Tests for airway inflammation

Tests for type 2 airway inflammation in asthma include:

- fractional exhaled nitric oxide (FeNO)
- blood eosinophil count
- sputum eosinophil count.

FeNO and blood eosinophil count reflect different inflammatory processes and provide complementary information.[Meulmeester 2025]

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Type 2 airway inflammation

For most people with asthma, airway inflammation is driven by T helper 2 lymphocytes (type 2 inflammation).[Fahy 2015] Type 2 inflammation involves multiple inflammatory pathways leading to recruitment of eosinophils and mast cells to the airways, which results in mucus hypersecretion, airway wall oedema and thickening, and airway hyperresponsiveness.[Fahy 2015, Lambrecht 2015, Brusselle 2022] It is characterised by raised blood eosinophil counts or by raised fractional exhaled nitric oxide (FeNO) levels.[Brusselle 2022]

Two groups of patients show prominent type 2 inflammation:[Kothalawala 2020, Aaron 2018]

- those with allergic asthma (typically childhood onset, often accompanied by atopic dermatitis or allergic rhinitis, with raised total serum immunoglobulin E and antigen-specific immunoglobulin E levels)
- those with eosinophilic non-allergic asthma (typically adult onset, with raised eosinophil count).

In other patients with asthma, airway inflammation can involve increased neutrophils, or no detected increase in granulocytes.[Brusselle 2022]

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Fractional exhaled nitric oxide (FeNO)

Inflammation of the airway, especially eosinophilic T-helper 2-driven (type 2) inflammation, is associated with increased synthesis and release of nitric oxide from airway epithelial cells.[Högman 2024]

The FeNO test is available in accredited respiratory function laboratories. The patient breathes into a mouthpiece attached to a monitor. Adults and most children aged 4–5 years and over can easily perform this test correctly.

This test is reimbursed by MBS if it is performed in an accredited respiratory function laboratory, in combination with spirometry that includes a bronchodilator responsiveness test, and is reported by a respiratory expert.

FeNO level reflects both airway inflammation and lung function changes.[Haccuria 2014]

FeNO is elevated in the presence of active type 2 inflammation of the airway associated with asthma. It is also elevated in some other inflammatory conditions (e.g. acute respiratory viral infection, allergic rhinitis/rhinosinusitis, and eosinophilic bronchitis).[GINA 2025]

FeNO is suppressed by smoking, ICS, systemic corticosteroids, and some monoclonal antibody therapies (e.g. dupilumab).[GINA 2025, Loewenthal 2022] FeNO may be normal in patients with asthma associated with types of airway inflammation (e.g. neutrophilic inflammation) and in those with obesity.[GINA 2025]

The upper limit of normal FeNO range for a population depends on age, height and sex. Development of consensus population reference ranges for the FeNO test has been limited by variation in results between measuring devices and testing protocols.[Högman 2024]

Relatively few respiratory function laboratories offer FeNO testing for children.

Table

Respiratory function laboratories providing testing in children

Location	Laboratory	Spirometry minimum age	FeNO minimum age	Bronchial provocation*	Accepts primary care referrals (wait time)†
Brisbane	Queensland Children's Hospital	3 years‡	No age restriction	Mannitol	No
Newcastle	John Hunter Hospital	5 years	5 years	Mannitol	Yes (<4 weeks)
Sydney	The Children's Hospital at Westmead	4 years	4 years	Mannitol	No
Sydney	Sydney Children's Hospital, Randwick	4 years	4 years	Mannitol	Yes (2–6 weeks)
Melbourne	Royal Children's Hospital	4 years	6 years	Mannitol Exercise	Yes (1–2 weeks)
Adelaide	The Lung Lab, Women's & Children's Hospital	5 years	5 years	Mannitol Exercise	Yes (8 weeks)
Perth	Perth Children's Hospital	5 years	7 years	Mannitol Exercise	Yes (1–2 weeks)

Additional information

Data obtained by personal communication mid-2025. This list is not exhaustive and services may change over time. Clinicians should check test availability and age restrictions with their local respiratory function laboratory before referring.

FeNO: fractional exhaled nitric oxide

*Main test(s) offered

† Estimated typical wait time for primary care referrals in May 2025. May not apply to specialist referrals and internal referrals from the affiliated or parent institution.

‡Accepted if considered able to cooperate with test procedure

Use of FeNO testing in diagnosis of asthma

FeNO testing is not mandatory in the diagnostic investigation of suspected asthma in primary care and a raised FeNO level is not required to make a diagnosis of asthma. However, FeNO testing provides useful information on airway inflammation and it is increasingly used in asthma diagnosis.

When interpreted in conjunction with clinical history and results of other investigations, elevated FeNO supports a diagnosis of asthma,[Karrasch 2017] but a normal FeNO level does not rule out asthma.[Karrasch 2017]

The combination of elevated FeNO and abnormal spirometry with a positive bronchodilator responsiveness test strongly supports the diagnosis of asthma.

In adults and adolescents, FeNO ≥40 ppb supports the diagnosis of asthma in a patient with signs and symptoms strongly suggesting asthma. See **Diagnosing asthma in adults and adolescents**.

In children 6–11 years, FeNO ≥25 ppb supports the diagnosis of asthma in a child with signs and symptoms strongly suggesting asthma. See **Diagnosing asthma in children 6-11 years**.

Cut-points for the diagnosis of asthma vary between guidelines: typically 40–50 ppb for adults and 25–35 ppb for children 5–18 years. Sensitivity and specificity vary according to population.

In non-smoking patients not treated with ICS:

- (adults) a FeNO level ≥ 50 ppb has a reported sensitivity of 0.19– 0.56 and specificity of 0.75–0.95 and for the diagnosis of asthma [Louis 2022]
- (adults) a FeNO level ≥ 40 ppb in adults has a reported sensitivity of 0.61 and specificity of 0.82 and for the diagnosis of asthma [Louis 2022]
- (children and adolescents aged 5–18 years) a FeNO level > 34 ppb has a reported sensitivity of 0.32 and specificity of 0.99 and for the diagnosis of asthma [BTS-NICE-SIGN 2024]
- (children and adolescents aged 5–18 years) a FeNO level > 24 ppb has a reported sensitivity of 0.50 and specificity of 0.91 and for the diagnosis of asthma.[BTS-NICE-SIGN 2024]

These sensitivities and sensitivities were calculated using a reference standard of physician diagnosis of asthma based on symptoms plus either positive bronchodilator responsiveness test on spirometry, a positive bronchial challenge test, or excessive peak flow variability.

Use of FeNO testing in asthma assessment

Regular FeNO testing is not routinely required to guide asthma management in primary care.

In general, elevated FeNO helps identify patients whose asthma symptoms will respond well to ICS.[Price 2018]

The combination of blood eosinophils and FeNO might be more useful than either biomarker alone for predicting exacerbations.[Meulmeester 2025]

In patients with severe asthma, FeNO testing is commonly performed alongside blood eosinophil count to assess asthma phenotype and predict which treatment options are likely to benefit the individual. High FeNO (>25 ppb in an adult using medium-dose ICS, or >20 ppb for and adult using high-dose ICS, despite good adherence and inhaler technique[GINA 2025] in patient with poor asthma symptom control or a history of asthma exacerbation, indicates that the person may benefit from monoclonal antibody therapy. High FeNO predicts a better response to add-on treatment with dupilumab, omalizumab or tezepelumab than a lower FeNO.[GINA 2025]

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Resources

Global Initiative for Asthma's **overview of Type 2 biomarkers in the diagnosis and management of asthma in adolescents and adults [Appendix A]**

Blood eosinophil count

Type 2 airway inflammation in patients with asthma is characterised by raised blood eosinophil levels.[Brusselle 2022]

Blood eosinophil count is also elevated in patients with atopic dermatitis [Simon 2004] and sensitised patients with recent allergen exposure.[Xu 2024]

Blood eosinophil count ≥300 cells/microlitre suggests non-asthma causes such as parasitic infestation, and very high levels (e.g. ≥1500 cells/microlitre) suggests eosinophilic granulomatosis with polyangiitis.[GINA 2025]

Levels are also influenced by sex, age, time of day, seasonality, smoking, and other conditions such as obesity and nasal polyposis, chronic infection and malignancy.[Blakey 2025]

Use of blood eosinophil count in diagnosis of asthma

Blood eosinophil count is not mandatory in the diagnostic investigation of suspected asthma in primary care and eosinophilia is not required to make a diagnosis of asthma.

False positive and false negative results may occur if a fixed cut-point is used for the diagnosis of asthma.[Blakey 2025]

Use of blood eosinophil count in asthma assessment

Blood eosinophil count is not routinely required for asthma management in primary care, but is recommended in investigation of difficult-to-treat asthma (e.g. when asthma symptoms are not well controlled or the patient experiences severe exacerbations despite maintenance treatment that includes at least a medium dose of ICS).

In patients using high-dose ICS, blood eosinophil count ≥150 cells/microlitre suggests the presence of refractory type 2 inflammation.[GINA 2025]

In patients with severe asthma, blood eosinophil count is performed to assess asthma phenotype and predict which treatment options are likely to benefit the patient.[GINA 2025] It is required for PBS reimbursement for some monoclonal antibody therapies for asthma.

Higher blood eosinophil levels correlates with increased risk of asthma exacerbations.[Mallah 2021, GINA 2025] Data from several observational studies in various populations demonstrate that blood eosinophil counts ≥200 cells/microlitre are consistently associated with significantly increased risk of asthma exacerbations and severe exacerbations requiring ED visits.[Mallah 2021] The combination of blood eosinophils and FeNO might be more useful than either biomarker alone for predicting exacerbations.[Meulmeester 2025]

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Resources

Global Initiative for Asthma's **overview of Type 2 biomarkers in the diagnosis and management of asthma in adolescents and adults [Appendix A]**

Sputum eosinophil count

Sputum eosinophil testing is not widely accessible in Australia. It is not used in primary care and rarely used in specialist centres.

A raised sputum eosinophil count indicates airway inflammation. In a patient using high-dose maintenance ICS treatment, sputum eosinophil count ≥2% suggests the presence of refractory type 2 inflammation.[GINA 2025]

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