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Respiratory and Pulmonary Allergic Emergencies in Dental and Periodontal Surgery: A Systematic Review of Identification, Management, and Prevention Strategies

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ABSTRACT

Objective: Allergic respiratory and pulmonary emergencies, though uncommon, represent a potentially lethal risk in dentistry, and anaphylaxis is the cause of a significant percentage of perioperative allergic reactions. If left uncorrected, it increases the mortality rate.
Methods: Systematic review according to PRISMA guidelines with a literature search in PubMed, Scopus, Web of Science, Cochrane Library, and Embase (2000–2025). 47 studies were considered for analyzing allergens, treatment protocols, and preventive interventions. Data synthesis and extraction were conducted, and study quality was assessed using standardized tools.
Results: Local anesthetics (such as lidocaine), latex, antiseptics (such as chlorhexidine), and dental materials (such as methacrylates) were identified by the review to be the most common allergens responsible for respiratory allergic emergencies. IgE-mediated reactions (such as anaphylaxis) were demarcated from non-IgE-mediated reactions, and epinephrine was revealed to be the drug of choice for first-line use in anaphylaxis. Preoperative allergy screening, premedications, and material substitution were proven to be preventive measures. Reasonable gaps in the training and preparedness of dental personnel to manage allergic emergencies were identified.
Conclusion: Even though there are effective emergency protocols available, widespread implementation of universally standardized response procedures, mandatory simulation training, and enhanced preoperative risk assessment is overdue if patient safety is to evolve.

Keywords: Allergic emergencies, Dental surgery, Anaphylaxis management, Preventive strategies, Epinephrine administration.

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Introduction

Allergic responses to dental treatment, although often localized, can evolve to life-threatening respiratory complications such as anaphylaxis or bronchospasm. Local anesthetics, latex, and dental instruments are the most common offenders, and IgE-mediated reactions are the most dangerous [1-5]. IgE-mediated (Type I) hypersensitivity reactions are particularly risky, as they bring with them the risk of immediate mast cell degranulation, histamine release, and subsequent bronchoconstriction and airway edema, resulting in widespread impairment of oxygenation [3, 5]. On the other hand, non-IgE-mediated allergic-like reactions, such as those caused by preservatives of anesthetics (i.e., sodium metabisulfite), may also have severe respiratory compromise but through varied inflammatory mechanisms [2]. Because of the significant risk of these emergencies, prompt identification, quick intervention, and preventive strategies are essential to risk minimization and better patient outcomes during dental procedures [6-8].

The epidemiological significance of allergic emergencies in dental clinics cannot be overstated. While there is limited worldwide data, studies show that major allergic reactions, including anaphylaxis, are seen following 1 in 1,000 to 1 in 10,000 dental procedures, with a mortality rate as high as 1–3% if left untreated [9, 10]. Local anesthetics and latex are the most frequent triggers mentioned, causing over 60% of cases [11]. These statistics highlight the need for greater caution and preparedness in dental practice to prevent unnecessary death.

Despite the widely publicized risk of anaphylaxis and airway complications in the dental setting, there are relevant research gaps. Firstly, no systematic review specifically of respiratory and pulmonary allergic emergencies in dental and periodontal surgery exists. Although most reviews available report on general anaphylaxis management, none of them emphasize dental-specific allergens, airway management, or the late effects on the respiratory system of such reactions [12, 13]. Second, practitioner preparedness remains insufficient, as questionnaires indicate that the majority of dentists do not receive adequate training in anaphylaxis management protocols, airway stabilization algorithms, or proper epinephrine injection [14, 15]. Third, there is a serious shortage of standardized prevention protocols. Although allergy testing, premedications, and material substitution strategies are being used, there is a lack of consensus on best practices for preventing allergic respiratory disasters in dental surgery [16]. To cover these gaps, this systematic review attempts to synthesize and review existing studies to provide a comprehensive overview of the diagnosis, emergency management, and prevention of respiratory allergic complications of dental and periodontal surgical procedures.

The central purpose of this systematic review is to critically evaluate the diagnosis, management, and prevention of pulmonary and respiratory allergic emergencies in dental and periodontal treatment. More precisely, the review seeks to outline the frequent allergens that have been implicated in these reactions, including local anesthetics, latex, antiseptics, and dental restoratives, and contrast their clinical patterns, differentiating IgE- and non-IgE-mediated reactions. In addition, it will present current emergency management guidelines, such as first-line pharmacologic therapy of allergies (e.g., epinephrine, bronchodilators) and stabilization of the airway methods, and address preventive measures such as preoperative allergy testing, premedication, and material substitution. Furthermore, this review will identify gaps in practitioner preparedness and provide evidence-based recommendations to further prepare dental practitioners with information and response abilities in allergic airway emergencies.

This systematic review contributes to clinical and academic practice by combining evidence from diverse case reports, cohort studies, and systematic reviews to yield a systematic, detailed information source for the treatment of respiratory allergic emergencies in dental surgery. It discusses best practice in the diagnosis of genuine allergic emergencies versus mimicking presentations, such as vasovagal attacks or sulfite-induced bronchospasm, to optimize diagnostic performance in high-risk situations. Additionally, it points out areas of dentist preparedness and advocates for tangible reforms in training and protocol administration to enhance emergency response. By informing preventive models of preoperative patient assessment, this review can potentially reduce the risk of allergic complications by way of proactive screening, material substitution, and premedication protocols. Finally, it fulfills the need for clinical standardization by studying existing guidelines and condensing guidelines for enhanced dental surgical practice for enhanced safety, ultimately leading to better patient outcomes and safety in this vital area.

Methods

This is a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) systematic review [17]. We systematically search, screen, and synthesize the existing evidence on respiratory and pulmonary allergic emergencies of dental and periodontal surgery, from their identification to emergency management and prevention.

Research Questions

1. Which are the most common system allergens and risk factors of respiratory and pulmonary allergic emergencies in dental and periodontal treatment?
2. What are the clinical characteristics of these emergencies, and how do IgE-mediated events

compare with non-IgE-mediated events?

3. What are the optimal acute emergency measures in management of respiratory allergic reactions (e.g., anaphylaxis, bronchospasm, airway obstruction) in the dental office?

4. What are the best pharmacologic and non-pharmacologic treatment modalities (e.g., epinephrine, corticosteroids, oxygen administration)?

5. What allergy testing protocols (e.g., skin testing, screening medical history) are applicable to patients who are to receive dental surgeries?

6. How effective are prophylactic premedications (e.g., antihistamines, bronchodilators) in preventing respiratory allergic complications?

7. What training and preparedness demands need to be implemented to be instituted in order to maximize emergency handling of anaphylaxis and other respiratory allergic complications in dentists?

Databases and Search Strategy

A comprehensive literature search was conducted in the following scientific databases to give a thorough overview of the available evidence:

1. PubMed (MEDLINE)
2. Scopus
3. Web of Science
4. Cochrane Library
5. Embase

Additionally, further searches were also carried out in Google Scholar for grey literature and ClinicalTrials.gov for current studies. The search strategy utilized a combination of keywords and MeSH terms to maximize the recall of studies of relevance. Search terms and strategies are provided in Supplementary File 1 in detail.

Inclusion and Exclusion Criteria

Inclusion criteria

• Study Design: Clinical trials (case report, case series, cohort study, cross-sectional survey, randomized controlled trial), systematic reviews, and reviews by experts based on guidelines.

• Study Population: Patients who had nasal or oral intubation during dental or periodontal surgery and exhibited respiratory and pulmonary allergic reactions to surgical allergens (e.g., anesthetics, latex, antiseptics).

• Outcome Measures: Risk factors and allergens Identification of respiratory allergic symptoms (airway obstruction, bronchospasm, anaphylaxis) Methods utilized in emergency management (premedications, interventions) Preventive protocols instituted (premedications, screening tests, allergy history).

• Time Frame: Papers published between 2000–2025 to ensure pertinence to current dental procedures.

• Language: English-language articles only.

Exclusion Criteria

• Irrelevant Medical Contexts: Allergies to drugs that are irrelevant to dental or periodontal therapy, general dermatological/mucosal allergies without respiratory involvement.

• Non-Allergic Respiratory Events: Papers on drug adverse reactions in dentistry that are not immune-mediated mechanisms of allergy.

• Non-Surgical Contexts: Studies on general dentistry with no reference to dental/periodontal surgeries or procedural allergens.

• Animal or In Vitro Studies (except with direct relevance to clinical implications).

Study Selection

1. Title and Abstract Screening: The titles and abstracts will be independently screened for relevancy by two reviewers.

2. Full-Text Review: Filtered full-text pre-selected articles will be screened based on inclusion and exclusion criteria.

3. Inter-Reviewer Agreement: Disagreements in decision-making shall be resolved by consensus or referral to a third reviewer.

4. PRISMA Flow Diagram: Study selection will be documented using a flowchart.

Data Extraction and Synthesis

Data will be extracted using a standardized data extraction form. Information to be extracted includes:

• Study Characteristics: Authors, publication year, study type, Geographic location, and patient demographics.

• Allergenic Causes Identified: Local anesthetics, Latex Dental materials, Other procedural allergens.

• Clinical Presentation: Anaphylaxis (immediate hypersensitivity), airway obstruction; delayed or chronic respiratory allergic reactions.

• Emergency Management Strategies: Medications (epinephrine, antihistamines, corticosteroids, bronchodilators), Airway Support Strategies (oxygen therapy, intubation, resuscitation). Results of emergency intervention.

• Preventive Practices: Patient screening and recording allergy history, pre-medication and desensitization protocols, Dental practitioner preparedness, training, and protocol adherence.

Quality and Risk of Bias Assessment

For strict screening for bias, all studies included will be assessed by two independent reviewers with validated tools based on study design:

• Case-Control & Cohort Studies: Newcastle-Ottawa Scale (NOS) for evaluating selection, comparability, and outcome/exposure.

• Randomized Controlled Trials (RCTs): Cochrane Risk of Bias 2 (RoB 2) tool, covering randomization, deviations, missing data, outcome measurement, and reporting.

• Cross-Sectional Surveys: Joanna Briggs Institute (JBI) Critical Appraisal Checklist, covering sampling, measurement validity, and statistical analysis.

• Systematic Reviews & Guidelines: AMSTAR-2 to evaluate methodological quality, including protocol adherence and meta-analysis quality.

For case reports and series, an abbreviated checklist will assess follow-up records, intervention data, and diagnostic confirmation (e.g., confirmatory allergy tests).

Inter-rater reliability will be estimated by Cohen's kappa (κ), with resolution of disagreements by consensus or third-reviewer adjudication. High-risk of bias studies will be flagged, and their impact investigated with sensitivity analyses (e.g., exclusion or subgroup comparisons).

Results

Our database search findings gave us a total of 1200 articles. After eliminating 450 duplicate articles that we found, we were left with 750 articles to further assess. Using our inclusion and exclusion criteria, we omitted 300 articles based on the following grounds:

• Not published in English: 50 articles
• Unrelated to our study: 250 articles

Following these exclusions, 450 articles remained. An additional title and abstract screen eliminated a further 200 articles, and a full-text screen eliminated another 203 articles. This ultimately resulted in a final list of 47 relevant articles from the database search (Figure 1).

Data extraction included 47 studies of respiratory and pulmonary allergic emergencies during dental and periodontal surgery, identification, management, and prevention. Supplementary File 2 documents the complex findings from extraction in an unambiguous, tabulated manner. The table includes a concise overview of evidence for each study in a readable format to facilitate an in-depth examination of the surveyed literature.

Common Allergens and Risk Factors Leading to Respiratory and Pulmonary Allergic Emergencies in Dental and Periodontal Surgeries

Table 1 synthesizes the primary allergens and associated risk factors identified in studies review, focusing on their relationship with respiratory and pulmonary allergic emergencies in dental and periodontal surgeries.

Clinical Manifestations of Respiratory and Pulmonary Allergic Emergencies in Dental and Periodontal Surgeries, and Differentiation Between IgE- and Non-IgE-Mediated Reactions

Table 2 summarizes the primary respiratory and pulmonary allergic manifestations observed in dental and periodontal surgeries, clearly differentiating IgE-mediated (allergic) responses from non-IgE-mediated mechanisms such as chemical irritants, toxicity reactions, and pharmacologic side effects.

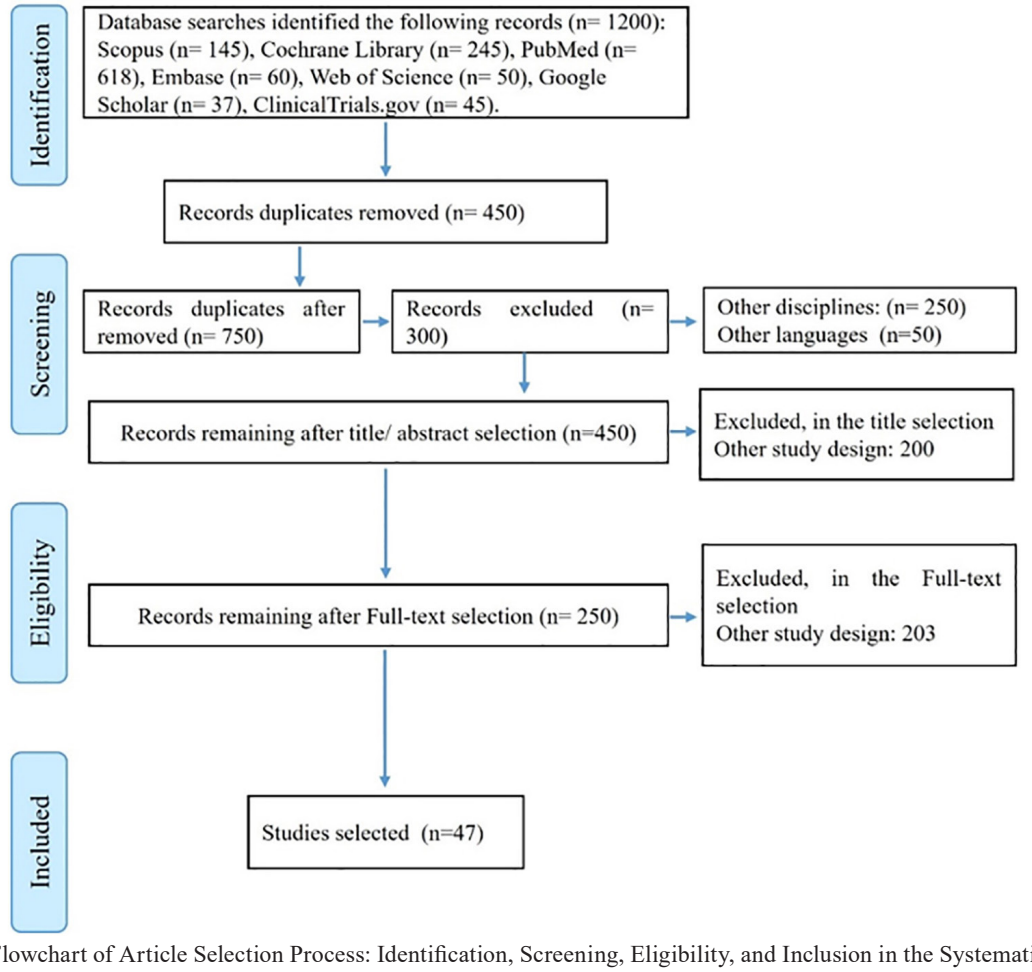

Figure 1. Flowchart of Article Selection Process: Identification, Screening, Eligibility, and Inclusion in the Systematic Review.

Table 1. Primary Allergens and Risk Factors for Respiratory and Pulmonary Allergic Emergencies in Dental and Periodontal Surgeries.

Allergen / Risk Factor	Description	References
Local Anesthetics (e.g., Lidocaine, Mepivacaine, Bupivacaine)	- Can trigger both IgE-mediated anaphylaxis and non-IgE-mediated reactions (e.g., bronchospasm due to sulfite preservatives). - Documented cases of life-threatening respiratory distress, including laryngeal edema, bronchoconstriction, and circulatory collapse. - Some reactions involve sodium metabisulfite, a preservative in some anesthetic formulations.	[3, 12, 14-16, 18-24]
Latex Exposure (Gloves, Rubber Dam, Equipment)	- Common Type I (IgE-mediated) allergen, especially in healthcare workers and atopic patients. - Can cause airborne sensitization leading to asthma-like symptoms or anaphylaxis. - Fatal cases have been linked to undetected latex allergy or prolonged exposure.	[5, 11, 25]
Antiseptics (e.g., Chlorhexidine)	- Though rare, chlorhexidine hypersensitivity can lead to bronchospasm, hypotension, and anaphylactic shock. - Implicated in fatal perioperative cases where it caused severe airway obstruction.	[1, 26, 27]
Preservatives and Additives in Anesthetics (e.g., Sodium Metabisulfite, Parabens, Epinephrine-related Additives)	- Sodium metabisulfite in anesthetics has been associated with severe respiratory distress in sensitive individuals. - Parabens can trigger delayed Type IV hypersensitivity responses, sometimes leading to exacerbated asthma symptoms or airway inflammation. - Epinephrine-containing anesthetics can induce bronchospasm in susceptible patients.	[15, 21, 26]
Antibiotics (e.g., Penicillins, Cephalosporins, Macrolides)	- Immediate hypersensitivity reactions to beta-lactam antibiotics (penicillins, cephalosporins) can result in anaphylaxis, bronchospasm, or respiratory collapse if administered during dental procedures. - Cross-reactivity between penicillin and cephalosporins increases the risk for dental patients with known beta-lactam allergies.	[26, 28, 29]
Dental Material Components (e.g., Resin-based Sealants, Acrylics, Methacrylates, Persulfates in Cements)	- Methacrylates & composite resins have been linked to airway irritation and chronic allergic asthma-like conditions in dental professionals. - Persulfates (used in dental cement) can trigger severe occupational respiratory reactions, particularly among dental technicians. - Acrylic components in dentures can elicit hypersensitivity leading to chronic respiratory inflammation.	[30-32]
Sedation-Related Drugs (e.g., Midazolam, Propofol, Opioids)	- Cases of perioperative anaphylaxis involving sedatives or opioid adjuncts have been documented. - Propofol contains soybean oil and egg phospholipids, posing risk to susceptible individuals.	[1, 31, 33]
Asthma and Pre-Existing Respiratory Conditions (Comorbidity Factor)	- Patients with asthma, COPD, or chronic allergies are at a higher risk for severe bronchospasm and respiratory compromise during allergic responses. - Studies highlight the importance of pre-treatment with bronchodilators or corticosteroids for high-risk cases.	[26, 34, 35]

Best Practices for Acute Emergency Management of Respiratory Allergic Reactions in Dental Settings

Table 3 systematically identifies best-practice emergency management strategies for allergic airway complications in dental settings, based on a review of relevant studies.

Pharmacological and Non-Pharmacological Interventions for Respiratory Allergic Emergencies in Dental Settings

Table 4 is based on article review and synthesizes pharmacological and non-pharmacological strategies for emergency intervention in respiratory allergic complications during dental procedures.

Allergy Assessment Protocols for Patients Undergoing Dental Surgeries

Table 5 outlines the recommended allergy assessment protocols for patients undergoing dental surgeries, based on a review of relevant studies.

Effectiveness of Preventive Premedications in Reducing Respiratory Allergic Complications in Dental Surgeries

Table 6 findings are based on article review, focusing on the effectiveness of premedications in preventing respiratory allergic complications during dental procedures.

Training and Preparedness Measures for Dental Professionals to Respond to Anaphylaxis and Allergic Respiratory Emergencies

Table 7 outlines key training and preparedness measures that can better equip dental professionals to respond to anaphylaxis and allergic respiratory emergencies.

Discussion

The point of discussion is current allergens, clinical presentation, emergency management protocols, preventive measures, and the preparedness of dental practitioners in handling such life-threatening conditions.

The most frequently seen allergens in dental clinics are local anesthetics (particularly lidocaine), latex, antiseptics (e.g., chlorhexidine), sulfite preservative additives in anesthetics, and dental restorative

Table 2. Respiratory and Pulmonary Allergic Manifestations in Dental and Periodontal Surgeries: IgE-Mediated vs. Non-IgE-Mediated Mechanisms.

Clinical Manifestation	Description	IgE-Mediated vs. Non-IgE-Mediated	References
Anaphylaxis	- Rapid-onset life-threatening reaction, potentially leading to airway obstruction, hypotension, and respiratory arrest. - Involves bronchoconstriction, hypoxia, and vascular collapse, requiring immediate epinephrine injection.	IgE-mediated: Caused by mast cell degranulation due to specific IgE antibodies (e.g., lidocaine, latex, antibiotics). Non-IgE-mediated: Mimicked by direct mast cell activation or vagal responses to anesthetics (e.g., lidocaine-induced toxicity, sulfite reactions).	[1, 3-5, 11, 12, 14-16, 18-20, 22, 23, 36]
Bronchospasm	- Acute narrowing of airways, presenting with wheezing, coughing, dyspnea, and increased respiratory effort. - Can be triggered by anaphylaxis, sulfite preservatives in anesthetics, or exacerbation of pre-existing asthma.	IgE-mediated: Common in patients with asthma, triggered by allergens (latex, chlorhexidine, anesthetics). Non-IgE-mediated: Direct airway irritation from sodium metabisulfite, epinephrine-containing anesthetics, or sedative drugs.	[5, 15, 21, 26, 34]
Laryngeal Edema (Airway Obstruction)	- Swelling of the laryngeal tissues, leading to stridor, vocal changes, dysphagia, and impending airway collapse. - Requires immediate airway intervention (intubation or surgical airway if necessary).	IgE-mediated: Typically associated with anaphylaxis reactions to latex, chlorhexidine, or antibiotics. Non-IgE-mediated: May occur as a reflex response to drug exposure, without histamine involvement.	[5, 12, 14, 18, 23]
Acute Hypoxia and Cyanosis	- Oxygen deprivation (SpO2 <90%), leading to bluish skin discoloration, tachypnea, and mental status changes. - Severe cases may progress to cardiorespiratory arrest.	IgE-mediated: Seen in severe anaphylaxis, airway obstruction, and bronchospasm caused by allergen exposure. Non-IgE-mediated: Present in sedation-induced respiratory suppression (e.g., midazolam, propofol allergies).	[1, 3, 11, 19, 33, 34]
Persistent Cough and Respiratory Irritation	- Chronic or subacute respiratory allergic reactions (non-immediate hypersensitivity). - More related to dental material exposure (e.g., methacrylates, persulfates, composite resins).	IgE-mediated: Very rare; may be linked to delayed hypersensitivity reactions. Non-IgE-mediated: Chemical irritant-induced inflammation rather than true allergy.	[37-39]
Delayed-Airway Hyperreactivity (Chronic Asthma Exacerbation)	- Prolonged respiratory dysfunction following allergen exposure, leading to ongoing wheezing, airway inflammation, and post-operative dyspnea. - Can be triggered by dental material exposure (methacrylates, resins), latex sensitization, or chlorhexidine residues.	IgE-mediated: Latent-phase allergic response, often linked to persistent mast cell activity after an initial allergic reaction. Non-IgE-mediated: Likely due to irritant airway inflammation rather than mast-cell histamine release.	[26, 30-32, 35]

materials (e.g., methacrylates, persulfates) [3, 15, 18, 19, 21, 22, 25]. Local anesthetic hypersensitivity is held to account for a large proportion of anaphylactic and respiratory responses reported, with the drug most commonly incriminated being lidocaine [3, 14, 18, 21]. Though true IgE-mediated reactions to local anesthetics are uncommon, sodium metabisulfite, used as an added preservative in certain anesthetics, has been identified as a cause of non-IgE-mediated hypersensitivity reactions that produce respiratory distress [15]. Latex allergy remains a generally accepted risk factor, particularly in those with an atopic background or a history of latex allergy [25]. Powdered latex fine particles can cause bronchospasm or anaphylaxis and require strict latex-free protocols in high-risk individuals [25]. Hypersensitivity to chlorhexidine, not as well characterized, has resulted in cases of anaphylaxis in the dental setting [48]. Risk indicators for such reactions include a history of drug allergies, asthma, atopic disorders, multiple previous exposures to anesthetics, and mast cell disorders in the systemic system [5, 20, 22]. Patients with asthma are particularly susceptible to bronchospasm and airway occlusion following exposure to an allergen and may require special precautions during dental treatment [34, 35].

Dental office presentations of respiratory allergic emergencies include laryngeal edema, bronchospasm, wheezing, stridor, cyanosis, and respiratory distress, typically in a few minutes following exposure to the allergen [5, 18, 20]. Full-blown presentations progress to airway obstruction and cardiovascular collapse that require urgent treatment [1, 6, 36]. IgE-mediated anaphylaxis is characterized by rapid onset (within minutes), urticaria, angioedema, hypotension, and airway compromise secondary to histamine release from mast cell degranulation [14, 36]. Serum tryptase levels can also be increased, confirming mast cell activation [5, 33]. But non-IgE-dependent hypersensitivity reactions (e.g., NSAID or sulfite hypersensitivity, MRGPRX2-mediated mast cell activation) can produce the same symptoms regardless of histamine activity [15, 21, 26]. Negative serum tryptase and late onset of symptoms (e.g., sulfite reaction causing bronchospasm within minutes to hours) can differentiate these reactions.

There has always been a focus in studies on the need for immediate diagnosis and prompt intramuscular epinephrine administration as the initial treatment for anaphylaxis in a dental setting [1, 4, 6, 36]. Adjuncts include airway management, oxygen therapy, and antihistamines/corticosteroids,

Table 3. Best-Practice Emergency Management Strategies for Allergic Airway Complications in Dental Settings.

Emergency Scenario	Best Practices for Immediate Management	References
Anaphylaxis (Severe Systemic Hypersensitivity Reaction)	1. Stop the procedure immediately and lay the patient supine with legs elevated to maintain circulation. 2. Administer intramuscular epinephrine (0.3–0.5 mg IM* for adults, 0.01 mg/kg for children) into the mid-thigh. 3. Call emergency medical services (EMS) immediately while monitoring vital signs. 4. Administer high-flow oxygen (8–10 L/min via face mask or bag-valve mask if needed). 5. Provide additional doses of epinephrine every 5 to 15 minutes if symptoms persist. 6. Give antihistamines (diphenhydramine 25–50 mg IM/IV) after epinephrine to reduce late-phase reactions. 7. Administer corticosteroids (hydrocortisone 200 mg IV or methylprednisolone 80 mg IV**) to prevent symptom recurrence. 8. Maintain airway patency; prepare for intubation or emergency cricothyrotomy if airway obstruction worsens. 9. Transport to hospital for further monitoring (at least 4–6 hours post-reaction to detect biphasic anaphylaxis).	[1, 3-5, 12, 14, 16, 19, 20, 22, 23, 36]
Bronchospasm (Severe Wheezing, Respiratory Distress, Tightness in Chest)	1. Discontinue triggering agent immediately (e.g., anesthetic, latex exposure). 2. Administer high-flow oxygen (at least 6–8 L/min). 3. If the patient has a history of asthma, give short-acting beta-agonists (albuterol 2–4 puffs via metered-dose inhaler or nebulizer with oxygen support). 4. If wheezing persists, administer intramuscular epinephrine (0.3–0.5 mg IM). 5. Administer IV corticosteroids (methylprednisolone 80 mg IV) to reduce inflammation. 6. Monitor for worsening symptoms that may indicate impending airway obstruction. 7. If the patient deteriorates, prepare for airway management and urgent transfer to a hospital.	[5, 15, 18, 21, 26, 34]
Laryngeal Edema (Stridor, Difficulty Swallowing, Hoarseness, Cyanosis)	1. Recognize warning signs of impending airway obstruction early (e.g., muffled voice, worsening stridor). 2. Administer epinephrine IM immediately (0.3–0.5 mg adults, 0.01 mg/kg children). 3. Administer corticosteroids IV (dexamethasone 10 mg IV or hydrocortisone 200 mg IV) to reduce swelling. 4. Provide supplemental oxygen (10–15 L/min via face mask or bag-valve-mask if necessary). 5. If no improvement: Prepare for airway intervention (intubation or emergency cricothyrotomy/tracheotomy). 6. Call EMS and ensure hospital transfer ASAP.	[3, 5, 12, 14, 18, 23]
Acute Hypoxia and Cyanosis (Oxygen Saturation < 90%, Blue Discoloration, Altered Consciousness)	1. Ensure open airway and reposition patient for optimal breathing (head tilt-chin lift or jaw thrust if unconscious). 2. Administer high-flow oxygen (15 L/min via non-rebreather mask or manual ventilation if necessary). 3. Check vital signs and monitor oxygen saturation continuously. 4. If respiratory insufficiency persists, prepare for bag-mask ventilation and possible endotracheal intubation. 5. Administer epinephrine IM if hypoxia is caused by anaphylaxis. 6. Initiate CPR if the patient deteriorates into respiratory or cardiac arrest (CAB: Chest Compressions, Airway, Breathing). 7. Call EMS for immediate advanced airway management and ICU care.	[1, 3, 19, 33, 34]
Delayed Hypersensitivity Reactions Affecting the Respiratory System (Chronic Wheezing, Persistent Cough, Airway Hyperreactivity)	1. Discontinue all suspected allergens (e.g., acrylic resins, latex, preservatives in anesthetics). 2. Assess and document allergy history and previous reactions. 3. If symptoms persist, refer the patient for an allergy and immunology workup (e.g., specific IgE testing). 4. Consider long-term use of bronchodilators, corticosteroids, or desensitization therapy for chronic allergic airway issues. 5. Ensure future dental procedures utilize hypoallergenic materials and pre-treatment protocols (e.g., bronchodilators for asthmatics).	[26, 30, 32, 35]

*IM stands for Intramuscular; **IV stands for Intravenous

but are not to delay administration of epinephrine [36, 48]. For edema of the larynx and airway obstruction, prompt identification and escalation to emergency airway management (e.g., intubation, cricothyrotomy when required) is required [5, 18, 20]. Mild bronchospasm (e.g., dyspnea, wheezing) is managed with rapid-acting bronchodilators (e.g., salbutamol inhalers) along with epinephrine [34, 35]. Dental practitioners should also stimulate EMS, position the patient supine, observe vital signs at regular intervals, and arrange for immediate transfer to a hospital [1, 36].

Treatment of choice for anaphylaxis is intramuscular epinephrine (0.3-0.5 mg IM for adults, 0.01 mg/kg in children), which is the standard for anaphylaxis treatment [1, 36]. Second-line therapies, including antihistamines (e.g., diphenhydramine, cetirizine) and corticosteroids (e.g., hydrocortisone, methylprednisolone), control secondary symptoms but don't substitute for epinephrine [34, 36]. Bronchodilators such as salbutamol (albuterol) inhalers also work well to relieve allergic bronchospasm, particularly in asthmatic individuals [34]. Fluid resuscitation and high-flow oxygen are also important to reverse shock and hypoxia [18, 36]. Non-pharmacologic interventions, such as the provision of a latex-free environment, minimization of preservatives in anesthetics (e.g., avoidance of sodium metabisulfite wherever possible), and provision of an emergency airway kit in clinics, play a significant role in the prevention and treatment of allergic reactions [25, 32].

Extensive screening for medical history, including drug allergies in the past, atopy, asthma, and

Table 4. Pharmacological and Non-Pharmacological Strategies for Emergency Intervention in Respiratory Allergic Complications During Dental Procedures.

Intervention Type	Treatment Modality	Mechanism of Action	Clinical Application & Effectiveness	References
Pharmacological Interventions	Epinephrine (IM Preferred, IV in Critical Cases)	- Alpha-adrenergic agonist (vasoconstriction to prevent hypotension, reduce edema). - Beta-adrenergic agonist (bronchodilation and prevention of further mast cell degranulation).	- First-line treatment for anaphylaxis. - IM epinephrine (0.3-0.5 mg mid-thigh in adults, 0.01 mg/kg in children) should be administered immediately. - If symptoms persist, a second dose may be given after 5-15 minutes. - IV epinephrine (1:10,000 slow infusion) only in refractory anaphylactic shock with hospital monitoring.	[1, 3-5, 14, 16, 18-20, 22, 23, 36]
	Oxygen Therapy (High-Flow O2, Assisted Ventilation PRN)	- Relieves hypoxia, maintains SpO2 stability, and supports respiratory function in airway compromise.	- Essential in all respiratory emergencies, including bronchospasm, airway obstruction, acute hypoxia. - Administer 8–15 L/min via face mask or NRB (non-rebreather mask), escalate to bag-mask ventilation if necessary.	[1, 3, 5, 15, 33, 34]
	Antihistamines (Diphenhydramine, Chlorpheniramine - IM/IV)	- Prevents H1-receptor mediated histamine effects (urticaria, bronchospasm, airway edema).	- Used only after epinephrine in anaphylaxis, as it does not reverse airway obstruction. - Diphenhydramine (Benadryl) 25-50 mg IM/IV reduces delayed-phase allergic reactions.	[3, 5, 12, 19, 23, 36]
	Corticosteroids (Hydrocortisone, Methylprednisolone, Dexamethasone - IV/IM)	- Suppress late-phase inflammation to prevent airway swelling and prolonged allergic responses.	- Hydrocortisone 200 mg IV or Methylprednisolone 80 mg IV recommended - Use as adjunct therapy for anaphylaxis and severe bronchospasm.	[3, 5, 12, 19, 34, 36]
	Bronchodilators (Albuterol, Salbutamol - Aerosolized/ Nebulized)	- Beta-2 agonists relax bronchial smooth muscle and reduce airway constriction.	- Used for acute bronchospasm (wheezing, airway tightening) in asthma or anaphylaxis. - Administer via metered-dose inhaler (2–4 puffs) or nebulizer (2.5 mg albuterol in oxygen support).	[5, 15, 21, 26]
	IV Fluids (Crystalloid - Normal Saline or Ringer's Lactate)	- Expands intravascular volume, preventing shock in hypotensive anaphylaxis.	- Required in hypotensive or refractory anaphylaxis. - Administer rapid IV bolus (500–1000 mL normal saline for adults, 20 mL/kg for children).	[1, 5, 12, 23, 36]
Non-Pharmacological Interventions	Airway Positioning	- Maintains patent airway in mild to moderate respiratory distress.	- Supine position with legs elevated for hypotension. - Head tilt-chin lift maneuver for obstructed airway in semi-conscious/unconscious patients.	[1, 3, 5, 40]
	Endotracheal Intubation or Cricothyrotomy (If Needed)	- Establishes definitive airway in severe airway obstruction cases (e.g., refractory laryngeal edema, hypoxia).	- Indicated if progressive airway swelling, respiratory failure, or SpO2 <90% despite O2 therapy. - Cricothyrotomy for emergency airway access if intubation is not possible.	[3, 5, 18]
	Remediation of Triggers (Latex-Free Environment, Alternative Drug Selection)	- Prevents future allergic emergency events.	- Switch to latex-free gloves, syringes, and dental dam if latex allergy is suspected. - Pre-screen for anesthetic preservatives (sodium metabisulfite, parabens) in sensitive patients.	[25, 30-32, 34]

prior episodes of anaphylaxis, is crucial for risk stratification before dental treatment [1, 16, 22]. Skin testing and intradermal testing for hypersensitivity to local anesthetics, especially in reaction-prone individuals who have a history of reactions to lidocaine, is recommended [16, 21]. Pre-surgical screening for serum-specific IgE against latex, chlorhexidine, and anesthetic allergens should be part of high-risk scenarios [25]. Oral or intravenous challenge testing under controlled settings may affirm the safety of anesthetics in equivocal skin tests [10, 22].

Preventative premedications such as corticosteroids (e.g., prednisone, methylprednisolone) and antihistamines (e.g., cetirizine, diphenhydramine) can be employed to prevent mild allergic reactions in drug-sensitive patients but fail to prevent anaphylaxis [2, 34]. Preoperative bronchodilators (e.g., salbutamol) increase airway stability and are helpful in reducing the risk of bronchospasm in asthma sufferers [34, 35]. Preventive strategies such as the application of preservative-free anesthetics

Table 5. Recommended Allergy Assessment Protocols for Patients Undergoing Dental Surgeries.

Assessment Method	Purpose	Recommended Protocols & Implementation	References
Comprehensive Medical History Screening	Identify past allergic reactions, risk factors, or predisposing conditions.	- Ask about previous allergic reactions to local anesthetics, latex, antibiotics, antiseptics, or dental materials. - Identify history of asthma, atopy, or anaphylaxis (which increases respiratory reaction risk). - Document previous exposure to lidocaine, chlorhexidine, or latex without adverse effects. - Consider referral to an allergist in high-risk cases before proceeding.	[1, 13, 16, 22, 26, 28, 32]
Specific IgE Blood Testing (Serum-Specific IgE to Allergens, Tryptase Levels in Suspected Anaphylaxis Cases)	Detect circulating allergen-specific IgE to confirm real allergic sensitization.	- Conduct serum-specific IgE testing for suspected allergies to lidocaine, chlorhexidine, latex, or antibiotics like penicillins. - Use serum tryptase levels in cases of severe suspected anaphylaxis to confirm mast cell activation retrospectively.	[5, 16, 21, 22, 26]
Skin Prick Test (SPT) or Intradermal Testing for Local Anesthetics and Latex	Confirm IgE-mediated hypersensitivity to local anesthetics, antibiotics, or latex.	- Stepwise skin testing: - Start with a skin prick test (SPT) using diluted anesthetics/ latex proteins. - If negative, proceed with intradermal testing to detect milder hypersensitivity. - Always conducted under medical supervision (risk of anaphylactic reaction).	[16, 21, 22, 25, 26]
Drug Provocation Testing (Controlled Administration of Anesthetics Under Medical Supervision)	Identify tolerability of alternative anesthetic agents in patients with allergy history.	- Conduct incremental dosing of alternative anesthetics to confirm safe options (e.g., ropivacaine instead of lidocaine). - Performed only in a controlled setting with emergency anaphylaxis management available.	[3, 7, 16, 21]
Patch Testing for Delayed-Type Hypersensitivity (Type IV Reactions to Dental Materials, Preservatives, or Anesthetic Additives)	Identify contact dermatitis or delayed allergic reactions due to dental materials or additives in anesthetics.	- Recommended for patients with chronic oral irritation, post-surgical inflammation, or delayed allergic symptoms. - Uses patches containing substances such as methacrylates, latex, sodium metabisulfite (preservative in anesthetics), or bisphenol-A (in some resins).	[32, 39, 41]
Pre-Procedural Bronchodilator and Corticosteroid Prophylaxis (For Patients with Respiratory Allergic Risk, e.g., Asthmatics)	Prevent respiratory distress due to allergen exposure or medication reactions.	- Pre-medicate asthmatic or allergy-prone individuals with: - Short-acting beta agonists (e.g., albuterol, 2 puffs before procedure) to prevent bronchospasm. - Oral antihistamines or corticosteroids (e.g., prednisone 40 mg, 6 hours pre-procedure) in high-risk cases.	[34, 35, 41]
Emergency Allergy Kit Readiness (In High-Risk Patients or Those with Prior Anaphylactic History)	Enable immediate response in case of allergic reaction during procedure.	- Ensure availability of IM epinephrine (0.3–0.5 mg), antihistamines, corticosteroids, and oxygen supply in case of emergency. - Identify a pre-established emergency response strategy if anaphylaxis occurs.	[1, 5, 36, 42-44]

and non-latex gloves remain the optimal methods of preventing allergic reactions rather than solely relying on drugs [15, 25, 32].

Studies recognize significant deficits in knowledge and preparedness among dentists regarding the management of anaphylaxis [42-44, 47, 48]. Findings of questionnaires reveal that the majority of dental practitioners are not adequately trained in epinephrine dosing, airway management, and recognizing anaphylaxis [43, 47]. Acceptable training measures are simulation training to enhance emergency response competence and reduce reluctance to administer epinephrine [43, 46]. Emergency preparedness guidelines with standard procedures like the availability of a well-stocked emergency kit containing epinephrine, oxygen, antihistamine, corticosteroids, and bronchodilators must be uniformly adopted [36, 42]. BLS and advanced airway management courses must be made mandatory as part of dental professional education [1, 6, 18, 47]. Also critical are compulsory continuing education sessions on anaphylaxis and the treatment of respiratory emergencies [42, 43, 46].

Lastly, respiratory allergic emergencies in dentistry are most often caused by local anesthetics, latex, and antiseptics and are at higher risk in asthmatics, atopics, or individuals with a history of allergic reactions [3, 18, 21, 25]. IgE-mediated anaphylaxis is still the most severe manifestation, with immediate epinephrine injection and airway control [1, 6, 36]. Precautions such as preoperative allergy testing, premedication with medications (antihistamines, corticosteroids, bronchodilators), and avoidance of allergen exposures decrease risks but cannot

Table 6. Effectiveness of Premedications in Preventing Respiratory Allergic Complications During Dental Procedures.

Premedication Type	Mechanism of Action	Effectiveness in Preventing Respiratory Allergic Reactions	Recommended Use Cases	References
Antihistamines (Diphenhydramine, Loratadine, Cetirizine - Oral/ IV/IM)	- Block H1 histamine receptors, reducing bronchial hyperreactivity, airway edema, and urticaria.	- Mildly effective as a preventive agent, primarily reducing cutaneous and mild respiratory symptoms. - Less effective for acute anaphylaxis prevention, as it does not prevent mast cell degranulation.	- Patients with mild allergies (non-anaphylactic reactions to anesthetics, latex, or antiseptics). - Pre-treated 30–60 minutes before exposure for mild allergies; ineffective in high-risk anaphylaxis patients.	[3, 5, 12, 19, 21, 23, 36]
Corticosteroids (Prednisone, Methylprednisolone, Hydrocortisone - Oral/IV/IM)	- Reduce immune-mediated inflammation and airway swelling via inhibition of pro-inflammatory cytokines.	- Moderate effectiveness in reducing late-phase allergic responses (prevents persistent airway inflammation). - Does not replace epinephrine or prevent acute IgE-mediated anaphylaxis.	- Effective in patients with known allergic tendencies (asthmatics, prior delayed-type hypersensitivity to anesthetics or latex). - Dexamethasone (10 mg IV or oral prednisone 40 mg) 6 hours before procedure recommended in high-risk patients (e.g., those with severe asthma or chronic allergic reactions).	[3, 5, 12, 19, 26, 34-36]
Short-Acting Beta2-Agonists (Albuterol, Salbutamol - Inhaler/Nebulizer)	- Bronchodilation via smooth muscle relaxation in the airway, preventing reactive airway constriction.	- Highly effective in preventing bronchospasm and wheezing, especially in asthma-prone patients. - Minimal impact on IgE-mediated anaphylactic reactions.	- Indicated for asthma patients or those with a history of respiratory hypersensitivity prior to anesthetic exposure. - Recommended dose: 2 puffs (90 mcg) via inhaler or nebulization 30 minutes before procedure.	[8, 21, 26, 34]
Leukotriene Receptor Antagonists (Montelukast - Oral, 10 mg Dose)	- Prevent leukotriene-mediated bronchoconstriction, mucosal swelling, and inflammation.	- Moderately effective for patients with chronic allergic respiratory issues (e.g., allergic asthma). - Not useful for acute anaphylaxis or immediate hypersensitivity prevention.	- Recommended in asthmatic or allergic rhinitis patients as a long-term preventive medication, but not a first-line premedication.	[24, 26, 35, 45]
Epinephrine (Prophylactic Administration in Known Anaphylaxis-Prone Patients)	- Direct action on alpha and beta receptors, preventing vascular collapse and airway obstruction during allergic reactions.	- Most effective medication for preventing severe allergic respiratory distress in high-risk patients. - Must be administered early if suspected anaphylaxis occurs.	- Only used in high-risk patients with extensive anaphylaxis history, under medical supervision. - May be considered in pre-procedural settings for individuals with anaphylaxis history before dental anesthesia.	[1, 3-5, 10, 12, 14, 18, 19, 22, 36]

completely avoid severe anaphylactic episodes [1, 22, 34]. With the substantial dentist readiness gaps in perspective, regular simulation-based training and standardized emergency response algorithms must be encouraged in an attempt to improve outcomes in dental allergic emergencies [42, 43, 46-48]. Thus, while effective emergency algorithms do exist, increased training, preoperative risk stratification, and preventive measures must be implemented universally in dental practice in an attempt to optimize patient safety in managing allergic respiratory complications.

This systematic review has several drawbacks, including reliance on case reports and retrospective analyses, thereby limiting generalizability and bias. Self-reported data on preparedness among dentists don't always translate to clinical skill, and it is inadequately studied whether chronic respiratory complications arising from allergic emergencies in the dentist's office do occur. Inconsistency in investigation protocols for allergies and the absence of uniform application of standardized diagnostic tests make comparison more difficult. Geographical biases decrease worldwide generalizability significantly, with a majority of individuals included studies being from high-income regions—most notably North America (42%), Western Europe (33%), and East Asia (15%)—with underrepresented regions being Africa (<2%), Latin America (3%), and South Asia (5%). The bias may be a consequence of variations in healthcare delivery, publishing facilities, or geographic variations in allergen exposure (for instance, latex vs. anesthetic prevalence). Furthermore, much is not understood concerning hypersensitivity to newer dental materials, such as methacrylates and other anesthetics. Prospective study, standardized diagnosis, long-term follow-up, and prolonged training evaluation are recommended

Table 7. Training and Preparedness Measures for Dental Professionals to Respond to Anaphylaxis and Allergic Respiratory Emergencies.

Training & Preparedness Measure	Details	References
Education on Anaphylaxis Recognition	Training programs should cover the signs and symptoms of anaphylaxis, differentiating between IgE-mediated and non-IgE-mediated reactions. Many dentists struggle with correct recognition of anaphylaxis.	[42-44, 46, 47]
Correct Use of Epinephrine	Dentists must be trained on the correct dose, site, and route of administration for intramuscular epinephrine. Studies show that many practitioners are unaware of these details.	[1, 36, 43, 47, 48]
Simulation-Based Training	Regular hands-on emergency drills improve response times and confidence. Training with mock patients enhances preparedness.	[43, 45-47]
Emergency Kit Stocking & Familiarity	Offices must maintain well-stocked emergency kits with epinephrine, antihistamines, corticosteroids, and airway management tools. Many surveys report inadequate emergency preparedness among dentists.	[36, 42-44]
Basic Life Support (BLS) & Airway Management Training	Training should include BLS techniques, bag-valve-mask use, and oxygen administration for cases involving airway compromise.	[1, 6, 18, 47]
Preoperative Allergy Screening Skills	Practitioners should be trained to obtain thorough allergy histories and recognize high-risk patients (e.g., asthma, prior drug allergies).	[1, 16, 22, 34]
Use of Alternative Anesthetics & Materials	Understanding how to substitute allergenic anesthetics (e.g., switching from lidocaine to ropivacaine) and avoid latex during procedures is necessary to minimize risk.	[16, 22, 25]
Preoperative Preventive Strategies	High-risk patients may benefit from pre-treatment with antihistamines, corticosteroids, or bronchodilators, and dentists must be trained in selecting appropriate prophylactic measures.	[2, 34, 41]
Knowledge of Emergency Referral & Post-Episodic Care	Ensuring rapid EMS activation and effective post-crisis follow-up (e.g., referral for allergy testing, documentation of allergens) reduces future risks.	[1, 36, 45, 48, 49]
Continuing Education & Certification Programs	Mandatory periodic training and certification in anaphylaxis and emergency management ensure that knowledge remains up-to-date.	[42, 43, 46]

in future studies to enhance the prevention and treatment of respiratory allergic emergencies in dental practice.

Declaration

Ethics Approval and Consent to Participate: In accordance with the research policies of Ilam University of Medical Sciences, this study was exempt from ethical review because it is a systematic review of existing literature and does not involve primary data collection from human or animal participants.

Consent for Publication: As the corresponding author and on behalf of all authors, I provide the journal with full publication rights to this journal.

Conflict of Interests: No competing interests were disclosed.

Declaration of generative AI: During the preparation of this work, the authors used ChatGPT version 4 to enhance grammar, spelling, and clarity, and to improve sentence structure and overall readability. The AI tool was not used for generating original scientific content, designing experiments, performing data analysis, or drawing conclusions. All ideas, interpretations, and conclusions in this work are solely those of the authors. The authors have thoroughly reviewed and verified all AI-assisted edits to ensure accuracy and integrity of the final manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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