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DISCOVERY SCIENTIFIC SOCIETY

Types of pharmacological sedation for uncooperative patients in pediatric dentistry - narrative review

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ABSTRACT

Background: Dental fear is, and has been for centuries, a great problem when it comes to treating patients, especially pediatric patients. When non-pharmacological techniques are insufficient, the use of pharmacological sedation becomes necessary. It allows behavior management, pain minimization, and ensures patient safety. *Aim*: The aim of this systematic review is to compile scientific evidence on the clinical effectiveness and safety profile of various sedation methods in uncooperative pediatric patients. *Material and methods*: The present paper searched the literature on electronic databases, including PubMed, using the keywords: "Pediatric dentistry", "Pharmacological sedation", "Dental phobia", "Dental procedures". Articles included randomized controlled trials, meta-analyses, and systematic reviews from 2015 to the present year. *Results*: Evidence shows that Midazolam and Nitrous Oxide remain the most commonly used and best-studied drugs. They can effectively improve a child's behavior during dental procedures. Dexmedetomidine is also playing an increasingly important role. The review emphasizes significant diversity in international guidelines and the absence of a "gold standard" for dosing and monitoring methods. *Conclusions*: Pharmacological sedation is a safe and effective alternative to general anesthesia in pediatric dentistry; however, its success depends on careful selection of the drug, route of administration, and the operator's qualifications. There is an urgent need to standardize research and clinical protocols to optimize care for pediatric patients and improve the predictability of treatment outcomes.

Keywords: Pediatric dentistry, Pharmacological sedation, Dental phobia, Dental procedures

1. INTRODUCTION

For centuries, people have been struggling with various phobias. One of the most common fears, persisting over many years, is the fear of doctors, including dentists. Patients are afraid of the dental office itself, pain, discomfort, and sometimes the phobia is so strong that they are unable even to sit in a dental chair. This situation occurs most frequently in children. Dental anxiety affects between 5% and even 43%

of the pediatric population and is a major cause of uncooperative behavior in a dental office (Zhang et al., 2024). There are many reasons why a child might struggle in the dental office: autism, parents' own dental anxieties, or simply having a dentist who isn't used to working with kids can all play a part. In situations where conventional methods and attempts to promote cooperation fail, the use of drugs is the only remaining option to ensure the safety of the child and minimize pain (Di Spirito et al., 2026).

General anesthesia, commonly referred to as "narcosis," can be used in such patients; however, in dental procedures where it is not absolutely necessary, sedation is also an option. Moderate (conscious) sedation is defined as a state of reduced consciousness in which the child maintains airway patency, protective reflexes, and the ability to respond to stimuli (Marques et al., 2024). The pediatric dentist of today has numerous alternatives regarding sedation, applying various medicines and methods of their administration in accordance with individual needs of the patient. Midazolam, which is one of the benzodiazepines, enjoys great popularity among pediatric dentists because of its rapidity and amnesia-inducing effect (Barot et al., 2025). Moreover, nitrous oxide inhalation is commonly used (Di Spirito et al., 2026). Dexmedetomidine is becoming popular due to its lack of effect on respiration as well as retention of cardiac functions and hemodynamics (Gao and Wu, 2023).

Other methods of administration include the use of ketamine, chloral hydrate, and drug mixtures (Verma, 2022). Methods of administration depend on whether the drugs will be orally administered, intranasally administered, or intravenously administered depending on the procedure type and the child's reaction to new situations (Haridoss et al., 2025). Although advances in pharmacology, a "gold standard" of management is still lacking, and international guidelines show considerable differences in recommended dosages and monitoring methods (Di Spirito et al., 2026). This is the purpose of this systematic review – to synthesize the available scientific knowledge about the clinical efficacy and safety of different types of sedation. Knowing these aspects is necessary to improve dental care and treatment experiences for young patients.

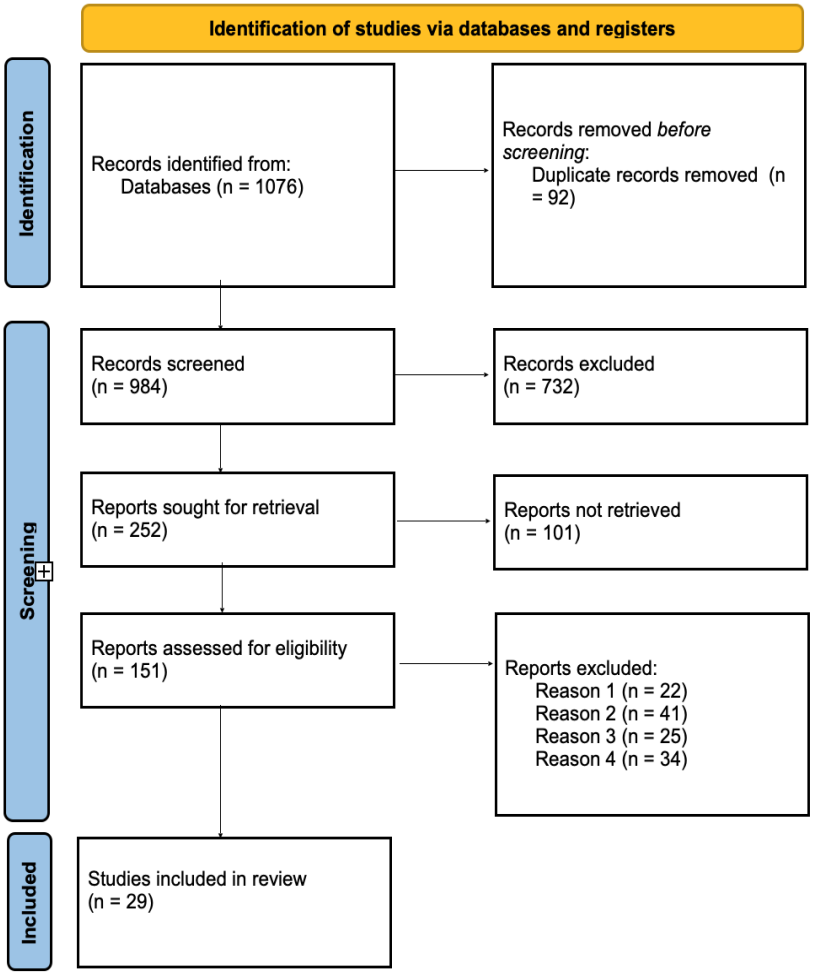

Figure 1. PRISMA flow diagram.

2. REVIEW METHODS

The current literature review was performed from February to April 2026. The databases used for the literature search were PubMed and Google Scholar. This study covered randomized controlled trials (RCTs), meta-analyses, and systematic reviews. It covered studies on children who are afraid of dental work. Studies written in the English language between January 1, 1997 and April 1, 2026 were included in this review. There are four criteria for exclusion: (1) case reports and editorials; (2) studies that were not available in full text form; (3) non-English language studies; (4) studies done exclusively on the adult population.

Ultimately, we included 29 studies in qualitative synthesis. The article screening process followed the PRISMA guidelines, as illustrated in Figure 1.

3. RESULTS AND DISCUSSION

Classification of Pharmacological Agents in Pediatric Dental Sedation

This is the comprehensive chapter that provides information about classification of sedatives used in pediatric dental sedation. Selection of the proper pharmacological agent is crucial for clinical success and safety of uncooperative pediatric patients (Ashley et al., 2018). This work describes the most widely used medications (Zhang et al., 2024).

Benzodiazepines

These are the most studied and applied types of drugs in pediatric dentistry; they work on increasing the inhibitory actions of the neurotransmitter gamma aminobutyric acid (GABA) (Khole et al., 2025).

Midazolam: The most commonly used sedative in pedodontics. The medication of choice because of its quick onset and the capability to produce anterograde amnesia (Ashley et al., 2021). This reduces the chances of getting future dental injuries. It can be given through different routes of administration (Di Spirito et al., 2026).

Diazepam: currently, it is used less often. Its duration of effect is prolonged (with an elimination half-life of 24–48 hours). Diazepam is usually administered orally or rectally.

Inhalational sedation gases

Nitrous Oxide: one of the most widely used agents, and is considered a standard for inhalation sedation. Used in a 30-50% concentration that provides anxiolytic and mild analgesic effects while the patient remains conscious and responsive. Due to its poor solubility, it causes and reverses quickly, within a few minutes (Ghabchi et al., 2025).

Sevoflurane: The anesthetic vapor is commonly used in small amounts. They range from 0.1 to 0.3 %. The gas vapor is highly useful in the sedation of very anxious children and those with intellectual disability, who may require sedation using some other way (Liu et al., 2025).

Alpha-2 Adrenergic Receptor Agonists

Dexmedetomidine: the most common representative of this group. It is a modern sedative drug with analgesic effects and low depressive influence on the respiratory system (Mohite et al., 2019). Its effects may resemble natural sleep. Thanks to intranasal administration, the stress of injections can be avoided. It provides a more stable mental state during parental separation, and it also has a more predictable recovery process with a lower risk of delirium in comparison to midazolam (Khole et al., 2025).

Dissociatives

Ketamine, which is a derivative of phencyclidine, functions through its ability to function as an antagonist to the N-methyl D-aspartate (NMDA) receptor, which is non-competitive (Gao and Wu, 2023). It results in a state of dissociative sedation that provides profound pain relief and loss of memory while allowing normal respiratory reflexes and normal cardiac function of the patient (Zhang et al., 2024; Gao and Wu, 2023). It is particularly useful in treating pediatric patients who are difficult to handle in any other way (Di Spirito et al., 2026; Haridoss et al., 2025). However, it causes hallucinations and agitations in patients recovering from anesthesia (Verma, 2022). The advantages of this combination will be explored further in this chapter.

Sedative-hypnotics and others

The use of non-benzodiazepine sedative-hypnotics is limited to specific, rare clinical scenarios. It is caused by the safety concerns with the drugs presented in this section (Di Spirito et al., 2026).

Chloral hydrate: Although widely used in the past for sedation and hypnotic purposes, nowadays, this drug is hardly ever used in dentistry due to having a low safety margin between the effective and lethal dose, lack of any antidote, and the possibility of developing respiratory obstruction (Gao and Wu, 2023; Nelson and Xu, 2015).

Melatonin: indoleamine, which has been widely researched as a natural substitute for other hypnotics (Di Spirito et al., 2026). Although it affects sleep via circadian rhythm, the intraoperative effect is insufficient (Ashley et al., 2018).

Modern Oral Hypnotics: this specific group involves agents used mostly in hospital settings (Ashley et al., 2021), such as Zolpidem, which is a short-acting imidazopyridine derivative. Its effects can be successfully reversed by flumazenil. The second agent is Triclofos, which provides long-lasting sedation. It should be done carefully and constantly monitoring patients, since there is no specific antagonist (Di Spirito et al., 2026).

Adjunctives

This class of drugs is very important for making therapy more effective. Due to adjuvant medications, the dose of the drug in question will decrease and therefore its adverse effects will be reduced (Inchingolo et al., 2024).

Antihistamines: namely, first-generation H1-antagonists (mostly hydroxyzine or promethazine) (Kim et al., 2022). Unlike second-generation antihistamines, they can freely penetrate the blood-brain barrier. They exert sedative effects through suppression of hypothalamic nuclei and autonomic sympathetic nervous system. Apart from their sedative action, they exert anxiolytic, antiemetic, antispasmodic and anticonvulsive effects (Gao and Wu, 2023). Moreover, one of their side effects is xerostomia and it might be useful in case of dental treatment. They intensify the sedative effects of other drugs (e.g., benzodiazepines or opioids) on the central nervous system (Kim et al., 2022).

Opioids: Opioids can be exemplified using either fentanyl or meperidine (Inchingolo et al., 2024). Primarily used for their analgesic effects. Work in conjunction with benzodiazepines by minimizing paradoxical effects. Opioids ensure that patients remain stable psychologically, hence are less susceptible to unexpected agitations (Gao and Wu, 2023).

Propofol: This drug is given via the intravenous route (Gao and Wu, 2023). The drug has a quick onset of action but a short duration of action (Marques et al., 2024). Due to the risk of respiratory depression, there is a need for close monitoring of vital signs when giving the drug.

Polypharmacy

Various drug combinations are often used in order to achieve better clinical effects. Polypharmacy allows for lowering the dose of each agent, thus reducing complications (Gao and Wu, 2023). Overall, it usually induces deeper and more stable sedation and better recovery (Baek, 2015; Swaminathan et al., 2025). Here are the most frequently observed combinations.

Midazolam + N_2O: It is the most recommended regimen by international standards (Marques et al., 2024). It is perceived as the standard in pediatric dentistry (Ashley et al., 2021). Combining these two medications provides effective anxiolysis with a high safety profile (Ghabchi et al., 2025; Khole et al., 2025). The addition of nitrous oxide has been proven to shorten the recovery time (Park et al., 2023).

Ketamine + Midazolam: It provides the anxiolytic and amnestic effects of benzodiazepine along with analgesic and sedative effects of ketamine (Gao and Wu, 2023; Swaminathan et al., 2025). It provides good mental stability of uncooperative patients compared to other protocols. The most important fact is that midazolam effectively reduces ketamine's side effects, such as hallucinations or emergence agitation, providing a calmer recovery process (Verma, 2022).

Chloral Hydrate + Hydroxyzine: This is a historical combination traditionally used for very young children (Baek, 2015; Park et al., 2023). Hydroxyzine, acting as a sedative and antiemetic, increases the effects of chloral hydrate and helps prevent the nausea often occurring during monotherapy (Inchingolo et al., 2024). Due to a narrow therapeutic index of chloral hydrate, this protocol is no longer recommended (Di Spirito et al., 2026; Marques et al., 2024).

Classification of sedation methods according to the route of drug administration

The correct choice of means of administration is highly important and should not be neglected. It depends on the patient's age, level of dental fear, and cooperation, as well as on the character of the planned procedure and the agent used to induce sedation (Zhang et al., 2024). The available routes of administration are presented below.

Oral sedation: the most common route of administration. It is well accepted among pediatric patients and easy to perform. It is also considered a low-cost option (Ashley et al., 2021). However, drugs taken orally undergo hepatic first-pass metabolism, which decreases drug concentration (Gao and Wu, 2023). It may also cause trouble with precise dosage (Nelson and Xu, 2015). Medications administered orally are commonly in the form of pills or syrup (Ashley et al., 2021).

Inhalation sedation: Sedative gases like nitrous oxide or sevoflurane are inhaled through a mask placed in the nose. The inhalation method is very titratable because the amount of sedation can be easily controlled (Ashley et al., 2021).

Transmucosal sedation: This method is becoming more widespread. It is non-invasive, well-tolerated by the patients, and easy to perform. It is recognized for rapid absorption directly into the bloodstream, which allows for avoiding the presystemic metabolism of the sedative (Haridoss et al., 2025). Transmucosal sedation can be classified into different types according to the administration site.

- Intranasal: This refers to a mucosal atomization device that sprays the medicine as an aerosol in the nasal region (Nie et al., 2023).
- Sublingual: In this method the drug is placed underneath the tongue, where it is absorbed by the blood vessels (Mohite et al., 2019).
- Buccal: The drug is applied inside the cheek, and it is absorbed by the oral mucosa (Nelson and Xu, 2015).

Intravenous sedation: This is the fastest way to achieve clinical effects. It provides the best control of the level of sedation (Khole et al., 2025). Advanced techniques such as TIVA (Total Intravenous Anesthesia) and TCI (Target-Controlled Infusion) support precise titration of the medication (Barot et al., 2025). Unfortunately, this route of administration is associated with an unpleasant experience of injection, making it distressing and hard to implement in uncooperative children (Nelson and Xu, 2015).

Submucosal sedation: Used rather rarely, as an addition when oral sedation is insufficient. The medication (e.g., midazolam) is injected into the oral vestibule or retromolar area. This route allows rapid absorption as a result of the rich vascularization in the administration area (Baek, 2015).

Intramuscular sedation: Despite being less preferred due to the discomfort associated with an injection, it offers very predictable drug absorption (Ashley et al., 2021).

Rectal sedation: This technique is less commonly applied, mostly when dealing with infants, toddlers, or those who cannot tolerate oral drugs (Di Spirito et al., 2026).

Comparison of the clinical efficacy of sedative agents and their use in pediatric patients

Contemporary pediatric dentistry aims to standardize methods of pharmacological anxiolysis for uncooperative patients, as evidenced by numerous scientific publications documenting the rapid development of sedation research over the past three decades (Zhang et al., 2024). It is significantly important because odontophobia is associated with impaired quality of pediatric patients' lives. The leading contributors to research on pharmacological methods of anxiety reduction are the USA, Great Britain, and India, with the efficacy of midazolam and nitrous oxide remaining a major focus of interest (Pooja et al., 2023).

Sedation with maintained consciousness is regarded as a valid alternative to general anesthesia. Conscious sedation techniques, especially oral or inhalation methods, decrease the invasiveness of the procedure, total costs, recovery time, and the need of advanced equipment, while maintaining a high rate of successful treatment completion in uncooperative patients, who are difficult to manage with non-pharmacological techniques (Di Spirito et al., 2026).

Midazolam

Midazolam is viewed as the gold standard for anxiolysis because of its immediate onset of action, short duration, multiple routes of administration, anticonvulsant properties, muscle-relaxing effects, and minimal adverse reactions (Gao and Wu, 2023; Khole et al., 2025). Furthermore, the medication frequently induces anterograde amnesia (Ashley et al., 2021). According to Cochrane meta-analysis, there is moderate-certainty evidence that the use of oral midazolam in doses between 0,25 mg/kg and 1 mg/kg is correlated with more co-operative behavior in comparison to placebo (Ashley et al., 2018). As per recently published studies, the use of midazolam via the submucosal route along with oral consumption of CH is found to be more sedating and reduces the incidence of vomiting (Baek, 2015). Midazolam administered intranasally is a better choice for brief procedures since it acts in 5 to 10 minutes compared to 15 to 20 minutes when taken orally (Swaminathan et al., 2025).

Dexmedetomidine

Dexmedetomidine is gaining importance in pediatric sedation because of its minimal respiratory depression ability and no drug interactions with opioid and GABA receptors, unlike other agents (Mohite et al., 2019). Dexmedetomidine results in a more stable and tranquil state while the patient is separated from their parents, which is often a challenging part of pediatric dentistry, than midazolam; therefore, it poses a less dose-dependent risk of side effects such as paradoxical behavior. However, DEX exhibits a slower onset of action (Barot et al., 2025) , which gives an advantage to midazolam in short procedures.

Notably, Nie et al., (2023) reported that the combination of oral midazolam and intranasal dexmedetomidine was associated with a higher sedation success rate for managing the behavior of non-cooperative children during dental treatment than oral midazolam alone. According to the latest research, dexmedetomidine contrasted to midazolam showed superior venipuncture acceptance, had less intraoperative coughing, and required fewer suction. It seems to be an advantageous alternative to midazolam as premedication for deep sedation in pediatric dental treatment (Cheng et al., 2024).

Nitrous Oxide

Nitrous Oxide is one of the most commonly used methods of inhalational sedation; it demonstrates a clinical success rate of over 90% in procedures such as extraction and restorative dentistry (Ghabchi et al., 2025). Research indicates that nitrous oxide and midazolam achieve similar results in terms of patient cooperation, depth of sedation, and rates of completed procedures. Nonetheless, recovery time to full awareness is relatively longer for patients administered with midazolam. No study reported any incidence of respiratory depression, and excitatory reactions were seldom reported (Khole et al., 2025). N2O is known to cause a depression of the central nervous system under controlled conditions, thereby facilitating the dental procedure to be performed in conjunction with communication with the patient. This allows better control of perioperative stress and pain and enables careful monitoring of vital signs (Cenzato et al., 2025). In addition, inhalational sedation has a rapid onset, which is especially useful in pediatric dentistry, as diminishing patient anxiety could significantly affect the success of the procedure (Swaminathan et al., 2025).

Multi-drug sedation

In the case of extremely uncooperative patients who show significant resistance to treatment, polypharmacy proves to be helpful (Albaker et al., 2025). A multidrug sedation regimen is based on the synergistic action of agents with different mechanisms of action, enhancing their combined pharmacological effect. This results in increased efficacy while minimizing the side effects of the individual drugs when administered separately. DMH therapy success was found to be 89% in the study group, where 71% showed positive behavior and older age of the patient was found to be a positive predictive factor for procedural success (OR 0.8; $p = 0.0047$) (Albaker et al., 2025).

Midazolam oral + ketamine oral, for example, 0,3 mg/kg MID + 3 mg/kg KET, works wonderfully and has greater efficacy and analgesic effects compared to midazolam alone (Swaminathan et al., 2025). Of importance is that in ASD patients, midazolam works better and gives a shorter duration of response compared to diazepam; thus, midazolam is preferred (Vallogini et al., 2022). The summary of sedative agents used in pediatric sedation is portrayed in Table 1.

Table 1. Summary of sedative agents used in pediatric sedation.

Medicine	Route of administration	Clinical success rate (%)	Onset time (min)	Major advantage
Midazolam	Oral/ intranasal	64-80	5-20	Gold standard, retrograde amnesia
Dexmedetomidine	Intranasal	47-83	15-30	Absence of respiratory depression
Nitrous oxide	Inhalational	~91,9	0,5-3	Rapid recovery of consciousness
Ketamine + midazolam	Oral/ intranasal	> 90	15-25	Significant analgesia in anxious patients
DMH regimen	Oral	89	30-45	Effective in moderate sedation
Hydroxyzine	Oral	~81	30-60	Antiemetic properties

Safety profile and adverse effects

The safety of adolescent patients is a priority, numerous meta-analyses indicate that sedation in pediatric dentistry is commonly well-tolerated when performed appropriately, when strict super vision protocols are respected (Velez-León et al., 2022). However, adverse effects may occur, most commonly including nausea, vomiting, paradoxical reactions presenting as anxiety and aggression particularly with benzodiazepine use (Ashley et al., 2018). Nausea and vomiting are relatively frequent and may be induced by midazolam and nitrous oxide (Ashley et al., 2021).

Importantly, reversal agents for sedative drugs are available, with flumazenil being one of them, which is an antidote to benzodiazepines through competitive inhibition (Ashley et al., 2021). Flumazenil can reverse hypersedation associated with benzodiazepines such as midazolam and decrease amnesic effects. It may be administered intramuscularly and submucosally (Baek, 2015) or intravenously for a rapid onset (Ashley et al., 2021).

The most serious risks remain respiratory depression and hypoxemia, which are closely related to the depth of sedation and the combination of sedative agents (Zhang et al., 2024; Khole et al., 2025). According to the literature, sedation-related dental surgery deaths were almost always due to respiratory failure (Zhang et al., 2024). Respiratory problems related to dose dependency occurred following ingestion of midazolam orally, while no respiratory problems arose following ingestion of dexmedetomidine (Barot et al., 2025). The reported side effects from the policy of the European Academy of Pediatric Dentistry concerning conscious sedation for pediatric dental patients include respiratory depression during N2O- O2 inhalation sedation (Ghabchi et al., 2025). Oxygen desaturation or hypoxemia occurred in 3 of 58 patients (5.17%) receiving ketamine (Di Spirito et al., 2026). Some factors that may increase the risk are tonsillar hypertrophy, which directly affected the airway patency and increased hypoxemia risk 10 times (33.3% vs. 3.3%; $P < 0.001$) (Liu et al., 2025). Importantly, as the depth of sedation increases, the protective function of the airway reflexes decreases, increasing the risk of airway obstruction or foreign body aspiration (Gao and Wu, 2023). Another side effect is aspiration of gastric contents; in order to prevent this, it is essential to follow the fasting guidelines outlined in Table 2 (Green et al., 2020).

Table 2. Fasting guidelines

Ingested substance	Fasting time
Clear liquids[1]	2h
Breast milk	4h
Food, formula, non-human milk	6h

([1])- Clear liquids are generally considered to include water, fruit juices without pulp, clear tea, black coffee, and specially prepared carbohydrate-containing fluids.

Moreover, sedation can lead to cardiovascular complications. Barot et al., (2025) found that dexmedetomidine preserves stable blood pressure and heart rate during sedation. Although procedural sedation using dexmedetomidine is generally safe, bradycardia caused by ketamine could be a potential issue (Gao and Wu, 2023). Ketamine raises the cardiac output, pulse rate, arterial and central venous pressures, and has little effect on the total peripheral resistance (Johnstone, 1976). Furthermore, midazolam has the ability to significantly reduce blood pressure and heart rate while continuing acceptable oxygen saturation levels (Inchingolo et al., 2024).

Additionally, sedation may be associated with behavioral disturbances. Midazolam has reported side effects of paradoxical and extrapyramidal reactions such as agitation and hyperactivity, possibly due to midazolam being 3–4 times more potent than diazepam (Albaker et al., 2025). Moreover, ketamine poses the possible risks of undesired adverse effects, such as emergence phenomenon (Gao and Wu, 2023). In the process of sedation, it is advisable for the healthcare professionals to consider any possible drug interactions. In such cases, nitrous oxide may have a synergistic effect on the other sedatives such as opioids or benzodiazepines and cause CNS depression (Ashley et al., 2021). The administration of midazolam together with antipsychotics, H1 antihistamines, and centrally acting antihypertensive medications may have an additive sedative effect (Gao and Wu, 2023).

The time of recovery and restoration of complete psychomotor performance are safety criteria. Seven studies analyzed in the meta-analysis indicate that the use of dexmedetomidine was associated with significantly prolonged recovery as compared to midazolam and ketamine. Among the compared drugs, midazolam demonstrated the shortest recovery time (mean difference: −19.1 min, $p < 0.05$), followed by ketamine (mean difference: −15.6 min, $p < 0.05$) (Haridoss et al., 2025). It is because midazolam is water soluble and consequently does not form an active metabolite (Baek, 2015). Intranasal midazolam also resulted in faster recovery than its oral form (Ashley et al., 2018). Thanks to midazolam rapid onset and short duration, this drug is appropriate for short dental procedures necessitating quick recovery (Barot et al., 2025). Of note, esketamine has the potential clinical advantage of a shorter recovery time and

quicker orientation recovery time compared to racemic ketamine (Gao and Wu, 2023). Khole et al., (2025) found that nitrous oxide led to less discomfort, with fewer side effects and faster recovery than midazolam.

It is worth noting that hydroxyzine is safe to use, with a very low incidence of side effects. The most common adverse events are drowsiness and dryness of the mouth. Interestingly, this drug is classified as a histamine blocker with antiemetic action; nausea/vomiting is not likely to be an adverse effect. However, the administration of this medication alone is limited to the management of mild to moderate fear (Kim et al., 2022).

Due to the various potential side effects of sedation, it is important to carefully observe the vital signs during the entire process. It is important that the oxygen levels are measured by pulse oximetry at all times. The ventilation has to be monitored regularly in cases of moderate sedation and continuously monitored during deep sedation. The usual equipment for monitoring includes the equipment that measures heart rhythm, blood pressure, oxygen saturation, and respiration. The EtCO monitor is highly recommended. The BIS monitor is useful as well, since it measures objectively the level of sedation (Gao and Wu, 2023). The necessary equipment for safe administration of pediatric sedation "SOAPME" is portrayed in Figure 2.

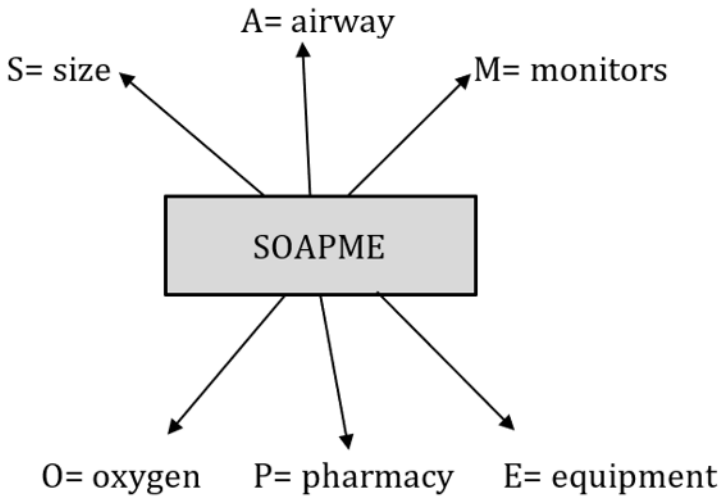

Figure 2. Necessary equipment for safe administration of pediatric sedation "SOAPME". *Explanation*: S- appropriately sized suction catheters and a working suction system, O- Sufficient oxygen supply with equipment enabling its delivery, such as flow meters, A- Size-appropriate bag-valve-mask, nasopharyngeal and oropharyngeal airways, laryngeal-mask-airway, laryngoscope blades, endotracheal tubes and stylet, face mask, P- All fundamental medications needed for emergency life support, including antagonists, M- functioning pulse oximeters, size-appropriate oximeter probes, end-tidal carbon dioxide monitor, other monitors as appropriate for the procedure, E- Special equipment or medications as needed (Gao and Wu, 2023).

The results of the study by Marques et al., (2024) prove the necessity of more international standardization of sedation guidelines, especially pharmacological protocols, in order to increase the consistency in the process of clinical decision making and ensure the safety of patients. Furthermore, each member of the clinical team needs to have theoretical and practical training in basic life support. The BLS protocol must be in accordance with the currently applicable standards set by national regulatory agencies and professional dental organizations (Ashley et al., 2021).

Summarizing the above information, the sedation technique must be chosen individually for each child depending on his/her age, temperament, and certain anatomical features, such as hypertrophy of the tonsils. All the mentioned sedation techniques are safe if the procedure is performed by qualified medical professionals (Di Spirito et al., 2026; Marques et al., 2026).

4. CONCLUSION

This paper presents a systematic review of pharmacological sedation methods used in children who show lack of obedience during dental procedures. The main aim of the study was to gather evidence on the efficacy and safety of various agents. Midazolam is regarded as the "gold standard" owing to its fast action and capability of inducing anterograde amnesia. One of the frequently applied

drugs is nitrous oxide that is appreciated for its rapid recovery time. Dexmedetomidine is another substance that grows in significance as it brings cardiovascular stabilization and does not induce respiratory depression in contrast to many other agents. In case of more complicated procedures, ketamine is used in combination with midazolam in order to control the pain and minimize the likelihood of post-procedural hallucinations. The selection of drug administration routes will depend on the age and anxiety level of a particular patient as well as on the kind of dental treatment required. Using various drugs in combination with each other is one of the most widespread ways to administer them as it enables using small doses of all medications.

One of the most important aspects in this paper is safety, as respiratory depression and hypoxemia are the most serious risks. This requires strict adherence to preoperative fasting guidelines and continuous monitoring of vital signs. Clinical success depends on an individualized approach to the patient, their temperament and anatomical conditions. Sedation itself represents a safe and effective alternative to general anesthesia. This paper points out that international guidelines and clinical protocols need to be standardized to optimize care and improve the predictability of treatment outcomes in pediatric patients.

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Data and materials availability
All data associated with this study will be available based on the reasonable request to corresponding author.

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