



## Original Research

# Owner Compliance to an Environmental Management Protocol for Severe Equine Asthma Syndrome

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## ABSTRACT

Severe equine asthma (SEA) syndrome is a chronic recurrent respiratory disease, common among adult horses. The disease occurs in genetically susceptible individuals after their exposure to organic dust. Thus, environmental management has proved essential in controlling airway challenge and disease exacerbation. This is a demanding process that can only be achieved through the horse owners' cooperation. One year after initial diagnosis of SEA in a group of 39 horses, owner compliance to an environmental management protocol was evaluated. The overall compliance to the protocol was poor and the horses' clinical health and need for pharmacological management was related to the successful implementation of the environmental recommendations provided on disease diagnosis.

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## 1. Introduction

Severe equine asthma (SEA) syndrome is a chronic recurrent respiratory disease which appears to be related to domestication [1,2]. The disease is fairly common in the Northern hemisphere where horses are stabled during part of the year and in the UK there is an estimated prevalence of 14% [3].

This naturally occurring illness occurs in genetically predisposed individuals after exposure to environmental risk factors (organic dust) [4,5]. Feed and bedding materials are the main sources of respirable dust particles, which include mold spores, mites, endotoxins, antigenic materials, and pollen [6,7]. In addition, traditional housing systems have significantly higher respirable dust concentrations than outdoor systems [8].

*Animal welfare/ethical statement:* Horses described in this work where clinical cases referred to the FMV-UL Equine Teaching Hospital for respiratory evaluation. Owner's signed an informed consent form, specific for this work, which was also approved by the Ethics and Animal Welfare Comity of the Faculty of Veterinary Medicine of the University of Lisbon, under project reference 007/2014.

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When exposed to organic dust, susceptible horses present with airway inflammation and obstruction as well as bronchial hyperresponsiveness. The most common clinical signs are cough, nasal discharge, increased respiratory efforts at rest, and exercise intolerance [9].

Management of SEA requires environmental control and medical treatment. Medical treatment focuses on controlling airway inflammation through corticosteroid therapy and reducing bronchospasm with bronchodilators [10]. However, environmental management should be the primary goal because clinical signs and lung function quickly improve in a low-dust environment, even without medication [11,12]. Ideally, asthmatic horses should be kept at pasture all day and fed grass or a completely cubed or pelleted diet. Alternatively housing facilities, bedding materials, stable management, and feeding, should be adapted to minimize airway challenge and accommodate the requirements of the asthmatic horse [10,13].

## 2. Materials and Methods

### 2.1. Horses

Severe equine asthma was diagnosed in 39 adult horses from independent locations, aged between 8 and 18 years (mean age

12.6 ± 3.7). The horses were referred to the Equine Teaching Hospital of Lisbon's Veterinary College (University of Lisbon) and were examined during disease exacerbation.

All animals were vaccinated for tetanus and influenza and had a history of being fed hay in the last two months before examination. Pharmacological treatment, with either corticosteroids or bronchodilators, was not administered in the 2 weeks before the horse's clinical evaluation at the Equine Teaching Hospital.

## 2.2. Severe Equine Asthma Syndrome Staging

Severe equine asthma diagnosis was based on clinical examination, thoracic x-ray, bronchial endoscopy, and bronchoalveolar lavage fluid cytology, according to clinical staging method published by Tilley et al. [14].

A score was attributed to each parameter, based on specific clinical variables, and the sum of the scores indicated the stage of the horse. The clinical score involved the evaluation of cough, nasal flare, and abdominal lift. The thoracic x-ray score required assessment of interstitial pattern, bronchial radiopacity, tracheal thickening, and bronchial thickening. The endoscopy score was determined based on mucus characteristics, namely accumulation, color, localization, and thickness and apparent viscosity. The bronchoalveolar lavage fluid cytology score was based on neutrophil percentage. Horses were considered to be SEA-affected if staged  $\geq 1$  [14].

## 2.3. Environmental Management—Initial Evaluation

On disease diagnosis, a questionnaire was given to the owners to obtain information concerning the housing and feeding conditions of each horse as well as the clinical signs perceived by the owners.

**Table 1**  
Horse owner questionnaire used in both interviews to evaluate environmental management.

Environmental Management Questionnaire
1. Is your horse stabled? <input type="checkbox"/> Stabled <input type="checkbox"/> Pasture
2. How would you describe the housing ventilation? <input type="checkbox"/> Poor (<2 distinct openings to facilitate ventilation) <input type="checkbox"/> Good ( $\geq 2$ distinct openings to facilitate ventilation)
3. On average how much time does the horse spend outdoors daily? <input type="checkbox"/> <6 hours <input type="checkbox"/> >6 hours
4. During cleaning and mucking out does the horse stay inside the stables? <input type="checkbox"/> Yes <input type="checkbox"/> No
5. How is the dust content of your horses' bedding material? <input type="checkbox"/> Low dust content (wood shavings, grass, rubber mattress) <input type="checkbox"/> High dust content (sawdust, straw)
6. What type of forage do you feed your horse? <input type="checkbox"/> Unsoaked hay <input type="checkbox"/> Soaked hay > 20 minutes <input type="checkbox"/> Other: _____
7. Does your horse have nasal discharge? <input type="checkbox"/> Yes <input type="checkbox"/> No
8. Does your horse have an increased breathing effort at rest? <input type="checkbox"/> Yes <input type="checkbox"/> No
9. Does your horse have episodes of cough? <input type="checkbox"/> Yes <input type="checkbox"/> No
10. Are the clinical signs associated with: <input type="checkbox"/> Hay feeding <input type="checkbox"/> Season <input type="checkbox"/> Exercise <input type="checkbox"/> No trigger factor identified
11. How often does the horse exhibit clinical signs? <input type="checkbox"/> Rarely <input type="checkbox"/> Occasionally <input type="checkbox"/> Frequently
12. Was treatment with corticosteroids and bronchodilators required to manage clinical signs? <input type="checkbox"/> Yes <input type="checkbox"/> No
Final owner assessment: Do you feel the horse has improved since the initial diagnosis? <input type="checkbox"/> Yes <input type="checkbox"/> No

The questionnaire comprised 12 closed questions and each interview was conducted by two veterinary practitioners trained for consistency (Table 1). For each animal, the housing ventilation was classified as poor (<2 openings to facilitate air circulation) or good ( $\geq 2$  sources for air circulation). Furthermore, it was ascertained if the horse was stabled or kept at pasture, the amount of time each horse spent outdoors ( $\leq$  or > than 6 hours), if the horse was turned out or kept inside during cleaning of the stables, the type of bedding material (high or low dust content), and if the horse was fed dry hay or another forage alternative. Owners were questioned whether the affected horses exhibited signs of nasal discharge, increased respiratory effort at rest, and cough. Similarly, the need of pharmacological management, with corticosteroids and bronchodilators was registered, as well as the frequency of the clinical signs observed by the owner (rare, occasional or frequent). Pharmacological treatment was administered systemically (intravenous or intramuscular) for a short period as a way of controlling overt clinical signs and was administered under the supervision of the referring veterinarian practitioners. The use of topical aerosol therapy was not reported for any of the horses included in the study. If the horse owner was unaware of the type of medication that had been administered to horse, this information was provided by the referring veterinarian. In addition, we asked the owners to identify the main trigger of their horses' clinical sign (feed, season, exercise).

After the initial evaluation, a set of guidelines comprising six management recommendations was provided to each interviewee to promote asthma remission (Table 2). The six parameters of the environmental protocol were quality of ventilation, type of housing, amount of time spent outdoors, removal of the horse during cleaning of the stables, type and dust content of bedding material used, and type of forage fed (dry hay or soaked hay).

## 1.4. Environmental Management—Follow-up

One year after initial environmental management evaluation, a telephone follow-up interview was conducted for all the participants to ascertain owner compliance to the environmental management recommendations provided a year prior. All interviews were conducted by the same veterinarian using the same 12 questions from before. Additional enquiries were made to ascertain whether the clinical status of the horse had improved (Table 1).

## 1.5. Evaluation of Owner Compliance and Influence of Environmental Parameters on Clinical Signs

To ascertain whether the owners had followed the provided guidelines (Table 1) and whether these changes had had a positive effect on the horses' respiratory health, the information obtained via telephone interview was compared with the data collected a year earlier.

The statistical analysis was performed using IBM SPSS Statistics V21.0.0 software and cross-tabulation analysis in association with the z test was used to compare proportions. An  $\alpha$ -level of 0.05 was considered significant.

Owner compliance to environmental management was classified as poor (0–2 parameters), acceptable (3–4 parameters), or good (5–6 parameters), depending on the number of environmental parameters adopted (Table 1).

**Table 2**

Environmental management guidelines given to each SEA-affected horse owner after diagnosis.

Parameter	
1	Housing must have <b>good ventilation</b> (at least two openings for fresh air circulation);
2	Avoid stabling and opt for keeping your horse at <b>pasture</b> ;
3	<b>Turn out</b> your horse for the largest amount of time possible, at least 12 hours a day;
4	During grooming and cleaning of the stables horses should stay <b>outside</b> ;
5	Bedding material: Preferential use of commercial <b>dust-free wood shavings</b> , cardboard or other low dust option and avoid materials with a potentially high dust content, such as saw dust and straw; Forage and feed
6	<b>Do not</b> feed dry hay, because of its' high dust concentration; Opt for <b>cubed or pelleted diet</b> or <b>completely immerse the hay in water for 20–30 min</b> before feeding it to your horse.

Key goal: improve air quality and reduce horse's exposure to respirable dust.

### 3. Results

#### 3.1. Clinical Signs

In the initial evaluation, all horses presented with cough and increased respiratory effort at rest ( $n = 39$ ) and a large number also exhibited nasal discharge ( $n = 22$ ). The occurrence of these clinical signs was described as either frequent ( $n = 32$ ) or occasional ( $n = 7$ ). Owners also reported that all 39 animals had required treatment with corticosteroids and bronchodilators in the two weeks before the disease diagnosis (Table 3).

When asked to identify trigger factors associated with the occurrence of clinical signs, 64.1% of owners ( $n = 25$ ) considered hay to be the main trigger factor, followed by season (30.8%,  $n = 12$ ) and exercise (5.1%,  $n = 2$ ).

A year later, owners reported an improvement of clinical signs for some horses ( $n = 25$ ), with 20 horses rarely showing clinical signs, while 6 animals continued exhibiting frequent asthma signs. During the year after the implementation of the environmental management protocol, almost half of the horses ( $n = 17$ ) did not require any medication. Regarding overall clinical improvement, cough, and nasal discharge, no significant statistical difference was found between the proportion of horses medicated and the proportion of horses which were not. However, regarding respiratory effort at rest, a significantly higher proportion ( $P < .05$ ) of the horses which did not receive medication during this period presented with a normal breathing at rest compared with the proportion of horses which received medication.

#### 3.2. Influence of Environmental Management on Clinical Signs

A statistical effect was found between poor ventilation and the presence of increased respiratory effort at rest, cough, and the need for medical treatment (Table 4). On the other hand, a good ventilation influenced the occurrence of rare clinical signs and overall improvement of the horse.

While stabling influenced the presence of cough, pasture influenced the absence of nasal discharge and cough, as well as reports of rare clinical signs, absence of pharmacological treatment, and overall clinical improvement.

The effect of the amount of time spent outdoors on breathing effort, cough, medical treatment, and overall clinical improvement was statistically significant. A statistically significant proportion of horses spending more than 6 hours outdoors had normal breathing effort at rest, did not require administration of corticosteroids and

**Table 3**

Adoption of each environmental management parameter by horse owners and health status of SEA-affected horses, before and after the implementation of the environmental guidelines.

Parameter	Before	After
Ventilation ( $n = 39$ )		
Poor	19	16
Good	20	23
Housing ( $n = 39$ )		
Stabled	39	31
Pasture	0	8
Time spent outdoors ( $n = 39$ )		
≤6 hours	31	23
>6 hours	8	16
During cleaning ( $n = 39$ )		
Stays inside	16	12
Turned out	23	27
Bed material ( $n = 39$ )		
High dust	29	18
Low dust	10	21
Hay ( $n = 39$ )		
Dry	39	30
Soaked	0	9
Nasal discharge ( $n = 39$ )		
Yes	22	15
No	17	24
Breathing effort ( $n = 39$ )		
Yes	39	14
No	0	25
Cough ( $n = 39$ )		
Yes	39	29
No	0	10
Medical treatment ( $n = 39$ )		
Yes	39	22
No	0	17
Frequency of clinical signs ( $n = 39$ )		
Rare	0	20
Occasional	7	13
Frequent	32	6
Clinical improvement ( $n = 39$ )		
Yes	—	25
No	—	14

bronchodilators, and showed clinical improvement. On the other hand, horses spending 6 hours or less outdoors was reflected by on the presence of cough.

In addition, remaining indoors during cleaning of the stables influenced owner-reporting signs of cough and the need for pharmacological treatment to manage clinical signs. There was a significant difference ( $P < .05$ ) between the proportion of horses which were turned out during this period of increased stable activity and the horses which remained indoors.

The effect of low-dust bedding materials was statistically significant ( $P < .05$ ), regarding the absence of increased respiratory effort and reports of no need for medical treatment as well as overall clinical improvement. A statistically significant difference was observed between the proportion of horses with high-dust bedding material, such as sawdust and straw, and those with low-dust bedding materials. Reporting of the presence of cough was influenced by the use of materials with high dust content.

Finally, a significant difference between the proportion of horses fed dry hay and those fed soaked hay was observed. The effect of dry hay feeding on cough, need for pharmacological treatment, and frequency of clinical signs was statistically significant ( $P < .05$ ). On the contrary, properly soaked hay (between 20–30 minutes) was related to the reports of absence of cough, of lack of medical treatment, of infrequent occurrence of clinical signs, and of overall clinical improvement.

**Table 4**  
Influence of the environmental parameters adopted by horse owners on the SEA-affected horses' health status.

Environmental Parameter	Nasal Discharge		Breathing Effort		Cough		Medical Treatment		Clinical signs			Improvement	
	Yes	No	Yes	No	Yes	No	Yes	No	Rare	Occasional	Frequent	Yes	No
Ventilation													
Poor	50%	50%	62.5% <sup>a</sup>	0% <sup>b</sup>	100% <sup>a</sup>	0% <sup>b</sup>	81.3% <sup>a</sup>	18.8% <sup>a</sup>	25% <sup>a</sup>	37.5% <sup>a</sup>	37.5% <sup>a</sup>	37.5% <sup>a</sup>	62.5% <sup>a</sup>
Good	30.4%	69.6%	17.4% <sup>b</sup>	43.5% <sup>b</sup>	56.5% <sup>b</sup>	43.5% <sup>b</sup>	39.1% <sup>b</sup>	60.9% <sup>b</sup>	69.6% <sup>b</sup>	30.4% <sup>a</sup>	0% <sup>b</sup>	82.5% <sup>b</sup>	17.4% <sup>b</sup>
Housing													
Stabled	48.4% <sup>a</sup>	51.6% <sup>a</sup>	41.9%	16.1% <sup>a</sup>	83.9% <sup>a</sup>	16.1% <sup>a</sup>	64.5% <sup>a</sup>	35.5% <sup>a</sup>	41.9% <sup>a</sup>	38.7% <sup>a</sup>	19.4% <sup>a</sup>	58.1%	41.9%
Pasture	0% <sup>b</sup>	100% <sup>b</sup>	87.5%	62.5% <sup>b</sup>	37.5% <sup>b</sup>	62.5% <sup>b</sup>	25.5% <sup>b</sup>	75% <sup>b</sup>	87.5% <sup>b</sup>	12.5% <sup>a</sup>	0% <sup>a</sup>	87.5%	12.5%
Time outdoors													
≤6 hours	43.5%	56.5%	52.2% <sup>a</sup>	8.7% <sup>a</sup>	91.3% <sup>a</sup>	8.7% <sup>a</sup>	69.6% <sup>a</sup>	30.4% <sup>a</sup>	39.1% <sup>a</sup>	34.8% <sup>a</sup>	26.1% <sup>a</sup>	47.8% <sup>a</sup>	52.2% <sup>a</sup>
>6 hours	31.3%	68.8%	12.5% <sup>b</sup>	50% <sup>b</sup>	50% <sup>b</sup>	50% <sup>b</sup>	37.5% <sup>b</sup>	62.5% <sup>b</sup>	68.8% <sup>a</sup>	31.3% <sup>a</sup>	0% <sup>b</sup>	87.5% <sup>b</sup>	12.5% <sup>b</sup>
During cleaning													
Stays inside	58.3%	41.7%	58.3% <sup>a</sup>	8.3%	91.7%	8.3%	83.3% <sup>a</sup>	16.7% <sup>a</sup>	16.7% <sup>a</sup>	50% <sup>a</sup>	33.3% <sup>a</sup>	41.7%	58.3%
Turned out	29.6%	70.4%	25.9% <sup>a</sup>	33.3%	66.7%	33.3%	44.4% <sup>b</sup>	55.6% <sup>b</sup>	66.7% <sup>b</sup>	25.9% <sup>a</sup>	7.4% <sup>b</sup>	74.1%	25.9%
Bed material													
High dust	47.4%	52.6%	52.6% <sup>a</sup>	10.5% <sup>a</sup>	89.5% <sup>a</sup>	10.5% <sup>a</sup>	73.7% <sup>a</sup>	26.3% <sup>a</sup>	36.8%	36.8%	26.3%	57.9%	42.1%
Low dust	30%	70%	20% <sup>b</sup>	40% <sup>b</sup>	60% <sup>b</sup>	40% <sup>b</sup>	40% <sup>b</sup>	60% <sup>b</sup>	65% <sup>b</sup>	30%	5%	70%	30%
Hay													
Dry	46.7%	53.3%	43.3%	6.7% <sup>a</sup>	93.3% <sup>a</sup>	6.7% <sup>a</sup>	70% <sup>a</sup>	30% <sup>a</sup>	40% <sup>a</sup>	40% <sup>a</sup>	20% <sup>a</sup>	53.3% <sup>a</sup>	46.7% <sup>a</sup>
Soaked	11.1%	88.9%	11.1%	88.9% <sup>b</sup>	11.1% <sup>b</sup>	88.9% <sup>b</sup>	11.1% <sup>b</sup>	88.9% <sup>b</sup>	88.9% <sup>b</sup>	11.1% <sup>a</sup>	0% <sup>a</sup>	100% <sup>b</sup>	0% <sup>b</sup>

Different letters indicate a difference in proportions for a  $P < .05$ . Comparisons were made for each variable, by line and for each factor level.

### 3.3. Owner Compliance to Environmental Management Guidelines

The overall compliance to the environmental management guidelines was deemed poor in 51.3% of the cases ( $n = 20$ ), acceptable in 33.3% ( $n = 13$ ), and good for the remaining 15.4% ( $n = 6$ ). Of this last group, only 3 interviewees (7.7%) managed to adopt all the six environmental parameters suggested (Table 5).

In addition, four owners failed to adopt any of the environmental management parameters recommended to them and reported no clinical improvement, as well the need to use corticosteroids and bronchodilators to manage the disease.

The two parameters which were most unpopular among the owners were feeding soaked hay (23.1%) and keeping the horse at pasture (20.5%). By contrast, the change of bedding material was the most adopted environmental parameter (53.8%) (Table 3).

Increased compliance had an effect on the absence of respiratory effort at rest, absence of cough, decreased frequency of clinical signs, nonadministration of pharmacological treatment, and a clinical improvement of the horse.

## 4. Discussion

In this study, SEA was diagnosed using a clinical staging method. The discriminant analysis of this method showed very good results, with 92.5% of original cases correctly classified and 85% of cases correctly classified through cross-validation, thus presenting a viable discrimination between groups [14].

To evaluate owner compliance, owners were interviewed to ascertain the adherence to environmental management parameters, before and one year after disease diagnosis.

At the time of diagnosis, all horses presented with cough and increased respiratory effort at rest and all required treatment with corticosteroids and bronchodilators for the control of airway inflammation and obstruction. Furthermore, 22 horses showed signs of nasal discharge, which may indicate that this clinical sign is not always present in SEA-affected horses or that owners tend to neglect its occurrence [1,15].

The assessed overall compliance to environmental management was extremely low, with more than half the owners (51.3%) adopting only two or less of the suggested parameters (poor compliance). The compliance could only be considered good in 6 cases (15.4%), in which 5 or 6 of the suggested parameters were adopted.

Compliance was based on the number of parameters adopted, and although the adoption of one parameter might influence the occurrence of others (e.g., a horse in pasture will have a good ventilation), care has been taken to evaluate each parameter individually. In fact, even though some of our studied population was turned out to pasture, they were still being fed dry hay, which would result in a high concentration of airborne dust particles around the horse's nostrils when eating [13].

Furthermore, four of the interviewed owners chose not to adopt any of the provided environmental recommendations, which can be considered very worrying. These particular animals did not show any signs of clinical improvement, required pharmacological treatment to control clinical signs, and the owners continued to report frequent signs of nasal discharge, cough, and increased breathing effort at rest one year after the initial diagnosis of the disease at the time of the second questionnaire.

Of all the environmental recommendations, the type of bedding was the most easily modified ( $n = 11$ ). Still, the use of straw and saw dust bedding was associated with cough, which can be related to the high content of respirable dust particles found in these materials [16].

Despite ventilation being essential for air renewal and, for eliminating some of the ammonia and dust particles found in

**Table 5**  
Influence of owner compliance on SEA-affected horses health status.

Health Status	Owner Compliance		
	Bad (n = 20)	Acceptable (n = 13)	Good (n = 6)
Nasal discharge			
Yes	55%	23.1%	16.7%
No	45%	76.9%	83.3%
Breathing effort			
Yes	55% <sup>a</sup>	23.1%	0% <sup>b</sup>
No	45% <sup>a</sup>	76.9%	100% <sup>b</sup>
Cough			
Yes	100% <sup>a</sup>	69.2% <sup>b</sup>	25.6% <sup>c</sup>
No	0% <sup>a</sup>	30.8% <sup>b</sup>	100% <sup>c</sup>
Treatment			
Yes	80% <sup>a</sup>	46.2% <sup>b</sup>	0% <sup>c</sup>
No	20% <sup>a</sup>	53.8% <sup>b</sup>	100% <sup>c</sup>
Clinical signs			
Rare	25% <sup>a</sup>	69.2% <sup>b</sup>	100% <sup>b</sup>
Occasional	45% <sup>a</sup>	30.8% <sup>a, b</sup>	0% <sup>b</sup>
Frequent	30% <sup>a</sup>	0% <sup>b</sup>	0% <sup>a, b</sup>
Improvement			
Yes	45% <sup>a</sup>	76.9% <sup>a, b</sup>	100% <sup>b</sup>
No	55% <sup>a</sup>	23.1% <sup>a, b</sup>	0% <sup>b</sup>

Different letters indicate a difference in proportions for a  $P < .05$ . Comparisons were made for each variable and for each column.

stables [8], at least 16 asthmatic horses were continually maintained in stables with poor ventilation.

At the time of the initial evaluation, all 39 asthmatic horses were stabled and owners reported that they frequently manifested clinical signs [1]. At the second interview, the horses, which were kept at pasture, presented with rare clinical signs of nasal discharge and cough and showed an overall improvement associated with lack of need for pharmacological treatment.

Turning the asthmatic horses out for more than 6 hours per day was insufficient to ensure disease remission. This could be related to the fact the owners may have included, here, the time spent riding the horse, which may further contribute to hyper-reactiveness and inflammation, caused either by dusty riding arenas or by the air flow velocity and temperature during exercise [17].

It is possibly easier for owners to adopt a change in protocol which solely involves a new purchase (e.g., wood shavings) rather than one that requires a change in everyday habits (e.g., turning out the horses or taking them from the stables during periods of increased activity) or modification of infrastructures (e.g., ventilation).

The fact that the horse should not be inside during cleaning and mucking out is an established husbandry practice mostly related to the risk of injuring the horse while cleaning the bed. The potential respiratory hazard for the horses associated with the increased concentration of respirable dust particles is usually neglected, although owners seem aware of the health risk it poses for humans. Some owners claimed it was unpractical to remove the horses, thus these animals tended to present cough and required medical treatment.

Furthermore, although hay was identified as a trigger factor in 64.1% of the cases, owners proved reluctant in changing their horse's forage. To significantly reduce the concentration of respirable dust, hay should be soaked (completely immersed) in water for 20–30 minutes [13,16,18–20]. Most interviewees simply sprinkled the hay surface with water, which caused its center to remain dry and was therefore ineffective [21]. Hay soaking is a time-consuming procedure and this might be one of the reasons why so many owners refused to adopt this practice. Dry hay feeding was related to reports of cough and soaked hay feeding to clinical improvement.

In this study, overall compliance was rather poor, and many horses required medical treatment, which provides an immediate relief of clinical signs, allowing the horse to assume a more comfortable

breathing pattern. Nonetheless, airway inflammation persists if the horse's environment is not addressed [10].

It is important to note some confounding factors, namely the frequency of pharmacological administration. Although, in the present study, medication was used as a mean of controlling clinical signs for a short period, there is the possibility that owners relied on medication and opted for a suboptimal environmental management. In addition, because we did not enquire about the last time the horse was medicated before the second interview, there is also the possibility that at this time, some horses were under the influence of medication. However, we found no significant difference in overall clinical improvement, cough, and nasal discharge, between the proportion of horses which received treatment and those which did not, which supports the use of bronchodilators and corticosteroids as a temporary means of reducing airway inflammation.

A good owner compliance was associated with rare clinical signs, lack of pharmacological treatment to maintain respiratory function, and overall clinical improvement of the SEA-affected horses.

Owner compliance is therefore pivotal and persistence in maintaining the newly adopted environmental changes is essential for the horse's long-term well-being [3,18]. The poor compliance observed in the present study reinforces the need to alert veterinarians of this reality. The authors believe it is of utmost relevance that enough time is taken during consultation to increase owner awareness of the risks that are taken by lack of compliance.

In fact, in clinical trials in humans, there has been a switch from compliance to adherence, to decrease dropout rates [22]. Therefore, maybe in veterinary medicine, we should not be talking about compliance, which is based on the owner following the suggestion of the veterinarian as a form of authority, leading to a passive behavior. Instead, maybe we should work on adherence, which is based on the owner being better informed to increase trust, leading to active choices on the owner's behalf.

### Study Limitations

This study used a population of only 39 SEA-affected horses and their corresponding owners. It would be pertinent to evaluate a larger population to obtain more insight on the difficulties associated with owner compliance. Also, the frequency of pharmacological treatment varied significantly between horses, and this might have had an impact on the data obtained.

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All authors contributed to the study design, execution, interpretation of findings, and approved the final manuscript.

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