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EAACI

POSITION PAPER

Paediatric rhinitis: position paper of the European Academy of Allergy and Clinical Immunology

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Abstract

Rhinitis is a common problem in childhood and adolescence and impacts negatively on physical, social and psychological well-being. This position paper, prepared by the European Academy of Allergy and Clinical Immunology Taskforce on Rhinitis in Children, aims to provide evidence-based recommendations for the diagnosis and therapy of paediatric rhinitis. Rhinitis is characterized by at least two nasal symptoms: rhinorrhoea, blockage, sneezing or itching. It is classified as allergic rhinitis, infectious rhinitis and nonallergic, noninfectious rhinitis. Similar symptoms may occur with other conditions such as adenoidal hypertrophy, septal deviation and nasal polyps. Examination by anterior rhinoscopy and allergy tests may help to substantiate a diagnosis of allergic rhinitis. Avoidance of relevant allergens may be helpful for allergic rhinitis (AR). Oral and intranasal antihistamines and nasal corticosteroids are both appropriate for first-line AR treatment although the latter are more effective. Once-daily forms of corticosteroids are preferred given their improved safety profile. Potentially useful add-on therapies for AR include oral leukotriene receptor antagonists, short bursts of a nasal decongestant, saline douches and nasal anticholinergics. Allergen-specific immunotherapy is helpful in IgE-mediated AR and may prevent the progression of allergic disease. There are still a number of areas that need to be clarified in the management of rhinitis in children and adolescents.

Abbreviations
AR, allergic rhinitis; ARIA, Allergic Rhinitis and its Impact on Asthma; CSF, cerebrospinal fluid; EAACI, European Academy of Allergy and Clinical Immunology; IgE, immunoglobulin E; ISAAC, International Study of Asthma and Allergies in Childhood; NSAID, nonsteroidal, anti-inflammatory drug; PFS, pollen–food syndrome; SCIT, subcutaneous injection immunotherapy; SIT, specific immunotherapy; SLIT, sublingual immunotherapy; SPT, skin prick test.

Rhinitis is a common problem in childhood and adolescence (1, 2). The burden associated with rhinitis is often ignored as it is frequently seen as just a common cold or just as trivial as a cold. In reality, patients experience disruptive sneezing, itching, watery rhinorrhoea and nasal blockage. Other children and adolescents may present atypically with cough or snoring. Rhinitis impacts negatively on physical, social and psychological well-being (3, 4). The direct effect of symp-

Figure 1 Paediatric rhinitis taskforce logo.

toms, indirect effect of sleep disturbance with consequent daily fatigue and the use of antihistamines (5) all result in impaired school performance (6). The impact extends to the rest of the family (7).

This position paper has been prepared by the European Academy of Allergy and Clinical Immunology (EAACI) Taskforce on Rhinitis in Children (Fig. 1). The taskforce was initiated as at present, there are no guidelines that specifically focus on paediatric rhinitis despite the huge burden of rhinitis in childhood and adolescence as well as the differences from adult rhinitis. The paper uses the terms children and childhood to cover patients up to 18 years of age unless specific age groups are mentioned. The position paper aims to provide evidence-based recommendations for diagnosis and therapy. The breadth of rhinitis is encompassed although, for brevity, the therapy section focuses on allergic rhinitis. A systematic extensive literature search was undertaken using MEDLINE and EMBASE (search terms: rhinitis, prevalence, diagnosis and differential diagnosis, comorbidity, education, pathophysiology, presentation, quality of life and treatment; restricted to children) and Cochrane Library in September 2010 for the previous 5 years. The literature search returned 4955 references that were reviewed to remove case reports and nonsystematic reviews to give 589 that were reviewed as part of the taskforce. Members were also free to add other papers from before 2005. An updated search was undertaken in June 2012, it returned another 2913 references of which 63 were reviewed in detail. Although a systematic review of the evidence was undertaken, only the highest available evidence for each issue is presented here. The recommendations in this document are labelled to indicate the grade of recommendation (8). The taskforce's recommendations have been reviewed by invited external experts, members of the EAACI ENT and Pediatric Sections and Executive Committee.

Definition and classification

Rhinitis is defined as an inflammation of the nasal epithelium and is characterized by at least two nasal symptoms: rhinorrhoea, blockage, sneezing or itching. There are a number of different clinical presentations of rhinitis which overlap. The commonest form is '*allergic rhinitis*' (AR) (Box 1) signifying symptoms caused by exposure to an allergen to which a patient is sensitized, in other words, allergen driven. Traditionally, this group would be classified as having AR on the basis of rhinitis symptoms in the presence of sensitization (9). Typical allergens include house dust mite, grass pollen, tree pollen, weed pollens, cat, dog and moulds (10). In adults, there is evidence to suggest that this form of rhinitis may exist despite a lack of apparent specific sensitization due to local immunoglobulin E (IgE) production in the nose, otherwise known as entopy (11). It is unclear whether or not this is also seen in children (12). Allergic rhinitis can be seasonal or perennial, according to the relevant allergen. The distinction between seasonal and perennial is not globally applicable, and therefore, it has been revised by the Allergic Rhinitis and its Impact on Asthma (ARIA) group (9). Based on duration of symptoms, ARIA subdivides AR into intermittent or persistent (9). Both approaches have their value, seasonal–perennial is useful for describing specific seasonal relationships with allergen exposure, whilst the ARIA approach is useful both for describing how the rhinitis manifests in terms of symptoms, its effects on quality of life and suggests the treatment approach. Allergic Rhinitis and its Impact on Asthma also usefully divides AR severity into mild, moderate and severe according to its impact on quality of life (13).

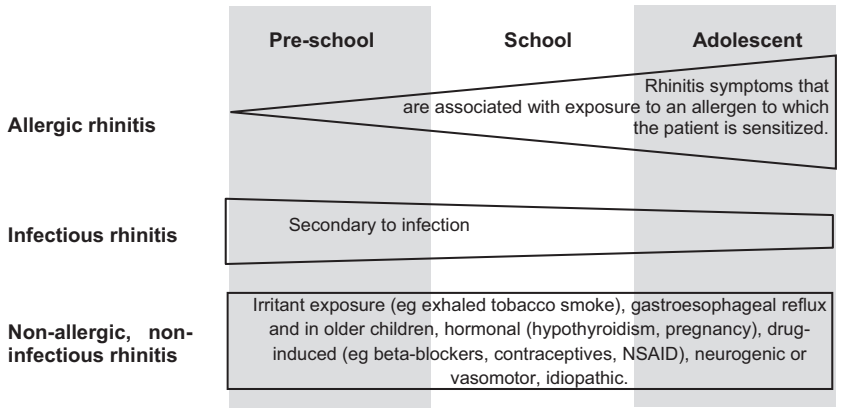
The second form of rhinitis is *infectious rhinitis*, usually secondary to a viral infection. There is some overlap between allergic and infectious rhinitis in that atopic children with or without allergic rhinitis can also present with an infectious rhinitis. Such atopic individuals may have an exaggerated response to viral upper respiratory tract infections; however, only indirect data support this (14).

Finally, there is a *nonallergic, noninfectious* group of other disorders that may present with rhinitis including those associated with exposure to irritants, hormonal dysfunction and specific medications (Box 1).

Prevalence and epidemiology

The International Study of Asthma and Allergies in Childhood (ISAAC) phase three studies (1999–2004) revealed an average prevalence of rhinitis of 8.5% (range 1.8–20.4%) in 6- to 7-year-old children and 14.6% (1.4–33.3%) for 13- to 14-year-old children (15). A worldwide increase in reported rhinitis prevalence was observed since the identical phase one studies (1991–8) but with large variations between centres (16). International Study of Asthma and Allergies in Childhood defines current rhinitis on the basis of a positive answer by parents to '*In the past 12 months, have you (has*

Box 1: Classification of rhinitis causation in children



Different pathophysiologies may co-exist, particularly allergic rhinitis and infectious rhinitis. See Box 4 for conditions that may mimic rhinitis.

your child) had a problem with sneezing or a runny or blocked nose, when you (he or she) DID NOT have a cold or "the flu"?'(17). This question assumes that the respondent can correctly identify a cold or 'flu', for example, some children may only have significant symptoms with a combination of both allergic inflammation and a coexisting viral infection. This is a particularly issue in the preschool age (18). Furthermore, ISAAC uses the presence of coexisting itchy eyes to identify allergic rhinitis although this is probably more relevant for pollen-induced rather than rhinitis driven by perennial allergens such as house dust mite. The ISAAC questions have not been well validated in a paediatric population (17).

There are a few studies looking at the natural history of rhinitis in childhood. The 1989 Isle of Wight birth cohort of 1456 children had prevalences of 2.8 and 11.8% at 4 and 18 years for rhinitis in nonsensitized individuals with figures of 3.4 and 27.3% for those who were sensitized (19). There was a male predominance of allergic rhinitis and female predominance of nonallergic rhinitis during adolescence. The MAS study followed up 467 children until 13 years and showed similar frequency of rhinitis (20). Allergic rhinitis, but not nonallergic rhinitis, in early childhood is a risk factor for developing asthma in later childhood (21) and adulthood (22).

Presentation and associated comorbidities

Classic symptoms and signs

Classic symptoms and signs of allergic rhinitis are intermittent or persistent nasal obstruction, rhinorrhoea (anterior or posterior), pruritus and sneezing (23). All these impact negatively on quality of life (24). Symptoms occur generally within minutes after allergen exposure and may last for hours after an isolated exposure. 'Allergic shiners' (darkened lower eyelid due to chronic congestion) are also often present, and their darkness correlates with disease chronicity and severity (25). AR can present less clearly, particularly in young children. Recommendations (D) for the recognition of rhinitis are presented in Box 2.

Infectious rhinitis can be acute, commonly precipitated by a viral infection, or chronic, caused more often by bacteria and occasionally fungi. Children can typically have up to 11 upper respiratory tract infection episodes per year in infancy, eight episodes at preschool age and four at school age (26), and 0.2–2% of these develop into clinically important bacterial sinus infection (27). A chronic mucopurulent discharge suggests a rhinosinusitis of infective origin (28) (C). This may be secondary to other pathologies, such as adenoidal hypertrophy, anatomical abnormalities, primary immunodeficiency, primary ciliary dyskinesia or cystic fibrosis (28).

Nonallergic, noninfectious rhinitis is typically a chronic presentation that does not fit into an allergic rhinitis or infectious rhinitis pattern of symptoms. This should prompt the search for other causes (Box 1).

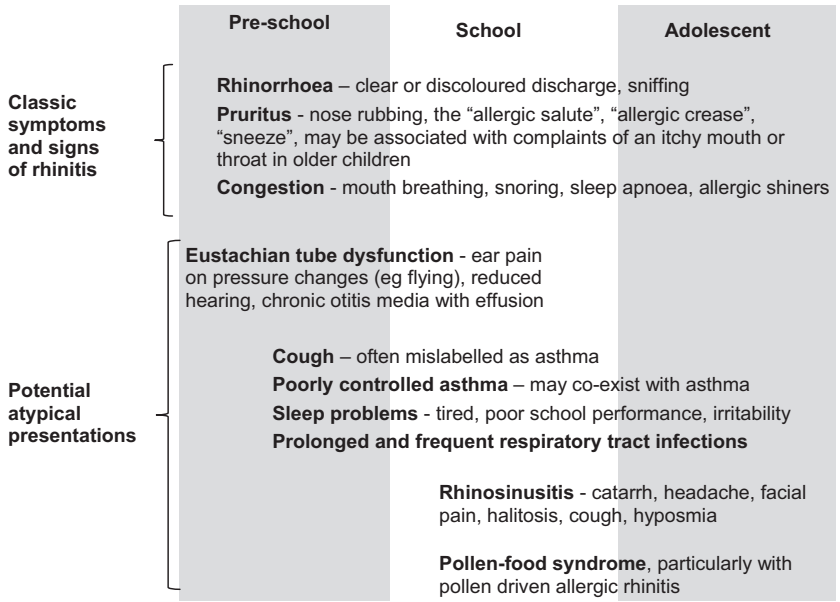
Presentations associated with rhinitis comorbidities

In childhood, the presentation of rhinitis can frequently relate to its associated comorbidities (Box 3). The nose is anatomically and functionally linked to the eyes, paranasal sinuses, nasopharynx, middle ear, larynx and lower airway, and so, presenting features may be conjunctivitis, chronic cough, mouth breathing, nasal speech and snoring with or without obstructive sleep apnoea.

Allergic conjunctivitis is reported as the commonest comorbidity associated with AR (16, 29). It is characterized by intense eye itching, conjunctival hyperaemia, watering eyes and occasional peri-orbital oedema.

Chronic allergic inflammation of the upper airways can cause lymphoid hypertrophy leading to prominence of the adenoidal and tonsillar tissue. In a case–control study of 600 children aged 4–9 years, more adenoidal hypertrophy was seen

Box 2: Recognizing rhinitis in childhood (D)



Box 3: Recognizing comorbidities of rhinitis in childhood (D)

Conjunctivitis
- Ask about a history of red, itchy, watery eyes, eye rubbing
- Eye examination looking for signs of conjunctivitis

Asthma
- Ask about any history of cough, wheeze, shortness of breath, exercise-induced bronchospasm
- Examine the chest – wheeze, hyperexpansion
- Assess peak expiratory flows, spirometry in older children preferably with reversibility testing with beta-2 agonists
- If in doubt, undertake an exercise, mannitol or methacholine challenge test

Impaired hearing
- Ask about any speech and language delay, increasing volume of TV, shouting, poor concentration, failing performance at school, frustration, irritability
- Examine the ears – pneumatic otoscopy if possible, Weber and Rinne tests
- Tympanoscopy for evaluation of tympanic membrane and middle ear
- Tympanometry
- Whisper test for screening of otitis media with effusion and hearing loss
- Audiometry in older children – pure tones, speech

Rhinosinusitis
- Ask about a history of nasal obstruction or discharge (purulent) with or without hyposmia, headache, facial pain or cough.
- Undertake nasendoscopy in older children
- CT scan/sinus X-rays not recommended unless there are complications or failed therapy, unilateral symptoms or severe disease unresponsive to medical therapy

Sleep problems
- Enquire about any history of disturbed sleep, snoring, apnoea, tiredness, irritability
- Assess nasal airway – spatula misting, nasal inspiratory peak flow, visual examination of nostrils and nasendoscopy in older children to view nasal airway and adenoids
- Consider sleep study

Pollen–food syndrome
- Ask about any oral pruritus with symptoms with (not cooked or frozen) foods such as apples
- Skin prick tests – seldom necessary to perform skin prick tests, and if so, it should be by prick-prick test with fresh foods and only with the incriminated fruit as nonclinically relevant positivity could be elicited.

in those with rhinitis, and it was suggested that this was driven by localized nasal inflammation (30). There is a significant increase in adenoidal size during the pollen season in children with pollen-driven rhinitis (31). In a case series of 93 children aged 2–10 years referred to a sleep laboratory for polysomnography, sleep apnoea–hypopnoea syndrome was strongly associated with the clinical history of nasal obstruction and AR (32). Chronic middle ear effusion and eustachian tube dysfunction, potentially causing hearing impairment, are associated with rhinitis (33–35). Local production of nonspecific and specific IgE against both environmental allergens and staphylococcal enterotoxin antigens may be involved in ongoing allergic inflammation observed in the adenoidal lymphatic tissue from atopic children (12, 36).

Other comorbidities

Asthma

Asthma frequently coexists with AR being seen in half to three quarter of children and teenagers with asthma in a range of studies (37–40). Asthma is similarly associated with nonallergic rhinitis as demonstrated by the COPSAC high-risk birth cohort (41). Allergic rhinitis is one of the risk factors for the development of asthma, and its signs and symptoms often precede those of asthma (22). In an international survey involving 8 countries in Europe and Asia, 76% of children had pre-existing symptoms of AR when asthma was first diagnosed (42). Allergic rhinitis also increases the risk of asthma hospitalization. In a cross-sectional study involving 126 asthmatic children and adolescents, the prevalence of AR was high and in combination with asthma severity constituted the major risk factor for emergency care attendance (43). Viral upper respiratory tract infection together with allergic sensitization and allergen exposure has been demonstrated to synergistically increase the risk of emergency care with asthma (44). The presence of a cough in association with rhinitis and postnasal drip may falsely suggest a diagnosis of asthma (45).

Eczema

Eczema and rhinitis frequently coexist in all age groups (46).

Pollen–food syndrome

Allergic rhinitis can be associated with pollen–food syndrome (PFS). Symptoms of oral pruritus and swelling occur due to cross-reactivity between aeroallergens, such as birch pollen, and fruits and vegetables such as apple (47). There are limited paediatric data focusing on this link although one study suggests that a quarter of 8 year olds with AR are affected (48).

Diagnosis

Clinical history, including type, duration and frequency of symptoms and exacerbating factors (see Box 1), is the cornerstone for diagnosing and characterizing rhinitis in children (49) (D). Specific findings such as unilateral symptoms, nasal obstruction without other symptoms, mucopurulent discharge, pain or recurrent epistaxis may suggest other diagnoses (see differential diagnosis section below). Examination of the nose is essential and should always be carried out, principally to rule out alternatives such as nasal polyps (49) (D). In daily practice, diagnosis is usually based on a suggestive clinical history supported by examination by anterior rhinoscopy demonstrating swollen mucosa (49) and a small number of IgE sensitization tests (SPT or specific IgE), in accordance with the history, population and region, which can suggest an allergic origin of the symptoms (D) (50). Where the diagnosis is in doubt, nasal provocation testing can be utilized although this has not been standardized (49, 51) (C).

Defining the presence of allergy

Allergic sensitization can be defined as a positive skin test or allergen-specific serum IgE. Measurement of total serum IgE has little value in assessing allergic aetiology of rhinitis in childhood. The presence of sensitization is a major risk factor for AR in children (19, 51). Outdoor allergens constitute a risk of seasonal rhinitis, whereas indoor allergens are associated with perennial rhinitis (52). The information on absence of sensitization can be clinically very valuable potentially ruling out a diagnosis of AR. The negative predictive value may be as high as 95% in a clinic population, and false negatives are associated with local specific IgE production, particularly in young children who have recently become symptomatic (12). Additionally, a proportion of children with positive tests have no symptoms and many children with symptoms of rhinitis are sensitized to allergens that do not give rise to the symptoms (10). So, a positive allergen-specific IgE test alone does not confirm the allergic origin of the symptoms, and results must be interpreted in the context of the clinical history (C). Quantification of specific IgE antibodies or the size of wheal following skin testing can improve the specificity of these tests in the assessment of airway diseases in childhood (53–55), and in practical terms, quantification of sensitization offers more information to the clinician than simple presence or absence of atopy (C).

Recent studies employing a molecular diagnostic approach suggest that measurement of IgE response to specific allergenic components may be more useful in determining clinically relevant sensitization to a specific pollen (56) and in predicting food allergy than currently used skin or blood tests based on whole extracts (57–59); this approach may provide new tools for the assessment of children with symptoms suggestive of AR.

Other investigations

Further investigations may be required to evaluate other possible diagnoses, especially in cases of treatment failure (49) (D). Measurement of nasal mucociliary clearance and nasal nitric oxide may be useful in diagnosing primary ciliary dyskinesia (60) (C). Nasal endoscopy may be useful for visualizing polyps (D). Acoustic rhinometry can reveal a reduction in the cross-sectional diameter of the nasal cavity at the level of the nasopharynx (49) (C). Lateral radiographs can be used

to evaluate the nasopharyngeal airway, and computer tomography may be helpful in the diagnosis of chronic rhinosinusitis (49) (D). It may be necessary to utilize other tests to evaluate potential coexisting medical problems such as asthma (Box 3).

Differential diagnosis

The differential diagnosis of rhinitis (Box 4) in children can best be approached using a symptom-based and age-related differential diagnosis (D). These need to be particularly considered when symptoms do not respond to therapy (61).

Nasal obstruction

Nasal obstruction in children may be the result of mucosal pathology and/or anatomical abnormalities. Nasal obstruction is often the presenting symptom of rhinitis in preschool children, with open mouth breathing, snoring and nasal secretions. However, adenoidal hypertrophy is a common disorder inducing similar symptoms. Severe septal deviations may occur in children and induce impaired nasal breathing, often unilateral in nature. Two thirds of children with cleft lip complain of nasal obstruction due to nasal septal deviation and the frequently associated stenosis of the nasal vestibulum. Rare conditions like choanal atresia or stenosis of the piriform aperture should not be overlooked in nasal obstruction in children. Nasal polyps in children impairing nasal breathing are rare (27), warranting investigations for cystic fibrosis and/or primary ciliary dyskinesia or an encephalocoele if unilateral polyp (D). Rarely, nasal obstruction may be due to a malignancy.

Colour of nasal secretions

The colour of *nasal secretions* provides a first diagnostic clue to the nature of the underlying pathology (D). Transparent secretions are seen initially in viral common colds, in AR and in the rare condition of leakage of cerebrospinal fluid (CSF). Thickened and often discoloured mucus is found in the nasal cavity of patients with adenoidal hypertrophy, recurrent adenoiditis and/or rhinosinusitis and in the later stages of the common

Box 4: Dierential diagnosis of rhinitis in children (D)

Diagnosis	Pre-school	School	Adolescent
Choanal atresia or stenosis	Obstruction without other features of allergic rhinitis		
Immuno-deficiency	Persisting mucopurlent discharge		
Encephalocoele	Unilateral nasal "polyp"		
Adenoidal hypertrophy	Mouth breathing, discoloured nasal secretions, snoring in the absence of other features of allergic rhinitis		
Foreign body	Unilateral discoloured nasal secretions, foul smell		
Rhinosinusitis		Discoloured nasal secretions, headache, facial pain, poor smell, halitosis, cough	
Cystic fibrosis	Bilateral nasal polyps, poor smell, chest symptoms, symptoms of malabsorption, failure to thrive		
Primary ciliary dyskinesia	Persisting mucopurlent discharge without respite between "colds", bilateral stasis of mucus and secretions at the nasal floor, symptoms from birth		
CSF leakage	Colourless nasal discharge often with a history of trauma		
Coagulopathy	Recurrent epistaxis with minimal trauma		
Septal deviation		Obstruction in the absence of other features of allergic rhinitis	

cold which is a viral rhinosinusitis. Sinusitis in children is always associated with inflammation of the nasal cavity; hence, the term 'rhinosinusitis' is preferred. Chronic severe rhinosinusitis may also be associated with primary ciliary dyskinesia, cystic fibrosis and humoral and/or cellular immune dysfunction. These conditions should be screened for in children with persistent and severe sinonasal symptoms (D). Children with unilateral discoloured secretions should be evaluated for foreign bodies (D).

Smell dysfunction

Smell dysfunction represents a typical feature of rhinosinusitis (27) and has not been well studied in children. It is, however, known that children with severe rhinosinusitis and nasal polyps, as in primary ciliary dyskinesia or cystic fibrosis, may experience hyposmia or anosmia, often without major subjective impairment. The rare Kallmann syndrome is characterized by anosmia due to hypoplasia of the olfactory bulb (62).

Headache

Headache in children is a manifestation of rhinosinusitis rather than rhinitis (49).

Epistaxis

Minor *epistaxis* in children is common in AR or in children with congestion of the vessels at the locus Kiesselbach. Excessive nasal bleedings warrant a nasal endoscopy excluding a nasopharyngeal angiofibroma (63) and coagulopathies (D).

Cough

Cough is an important manifestation of rhinitis due to postnasal drip and stimulation of cough receptors in nasal cavity, pharynx and larynx. Other diagnoses should be considered when there are no other features of rhinitis or where it fails to respond to therapy (64). Examples are recurrent upper airway infections, pertussis, habit cough, aspiration bronchiectasis, foreign body or tuberculosis; asthma is unlikely without other symptoms of bronchospasm.

Therapy

Apart from antibiotics in bacterial infectious rhinitis, we currently have no effective therapy for infectious rhinitis, and so, in this section, we will focus on AR. The management of AR includes avoidance of relevant allergens, symptomatic treatment and specific immunotherapy.

Allergen avoidance

Outdoor allergens, such as pollen, cannot be completely avoided. For indoor allergens, avoidance should be more possible. Few studies have investigated the effect of effective house dust mite avoidance in paediatric AR. In general, they have failed to demonstrate a benefit but cannot be described as conclusive due to their small size and design (65) (D). There is insufficient evidence on pet allergen avoidance in AR but it would be clinical practice to recommend avoidance (66) (D).

Pharmacological treatment

Oral and intranasal antihistamines

Both oral and intranasal second-generation antihistamines are equally effective for AR (67–73) (A). Oral ones may be better tolerated, whilst intranasal antihistamines have a more rapid onset of action (74). First-generation antihistamines should no longer be used, given their unfavourable therapeutic index (24, 74, 75) (B). In a minority of children, second-generation ones may also cause sedation (76) with perhaps the exception of fexofenadine (74).

Intranasal corticosteroids

Corticosteroids address the inflammatory component of AR, and results from a large number of well-designed studies would recommend their use in children and adolescents from 2 years (77–91) (A). The recent Cochrane review (92) failed to find evidence supporting the effectiveness of intranasal corticosteroids but it excluded all the recent high-quality randomized controlled trials as they allowed rescue medication. Several studies have shown that the effects of mometasone, fluticasone and ciclesonide commence within a day of starting therapy (93). Intranasal corticosteroids probably also improve coexisting asthma (94–96) (A), and fluticasone furoate and mometasone may be effective for conjunctivitis (77, 82, 97) (B).

In general, nasal corticosteroids are well tolerated. Newer, once-daily products (e.g. fluticasone propionate (98), mometasone (99–101), fluticasone furoate nasal spray (82)) are preferred as these have been shown, unlike beclomethasone, not impair growth velocity albeit only after a year of therapy (102, 103) (A). This is probably due to the much lower systemic bioavailability of the newer products (Fig. 2). Nasal perforation and epistaxis have been described as risks of nasal corticosteroids but there are no systematically collected data on these adverse effects in the literature.

Systemic corticosteroids

A few studies on systemic corticosteroid therapy have been performed in adults. In adults, a daily 7.5 mg prednisolone dose was marginally effective, whereas a 30 mg dose was effective but also associated with systemic side-effects (104). Depot corticosteroid injections are associated with local atrophy of the skin and muscles, reduced bone mineralization and impaired growth (105). If systemic corticosteroid treatment is necessary in children, a short course with 10–15 mg oral prednisolone a day for 3–7 days for school-age children may be sufficient (D).

Oral leukotriene receptor antagonist

Montelukast monotherapy is effective in both seasonal and perennial AR in two well-designed, but small, paediatric studies (106, 107) as well as in two meta-analyses dominated by adult studies (108, 109) (A).

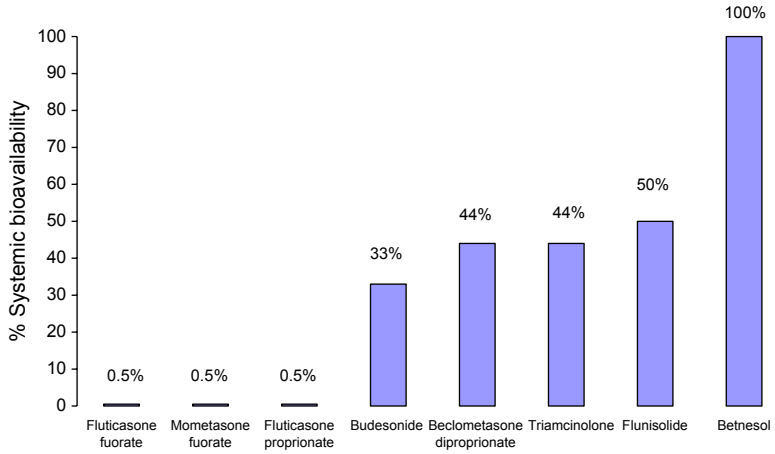


Figure 2 Systemic bioavailability of different nasal corticosteroids.

Nasal anticholinergics

Anticholinergics have been reported to be effective in controlling watery nasal discharge in the elderly (C) but not for itching, sneezing or obstruction (110). It is rarely prescribed in children.

Nasal decongestants

Topical decongestants can be used for a few days for severe nasal obstruction but should only be used for a few days as prolonged use may lead to rebound swelling of the nasal mucosa (111) (C).

Nasal sodium cromoglicate

Intranasal sodium cromoglicate is an effective AR therapy albeit the trials are relatively old (112) (A), and repeated use several times a day renders concordance difficult.

Other therapies

Saline douches are inexpensive and have been shown to be effective for rhinitis (113–115) (A). In patients with poorly controlled, moderate-to-severe allergic asthma and AR, omalizumab has been found to be effective for both rhinitis and asthma (116). There is no convincing evidence for the efficacy of alternative medication for AR (117).

Relative effectiveness of different pharmacological approaches in allergic rhinitis

Assessing the relative efficacies of therapies and the potential benefit of combining them is compromised by the lack of studies in the pre-adolescent age group. Nasal corticosteroids are more effective at controlling AR than either antihistamines or montelukast (73, 118–120) (B). All are more effective than nasal cromoglicate (73) (B). Symptoms of congestion are only effectively controlled by nasal corticosteroids (120) (B). In children, there are insufficient comparative data to determine whether antihistamines or montelukast is more effective, although some studies indicate that antihistamines are more effective for itching (121, 122). Antihistamines and montelukast may provide some additional benefit when used as add-on therapy with nasal corticosteroids (73, 74, 118, 120)(B). Given these data, we propose the approach to pharmacological management described in Fig. 3. We would suggest that topical nasal corticosteroids are the appropriate first-line therapy in moderate-to-severe AR, especially when congestion is the predominant complaint, but antihistamines may be preferred in mild AR to minimize the exposure to corticosteroid in children.

Pharmacotherapy for nonallergic, noninfectious rhinitis

There are no high-quality data to formulate treatment recommendations in children with nonallergic, noninfectious rhinitis. Management should be directed by the underlying cause (Box 1). Where this is not obvious, saline douches and/or topical corticosteroids should be tried first [D]. If symptoms continue, further investigation should be undertaken to exclude possible differential diagnoses. For persistent obstruction, topical antihistamine then short-term topical decongestants may be considered [D]. For watery rhinorrhoea, ipratropium may help [D]. There are adult controlled study data to suggest that capsaicin may reduce symptoms (123) [B].

Immunotherapy

Allergen-specific immunotherapy (SIT) is the specific treatment for IgE-mediated allergic disease in patients (124), and this may utilize the subcutaneous or sublingual routes.

Indications and contraindications

There should be a clear history of AR with evidence of a small number of clinically relevant sensitizations, in other words allergen-driven AR (125, 126) (D); this may limit its use in the preschool children. The need for injections also effectively limits the use of subcutaneous immunotherapy to school-age children. Specific immunotherapy should be performed with a standardized allergen extract or preparation registered or approved by the authorities (D). Therapy should be initiated by a physician with training in the diag-

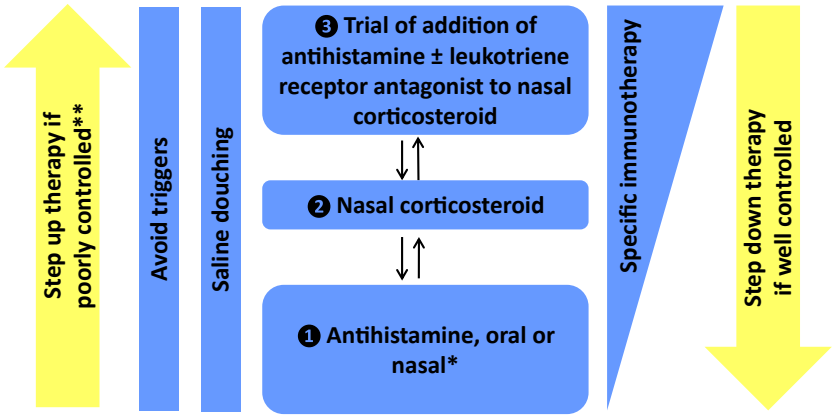


Figure 3 Approach to therapy for paediatric allergic rhinitis. ❶, ❷ and ❸ are potential entry points into therapeutic approach depending on the severity of the rhinitis symptoms. For seasonal disease, regular therapy should be commenced 2 weeks before the anticipated start of symptoms (150). *Oral antihistamines may be better tolerated, whilst intranasal antihistamines have a more rapid onset of action. **Reconsider diagnosis if not controlled within 1-2 weeks (61). If less than 2 years of age and do not respond to antihistamine within a week, reconsider diagnosis before stepping up therapy. If poorly controlled, consider a short rescue course of a decongestant or low-dose oral prednisolone to gain symptom control; topical ipratropium may be useful for rhinorrhoea.

nostic procedures, treatment and follow-up of allergic and asthmatic children (127) (D). Significant concurrent disease, impaired lung function and severe asthma are contraindications (125) (D).

Subcutaneous injection immunotherapy (SCIT)

The 2007 Cochrane systematic review of SCIT (128) in AR demonstrates that it is effective although there were no accepted studies that were conducted exclusively in children. Subcutaneous injection immunotherapy has been associated with systemic reactions but it is generally well tolerated in children (128, 129). There are also some nonblinded data to suggest that SCIT may alter the natural history of allergic disease in childhood (130). Factors associated with severe adverse effects are unstable asthma, elevated allergen exposure during therapy, concomitant diseases such as severe infections and inexperienced healthcare staff. There is some evidence to suggest that antihistamine premedication may reduce the rate of adverse effects (131) (B). Also, pretreatment with anti-IgE has been used to reduce the rate of adverse reactions associated with updosing with SCIT (132) (A). There are no paediatric data addressing the question of how long SCIT should be continued although adult data would suggest that 3 years is sufficient at least for pollens (133).

Sublingual immunotherapy (SLIT)

The effectiveness of SLIT for AR has been evaluated in a number of systematic reviews. The 2011 review demonstrates its effectiveness for pollen and house dust mite-driven rhinitis (134) (A). This review highlights the considerable heterogeneity between studies, not all preparations seem to be effective. Both continuous and coseasonal protocols have been described, both seem to be effective although the latter may take longer to impact on the symptoms (135). There are also some nonblinded data to suggest that SLIT may prevent the development of asthma (136); these studies are now being repeated with a SLIT product using a placebo-controlled design (137). Two commercial grass products have received European market authorization for patients at least 5 years of age (138, 139). Local oral reactions are experienced in up to three quarter of the patients but are mild to moderate, self-resolve after a few minutes and usually disappear after a few weeks therapy (129, 134, 140, 141). Severe adverse reactions have been seen but are very rare (142). There is concern about compliance with SLIT with sales data suggesting 44% compliance in the first year, 28% in second year and 13% in the third year (143) although regular clinic contact may improve this (144) (B). Again, adult data would suggest that 3 years of SLIT is sufficient, at least for pollens (145).

Health economics

Pharmacoeconomic models based on data provided by clinical trials and meta-analyses indicate that SIT is cost-efficient (146). One of the few real patient cohort studies to investigate cost-effectiveness of SCIT was performed in US children with allergic rhinitis; patients in the SCIT group incurred 33% lower healthcare costs (147, 148).

Compliance with therapy

The compliance of children with rhinitis therapy has not been well studied. Adherence to the use of nasal sprays may be suboptimal due to discomfort, particularly in young children (149). Further work is required in this area. Even when patients use their medication, it is critical that they know how to do so correctly, especially nasal medications and education are essential (D). Reassurance of the patient and caregivers about the safety of nasal corticosteroids is almost certainly necessary, together with information about the nature of rhinitis, its comorbidities and complications and the benefits of effective therapy.

Summary and conclusions

Rhinitis is a prevalent yet underappreciated paediatric problem. These are the first paediatric specific recommendations. Many children present with typical nasal symptoms, such as rhinorrhoea, blockage, sneezing or itching. Atypical presentations usually relate to associated comorbidities such as asthma, eczema, pollen–food syndrome, sleep disorders and hearing problems. The commonest presentations are *allergic rhinitis* and *infectious rhinitis*. Other children have a *nonallergic, noninfectious rhinitis* usually associated with exposure to irritants, gastro-oesophageal reflux, hormonal dysfunction, specific medications or simply idiopathic. A detailed comprehensive clinical history supported by a thorough examination of the nose is important to aid accurate diagnosis. A limited number of allergy tests are useful to confirm or refute allergic origins of symptoms. In case of treatment failure, further investigations are required to exclude other possible diagnoses. A successful therapeutic approach to paediatric AR should involve a holistic approach to all the manifestations with avoidance of relevant allergens where possible, pharmacotherapy with or without specific immunotherapy. Both oral and intranasal antihistamines are appropriate for first-line treatment for AR, whilst intranasal corticosteroids are considered the most effective therapeutic option for children with AR and nonallergic rhinitis with congestion. Add-on therapies are oral montelukast, intranasal anticholinergics for nasal discharge and decongestants for severe nasal obstruction. There are a number of unmet research needs in paediatric rhinitis (Box 5), including developing new approaches to control effectively the small but important number of children with ongoing symptoms despite the use of current medications.

Box 5: Unmet research needs in rhinitis in children

- Randomized double-blind, placebo-controlled studies focusing on potential for SIT to alter the natural history of allergy (e.g. development of further sensitization and asthma).
- Identification of patients in whom rhinitis will progress to asthma
- Generation of paediatric specific data for efficacy of SCIT and cost-effectiveness of SIT
- Evaluation of effective allergen avoidance as a useful therapy for AR.
- Evaluation of the potential value of component-resolved diagnosis and their health economics, in the evaluation of children with rhinitis.
- Investigate the potential role of local IgE production in paediatric rhinitis.
- Identifying patients with poor compliance and developing educational and other strategies to address this.
- Development of effective therapy for the small but important proportion of children with uncontrolled rhinitis despite maximal therapy.
- Role of viral infections in the aetiology of allergic rhinitis and as cofactors in the development of symptoms with allergen exposure.
- Development and validation of improved epidemiological definitions of the different types of childhood rhinitis.
- Controlled trials focused on noninfectious, nonallergic rhinitis in childhood.
- Public education campaign to promote the recognition of allergic rhinitis in children as a major health problem.

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Author contributions

The EAACI Pediatric Section, in collaboration with EAACI ENT and Asthma Sections, proposed the topic which was accepted by the EAACI Executive Committee. Each author drafted a section which GR edited into the final document. All authors reviewed and discussed the final document and approved the final version. The final version was evaluated and endorsed by the EAACI Executive Committee.

Conflicts of interest

GR, SH and EV are investigators in the ALK-Abello funded GAP SLIT asthma prevention study. NGP has received payment for consultancy from ABBOTT, Novartis, Menarini, for lectures from MSD, URIACH, GSK, ALLERGOPHARMA, Stallergens, MEDA, for development of educational presentations from MSD, URIACH, MEDA and grants from Nestle, MSD and Deviblis. GS has received research grants from GSK and ALK-Abello; honoraria for articles, consulting, lectures, chairing or advisory boards from ALK-Abello, Capnia, Circassia, Church & Dwight, GSK, Groupo Uriach, Meda and Merck, Ono, Oxford Therapeutics and Shionogi; and travel funding from GSK. LMB has received honoraria for lectures from MSD. GR, AC, PH and NP are members of the EAACI Executive Committee. FT is the director of the Nederlands Anafylaxis Netwerk.

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