

Epidemic thunderstorm asthma

SUMMARY

Certain types of thunderstorms in spring or early summer in regions with high grass pollen concentrations in the air can cause life-threatening allergic asthma flare-ups in sensitised individuals, even if they have not had asthma before.

Epidemics can occur when such a storm travels across a region and triggers asthma in many susceptible individuals, causing a high demand on ambulance and health services. Epidemic thunderstorm asthma events are uncommon.

People at risk of acute asthma flare-ups triggered by a thunderstorm include those with seasonal allergic rhinitis (with or without asthma), those with asthma (or a history of asthma), and those with undiagnosed asthma.

Data from thunderstorm asthma epidemics suggest that the risk of asthma triggered by a thunderstorm is highest in adults who are sensitised to grass pollen and have seasonal allergic rhinitis (with or without known asthma). The worst outcomes are seen in people with poorly controlled asthma. Regular treatment with an inhaled corticosteroid asthma preventer appears to be protective.

Thunderstorm asthma is thought to be triggered by exposure to ryegrass pollen allergens in wind gusts related to and just preceding a thunderstorm in springtime or early summer in south-eastern Australia.

In primary care, prevention of asthma triggered by thunderstorms is based on:

- year-round asthma control, including inhaled corticosteroid-containing preventers where indicated.
- pre-emptive treatment for people who are allergic to grass pollens but are not already taking regular medication: intranasal corticosteroids for people with allergic rhinitis and inhaled corticosteroids for people with asthma, ideally starting 6 weeks (but at least 2 weeks) before exposure to springtime high pollen concentrations and thunderstorms, and continuing throughout the grass pollen season (1 September–31 December).
- advice for at-risk patients to avoid being outdoors just before and during thunderstorms in spring and early summer – especially during cold wind gusts that precede the rain front.



What is epidemic thunderstorm asthma and what causes it?

'Epidemic thunderstorm asthma' is an unusual cluster of allergic asthma flare-ups (including severe acute asthma) associated with some types of thunderstorms in spring or early summer. It is thought to be caused by the combination of high grass pollen counts, unusual thunderstorm conditions that concentrate pollen grains/allergens, and grass pollen allergy in individuals. Other factors may be involved.

Thunderstorm asthma can occur in allergic individuals when they inhale air that contains a high concentration of pollen allergens during a thunderstorm.¹ Perennial ryegrass (*Lolium perenne*), a common pasture crop, has been implicated in all Australian thunderstorm asthma epidemics.² Fungal spores (e.g. *Alternaria*) may also contribute to risk for some people, but their role in thunderstorm asthma in Australia is unclear.²

The world's largest epidemic thunderstorm asthma event occurred in Melbourne and Geelong in November 2016.³ It resulted in a sudden large surge in emergency ambulance calls, thousands of emergency department presentations, hundreds of hospital admissions, 30 extra intensive care unit admissions, increased attendance to primary care (including doctors, nurses and pharmacies), and deaths due to asthma. Six epidemic thunderstorm asthma events have been reported in Melbourne since 1980. Previous thunderstorm asthma epidemics have also been reported during October and November in Canberra, Newcastle, Tamworth and Wagga Wagga.²⁻⁴

Who is at risk and when?

People at increased risk of acute asthma flare-up triggered by a thunderstorm include:

- those with seasonal (springtime) allergic rhinitis (with or without asthma). In Australia, it is reasonable to assume (in the absence of allergy tests) that people with seasonal allergic rhinitis are sensitised to ryegrass pollen.
- those with asthma, including any history of asthma
- those with undiagnosed asthma.

People with seasonal allergic rhinitis (hay fever), with or without known asthma, have the highest risk of asthma flare-ups triggered by thunderstorms (Table 1). Allergic rhinitis appears to be the strongest risk factor for developing thunderstorm-triggered asthma, but poorly controlled asthma is associated with the worst outcomes.

Epidemic thunderstorm asthma has been reported to occur during peak grass pollen season (October and November in south-eastern Australia). The risk may extend into December, when grass pollen levels can still remain high. Wind gusts that precede the rain front of a thunderstorm appear to carry the greatest risk of exposure to allergens.

Patients may present with asthma symptoms soon after exposure, or in the following days with an asthma flare-up that they may have been trying to manage on their own.

Only certain, uncommon types of thunderstorms might create the conditions for epidemic thunderstorm asthma. Inhaling outdoor air during such a thunderstorm in spring or early summer can cause severe asthma flare-ups in people with asthma,¹ and can also cause acute asthma reactions in people with allergic rhinitis due to grass pollen allergies, even if they have not had asthma before.¹⁻³ In Australia and internationally, almost all recorded cases of thunderstorm asthma (90–100%) have occurred in people with a history of allergic rhinitis.² People who are allergic to ryegrass are at highest risk of developing thunderstorm asthma.²

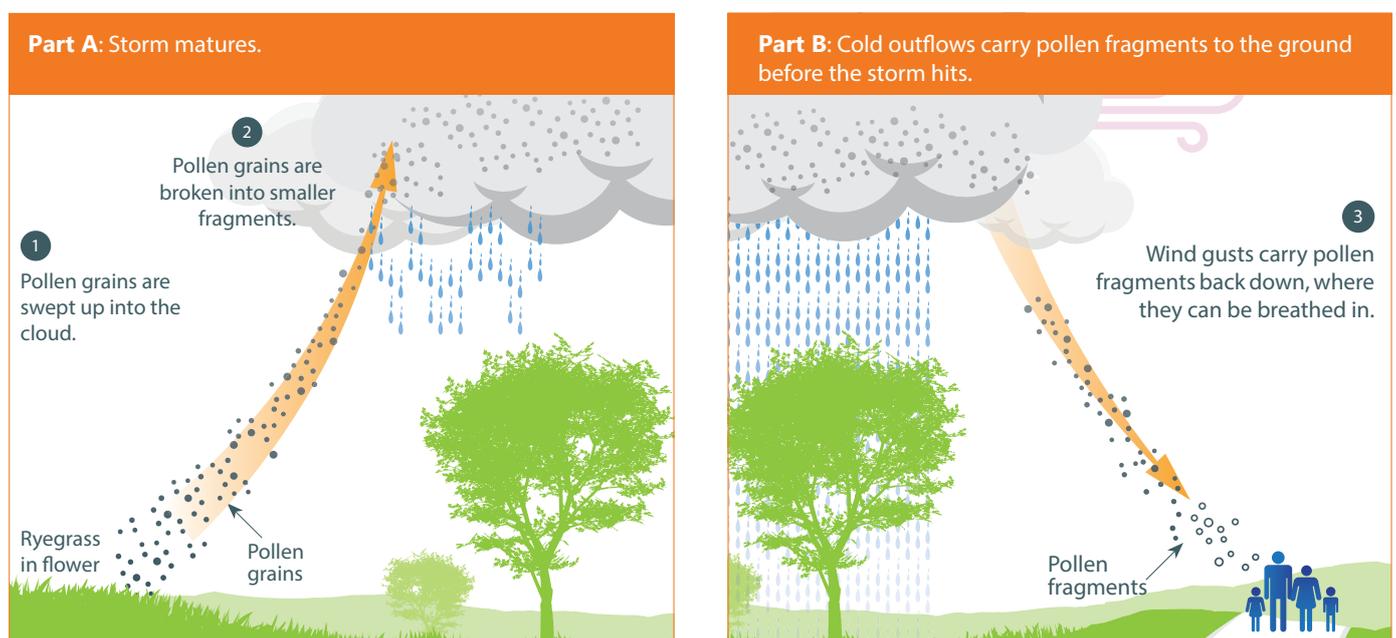
Based on preliminary data from the November 2016 Victorian epidemic, a history of known asthma increases the risk of life-threatening asthma requiring intensive care admission, or death due to thunderstorm asthma.⁷ People with asthma are at higher risk of having an asthma flare-up triggered by a thunderstorm if their asthma is poorly controlled or they are not taking regular preventer treatment with an inhaled corticosteroid.^{2,3}

Epidemic thunderstorm asthma appears to occur mainly in south-eastern Australia, but regional variations are not yet understood. Research is underway to identify the regions with the highest risk.

Weather conditions associated with epidemic thunderstorm asthma

The exact mechanism driving epidemic thunderstorm asthma events is still unclear. One hypothesis is that grass pollen is drawn upwards into a thunderstorm, where some grains rupture and release many small allergens (Figure 1).^{5,6} These are blown to ground level on the cold down-drafts and dispersed across the landscape in the wind gusts that precede the storm.

Figure 1. Possible mechanism of thunderstorm asthma



An alternative hypothesis is that high concentrations of grass pollen (some of which is already ruptured and has released its allergens) are blown across the landscape by a particular type of storm. A large number of people are affected due to the storm's ability to concentrate the allergens in the winds immediately preceding the storm and to disperse them across a large geographical area.

The role of other factors such as fungal spores, temperature and humidity changes or electrical charge from lightning is unclear. The November 2016 epidemic thunderstorm asthma event in Melbourne was not associated with high levels of usual air pollutants.

High levels of grass pollen are observed in Melbourne from October to the end of December, which suggests that the potential period of risk for that region is October–December.

Table 1. Risk factors for thunderstorm asthma in primary care

ESTABLISHED RISK FACTORS
Hypersensitivity to ryegrass pollen
Seasonal allergic rhinitis occurring in springtime (hay fever), with or without known asthma
Asthma (especially if poorly controlled)
Not taking an inhaled corticosteroid asthma preventer
History of asthma
Being outdoors, or exposure to wind gusts, just before and during a thunderstorm in pollen season (i.e. outdoors, or indoors with windows/doors open)
POSSIBLE RISK FACTORS
Asian ethnic background (During the November 2016 epidemic, people from Southeast Asia or the Indian subcontinent were disproportionately affected, ⁷ but it is unclear whether this was due to genetic, environmental or cultural factors.)
Age (During the November 2016 epidemic, the greatest increase in cases and worst outcomes were among adults). ⁷
PRACTICE POINTS
Ask people with allergic rhinitis whether they ever wheeze or have other asthma symptoms during pollen season. These patients may have undiagnosed asthma and may be at high risk for thunderstorm asthma.
People commonly deny or downplay mild asthma symptoms. When patients with a previous asthma diagnosis report that they no longer have asthma, careful questioning is needed to confirm they have experienced absolutely no asthma symptoms (including during exercise).
Consider sociocultural factors when providing asthma self-management education (refer to the Australian Asthma Handbook (www.asthmahandbook.org.au/populations/cald-peoples)).

How can thunderstorm-triggered asthma be prevented?

Prevention of thunderstorm-triggered asthma for people who are at risk due to asthma or seasonal allergic rhinitis, and live in or visit regions with seasonal high grass pollen levels, involves (Table 2):

- **good asthma control** – prescribing regular preventer treatment for people with asthma, including inhaled corticosteroids as indicated (Table 3), and regularly checking adherence and inhaler technique
- **good seasonal allergic rhinitis control** – advising regular intranasal corticosteroid for adults with seasonal allergic rhinitis throughout spring and early summer (1 September - 31 December). For children with allergic

rhinitis, treatment should follow current guidelines.

- **a written asthma action plan** – providing an up-to-date individualised written asthma action plan for people with asthma, which includes thunderstorm advice and advises the person to increase their dose of both preventer and reliever (and start taking systemic corticosteroids, if indicated) when they have asthma symptoms, according to recommendations in the Australian Asthma Handbook.
- **education** – warning about the risk of springtime and early summer thunderstorms, avoidance advice, and advice on how to obtain and use a reliever for asthma

symptoms. People at risk should avoid exposure to outdoor air just before and during a thunderstorm, especially during cold wind gusts just before the rain front hits (e.g. by going indoors with windows closed and air conditioner off or on recirculation mode,

or shutting car windows and recirculate air). These measures may not completely prevent exposure, so any symptoms should be managed immediately.

Is allergy testing necessary to identify people at risk of thunderstorm asthma?

Allergy testing is not routinely necessary, but it may be useful in some cases:

- It is reasonable to assume that all patients with seasonal allergic rhinitis in spring are sensitised to ryegrass pollen, and need advice and treatment to reduce their risk of thunderstorm asthma.
- For those with perennial allergic rhinitis without obvious seasonal exacerbation, consider allergy testing (skin prick test or allergen-specific IgE/RAST* blood test) to identify ryegrass allergy.
- For people with asthma, follow Australian Asthma Handbook recommendations for investigating and managing allergies (www.asthmahandbook.org.au/clinical-issues/allergies).

*Although standard radioallergosorbent tests are no longer used in most pathology laboratories, the term 'RAST' is still commonly used to refer to specific allergen immunoassays

Are masks recommended to prevent pollen inhalation?

Wearing a protective mask is not currently recommended as part of standard prevention because masks do not exclude all particles, and are only effective in reducing pollen inhalation if they are correctly selected and properly used. The use of masks may provide a false sense of security.

Masks cannot replace effective asthma management, which includes having an up-to-date personalised written asthma action plan and following it, regular use of preventer (if indicated), immediate availability of reliever, and knowledge and use of first aid for asthma.

In practice, masks can be uncomfortable. If they are poorly fitted, air leakage may occur around the edges (especially with facial hair).⁸ Masks can also become ineffective within a short time due to moisture from expired breath.

A P2, P3 or N95 mask might provide some protection for brief periods of obligatory outdoor exposure for those with seasonal symptoms in thunderstorm conditions, but mask wearing must never replace the measures specified in an appropriate written asthma action plan.

Where can patients get information about pollen counts and predicted storms?

Australian Government Bureau of Meteorology

Thunderstorm warnings are available via the website (www.bom.gov.au) or BOM Weather mobile app.

AusPollen

Pollen counts and forecasts for some major cities are available from AusPollen, the Australian Pollen Allergen Partnership (www.pollenforecast.com.au).

Counts begin in spring (1 September for Sydney, 1 October for Melbourne and Canberra, and 1 November for Brisbane), and continue into the following year until consistently low counts indicate the end of the pollen season for the particular region and year.

VicEmergency app and website

In Victoria, the Bureau of Meteorology is developing an epidemic thunderstorm asthma forecast, which will be available on the VicEmergency website (<https://emergency.vic.gov.au>) and VicEmergency app.

Table 2. Thunderstorm asthma prevention in at-risk adults

	Regular INCS	Regular ICS	Written asthma action plan	Thunderstorm avoidance
Allergic rhinitis	✓		*	✓
Asthma		✓	✓	✓
Asthma and allergic rhinitis	✓	✓	✓	✓

ICS: inhaled corticosteroid; INCS: intranasal corticosteroid starting before the pollen season (or exposure) and continuing throughout period of possible exposure (1 September–31 December)

* Patients with allergic rhinitis should have a written allergic rhinitis plan (see people with allergic rhinitis but never asthma)

Table 3. Summary of recommendations for asthma preventer treatment

ADULTS AND ADOLESCENTS
<p>Current Australian asthma guidelines⁹ recommend regular inhaled corticosteroid treatment for all adults and adolescents who report any of the following:</p> <ul style="list-style-type: none"> • asthma symptoms twice or more during the past month • waking due to asthma symptoms once or more during the past month • an asthma flare-up in the previous 12 months. <p>For detailed recommendations on preventer doses, monitoring, safety and patient education, refer to Australian Asthma Handbook (www.astmahandbook.org.au/management/adults/initial-treatment/preventers/ics-based-preventers).</p>
CHILDREN
<p>Recommendations for the use of asthma preventers in children are based on the child’s age and the pattern of asthma symptoms when not taking regular preventer.</p> <p>Current Australian asthma guidelines⁹ recommend that an inhaled corticosteroid at a low dose should be considered for children aged 2 years and older with moderate-to-severe persistent asthma. Montelukast is preferred as the first choice of preventer for children aged 2 years and older with frequent intermittent asthma or mild persistent asthma/wheezing.</p> <p>Regular preventer treatment is not recommended for children with intermittent asthma or viral-induced wheeze.</p> <p>For detailed advice on preventer doses, monitoring, safety and patient education, refer to Australian Asthma Handbook recommendations for children (www.astmahandbook.org.au/management/children).</p>

People with asthma

For adults and adolescents with any asthma symptoms during the previous 2 years or children with any asthma symptoms during the previous 12 months:

- manage and regularly review asthma, following current guidelines in the Australian Asthma Handbook (www.astmahandbook.org.au). Most adults and some children with asthma should use a regular inhaled corticosteroid long-term (Table 3). Even if regular inhaled corticosteroid treatment is not otherwise indicated for an adult or adolescent with known or presumed ryegrass allergy, it should be commenced well before exposure to springtime thunderstorms in regions with high levels of grass pollen (ideally 6 weeks, but at least 2 weeks before predicted peak pollen concentrations) and continued until pollens abate (1 September–31 December).
- provide training in correct inhaler technique, and check technique and adherence regularly. Instructions and videos are available from National Asthma Council Australia.
- advise patients to carry a reliever inhaler and replace it before the expiry date or when nearly empty.
- provide an up-to-date written asthma action plan that includes thunderstorm advice and instructs the person to increase doses of both inhaled preventer and reliever (as well as starting oral corticosteroids, if indicated) in response to flare-ups.
- review for allergic rhinitis – if present, treat with intranasal corticosteroids starting at least 2 weeks (ideally 6 weeks) before predicted peak pollen

concentrations and continuing until pollens abate (1 September–31 December).

- warn against being outdoors just before and during thunderstorms, especially in wind gusts that precede the rain front, in grass pollen season (October–December in south-eastern Australia).

People with any history of asthma

For people who have ever had asthma, but have had no symptoms of asthma (including during/after exercise) for at least 2 years without treatment (adults) or at least 12 months without treatment (children):

- review for allergic rhinitis – if present, treat with intranasal corticosteroids starting at least 2 weeks (ideally 6 weeks) before predicted peak pollen concentrations and continuing until pollens abate (1 September–31 December).
- judge the need for inhaled corticosteroid treatment during the pollen season by considering the patient's age, allergies (including hay fever), seasonality of symptoms, previous experience of wheezing or shortness of breath during a springtime thunderstorm, the length of time since last asthma symptoms, the severity of previous asthma (e.g. admission to hospital or intensive care unit), ability to avoid pollens, and other medical, geographic, social and psychological factors that could affect risk.
- explain how to recognise asthma symptoms and what to do. Ensure patients either carry a reliever inhaler, or know where to get one when needed (e.g. available over the counter from pharmacies, or in home/school first aid kit), and know how to use it correctly. Provide training in correct inhaler technique, and check technique each year before pollen season. Instructions and videos are available from National Asthma Council Australia. Provide asthma first aid education and written information, and explain when to call an ambulance.
- warn against being outdoors just before and during thunderstorms, especially in wind gusts that precede the rain front, in grass pollen season (October–December in south-eastern Australia).

How to treat

Follow current guidelines for the treatment of acute asthma.

Acute asthma management is based on:⁹

- assessing severity (mild/moderate, severe or life-threatening) while starting salbutamol treatment immediately, e.g:
 - adults and children over 6 years: 4–12 puffs (100 mcg per actuation) via pressurised metered-dose inhaler plus spacer for mild/moderate acute asthma; 12 puffs for severe acute asthma – doses repeated every 20 minutes for first hour; 2 x 5 mg nebulas via oxygen-driven nebuliser for life-threatening asthma
 - children under 5 years: up to 6 puffs for mild/moderate or severe acute asthma via pressurised metered-dose inhaler plus spacer (with mask if needed) – doses repeated every 20 minutes for first hour; 2 x 2.5 mg nebulas via oxygen-driven nebuliser for life-threatening asthma
- administering oxygen therapy, if required, and titrating oxygen saturation to target of 92–95% (adults) or at least 95% (children)
- completing observations and assessments (when appropriate, based on clinical priorities determined by

People with allergic rhinitis but never asthma

For people with allergic rhinitis but no history of asthma:

- identify those allergic to grass pollens for treatment. For adults, treat with intranasal corticosteroids starting at least 2 weeks (ideally 6 weeks) before predicted peak pollen concentrations and continuing until pollens abate (1 September–31 December).
- manage allergic rhinitis according to current guidelines for adults and children, and provide a [treatment plan](#).¹⁰
- explain how to recognise asthma symptoms and what to do, including how to get and use a reliever inhaler (ideally with spacer), and provide asthma first aid information – including when to call an ambulance.
- warn against being outdoors just before and during thunderstorms, especially in wind gusts that precede the rain front, in grass pollen season (October–December in south-eastern Australia).

If symptoms are not controlled by treatment, consider specialist referral to investigate other options, such as specific allergen immunotherapy (desensitisation).

Others

People without either allergic rhinitis or asthma are at low risk of thunderstorm asthma. They can be reassured that their risk is low and encouraged to learn asthma first aid so they can help others.

GPs, pharmacists and nurses working in communities with a high proportion of people born overseas can help raise awareness of epidemic thunderstorm asthma.

Many people who presented with thunderstorm asthma symptoms during the November 2016 Victorian epidemic thunderstorm asthma event were born overseas, and may not have had previous experience or knowledge of asthma or allergic rhinitis.

baseline severity)

- administering systemic corticosteroids within the first hour of treatment (routinely in adults and children 6 and over; if inadequate response to salbutamol children under 5)
- repeatedly reassessing response to treatment and either continuing treatment or adding on treatments, until acute asthma has resolved (or patient is transferred to an

intensive care unit or admitted to hospital)

- observing the patient for at least 1 hour after dyspnoea/ respiratory distress has resolved.

After the acute episode has resolved, comprehensive post-acute care should be provided and an appointment should be made for thorough follow-up.

Key messages for patients

The simple message is: By football grand final weekend, you should be taking your hay fever nasal spray, asthma preventer, or both – and don't stop until New Year's Day.*

*Most adults with asthma need to take a preventer all year, not just in springtime.

People with allergic rhinitis

If you have seasonal allergic rhinitis (springtime hay fever), there is a chance you could have an asthma attack if you are outside in gusty wind during a thunderstorm in a place where there is ryegrass pollen in the air (most of south-eastern Australia). This can happen even if you don't have asthma. The risk is highest between October and the end of December.

What you can do to keep safe:

- During spring and early summer, use a corticosteroid nasal spray (e.g. Avamys, Azonaire, Beconase, Budamax, Budesonide, Flixonase, Nasonex, Omnaris, Rhinocort, Sensease, Telnase). Start at the beginning of September and continue to the end of December.
- Follow the pollen counts and weather forecasts during spring and early summer so you know if a storm is coming.
- Just before and during storms with wind gusts, get inside a building or car with the windows shut and the air conditioner switched to recirculate/ recycled.

People with asthma

If you have asthma and pollen allergy, you could have a severe asthma attack if you are outside in gusty wind during a springtime thunderstorm in a place where there is ryegrass pollen in the air (most of south-eastern Australia).

How do I know if I'm allergic to ryegrass pollen without having allergy tests? Signs can include having asthma symptoms that tend to flare up in spring, and having allergic rhinitis (hay fever). If you're not sure, follow the safety steps anyway.

What you can do to keep safe:

- Keep taking your preventer medication as prescribed. If you do not normally use a preventer all year, you should use it during September–December if you are going to be in an area where there is ryegrass pollen.
- Follow the pollen counts and weather forecasts during spring and early summer so you know if a storm is coming.
- Make sure your written asthma action plan is up to date and includes thunderstorm advice – talk to your GP.
- Avoid being outdoors just before and during thunderstorms, especially in cold wind gusts that come before the rain. Get inside a building or car with the windows shut and the air conditioner switched to recirculate/recycled.

Everyone

Learn about asthma first aid (www.nationalasthma.org.au/asthma-first-aid)

Community-level strategy for managing epidemic thunderstorm asthma

Management strategies target community subgroups according to risk profile.

Strategies targeting the whole community

- Improved detection and management of asthma and allergic rhinitis
- Public education – people at low risk (no history of asthma, allergic rhinitis or allergy to ryegrass pollen) should be aware of epidemic thunderstorm asthma, be able to recognise the symptoms of asthma, and know how to perform asthma first aid in case they or their family or friends develop asthma in the future.

Strategies targeting those at risk due to a history of asthma or seasonal allergic rhinitis (hay fever)

Management depends on patient risk profile, including allergy status, and includes combinations of the following measures:

- appropriate availability of a reliever inhaler throughout the grass pollen season (all)
- knowledge of asthma first aid (all)
- avoidance advice (all) – avoid being outdoors just before and during thunderstorms in October through December, especially during wind gusts that precede the rain front
- effective management of allergic rhinitis, including treatment with intranasal corticosteroids throughout the grass pollen season (1 September–31 December) where indicated
- good year-round asthma control, including regular use of preventers containing inhaled corticosteroid where indicated, as recommended in the Australian Asthma Handbook (www.asthmahandbook.org.au)
- for those with asthma for whom year-round inhaled corticosteroids are not otherwise indicated, regular use of a preventer containing an inhaled corticosteroid throughout spring and early summer (1 September–31 December) to cover the grass pollen season
- provision of an up-to-date written asthma action plan that includes thunderstorm advice for those with asthma.

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More information

- ▶ Asthma first aid
nationalasthma.org.au/asthma-first-aid
- ▶ Asthma treatment guidelines
astmahandbook.org.au
- ▶ Inhaler demonstration videos and instruction handouts
nationalasthma.org.au/how-to-videos
- ▶ Asthma education and training workshops
nationalasthma.org.au/health-professionals/education-training
- ▶ Australasian Society of Clinical Immunology and Allergy
allergy.org.au

Information for your patients

- ▶ Better Health Channel
betterhealth.vic.gov.au
- ▶ Asthma Australia
asthmaaustralia.org.au

Disclaimer

Evidence on the causes and prevention of thunderstorm asthma is limited. National Asthma Council Australia will update information and recommendations as more evidence becomes available.

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