



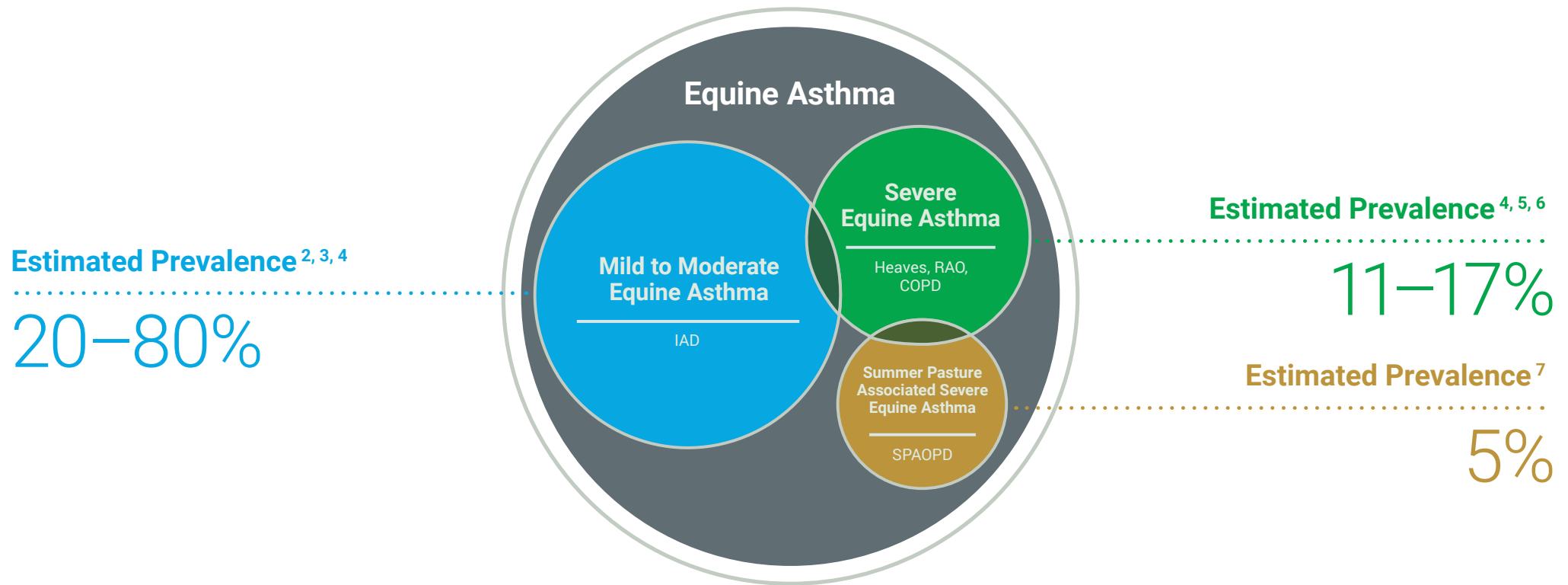
DISEASE & DIAGNOSIS

Could it be
equine asthma?

Equine asthma can take their breath away

What is Equine Asthma Syndrome?

Equine Asthma Syndrome is an umbrella term used to describe chronic, non-infectious inflammatory diseases affecting the lower airways in horses.¹



The air they breathe may be causing lower airway inflammation^{8,9}

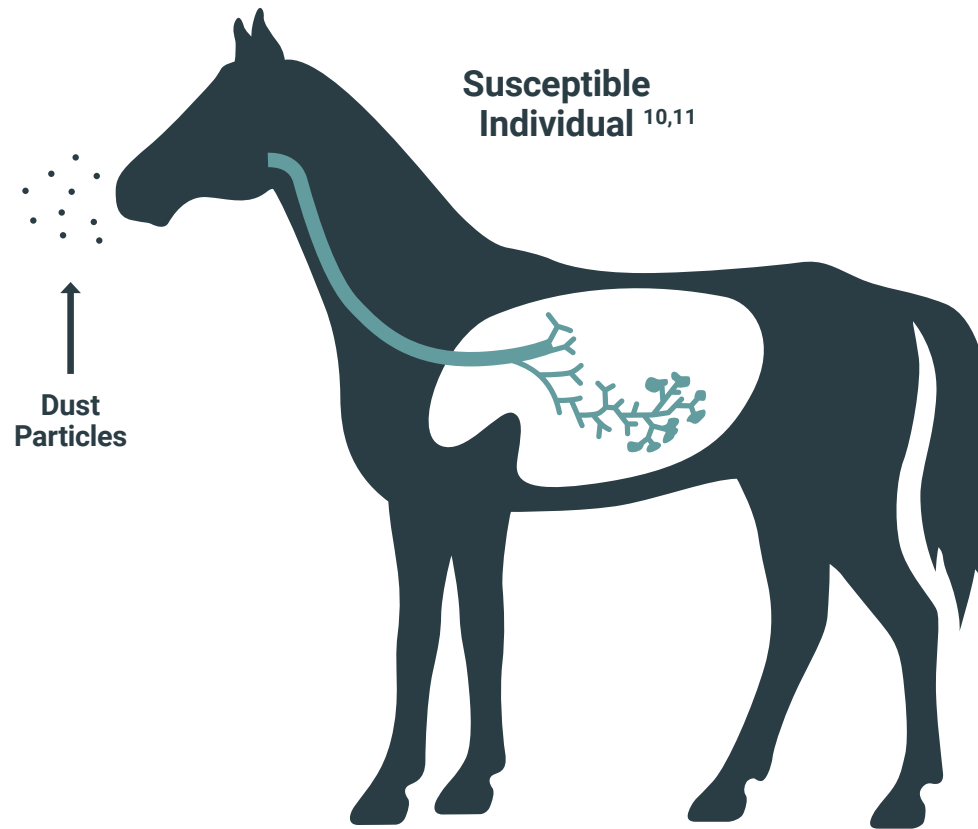
Hay & Bedding

are the main sources of respirable dust particles^{8,9}



$\leq 5\mu\text{m}$

is a respirable particle size that reaches the lower airway⁸



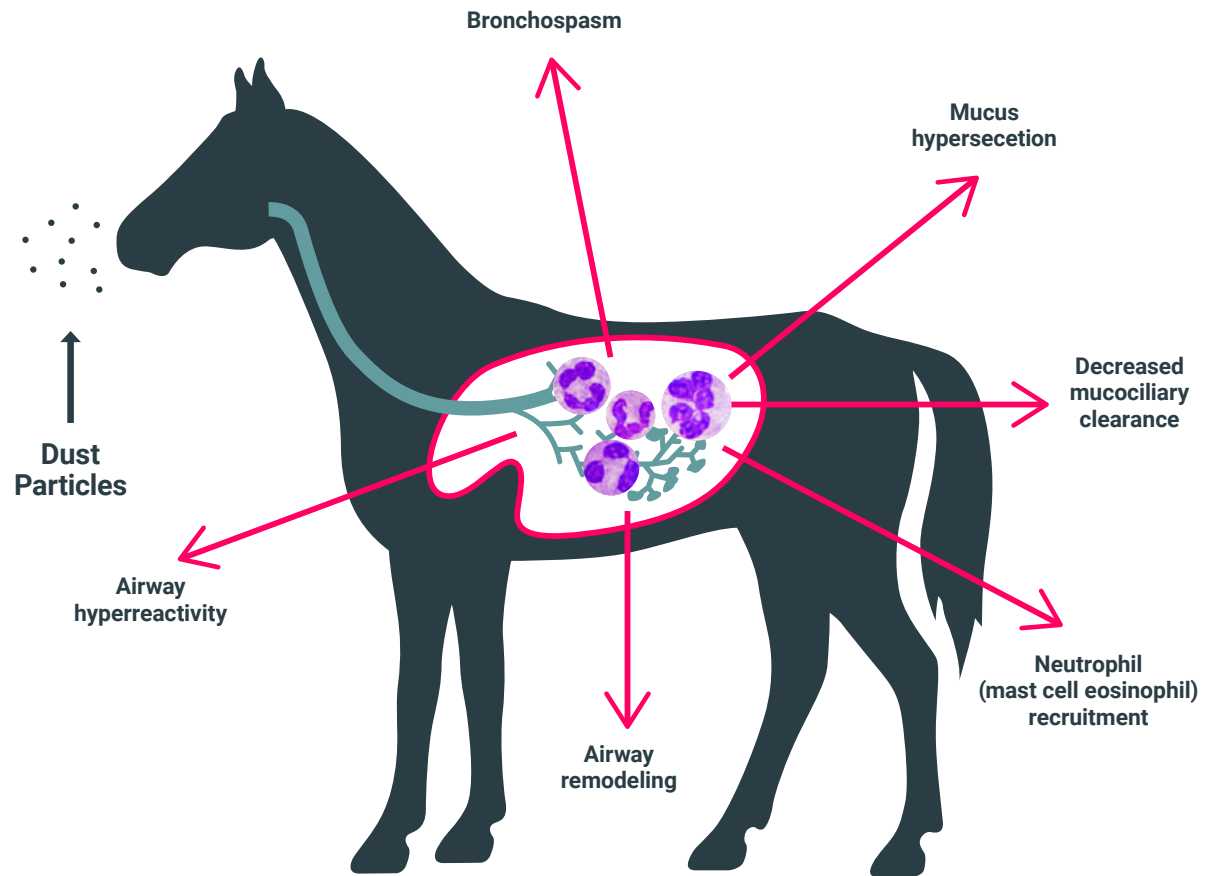
The air they breathe may be causing lower airway inflammation^{8,9}

Hay & Bedding

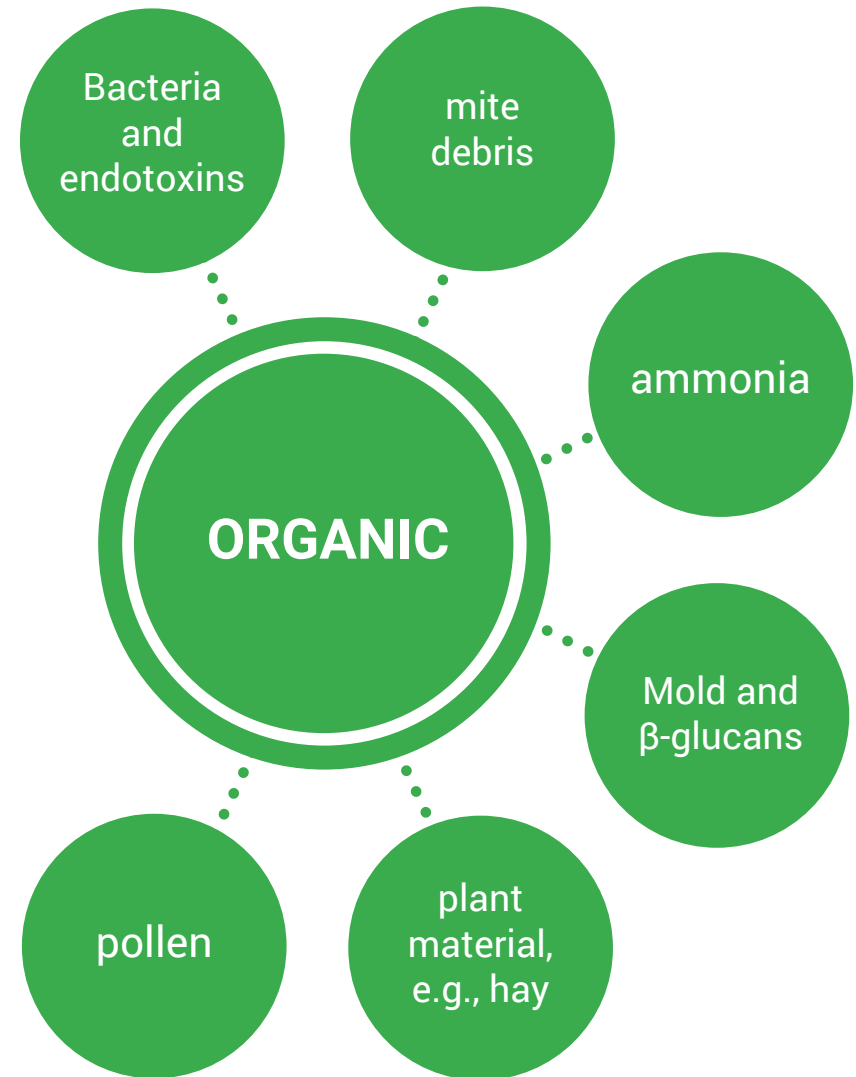
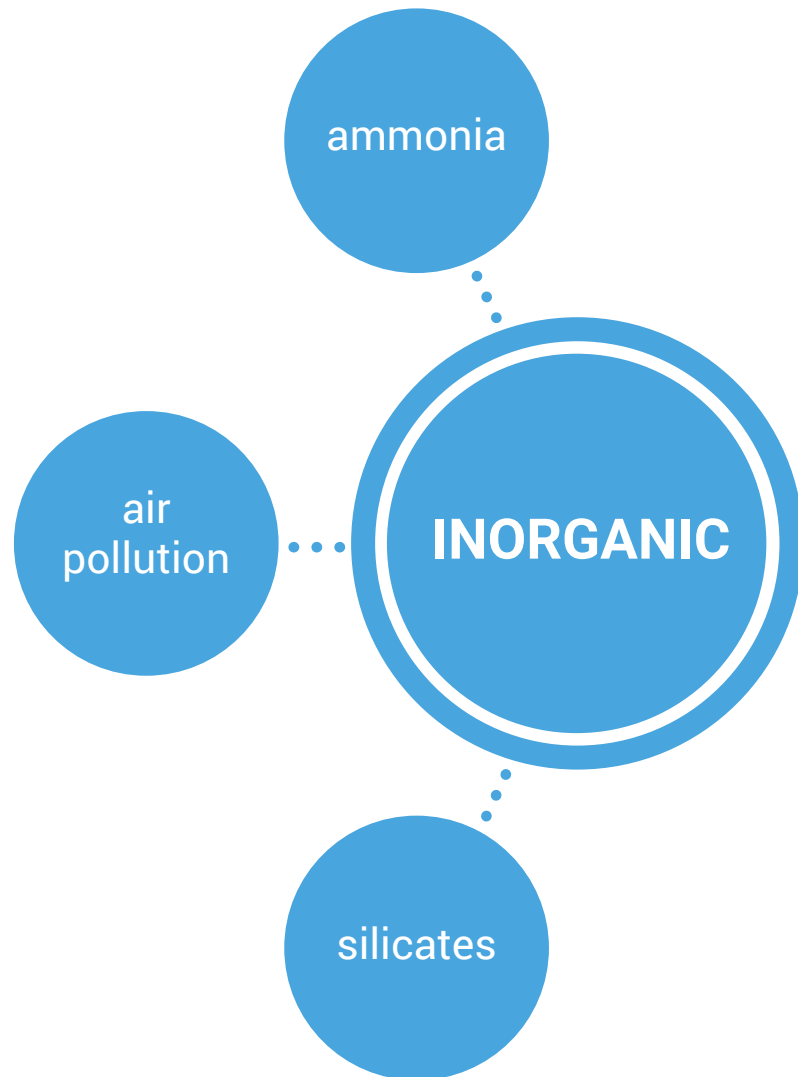
are the main sources of respirable dust particles^{8,9}

$\leq 5\mu\text{m}$

is a respirable particle size that reaches the lower airway⁸



Respirable particles associated with equine asthma^{8,9}





>25%

neutrophils in BALF may mean
severe equine asthma ¹

Cell types found in bronchoalveolar lavage fluid help tell the story of equine asthma from deep within the lung.

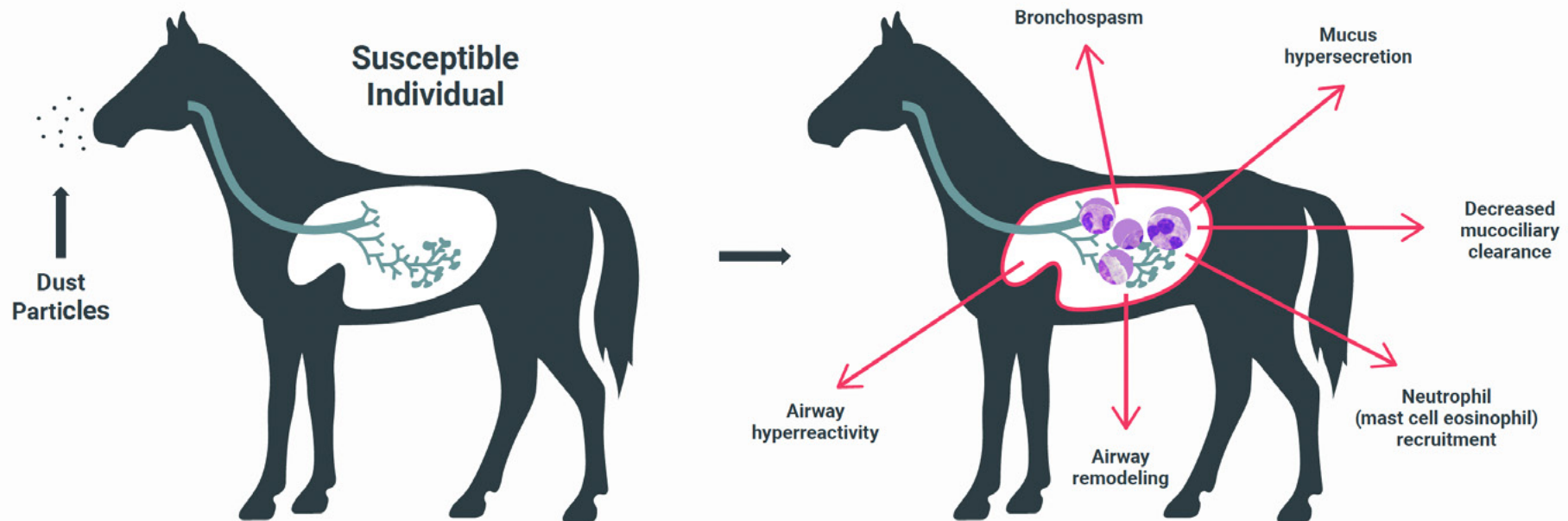
Pulmonary function testing is the gold standard for assessing severity of equine asthma and response to treatment; however, it is limited to specialized respiratory centers. ¹²

What's in your BALF? ¹

Inflammatory cells in BALF	Healthy horses	Mild to moderate equine asthma	Severe equine asthma
Neutrophils	≤5%	≥10%	>25%
Mast cells	≤2%	and/or ≥5%	≤2%
Eosinophils	≤1%	and/or ≥5%	≤1%

- Recommended as an aid in confirmation of diagnosis of equine asthma¹
- Recommended for monitoring the response to environmental modifications
- **NOT** recommended in assessing the response to pharmacological treatments^{13, 14}

Pathophysiology of equine asthma



Dust exposure

Respirable airborne particles from hay and bedding are the main triggers of equine asthma.¹

Susceptible individuals

Not all horses exposed to the same high dust environment will develop equine asthma. Genetics and infectious agents have been linked to increased risk of this disease.^{2,3,4}

Bronchospasm

Characterized by an exaggerated and persistent contraction of airway smooth muscle.⁵

Mucus hypersecretion

Increased mucus secretion in response to an influx of inflammatory cells in the airway contributes to airway obstruction in asthmatic horses.⁶

Decreased mucociliary clearance

Decreased rate of mucus clearance in horses with severe asthma may contribute to the accumulation of airway secretions and airway obstruction.⁶

Inflammatory cell recruitment

Equine asthma is characterized by a chronic increase in numbers of inflammatory cells in the lower airway, (mainly neutrophils).¹

Airway remodeling

Persistent structural thickening of small airways caused by chronic inflammation can result in smooth muscle thickness 3x that of normal airways.⁷

Airway hyperreactivity (AHR)

Exaggerated bronchoconstrictor response to inhaled stimuli that have little or no effect in healthy horses (e.g. moldy hay, histamine).⁸

References

1. Couëtill, L.L. et al, 2016. Inflammatory airway disease of horses—revised consensus statement. *Journal of veterinary internal medicine*, 30(2), pp.503-515.
2. Gerber, V. et al, 2009. Mixed inheritance of equine recurrent airway obstruction. *Journal of veterinary internal medicine*, 23(3), pp.626-630.

3. Fortier, G. et al, 2013. Long-lasting airway inflammation associated with equid herpesvirus-2 in experimentally challenged horses. *The Veterinary Journal*, 197(2), pp.492-495.
4. Houtsma, A. et al, 2015. Association between inflammatory airway disease of horses and exposure to respiratory viruses: a case control study. *Multidisciplinary respiratory medicine*, 10(1), p.33.

5. de Lagarde, M. et al, 2014. N-butylscopolammonium bromide causes fewer side effects than atropine when assessing bronchoconstriction reversibility in horses with heaves. *Equine veterinary journal*, 46(4), pp.474-478.
6. Gerber, V., 2001, July. Mucus in equine lower airway disease. In *Proceedings of the 2nd World Equine Airways Symp and 19th Comp Respir Soc Meet*, CD-ROM (pp. 1-11).

7. Leclerc, M. et al, 2011. Effect of antigenic exposure on airway smooth muscle remodeling in an equine model of chronic asthma. *American journal of respiratory cell and molecular biology*, 45(1), pp.181-187.
8. Hoffman, A.M., 2009. Airway reactivity in the assessment of lung function. In *World Equine Airway Symposium*, Bern.

	Mild to Moderate Equine Asthma (formerly IAD)	Severe Equine Asthma (formerly RAO, SPAOPD and HEAVES)
Age of onset	Likely younger horses (sport and racehorses), but all ages can be affected	Typically >7 years old
Clinical signs	<ul style="list-style-type: none"> • Poor performance • Occasional coughing during exercise or at rest • Nasal discharge may be present • Excess tracheal mucus 	<ul style="list-style-type: none"> • Increased respiratory effort at rest, with abdominal lift and nasal flaring • Frequent coughing • Nasal discharge • Exercise intolerance
Recurrence	May completely resolve with or without treatment - low risk of recurrence	Recurrent and progressive; incurable, requires lifelong management
BAL cytology	<ul style="list-style-type: none"> • Mast cells >5% and/or mild increase in neutrophils >10% and/or eosinophils >5% 	Moderate to severe increase in neutrophils >25%
Airway obstruction	<ul style="list-style-type: none"> • Subclinical • No evidence of airflow limitation based on esophageal balloon catheter technique ($\Delta P_{\max} < 10 \text{ cm H}_2\text{O}$) 	<ul style="list-style-type: none"> • Dyspnea at rest • Moderate to severe airflow limitation during disease exacerbation based on esophageal balloon catheter technique ($\Delta P_{\max} < 15 \text{ cm H}_2\text{O}$)
Airway hyperresponsiveness	Yes	Yes
Airway remodeling	No data/conflicting evidence	Airway smooth muscle hypertrophy and extracellular matrix deposition
Arterial blood gas	During maximal exercise, gas exchange may be impaired, with decreased partial pressure of oxygen (hypoxemia)	Impaired gas exchange has been found at rest (both during disease exacerbation and remission) and during exercise. At rest: hypoxemia. During submaximal exercise: hypercapnia, hypoxia and hyperlactatemia

1. Couëtil, L.L., Cardwell, J.M., Gerber, V., Lavoie, J.P., Léguillette, R. and Richard, E.A., 2016. Inflammatory airway disease of horses—revised consensus statement. *Journal of veterinary internal medicine*, 30(2), pp.503-515.
2. Mazan, M.R., 2015. Update on noninfectious inflammatory diseases of the lower airway. *Veterinary Clinics: Equine Practice*, 31(1), pp.159-185.
3. Burrell, M.H., Wood, J.L.N., Whitwell, K.E., Chanter, N., Mackintosh, M.E. and Mumford, J.A., 1996. Respiratory disease in thoroughbred horses in training: the relationships between disease and viruses, bacteria and environment. *Veterinary Record*, 139(13), pp.308-313.
4. Wasko, A.J., Barkema, H.W., Nicol, J., Fernandez, N., Logie, N. and Léguillette, R., 2011. Evaluation of a risk-screening questionnaire to detect equine lung inflammation: results of a large field study. *Equine veterinary journal*, 43(2), pp.145-152.
5. Couëtil, L.L., Ward MP., 2003. Analysis of risk factors for recurrent airway obstruction in North American horses: 1,444 cases (1990-1999). *J Am Vet Med Assoc*. 223:1645–50.
6. Hotchkiss, J.W., Reid, S.W.J. and Christley, R.M., 2007. A survey of horse owners in Great Britain regarding horses in their care. Part 2: Risk factors for recurrent airway obstruction. *Equine veterinary journal*, 39(4), pp.301-308
7. Swiderski, C.E., Bowser, J.E. and Costa, L.R.R., 2017. Pasture associated asthma. *Proceedings of the American College of Veterinary Internal Medicine*, National Harbor, Maryland, USA.
8. Art, T., McGorum, B.C. and Lekeux, P., 2002. Environmental control of respiratory disease. *Equine respiratory diseases*.
9. Clements, J.M. and Pirie, R.S., 2007. Respirable dust concentrations in equine stables. Part 1: validation of equipment and effect of various management systems. *Research in veterinary science*, 83(2), pp.256-262.
10. Gerber, V., Baleri, D., Klukowska-Rötzler, J., Swinburne, J.E. and Dolf, G., 2009. Mixed inheritance of equine recurrent airway obstruction. *Journal of veterinary internal medicine*, 23(3), pp.626-630.
11. Houtsma, A., Bedenice, D., Pusterla, N., Pugliese, B., Mapes, S., Hoffman, A.M., Paxson, J., Rozanski, E., Mukherjee, J., Wigley, M. and Mazan, M.R., 2015. Association between inflammatory airway disease of horses and exposure to respiratory viruses: a case control study. *Multidisciplinary respiratory medicine*, 10(1), p.33.
12. Hoffman, A.M., 2002. Clinical application of pulmonary function testing in horses. *Equine respiratory diseases international veterinary information service Ithaca*, DocumentNo B, 3040802.
13. Bullone M, Lavoie J-P. Science-in-brief: Equine asthma diagnosis: beyond bronchoalveolar lavage cytology. *Equine Vet*
14. Gerber, V., Schott li, H.C. and Robinson, N.E., 2011. Owner assessment in judging the efficacy of airway disease treatment. *Equine veterinary journal*, 43(2), pp.153-158.