Sedation in Pediatric Dentistry, Pediatr Dent, 2016.

Mild sedation (Anxiolysis) for Adults/Adolescents



Minimal Sedation (Anxiolysis)

- Normal response to verbal stimulation; although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected
- Pt can have a "light meal" (ie. toast and beverage without caffeine, no fat, no grapefruit)
- Pt is monitored visually
- Pt should have an escort
- Although it is prudent to administer the medication in the controlled environment of the dental office, anxiolytic doses can be taken at home prior to the appt

Prior to Sedation Appt

- Patients should always be instructed both **verbally** and **in writing** about:
 - Not driving, operating dangerous equipment, or making important decisions for 24 hours after the appt.
 - Bringing another responsible adult as an escort
- This information should be also placed in the chart for medicolegal purposes.

The Adult Oral Anxiolytic Appointment

- Review any changes in the medical history or treatment plan prior to administering sedative; obtain any written consent prior to administering sedative.
- Confirm escort
- Administer medication 1 hr before scheduled appointment with 8 oz glass of water by the dentist
- Observe for 45 min., if sedation adequate take to operatory, if not wait another 15 min.

The Adult Oral Sedation Appointment

- Escort patient to operatory
- Place supine, apply pulse ox and BP cuff (record q5min on anesthesia record)
- Oxygen via nasal cannula
- If sedation is less than optimal, careful administration of nitrous may be used depending on state regulations
- Obtain profound local anesthesia

The Adult Oral Sedation Appointment

- At end of appointment flush nitrous for 5 min. at 100% O₂
- Get final post-op vital signs
- Place patient in comfortable position and assess recovery
- Release to escort after instructions (verbal and written) are gone over with both patient and escort
- Have staff member go with patient to car
- Give post-op phone call in evening and once again go over instructions (precaution for retrograde amnesia)



Adult Precautions

- Geriatric Patients**
 - Consider using short acting medication (triazolam/zaleplon)
 - Decrease dosage (usually by half)
- Medically compromised patients**
 - Medical consultation is often recommended
 - Cardiovascular disease: pts benefit from decreased stress
 - Hepatic/Renal disease: for single doses used in oral sedation, no dose adjustment of BZDs is required

Adult Precautions

- Respiratory disease: pts can benefit from decreased stress; consider antihistamines; BZDs can be used as well for minimal sedation
- Diabetes: should continue regular eating schedule or may need dose of insulin adjusted
- Obstructive Sleep Apnea: pts can be extremely sensitive to CNS depressants and oral sedation should be approached with considerable caution

Resources

- AAPD Policy on Sedation:
http://www.aapd.org/media/Policies_Guidelines/G_Sedation1.pdf
- Informed Consent:
http://www.aapd.org/media/Policies_Guidelines/G_InformedConsent1.pdf
- Protective stabilization:
http://www.aapd.org/media/Policies_Guidelines/G_Protective1.pdf
- Sedation Record:
http://www.aapd.org/media/Policies_Guidelines/RS_SedationRecord1.pdf

Resources

- A Conscious Decision (full article available, free)
◊ [http://webarchive.nationalarchives.gov.uk/20130107105354/
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/en/documents/digitalasset/dh_4019200.pdf](http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/en/documents/digitalasset/dh_4019200.pdf)
- Silver Diamine Fluoride:
◊ <https://www.aacd.com/docs/2016symposium/Tomar.pdf>
◊ <https://www.ncbi.nlm.nih.gov.ezproxy.uthsc.edu/pmc/articles/PMC4778976/> (free article)