



**KING'S**  
*College*  
**LONDON**

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**University of London**

*Distinguish yourself*



Conscious Sedation:  
How to Manage Children in  
Dental Practice

Marie Therese Hosey

# Part 1: Let's meet the children



# Things that frighten children

- the unknown
- sight of the anaesthetic syringe
- sight, sound and sensation of the drill
- mutilation
- choking
- perceived expectation of ill-treatment / trauma
- strangers



# Dental Anxiety in Children

- As many as 16% of school-age children are afraid of the dentist and consequently avoid attending
- Children display their anxiety differently from adults, they are more irrational and less restrained
- There is wide variation between individual children, this may be is largely genetically determined
- Some children who refuse dental treatment have been shown to generally have difficulty adapting to change

# Age and Aetiology of Dental Anxiety

Townend E, Dimigen G, Fung D. (2000) A clinical study of child dental anxiety. *Behaviour Research and Therapy*, **38**, 31-46.

Locker D, Liddell A, Dempster L, Shapiro D. Age of onset of dental anxiety. *Journal of Dental Research* 1999; **78**:[3], 790-796.

# A Crash Course in Child

## Anatomy

- Large head, short neck, large tongue
- Narrow nasal passages
- Are obligate nasal breathers at birth
- High anterior larynx
- Larynx narrowest at cricoid cartilage

## Respiratory physiology

- Low functional residual capacity (FRC)
- Closing volume is greater than FRC up to 5 years of age, leading to increased ventilation/perfusion (V/Q) mismatch
- Horizontal ribs, weak intercostals muscles leading to relatively fixed tidal volume
- Oxygen consumption is high 6ml/kg/min compared to 3ml/kg/min in adults



## Temperature Regulation

- High surface area to body weight ratio
- Large head surface area and heat loss
- Require a higher temperature for a thermoneutral environment
- Immature responses to

## Nervous System

- Increased incidence of periodic breathing and apnoeas
- Ventilatory response to CO<sub>2</sub> is more readily depressed by opiates
- Immature neuromuscular junction leads to increased sensitivity to muscle relaxants

These differences result  
in hypoxia

Occurring more readily  
in children

So what might be causing this?



So, what will you do for these children?



## Part 2: Child Management

communication



education

interaction



# The role of the dentist

## Reducing child anxiety

- Preventing pain
  - Being friendly & establish trust
  - Working quickly
  - Having a calm manner
  - Giving moral support
  - Empathy
- (Corah et al 1988)



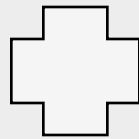


# Behavioural Management Techniques

- positive reinforcement
- tell show do
- acclimatisation
- desensitisation
- voice control
- distraction
- role modelling



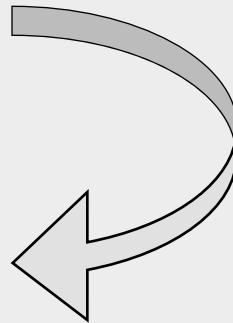
# Building a Treatment Plan



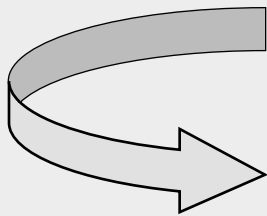
LA



IHS



GA?



## Part 3: Paediatric Dental Conscious

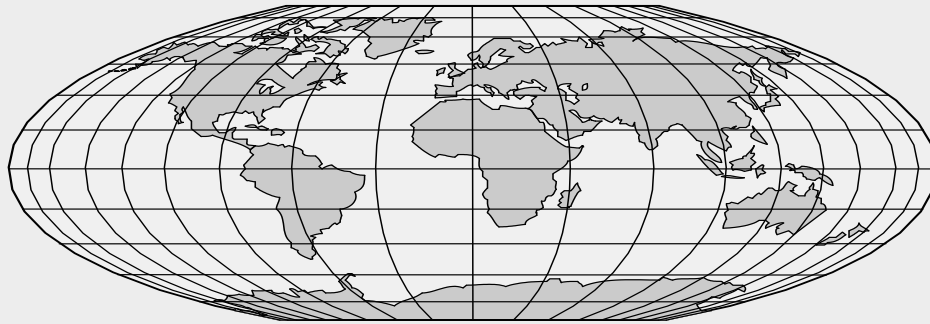


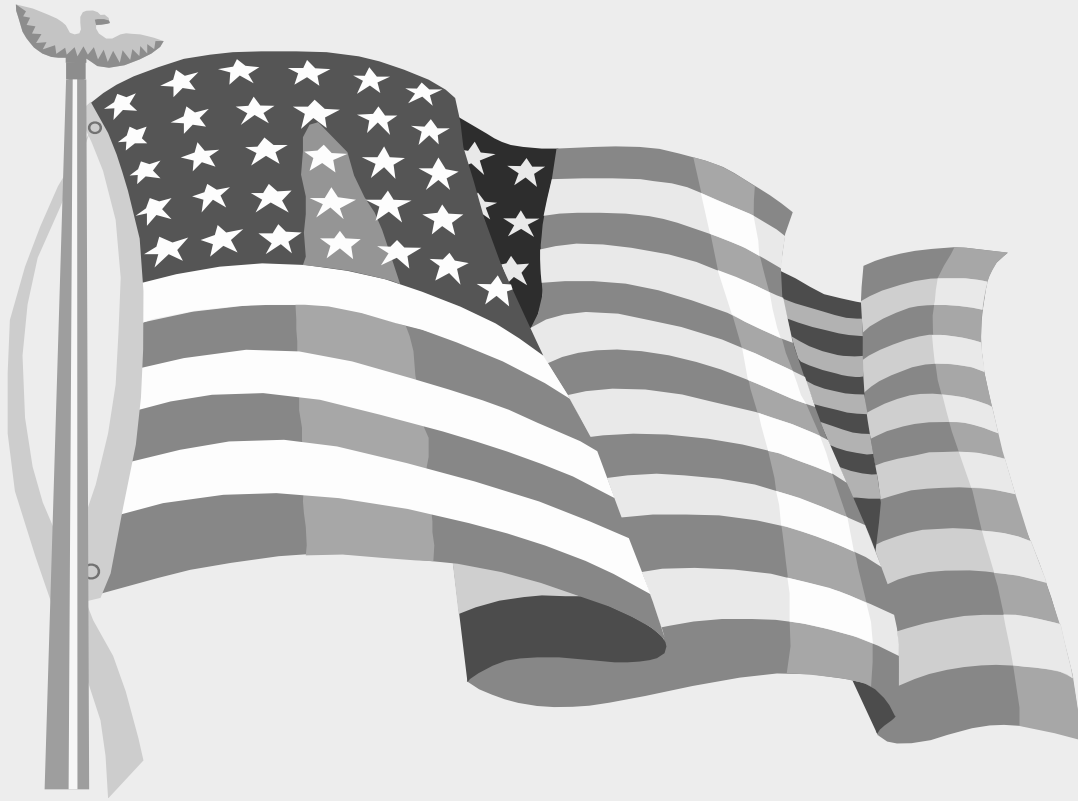
## Conscious sedation:

- Drug or ***drugs***
- Awake and communicating at all times
- ***IV not generally recommended in children***
- ***Dentist responsible for compliance of the anaesthetist?***



# Paediatric Dental Sedation around the World





conscious sedation---***DEEP SEDATION***---general  
anaesthesia

poly pharmacy is commonly advocated in specialist &  
hospital practice



# There is lots of literature . . . .

- 40 children, 24-60 months
- Half chloral hydrate & hydroxyzine
- Half also given pethidine
- All had 50% N<sub>2</sub>O
- All papoose
- Used the Houpt scale





- ‘Quiet’ and recovery rooms
- training requirements
- Location
- Monitoring
  - BP,
  - Pulse oximeter
  - Pre-cordial stethoscope



Cote et al. Adverse sedation events in pediatrics: a critical incident analysis of contributing factors. *Pediatrics* 2000 105: 805-814

## Crash course in child anatomy and physiology

These differences result in  
hypoxia  
occurring more readily in  
children

# Complications associated with paediatric dental sedation

## MOST COMMON

- Nausea & vomiting
- Hypoxia
- Unintentional loss of consciousness

These are usually related to extreme young age of the child, polypharmacy or use of multiple drugs.

# Complications associated with paediatric dental sedation

## ALSO

- aggression
- disinhibition
- hallucinations
  - mainly with ketamine and midazolam/ketamine - Roelofse 1996(a&b); 1998

Cote et al. Adverse sedation events in pediatrics: a critical incident analysis of contributing factors.  
Pediatrics 2000 105: 805-814

- *Review of adverse drug events reported for paediatric sedation by 4 reviewers cases where all agreed selected for this report*
- 95 incidents: **51 deaths**; 32 were for paediatric dental patients, 3 died receiving sedation from a 'pedodontist'
- more cardiac arrests in non-hospital settings
- inadequate resuscitation rated as the determinant of adverse outcome occurred most frequently in non-hospital settings
- death and permanent injury more common in non-hospital settings
- pulse oximetry was related to successful outcome
- *Poor outcome attributed to lack of skill in assessment of the problem and failure to resuscitate the patient*

# Guidelines

**European Academy of Paediatric Dentistry**

[www.eapd.gr/Guidelines.index.htm](http://www.eapd.gr/Guidelines.index.htm)

**UK**

**Dental Sedation Teachers Group**

[www.dstg.co.uk](http://www.dstg.co.uk)

**British Society of Paediatric Dentistry**

[www.bspd.co.uk](http://www.bspd.co.uk)

**Scottish Dental Clinical Effectiveness Programme**

[www.scottishdental.org/cep](http://www.scottishdental.org/cep)

# Choosing the sedative drug

the choice is endless....

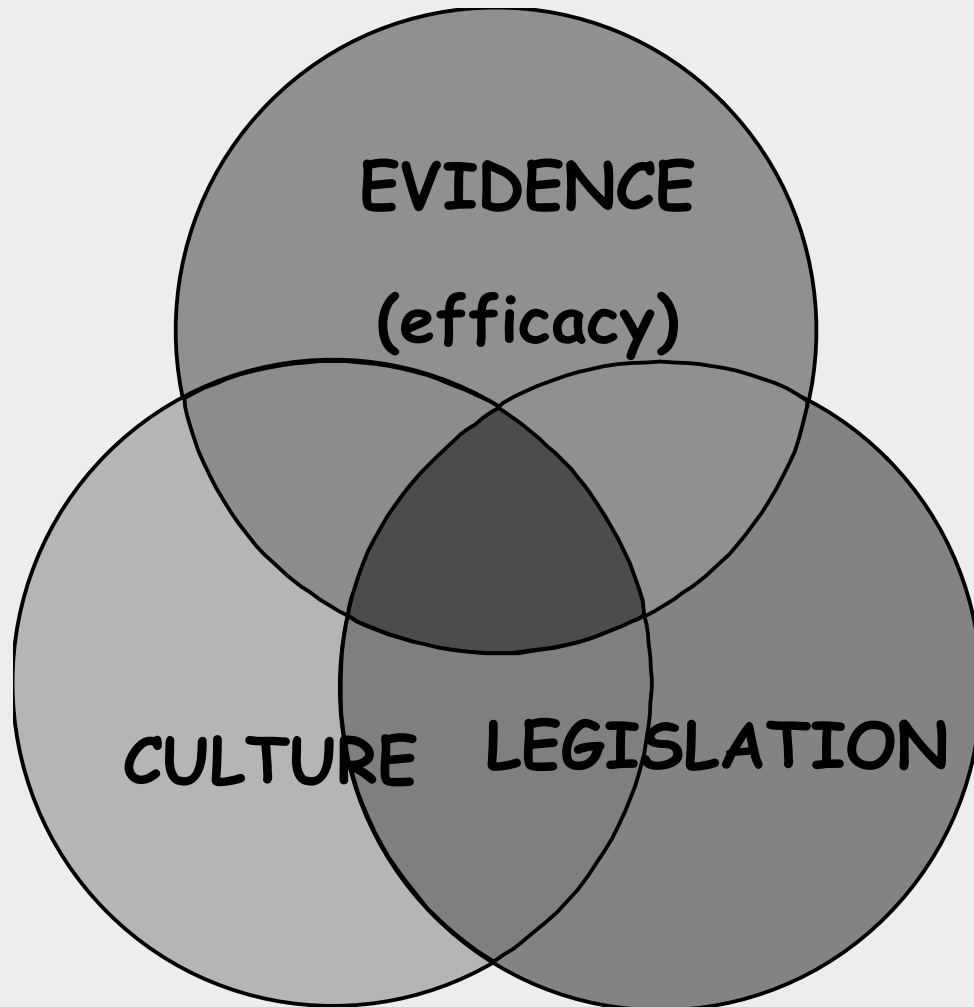
Drug Name	Dosage
Propofol	1-2 mg/kg bolus, then 0.5-1 mg/kg/hr infusion
Midazolam	0.05-0.1 mg/kg bolus, then 0.02-0.05 mg/kg/hr infusion
Fentanyl	1-2 mcg/kg bolus, then 0.5-1 mcg/kg/hr infusion
Etomidate	0.2-0.3 mg/kg bolus
Alfentanil	0.1-0.2 mcg/kg bolus, then 0.05-0.1 mcg/kg/hr infusion
Remifentanyl	0.5-1 mcg/kg bolus, then 0.1-0.2 mcg/kg/hr infusion
Clonidine	0.2-0.5 mcg/kg bolus, then 0.1-0.2 mcg/kg/hr infusion
Hydroxyzine	0.5-1 mg/kg bolus
Haloperidol	0.5-1 mg/kg bolus
Levomepromazine	0.5-1 mg/kg bolus
Chloralhydrate	0.1-0.2 g/kg bolus
Barbiturate	0.1-0.2 g/kg bolus
Valium	0.1-0.2 mg/kg bolus
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Barbiturate	0.1-0.2 g/kg bolus
Valium	0.1-0.2 mg/kg bolus

# Routes of administration

- oral
- intramuscular
- intravenous
- rectal
- submucosal
- inhalation
- intranasal?



Choice of drug and route-  
--- what would you choose?



Choosing the sedative drug

the role of research

# Research

Double blind randomised placebo controlled trials

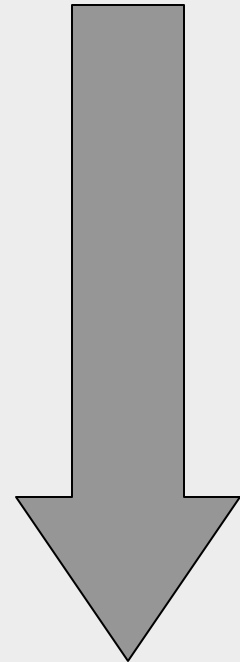
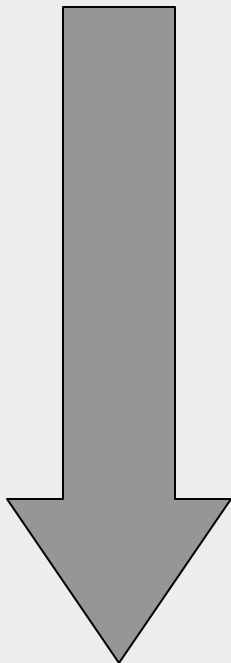
Meta analysis

Non randomised controlled trials

Clinical cohort studies

Clinical cases

Conference & expert consensus



# Cochrane

Matharu L, Ashley PF. Sedation of anxious children undergoing dental treatment. Cochrane database of systematic reviews, 2006, Issue 1, Art. No. : CD 003877. DOI: 10.1002/14651858.  
CD063877

[www.mtw.interscience.wiley.com/cochrane/clyev/articles/CD003877/pdf\\_fs.html](http://www.mtw.interscience.wiley.com/cochrane/clyev/articles/CD003877/pdf_fs.html)

- Method of randomisation unclear
- Inappropriate statistical tests
- Cross-over type studies should consider the carry-over effect
- Only 32% of studies reported baseline anxiety- even fewer reported anxiety at the end
- Little information regarding the actual treatment
- Repeatability not mentioned, especially when there was multiple operators or assessors
- Interpretation of outcome data relating to behaviour was difficult
- Over 50% of studies used the Houpt scale to record behaviour but in different ways and sometimes the subjects were papoosed

# NICE: Sedation for children and young people

- A clinical guideline offering evidence-based advice
- Not just about dentistry
- 0 to 18 years

*<http://guidance.nice.org.uk/CG112>*

# NICE definitions

## **Minimal sedation**

- A drug-induced state during which patients are awake and calm and respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.

## **Moderate Sedation**

- Drug-induced depression of consciousness during which patients are sleepy but respond purposefully to verbal commands (known as conscious sedation in dentistry) or light tactile stimulation. No interventions are required to maintain a patent airway. Spontaneous ventilation is adequate. Cardiovascular function is usually maintained.

## **Conscious sedation**

- Drug induced depression of consciousness, similar to moderate sedation, except that verbal contact is always maintained. This term is used commonly in dentistry.

## **Deep sedation**

- Drug induced depression of consciousness during which patients are asleep and cannot be easily aroused but do respond purposefully to repeated or painful stimulation. The ability to maintain ventilatory function independently may be impaired. Patients may require assistance to maintain a patent airway. Spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained

- Children and young people undergoing sedation and their parents and carers should have the opportunity to make informed decisions about their care and treatment....
- Treatment and care and information should be culturally appropriate
- Pre-sedation assessment and documentation
- Sets levels of expertise in sedation techniques in drug and life support skills
- Recommends psychological preparation



# Fasting and Life support recommendations

Minimal	Moderate	Conscious	Deep
BLS	ILS	ILS	ALS
No fasting	No fasting if verbal contact is maintained	IS= no fasting	Apply 2-4-6 rule

So what drugs can dentists use?



- *Local anaesthesia*

- Oral midazolam?

- *inhalation sedation*

monitors – at  
least a pulse  
oximeter

# Midazolam

- administered orally, intramuscularly, rectally and intravenously
- high affinity with benzodiazepine receptor
- high lipophilicity + high metabolic clearance mean rapid onset and recovery
- reversed by Flumazenil (Anexate)
- *more unpredictable in children*
- *not licensed for use in children*

*need monitors and a room for recovery*

# Midazolam: Adverse effects

- Respiratory drive decreases/apnea !!!
- Increased likelihood of hiccups
- Increased interactive drug effects
- Paradoxical effects (aggressive, crying, struggling)
- Drug Interactions:
  - *more* sedative effect – with erythromycin, ketoconazole, or consumption of grape-fruit juice.
  - *less* sedative effect – with tegretol or phenytoin

KE Wilson, RR Welbury, NM Girdler.

A randomised, controlled, crossover trial of oral midazolam and nitrous oxide for paediatric dental sedation.

Anaesthesia 2002, 57: 860-867.

- 46 children, 10 – 16 years
- Premolar (ortho) extractions
- either 0.5 mg/kg ORAL midazolam or IHS
- BP, heart rate and  $SO_2$  comparable
- Midazolam group took longer to achieve sedation  
– [20 (5-65) versus 5 (5-10) mins]  $p < 0.01$
- Treatment duration was similar
- 74% preferred to have midazolam again

# THREE ROUTES COMPARED: Buccal, IV, Oral

Modality	Buccal Midazolam	IV Midazolam	Oral Midazolam	
No subjects completing trial	36	40	46	42
Age mean (range)	[0.2 mg/kg] 12.9 yrs (10-16 yrs)	[0.5 mg min- to 5mg a] 13.2 yrs (12-16 yrs)	[0.5mg/kg] 12.5 yrs (10-16 yrs)	[0.3mg/kg] 7.4 yrs ((5-10 yrs)
No withdrawing	9	2	2	7
Vital signs	Within normal clinical limits	Within normal clinical limits	Within normal clinical limits	
Median time to peak sedation level	14 minutes	8 minutes	20 minutes	15 minutes
Mean total visit time	65 minutes	69 minutes	100 minutes	

# THREE ROUTES COMPARED

## Buccal, IV, Oral

<b>Modality</b>	<b>Buccal Midazolam</b>	<b>IV Midazolam</b>	<b>Oral Midazolam</b>	
<b>Overall Behaviour</b>	<b>No disruptive behaviour</b>	<b>No disruptive behaviour</b>	<b>1 became disruptive</b>	<b>2 became disruptive</b>
<b>Technique again</b>	<b>66%</b>	<b>80%</b>	<b>74%</b>	<b>59%</b>
<b>Preference</b>	<b>29%</b>	<b>51%</b>	<b>54%</b>	<b>36%</b>

## THREE 'Midazolam' ROUTES COMPARED

### Buccal, IV, Oral

- All midazolam routes appear to have minimal effect on the patient's vital signs indicating good safety profiles
- The IV route produces the fastest onset of sedation and therefore may be the most efficient
- There were more withdrawals where the buccal route was used owing to the difficulty with the taste
- The buccal midazolam was the least preferred route
- ***BUT- these studies also confirmed the efficacy of nitrous oxide IS– this provided the fastest onset of sedation and***



# Inhalation Conscious Sedation



# Nitrous oxide IHS

- Mean age 6 – 11 years
- successful in mild to moderate anxiety
- Successful
  - best with ortho extractions
- Failure related to:
  - young age
  - multiple extractions
  - irregular attendance

Blain & Hill. *Br Dent J.* (1998) 184(12):608-11.  
Veerkamp et al. *J Dent Child* (1993) **60**:175-182.  
Arch et al. *Int J Paed Dent* (2001) 11: 41-48  
Naudi et al. *Eur Archives Paed Dent* (2006)  
Major et al. (1981) *BDJ*; 151:186-191.  
Nathan et al. (1988) *JDent.Child*; 55:220-230.



# Inhalation Sedation (IHS)

## Physical properties

- sweet odour, pleasant to inhale, non-irritant
- liquid in cylinders, pressure constant (650-800lbs/in<sup>2</sup>) until all the liquid evaporates
- low tissue solubility so rapid onset & fast recovery
- MAC value in excess of one atmosphere so GA without hypoxia is impossible
- mild analgesic hence *Relative Analgesia* (RA) BUT LA still required

# Inhalation Sedation

## Indications

- ASA I:
  - no organic, physiologic, biochemical, or psychiatric disturbance.

# Inhalation Sedation

## Contraindications

- common cold
- tonsillitis
- nasal blockage
- neuromuscular disease e.g. myasthenia gravis, multiple sclerosis

## Problems

- tinnitus, headache, paraesthesia/ tingling, fear of the 'mask'

# Inhalation sedation method



# Inhalation Sedation: method

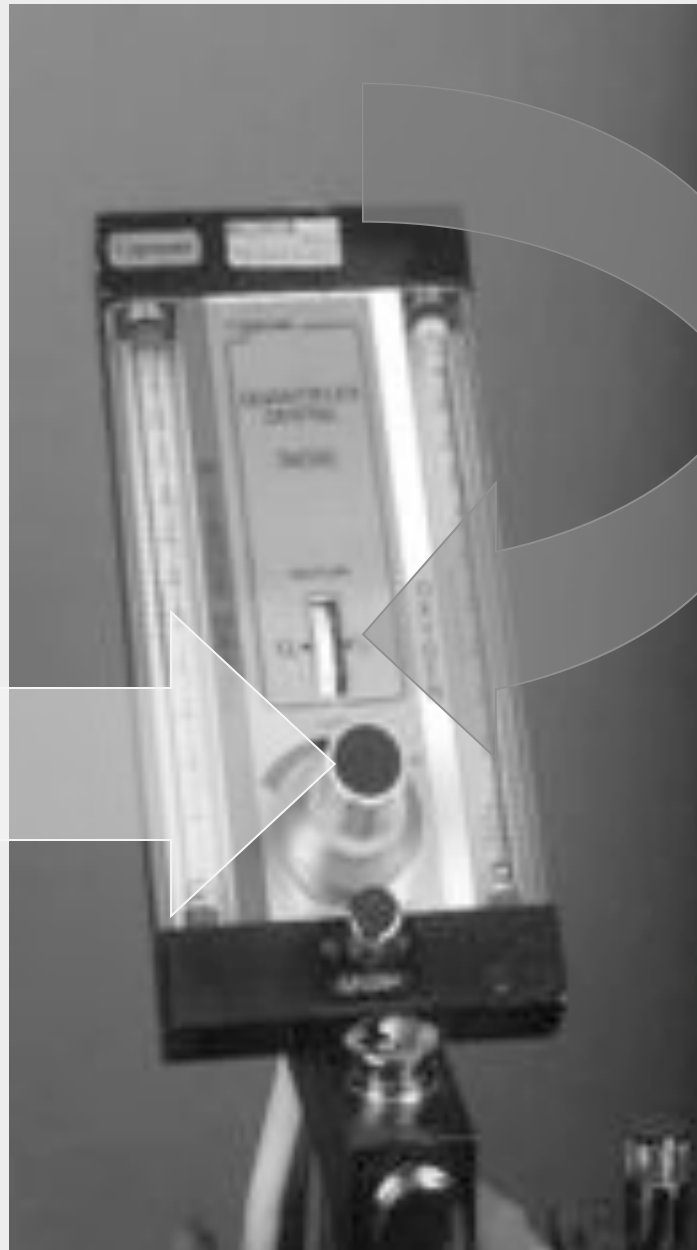
- 10% to 30% concentrations of nitrous oxide are most common

*i.e.*      *Nitrous oxide :*              *Oxygen*  
              *30%*                              *70%*

- titrated in 5% increments each 3-5 minutes
- monitor child's response and maintain dialogue and hypnotic suggestion
- allow at least 3 minutes pure oxygen recovery time



flow



titrate  
dose

# Inhalation Sedation

## Treatment Planning

- most successful when incorporated in a treatment plan from the beginning
- introduce gradually using behavioural management tools e.g. Tell Show Do
- not a panacea i.e. unlikely to be successful if used as a 'last ditch' attempt



# Toxicity of nitrous oxide to dentists and their assistants



- liver disease
- miscarriage
- bone marrow suppression
- addiction
- carcinoma
- birth defects

# Control of occupational exposure to nitrous oxide in the dental surgery

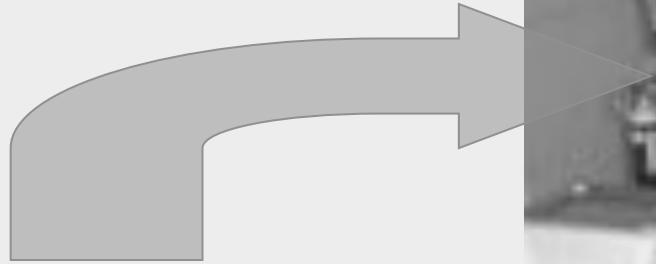
use :

- a properly maintained gas delivery system
- a scavenging nosepiece
- vented suction (scavenging) machine
- minimise speech by the patient
- rubber dam
- *fans to sweep air away from the operator*

*without these the air in the surgery can contain  
between 500-6700ppm*

*Whitcher at al. 1977, JADA vol. 95 page 763*

Active scavenging



Scavenging nose piece and delivery system



fan





# Paediatric dental sedation

- intertwined with behavioural management
- part of prevention and life-long rehabilitation
- integrated into a treatment plan
- facilitates quality restorative care
- NOT a 'quick fix'





So what would you do?

