PREPARATION FOR AND MANAGEMENT OF HORSES AND ATHLETES DURING EQUESTRIAN EVENTS HELD IN THERMALLY CHALLENGING ENVIRONMENTS

Dr David Marlin, Dr Martha Misheff & Dr Peter Whitehead
March 2018

SUMMARY

Whilst ideally all equestrian events would be run in optimal climatic conditions, this is often logistically not possible. Even events planned for ideal conditions can sometimes also experience unusually extreme weather. A significant amount of research has been undertaken and applied at major events since the early 1990s that has led to improved welfare for horses through good advice, event management and improved treatment.

One of the most important advances has been in understanding how heat or heat and humidity affect horses and how to measure the level of thermal environmental stress. The FEI has adopted the Wet Bulb Globe Temperature (WBGT) Index as its method for assessing and managing thermal stress.

Recognising high body temperature and the risk to horse welfare is also essential and this document lists the signs that athletes and anyone else involved with horses at competitions should be looking for.

Acclimatising horses has also been shown to help them cope better in competitions in hot or hot and humid climates, and this document explains ways of acclimatising horses. The increased demands of acclimatisation and competition in the heat may also have implications for how nutrition is managed. Travel, dehydration and changes in diet can all increase the risk of colic and care should be taken to minimise this risk.

Long-distance travel is an unavoidable part of taking horses to major competitions. Studies suggest horses take a number of days to recover, particularly when there are changes in feed and time-zone (jet-lag) and advice is provided on best-practice to minimise health issues.

In order to keep horses healthy and performing well under conditions of increased thermal stress, some changes to normal management are indicated and these are outlined in this document.

Having all team members familiar with cold-water cooling is critical to maintaining performance in the heat and reducing the risk of heat-related illness. This applies to ALL disciplines. Practising cooling procedures and ensuring everyone understands the need for aggressive cooling at home prior to travel is important.

Athletes and support staff can also be at an increased risk of heat illness. Dehydration and high body temperature can lead to weakness, disorientation and poor decision making. Therefore, it is vital that athletes and other team members take extra care in challenging conditions and are aware of how to decrease the risk of heat related illness and recognise and know how to manage it.

Finally, recognising that a horse is not coping with the heat and seeking veterinary help can ensure that horses can remain in competition and avoid significant injury. An outline of how

to recognise and manage horses suffering from heat exhaustion or heat stroke is also provided.

Background

At the 1992 Barcelona Olympic Games, many of the horses taking part were affected by the hot and dry climatic conditions. This was particularly noticeable during the long-format speed and endurance phase of the eventing competition. Fortunately, although some horses experienced heat exhaustion, due to the skill of athletes, grooms, team managers, vets and FEI officials, there were no serious injuries or illness as a result. However, it was clear that research needed to be undertaken. Prior to Barcelona, knowledge of acclimatisation, the effects of heat on exercising horses and cooling techniques was extremely limited. As a result of the observations in Barcelona, the FEI launched an International scientific and veterinary welfare initiative in 1993 in order to ensure that appropriate advice and management was in place for the 1996 Atlanta Olympic Games.

Prior to 1992, there were only a handful of scientific papers dealing with how horses respond to exercise in thermally challenging conditions. In the period between Barcelona 1992 and Atlanta 1996, there were over 50 different scientific papers published. The FEI initiative resulted in collaboration between research groups around the world and included veterinary surgeons and scientists in universities and research institutes, as well as many vets working in practice. The results of these studies were presented and discussed at a number of major international scientific meetings between 1993 and 1996, the first of which was the FEI Samsung International Sports Medicine Conference, which took place in Atlanta in March 1994 which was chaired by Professor Leo Jeffcott. A book entitled “On to Atlanta ‘96”, which summarised the scientific and veterinary aspects of the research undertaken to date, was published in 1994 by the Equine Research Centre at the University of Guelph in Ontario (CAN) and was made widely available.

Between 1992 and 1996 the research covered a wide range of topics related to competing in thermally challenging conditions, including:

- How to accurately measure thermal environmental stress
- The physiological demands of Olympic level Eventing competition
- How horses respond to exercise in hot and hot humid conditions
- The effects of hot and humid conditions on athletes
- Nutrition of the event horse
- Electrolyte supplementation
- The effects of long-distance transport on horses
- Anhidrosis – loss of ability to sweat
- Acclimatisation to heat and humidity
- Quantifying cross-country course effort
- Effects of modifying different phases of the speed and endurance test

- Clinical evaluation of fitness to continue in the 10-minute box
- Techniques for cooling horses after exercise

The contributions of the research that contributed to the safe running of the 1996 Atlanta Olympics has been summarised in a scientific paper.[1]

Prior to the 1996 Atlanta Olympics, various articles[2] were written and seminars held in an attempt to try and disseminate the findings of the research as widely as possible. Much of this was targeted at Eventing athletes, grooms and trainers as well as team managers and vets. In general, there was good consensus and different scientists and vets generally gave very similar advice.

The 1994 FEI World Equestrian Games™ in The Hague presented an opportunity to collect further data and observe the effects of hot conditions where the air temperature and humidity reached 33°C and 50%, respectively. However, in spite of these challenging conditions and a full long-format distance speed and endurance test, there were no major injuries, heat stressed horses or fatalities according to the official veterinary report. This was almost certainly due to the supply and use of large volumes of ice and water and provision of shade to cool horses in the 10-minute box after completion of phase C (second roads and tracks; prior to cross country).

In Atlanta in 1996, a variety of measures were put in place to reduce the risk of heat related illness or injury, particularly to horses competing in the speed and endurance test. The first of these consisted of an overall reduction in distance of the speed and endurance test: Phase A -30%; Phase B (steeplechase) -20%; Phase C -30%; Phase D (Cross-country) -23%. Phase C also included mandatory halts for cooling, the first being soon after the steeplechase. The 10-minute box was also extended to 15 minutes to allow more time for horses to be effectively cooled. The overall management of the competition by the Ground Jury was advised by continuous monitoring of the Wet Bulb Globe Temperature Index (WBGT Index) which had become recognised as the most accurate way to assess the real impact of all the climate factors. The WBGT Index is a measure of the heat stress in direct sunlight, which takes into account: temperature, humidity, wind speed, sun angle and cloud cover (solar radiation). This differs from the heat index or comfort index, which only takes into consideration temperature and humidity and is calculated for shady areas. This has been previously found to be misleading in the context of equestrian sport.

The WBGT index peaked around 30°C, but in spite of this there were no heat-related problems during the competition and on average horses finished the cross-country with rectal temperatures similar to that which would have been expected for the same course in cool weather.

[1] Contributions of equine exercise physiology to the success if the 1996 equestrian Olympic games: a review. (1999) Jeffcott, L.B. and Kohn, C.W. Equine Vet J., Suppl. 30, 347-355.
[2] Marlin, D.J. (1998) Acclimation and acclimatisation of the equine athlete. Int. J. Sports. Med. Suppl. 2. (19), S164-S166.

Why are thermally challenging conditions of concern? Firstly, horses cannot perform at the same level for as long in thermally challenging conditions, even when fully acclimatised. Thus, thermally stressful conditions reduce performance. Secondly, horses that become excessively tired (fatigued) during competition in the heat are at greater risk of injury or illness. This can be due, for example, to falls during competition, collapse from heat exhaustion at the end of competition or development of heat related illness (e.g. colic, laminitis) during the recovery period back in the stable. The aim of the FEI is to provide a meaningful competition but which takes into account the increased challenge to horses and riders imposed by heat or heat and humidity. As such, when managed appropriately it should be a fair competition in which the risk to horses is no greater than at any other competition at this level.

Whilst much of the focus on heat or heat and humidity has been on the event horse, it has become clear that horses in other disciplines may also be at significant risk of heat related injury. These include horses competing in Jumping, Dressage, Driving and Endurance. Whilst the actual duration of competition in Jumping and Dressage is short, these horses are often larger, heavier horses and therefore at greater risk of over-heating, especially as a result of long periods of warm-up. The Driving horse faces similar risk to the Eventing horse; large horses, intense exercise for moderate durations. For Eventing, the change to short format and removal of the roads and tracks and steeplechase has altered the risk from competing in thermally challenging conditions but has not eliminated it. In short format, there is good evidence that horses now work harder on the cross-country phase than they did in long format.

Since Atlanta, further research into the effects of heat or heat and humidity on horses during competition has been undertaken. In addition, further work funded or supported by the FEI has taken place, including at the Athens 2004 Olympic Games and the Beijing 2008 Olympic Games. It is inevitable that in the 21 years since Atlanta, many myths and rumours concerning management of competitions and horses in thermally challenging environments have arisen. This document aims to provide a review of best practice to prepare and compete horses in thermally challenging conditions. An attempt has been made to provide the information in readily understandable, non-scientific language.

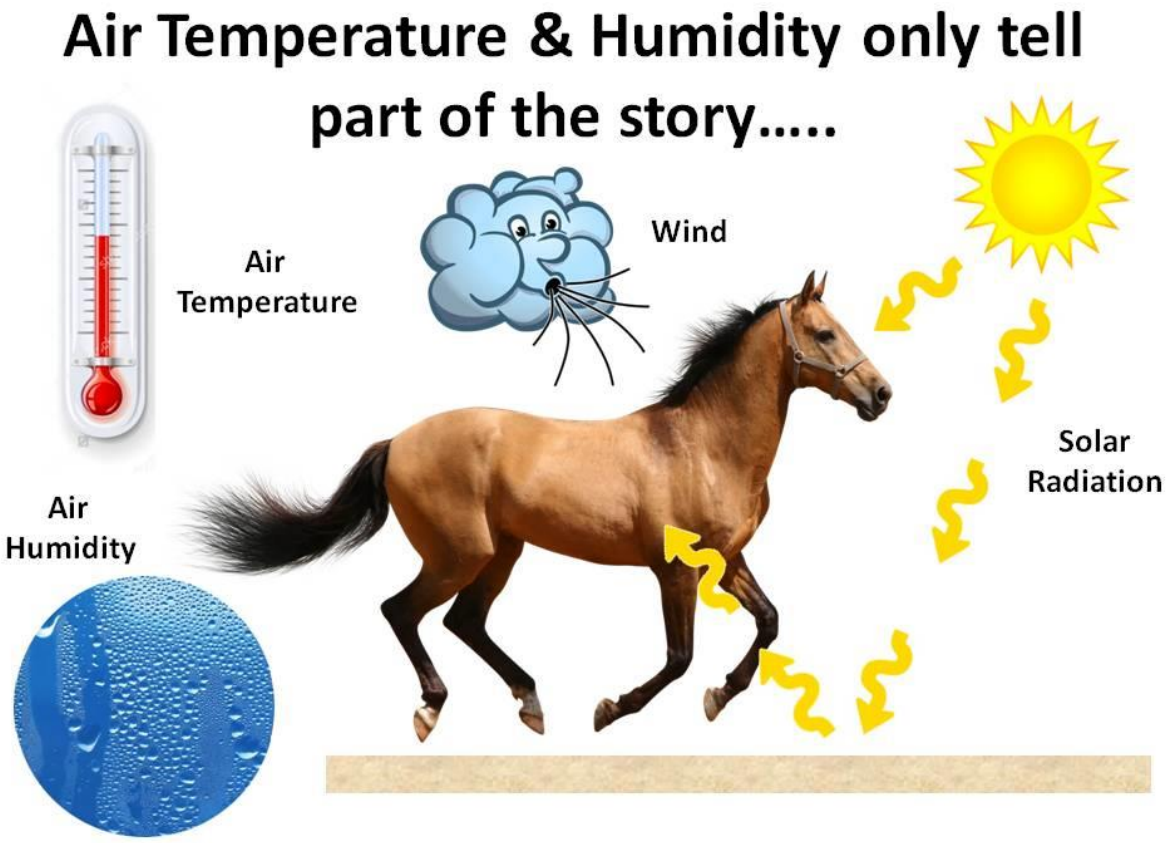
HOW DO WE ASSESS THE CLIMATE?

Assessing how thermally stressful the environment is at any point in time is unfortunately quite complex. We may have a feeling that is it particularly “hot” or “sticky” or uncomfortable, but the accuracy of our interpretation depends on many factors such as:

- Acclimatisation
- How long we have been out in the heat
- How hydrated we are
- Whether we are resting or working
- How hard we are working
- Individual tolerance of heat
- Whether we are in sun or shade

For these reasons, subjective assessment of the environment and its implications for horses and athletes is extremely unreliable. We therefore need to use objective measurement of the thermal environment. There are four different components that determine how thermally stressful any climate is at any point in time. These are a combination of:

- The shade temperature
- The amount of moisture in the air (often measured as % relative humidity)
- The strength of the sun
- The reflection of radiation off the ground
- The wind speed



Shade temperature

This is easily understood. 20°C (68°F) in the shade is comfortable. 40°C (104°F) is not comfortable.

Moisture in the air

The amount of moisture in the air is important as it determines how effective sweating is as a cooling mechanism. The amount of moisture in the air is usually expressed as the relative humidity (%RH). Horses rely heavily on sweating to keep themselves cool. In optimal conditions around 85% of heat is removed by evaporation of sweat and the remaining 15% is lost by evaporation from the respiratory tract. Sweat has to evaporate from the coat/skin to effectively cool the horse. Sweat evaporates best when the air is hot and dry and when there are clear skies and a breeze or wind. In still, overcast conditions and high humidity (80%RH or higher) even if the air temperature is high, sweat will evaporate very slowly and horses are at a high risk of overheating. Relative humidity can be confusing as in some climates it may be 100%RH and 25°C in the early morning but as the air temperature rises during the day the %RH actually decreases, although the amount of moisture in the air is actually the same.

The Sun

The sun contributes to how hot the horse or athlete feel in two ways. Firstly, the sun's rays heat us up directly. This is known as solar radiation. The best way to understand solar radiation is on a partly cloudy day, especially in winter. When the sun is out we can feel its warmth but as soon as the sun passes behind a cloud we immediately sense it's cooler. The

air temperature, humidity and wind will not have changed in that instant so the only difference is solar radiation. This is the reason why shade is helpful in hot climates. Secondly, the sun can also heat the horse and athlete up by radiation reflected up off the ground. The amount of radiation reflected depends on the surface. For example, grass absorbs a large amount of solar radiation and reflects very little making it more comfortable to be on grass in a hot climate. In contrast, arena surfaces and roads reflect a large amount of radiation and also heat up, making them less comfortable to be on.

Wind

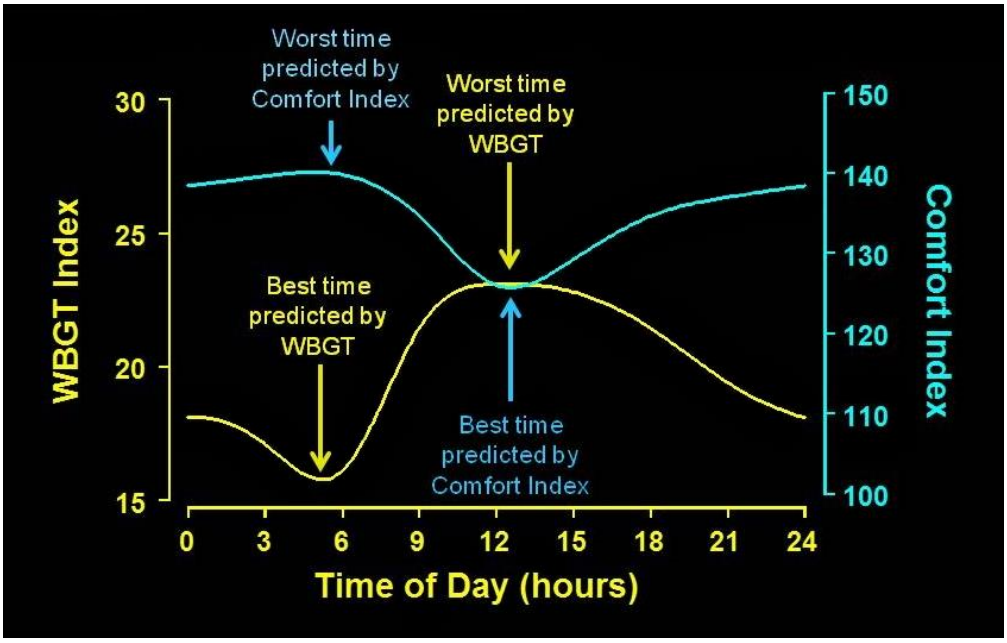
On a still day we feel less comfortable than on a day with a slight breeze. A breeze removes heat more quickly and also speeds up sweat evaporation. In winter we feel colder on a windy day due to what is usually referred to as "wind chill". This is why fans can make us and horses feel more comfortable in hot conditions.

Weighing up temperature, moisture, sun and wind

Trying to understand the overall effect of different combinations of temperature, moisture, sun and wind is extremely difficult. Many different heat indices have been developed. These are sometimes used on TV weather channels and weather websites. However, these indices have been developed for non-exercising people and not for exercising horses.

Heat Index / Comfort Index

This index should never be used for managing horses in hot or hot humid conditions as it has previously been demonstrated to be extremely unreliable and could lead to inappropriate decisions being made and a major risk to horse and athlete welfare. This index is especially unreliable in conditions of moderate to high humidity. The limitations of this index, which is calculated by adding air temperature in °F and relative humidity in %, became apparent during research for the 1996 Atlanta Olympic Games. The index predicted the worst time to run the competition would be early morning and the best time would be around noon; the opposite to what is apparent from actually riding a horse in that climate and the opposite of what local horse owners would do.



The WBGT Index

The only validated heat index for equestrian sport is the WBGT index[3]. This was developed primarily for management of the three-day event cross-country at the Atlanta 1996 Olympic Games but was also used in Athens 2004 and Beijing 2008. An FEI project to refine the guidelines based on the WBGT for Eventing, Dressage and Jumping is currently in progress.

The WBGT index is a single "temperature" that takes into account the effects of air temperature, humidity, sun and wind all at the same time. It is calculated from a measurement of Wet Bulb temperature and a measurement of the temperature inside a black globe (Figure 1). Alternatively, it can be measured with an inexpensive (~US$160; £120; €140) handheld device such as the ExTech HT30 which is widely available (Figure 2).

The WBGT index = 0.7 x Wet Bulb Temperature (°C) + 0.3 x Black Globe Temperature (°C)

Why do we use the WBGT Index?

The WBGT Index is used because although it's only one number, it accurately weighs up all the factors that determine thermal environmental load. It is also easy to measure with simple and inexpensive equipment such as the ExTech HT30 (see Figure 2).

[3] Schroter, R.C. and Marlin, D.J. (1995) An index of the environmental thermal load imposed on exercising horses and riders by hot weather conditions. Equine vet. J. Suppl. 20, 16-22; Schroter, R.C., Marlin, D.J. and Jeffcott, L.B. (1996) Use of the Wet Bulb Globe Temperature (WBGT) Index to quantify environmental heat loads during Three-Day Event competitions. Equine Vet. J. Suppl. 22, 3-6.

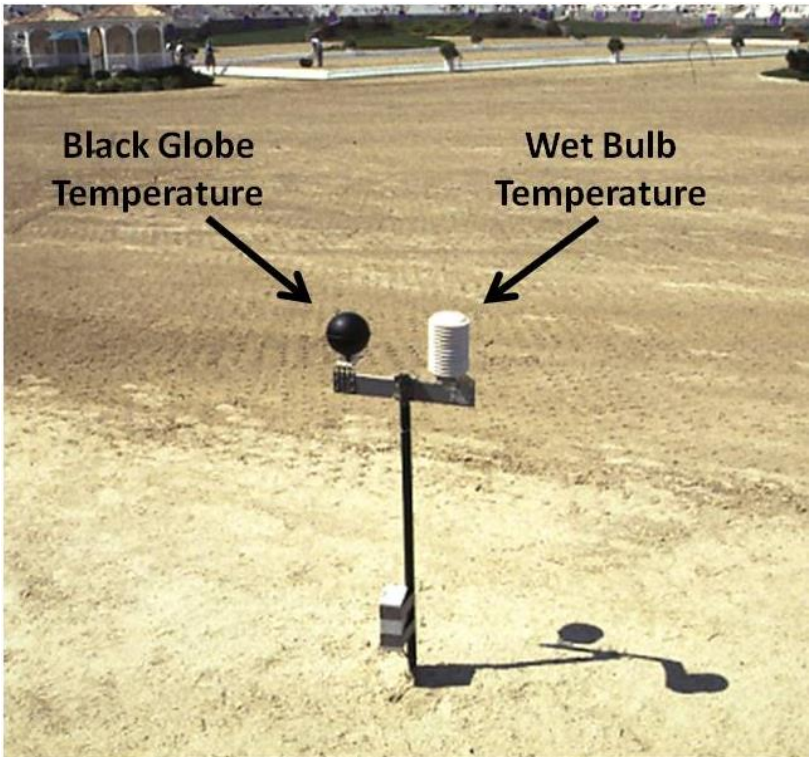


Figure 1. Equipment measuring WBGT index from black globe temperature (°C) and wet bulb temperature (°C) inside a shaded screen.

Figure 2. Handheld device with a direct readout of WBGT index (ExTech HT30; http://www.extech.com/display/?id=14523)

In Figure 3 the difficulty in interpreting temperature, humidity, wind and solar radiation is illustrated. The advantage of the WBGT index is that it gives a single temperature. The higher the WBGT the more uncomfortable it is. It should be noted that the difference in heat stress experienced for small changes at the lower end of the scale are not the same as at the higher end. For example, a change in WBGT from 18 to 20°C will not be noticed whereas a change from 28 to 30°C is appreciable.

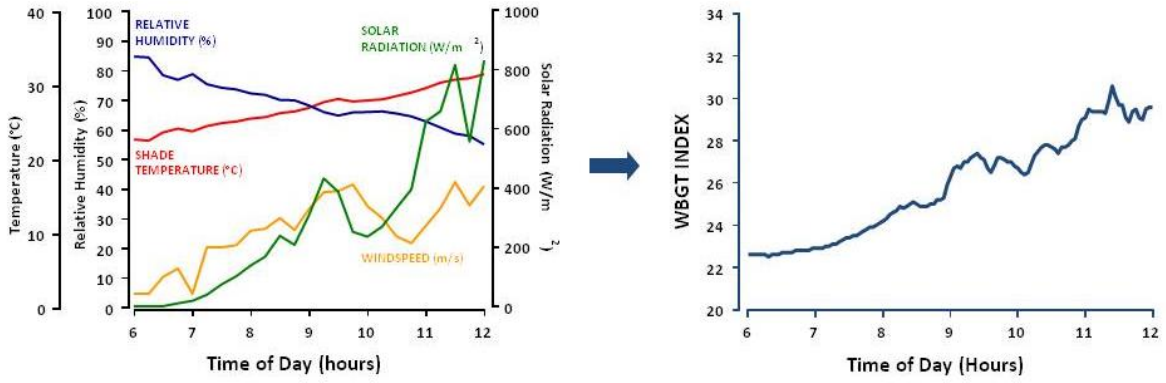


Figure 3. Simultaneous measurements of shade air temperature, relative humidity, wind speed and solar radiation (left) and WBGT index (right).

WBGT Index at Previous Olympic Games and prediction for Tokyo 2020

The WBGT index at previous Olympics is shown in Figure 4. It can be seen that the predicted peak WBGT during the period of the Tokyo Olympics is expected to be similar to that in Atlanta 1996 and Beijing 2008.

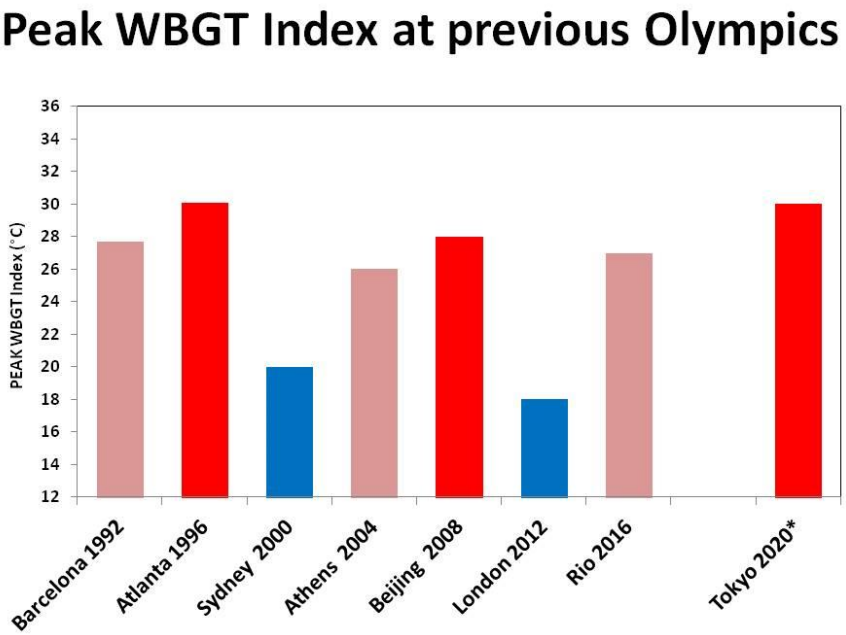


Figure 4. Peak WBGT index (°C) at previous Olympic Games and predicted peak WBGT index for Tokyo 2020*.

Current Guidelines for WBGT Index during Eventing Competition

The current recommendations for use of the WBGT Index for acclimatised horses competing in 3 or 4*CCI long-format Eventing were developed prior to and used during the Atlanta 1996 Olympic Games (Table 1; Schroter, Marlin & Jeffcott, 1996). They have since also been used at other Olympic Games. These guidelines have since been informally applied to short format Eventing cross-country (e.g. Athens 2004 and Beijing 2008) and to Dressage and Jumping. These recommendations are currently being reviewed in an FEI funded project prior to Tryon 2018 and Tokyo 2020.

Table 1. Recommendations for different levels of the WBGT Index for the Cross-Country day of Eventing (taken from the FEI Eventing Memorandum, 8th Edition – April 2015; Updated December 2017)

WBGT Reading	Recommendations
Less than 28	*No changes to the FEI recommended format for the Three-Day Event Competitions should be necessary.*
28-30	*Some precautions to reduce heat load on Horses will be necessary.*
30-32	*Additional precautions to those above to limit overheating of Horses will be necessary.*
32-33	*These are hazardous climatic conditions for Horses to compete in and will require further modifications to the Competition.*
Above 33	*These environmental conditions are probably not compatible with safe Competition. Further veterinary advice will be required before continuing.*

COMPETITION MANAGEMENT IN THERMALLY STRESSFUL CONDITIONS

The aim of the FEI, IOC and organising committees when competitions take place in potentially thermally stressful conditions is to make appropriate evidence-based adjustments to competition in order to ensure that a fair test takes place but that at the same time the risk of heat related illness is minimised. How this is approached varies between disciplines.

Dressage/Para Dressage – education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual competition; enhanced veterinary monitoring of horses.

Jumping - education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual competition; enhanced veterinary monitoring of horses.

Eventing - education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual Dressage and Jumping test of competition; reduction in overall effort of cross-country according to

conditions – managed on the day according to real-time conditions as assessed by WBGT index measured on course; enhanced veterinary monitoring of horses.

Driving - education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual Dressage and Cones test of competition; reduction in overall effort of Marathon according to conditions – managed on the day according to real-time conditions as assessed by WBGT index measured on course; enhanced veterinary monitoring of horses.

Endurance - education; provision of facilities for cooling; contingency for extreme conditions; courses may be shortened and heart rate limits, presentation times, and hold-times modified; managed on the day according to real-time conditions as assessed by WBGT index measured on course; enhanced veterinary monitoring of horses.

Vaulting - education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual competition; enhanced veterinary monitoring of horses.

Reining - education; provision of facilities for cooling; scheduling to avoid most thermally stressful times of the day; contingency for extreme conditions; no change to actual competition; enhanced veterinary monitoring of horses.

PREPARATION OF HORSES PRIOR TO TRAVEL

Acclimatisation

Horses can be prepared for competing in hot or hot and humid conditions by a period of heat acclimatisation. Scientific studies have shown that this benefits all but a very small number of horses; around 1 in 200.

Acclimatisation to heat can take place in one of three ways. Firstly, by living in a hot or hot humid climate. Secondly, by exercising in a hot or hot humid climate. Thirdly, by living and exercising in a hot or hot humid climate. In terms of preparing for competition, acclimatisation through exercise is considerably more effective. It is not necessary for horses to kept in hot or hot humid conditions all the time in order to acclimatise. Therefore, horses may exercise in heat and live in air-conditioning and still acclimatise. Horses travelling from cool climates to hot or hot humid climates are likely to show the greatest benefit from acclimatisation.

The key to acclimatisation is horses getting hotter (higher body temperature e.g. rectal temperature, sweating more, blowing harder after exercise) during exercise than they normally would. There are 5 ways this can be achieved.

- Training harder and longer than normal at home to reach a higher body temperature
- Scheduling training sessions at home for the hottest part of the day
- Training at home on a treadmill in a heated room

- Training at home using rugs
- Travelling to a hotter or hotter and more humid climate in advance of competition

Training harder and longer than normal at home to reach a higher body temperature
This option would not be encouraged as there would be an increased risk of injury and or over-training, resulting in decreased performance.

Scheduling training sessions at home for the hottest part of the day
If you live in a climate where it gets moderately hot during the middle part of the day in summer then changing your training sessions from early morning to coincide with the hottest part of the day could help partially acclimatise your horse prior to travelling to a hotter country to compete. Do not be tempted to train early morning or in the evening because it is more humid then. It is then heat that is most important, not the humidity.

Training at home on a treadmill in a heated room
Many of the studies of acclimatisation of horses to heat were undertaken with horses exercising on treadmills in heated rooms and horses were able to effectively acclimatise to heat this way. Replacing 3-4 normal ridden fitness sessions a week for several weeks with treadmill exercise sessions in a hot and humid environment would partially heat acclimatise a horse. The benefit of treadmills includes a consistent surface, lack of turning and removal of weight on the back, which can be beneficial. The negative side is that the surface on some treadmills is firm and of course this may reduce the amount of time the athlete is riding the horse.

Training at home using rugs
Horses can be made to get hotter than normal during regular training without having to work them harder by exercising them in thick rugs. This approach has previously been used by a number of teams although there is no formal scientific study of this method. The rugs should cover as much of the horse as possible, be of medium thickness and ideally be of a partially breathable material. The risks of using rugs are rubbing and horses becoming excessively over-heated (see below). When acclimatising at home by training in rugs, it is important to initially exercise for shorter periods and to regularly check the horse.

Travelling to a hotter or hotter and more humid climate in advance of competition
Whilst it may seem that travelling to the region where the competition is to be held to acclimatise offers the best solution, this may not always be the case. As several weeks training in the climate is required to achieve a reasonable degree of acclimatisation, there is clearly a significant logistic and cost implication. Furthermore, the climate is not always reliable and a worst-case scenario might be a period of unseasonably cool weather leading up to the competition such that horses are unable to acclimatise effectively, followed by a change to hot weather for the competition itself.

Given that the weather cannot always be relied upon, the best option for acclimatisation is to use a combination of approaches: training at home in the hottest part of the day; training at home with rugs; arriving at the competition region at least 10 and preferably 14 days before

the competition starts in order to allow time for recovery from transport and at least one week of training in the climate.

How often do I have to exercise my horse and for how many days?
The more you work your horse in the heat the quicker and greater the acclimatisation effect will be. One session per week for 3 weeks will have no effect. Exercise every other day for 2 weeks would have a good effect. Exercise for 5-6 days per week for 2 weeks should achieve a high level of acclimatisation. When starting acclimatisation, horses may appear to become worse after 2-3 days. This may persist for 5-7 days, but beyond this time horses should be coping better with exercise. A very small number of horses may not improve with acclimatisation. If a horse is not showing signs of improvement after 7 days then a veterinary surgeon should be consulted. In the absence of any medical reason for the horse being unable to cope with the training, it should be considered that the heat acclimatisation programme is too aggressive. Acclimatisation can continue but should be at a reduced workload. If after a further 7 days there is still no evidence of heat tolerance it is likely that this horse would need to be managed with heat avoidance as far as practically possible.

Does acclimatisation fully restore a horses' capacity for exercise in the heat?
Acclimatisation does not fully compensate for the adverse effects of very hot or hot and humid conditions, but it makes a significant difference and reduces the risk of heat related illness or injury.

What can I expect to see when I start heat acclimatisation?
It is not uncommon to see horses appearing to be tired and with reduced willingness to exercise as a result of starting heat acclimatisation training, especially in the first few days and they may show changes in water and feed intake and demeanour, especially around 3-5 days. However, they should be seen to return to normal certainly by 7 days.

Does heat acclimatisation work for all horses?
There are a small percentage of people that do not improve with heat acclimatisation and the same is true with horses. The number may be less than 1 in 200. These horses are likely to be identified during acclimatisation, and heat avoidance as far as possible and frequent aggressive cooling is likely to be the optimal management.

Human athletes
The effect of heat or heat and humidity on athletes can lead to fatigue, loss of strength, impaired balance, reduced reaction times and poor decision making with significant health and welfare implications for both athlete and horse, not to mention reduced performance. Athletes should be encouraged to undertake their own acclimatisation programme. Specific advice for human acclimatisation can be obtained from your National Federation or National Olympic Committee. General advice for equestrian athletes is given in Section 5 of this document.

Nutrition

Horses training and competing in hot climates will have increased sweat losses. Horse sweat is high in electrolytes. Over a period of weeks horses can develop electrolyte imbalances which can lead to reduced performance or an increased risk of conditions such as exertional rhabdomyolysis (tying-up) or synchronous diaphragmatic flutter (SDF, "thumps"). It is therefore recommended that consideration is given to evaluating the adequacy of dietary electrolyte intake and consideration be given to electrolyte supplementation.

Heat is produced from the breakdown of food in the digestive tract. Evidence from a number of studies suggests that the heat production from a high fat and forage diet is less than from diets which provide energy in the form of carbohydrates (starch and sugars). However, the advantage in terms of heat load on horses is likely to be very small and may not justify the risks involved in changing diet in horses that are healthy and performing to expectations.

Travelling combined with a change in diet represents a significant increased risk of colic in horses. This risk may be increased when taking horses to a hot or hot humid climate as water intake and appetite may be reduced following transport (especially if stables are not air-conditioned) and transiently during acclimatisation. Import restrictions may prevent taking the forage and feeds the horse is on at home to a competition. The risks of an abrupt diet change can be reduced in a number of ways.

- Travelling with feeds and forage that are permitted to be imported into the country of competition.
- Importing feeds and forages that are available in the country of competition to the home country and making a gradual transition at least 4 weeks prior to travelling.
- If enforced feed and forage changes cannot be avoided, consideration should be given to support with pre and probiotic supplements.

Any changes to the horses' diet should ideally be made at least 4 weeks and ideally at least 6 weeks before travel and ideally even earlier.

Cooling

How Do I Know How Hot My Horse Is?

There are a number of reliable indicators that a horse is very hot.

- Excessive sweating – horse completely covered in sweat and/or sweat running from the body
- Horse feels very hot to touch
- Ataxia (unsteadiness) – especially when stopping after exercise
- Blowing very hard (deep and laboured breathing)
- Panting (fast and shallow breathing)
- A high rectal temperature – above 40°C (104°F)
- Prominent blood vessels in the skin

- Horse may show little reaction to people or environment
- Horse may appear distressed

Recognised and Common Cooling Techniques
Most competition horses are used to and tolerate close proximity of grooms, vets, farriers, management, officials, etc at competitions. However, if horses have not experienced being aggressively cooled before then it is advisable to try and introduce this to them at home prior to competition. At major events the type of cooling facilities likely to be provided may include:

- Shaded areas
- Fans
- Misting fans
- Cold water hose sprays
- Mobile cold-water hose sprays mounted on all-terrain vehicles (ATVs)
- Large reservoirs of ice water from which buckets can be filled to pour over horses
- Sheets and cooling rugs

Ensuring horses are tolerant of fans, sprayed water from hoses and people working on both sides using small buckets at home is likely to ensure cooling is not compromised in the competition environment. It also provides an opportunity to train athletes and grooms and explain the advantages of aggressive cooling.

Aggressive cooling is almost certainly the single major factor in reducing heat related illness in horses in thermally stressful conditions. Aggressive cooling of hot horses does not cause muscle damage and can greatly reduce the risk of collapse and injury or the development of heat-related illness.

Shade
Keeping horses in the shade is more comfortable for them than being in the full sun but is not an effective management on its own for cooling hot horses.

Fans
Standing horses in front of fans increases heat loss by convection. It also increases the rate of evaporation of water or sweat. Fans also increase comfort but by themselves are not an effective cooling technique for hot horses.

Misting Fans
Misting fans provide comfort. On their own they are not an effective technique for cooling hot horses. Misting fans spraying ambient temperature water are less effective the higher the humidity. Misting fans spraying cold water (e.g. 5°C or 41°F) are more effective but still only appropriate for creating comfort as opposed to rapid and effective cooling.

Application of cold water
Applying large volumes of cold water all over the horse's body is the most effective way of cooling a horse (other than placing the horse in a pool of cold water). On a scale of 1 to 10, if cold water application is 10 then all other methods of cooling are in the range 1-3. Water should be applied all over the body using buckets/containers or where available, cold water sprays. Cold water sprays have the advantage of using less water and ice. There is no advantage to concentrating on applying cold water to specific areas (e.g. large blood vessels on the neck or between the legs, the large muscle groups, etc). The effectiveness of cooling is dependent on covering as much of the horse in cold water as possible, preferably ice water. There is no advantage to stopping to scrape off cold water that has been applied when cooling horses that are very hot and potentially at risk of collapse or distressed. This simply wastes time that could be used to apply more cold water.

Cooling rugs/cooling blankets
A number of cooling rug/cooling blanket products exist. These are soaked in water before being applied to the horse and depend on evaporation of water to cool the horse. They are most effective in hot, dry and windy weather. They become less effective as the humidity increases. These should be considered to provide comfort and not suitable for cooling hot horses. Some cooling rugs/blankets use alcohol-based fluids as opposed to water. These have the advantage that alcohol evaporation is affected much less by humidity. However, alcohol-based cooling blankets only provide comfort and should not be used as primary cooling for hot horses. Mesh cooling sheets and fleece "coolers" do not actually cool horses down but can provide protection from flies. White material is preferable to dark colours.

Ineffective Cooling techniques to avoid
A variety of old cooling methods still circulate which are not supported by current knowledge and recent research:

Ice packs
Placing ice packs over large blood vessels, such as those between the hind legs or over the jugular is an extremely inefficient way to cool a hot horse. Unfortunately, this approach is still advocated by many in the horse world.

Ice in rectum
Placing ice in the rectum is invasive treatment and is not permitted. Placing ice or cold water in the rectum is dangerous, is not an effective cooling practice. In reality the amount of ice that can be inserted and the rate of cooling are both small. The additional disadvantage of this approach is that subsequent rectal temperature measurements will be misleading.

Wet Towels
Placing wet towels over the horse is not an effective way to cool a hot horse. The cooling effect is dependent on the temperature of the water the towels are soaked in and the rate of evaporation. In a humid climate the towels will warm-up to the horse's skin temperature and then reduce heat loss.

TRAVEL

Practical Advice on Transporting Horses
Horses can vary tremendously in their previous experience of transport (good, indifferent or bad), the frequency and distance which they are transported and their response to transport. For the majority of the time horses are transported with no obvious negative effects, but transport can affect both health and performance. In the worst case, transport, especially over longer distances, can result in "shipping fever" (pneumonia), which if not promptly treated can be career ending and even fatal. Other health problems that can commonly occur in association with transport are colic and tying-up. Without good management the risk of problems during or following transport is increased, especially when this is over long-duration (>12h) and when combined with changes in diet, time-zone (jet-lag) and climate. Ensuring that a horse is in good health, particularly the respiratory system, is key for ensuring optimal performance.

Factors that cause stress to horses during transport
There are many things associated with transport that can cause a horse stress. Separation from familiar stable companions, change in routine, confinement in a restricted space, noise, vibration, acceleration, braking, cornering, reduced air quality, elevated head position, decreased feed and water intake and increased energy expenditure.

How can we recognise a horse that is stressed by transport? The easiest thing is to look at behaviour. Some horses will vocalise (whinny, call), some may sweat, others may be restless (pawing, kicking, etc) and others may not eat or drink. Stressed horses may lose more weight through sweating and loose watery droppings, they may show large increases in stress hormones in the blood such as cortisol or changes in their immune system. In many experimental studies of horses under transport, scientists and vets have measured heart rates. When a horse is upset, anxious or stressed during travel the heart rate can be seen to not only be much higher than normal resting level but also to show rapid spikes.

Transport can also be tiring for horses; one study found that travelling by road is almost equivalent to walking as the horse has to constantly use energy to maintain its balance.

Health

In terms of health, there are four body systems that are most commonly affected by transport. These are the respiratory system, the gut, the muscles and the immune system. Transport can result in upset to the gut, especially if horses are eating and drinking less and stressed, respiratory problems (either infection or worsening of allergic problems), muscle damage and a decreased ability to fight off infections. Put these all together with dehydration and tiredness and it's easy to see how transport could take the edge off a horse.

One of the major problems with transport and the respiratory system is the high head position that horses have during travel. The horse normally clears debris, including mucus, moulds, pollens, bacteria and viruses aided by gravity; that is when it has its head down grazing. Studies from Australia in the 1990s showed that the numbers of bacteria in the horse's trachea (windpipe) could increase 100 million times in as little as 6 hours if the head was tied up. Enough to cause shipping-fever.

Even if as a person you enjoy travelling, it's often tiring, it's not uncommon to develop a cold and changes in food, climate and jet-lag all make you feel a little below par for a few days after you arrive, for example after a long-haul flight. Experience suggests that horses rarely if ever improve with transport.

Paying careful attention to transport can result in improved performance and decreased risk of illness. A healthy horse arriving in good condition and given some time to recover before competing must be preferable to one that arrives late, tired, dehydrated and stressed.

- Before you set off on a journey, take the temperature of all horses.
- If within your control, travel at a time of day that is going to benefit your horse. An early start in summer or travelling overnight probably means that you will miss the heat and the traffic, having a shorter journey with less braking and accelerating.
- Some horses travel better than others. Horses that are fed and watered during transport usually travel better. Offering water frequently is essential.
- Reduce hard feed/concentrate and feed small amounts frequently during transport and periods of recovery to reduce the risk of tying-up and or colic.
- Orientation. Scientific studies where horses were travelled free and allowed to choose themselves which way to stand usually choose to stand diagonally either facing forward or backwards. So how a horse travels best is likely to be individual preference.
- Air quality is very important. Haylage/silage or soaked or steamed hay helps reduce dust. It's also very important to use low dust bedding and make sure there is good ventilation (in road transport).
- When you arrive, if it's possible to get your horse out and let it get its head down, that may help clear debris from the windpipe and lungs. Feeding hay from the floor can help a horse clear mucus from the airway.
- If you are planning to travel a long distance (more than 12 hours by road or air), then it's important to ensure horses start out healthy. Clinical evaluation of the respiratory system: Scoping horses 2-3 weeks before longer distance transport allows time for

treating respiratory infections and can reduce the risk of horses developing “shipping fever”.

- Rugs and boots have their place during transport, but remember the horse is probably better off being slightly cool than slightly hot.
- Allow time to recover. Horses usually lose around 1-2kg per hour of transport, but this can be double in hot weather in non-airconditioned trucks/trailers. A rule of thumb would be to allow one day of recovery with limited exercise for each 8 hours (1 day) of road travel or ½ day recovery for each hour of flight, up to 5 days.
- On arrival, get horses off the lorry and allow them to have a walk around and a drink.
- Monitor feed and quantity of water intake and clinical signs (especially rectal temperature, heart rate, urination and defecation) daily after arrival. This is critical for ensuring optimal health and performance.

MANAGEMENT OF HORSES AT AND DURING COMPETITION

Water

Horses should not have water restricted when training and competing in hot climates. Water intake may be 2-3 times greater than in cool climates and especially during and after travelling. If water is provided in buckets these should be checked frequently and more than one bucket provided, especially overnight. Research indicates there is no advantage to providing cold (10°C) drinking water and this may actually result in a lower intake. Studies also suggest a slight preference for water around 20°C compared to warm water (30°C).

Recovery from transport

On arrival after long distance transport, horses are at an increased risk of colic and respiratory disease (“shipping-fever”). For this reason, horses should be closely monitored for at least 3 days and allowed to rest and recover before any significant training in the heat is undertaken.

Daily monitoring

Observing behaviour, feed intake, water intake, droppings (frequency and consistency) and basic clinical parameters (rectal temperature, heart rate and respiratory rate) would be the minimum recommended for horses following prolonged transport.

Acclimatisation

The amount of time required for beneficial acclimatisation of horses coming from a cool climate to a hotter climate is around 14 days. Many horses will not arrive at major competitions with sufficient time to recover from transport and to acclimatise. Most stables do not open in time for full acclimatization to occur, therefore it is essential that some degree of acclimatisation training be undertaken before travel to the competition for horses travelling from significantly cooler climates.

Sunburn

In climates with strong solar radiation, some horses are at risk of sunburn, particularly light coloured/light skin tone horses.

Flysheets and rugs
White flysheets will provide better comfort for horses when outside than darker colours. Dark colours absorb solar radiation and heat up more than white colours.

Anhidrosis
Anhidrosis is a condition where sweat production is reduced or stops almost completely. The area that shows reduced sweating first is usually the hindquarters and some sweating usually remains on the neck. It is most common in horses that live in hot and humid or very hot climates. Affected horses usually also have dry and flaky skin. Horses affected by anhidrosis have a decreased capacity to cool themselves and require frequent and effective cooling with cold water. Anhidrosis usually develops over a period of months as opposed to weeks and thus it is unlikely that during a period of heat acclimatisation and competition that any horses will develop significant anhidrosis, although some may show signs of partial anhidrosis. The number of horses likely to be affected would be less than 1%.

Competition management
Warm-up
In hot climates horses warm-up faster but also tire more rapidly. Physical warm-up therefore takes less time. However, many athletes will want to warm up for longer than is required purely for physical reasons for skill training/preparation. This can be managed in a hot climate by having one or more cooling periods e.g. warm-up 20 min; cool horse; warm-up 20 min; cool horse; warm-up 20 min; cool horse; compete. This will result in a significantly decreased risk of heat related illness and likely a higher performance than a normal warm-up as would be conducted in a cool climate.

Water
It is advisable to allow horses to drink during breaks in training in hot climates. Water should not be restricted before or following competition. Immediately following exercise horses have an increased desire to drink and early rehydration can reduce the risk of heat related illness.

MANAGEMENT OF HORSES WITH HEAT RELATED ILLNESS

Signs of Heat Exhaustion/ Heat Stroke
Heat exhaustion tends to be less severe, and thus more subtle and insidious than heat stroke, although symptoms may appear suddenly, especially after prolonged exercise. Heat exhaustion is manifest by rapid breathing or panting, an increased heart rate, and an elevated rectal temperature, usually above 40° Celsius (104°Fahrenheit). Horses suffering from heat exhaustion may appear lethargic or depressed. Horses affected by heat stroke, on the other hand, can be extremely challenging to manage, because they typically exhibit altered mentation, aggressive behaviour, or signs that appear neurological. They seem to have no perception of where they are, with no regard for their handlers, running through or past them, or treading on them. This makes them extremely dangerous, as they may rear, strike,

and run over people. If a horse begins to exhibit bizarre, bullish behaviour after substantial exercise on a hot, humid day, he is most likely suffering from heat stroke. Although heat exhaustion may progress to heat stroke, heat stroke can occur suddenly and without warning. If not treated quickly and effectively, it can lead to death from damage to the kidneys, heart, lung, brain, or muscles. This makes situational awareness critical, because horsemen and veterinarians must be cognisant of risk factors and warning signs and be prepared to deal with heat-related medical emergencies.

Risk factors for heat-related illness

Big, heavily muscled horses or overweight horses with a high body condition score, unused to the work that they are being asked to do, are at high risk for heat-related illness. Horses coming from a cold to warmer climate are also at higher risk, as are horses with a dark coloured or long hair coat. Fit, athletic horses that have put forth maximal effort in hot, humid weather may also be affected, even though they are well acclimatised.

Management of heat exhaustion

Although unrecognised heat exhaustion may progress to heat stroke or lead to serious metabolic compromise if untreated, it can usually be managed in a relatively straightforward manner if it is promptly recognised. In many cases, discontinuation of exercise, allowing the horse to drink, and moving to a shaded area with good air movement may be all that is required. Application of cold water to the entire body hastens cooling and is encouraged.

Management of heat stroke

It is often necessary to tranquilise horses suffering from acute heat stress before it is possible to get close enough to safely treat them. This can be difficult and dangerous if the horse is intractable, because they are virtually uncontrollable, and sometimes rear and flip over backwards. The horse may collapse before tranquilisation can be accomplished. Horsemen who have seen horses with heat stroke are usually able to recognise the condition because the signs are plain and very characteristic. It is best to keep the horse constantly moving forward towards a shaded, grassy area, because once stopped, even if momentarily for closer examination or tranquilisation, they often collapse. While the horse is walking, cooling should be achieved by repeatedly dousing the horse with copious amounts of cold water, preferably ice water. It does not matter where on the body the cold water is applied to the horse; the goal is to cool the largest amount of body surface as rapidly as possible.

If the horse does collapse, it is advisable to keep him down by applying pressure just behind the poll with one knee while simultaneously raising the muzzle. The reason for keeping the horse down once it has collapsed is to avoid flailing and repeated unsuccessful attempts to stand. With one good horse handler placing hands and a knee on the poll and a second person on the neck, the horse can be controlled and prevented from attempting to rise. The muzzle is tipped up by placing upward traction on the head collar or bridle. Towels or padding should be placed to avoid pressure on the facial nerve and protect the eye on the ground. The veterinarian can then administer tranquilizer to the horse and place an IV catheter, if necessary. Catheter placement in the recumbent horse is most safely accomplished from the dorsal aspect, away from the legs, with the head and neck stretched out. To prevent a bad

situation from becoming worse, the safety of the people helping must not be neglected, and an experienced veterinarian should direct rescue efforts. Cold water application should be continued while the horse is down. Rehydration is an important part of treatment, and large volumes of isotonic fluid can be safely administered intravenously in a short time. NSAIDs (phenylbutazone, “bute” or flunixin meglumine: Finadyne, Banamine) should *never* be given until the horse has been rehydrated, or severe and permanent kidney damage may result. Similarly, steroids should not be administered prior to rehydration, due to the risk of inducing laminitis. Only once control of the animal is gained and fluid therapy is begun should a physical examination be performed, blood collected, and the temperature taken. Heat stroke is a medical emergency, and rapid cooling and rehydration are essential. Organ damage can occur if treatment is delayed, increasing the risk of serious complications. With prompt and appropriate treatment, most horses that suffer from heat related illness make a speedy and complete recovery.

Follow-up monitoring

Although most horses affected by heat-related illness recover quickly and completely, it is important to recognise that some do not, particularly if they also suffer from dehydration or volume depletion. Therefore, any horse that has been compromised by heat, whether the signs were dramatic or subtle, should be closely monitored to ensure normal urination, defecation, water consumption and appetite. The heart rate should drop below 50 and the respiratory rate should return to 18-24 within an hour. A complete blood count and biochemistry evaluation should be performed to ensure normal hydration, white blood cell values, muscle enzyme levels, and kidney function.

ADVICE FOR EQUESTRIAN ATHLETES & SUPPORT STAFF IN ADVERSE CLIMATES

Heat is generated in exercise and, especially in hot dry climates, is lost by evaporation of sweat. Hot and humid climates are even more challenging as sweat does not evaporate as fast and body temperatures rise more quickly. Allowing the body temperature to rise impacts negatively on performance and can ultimately cause serious heat illness, and an increased risk of injury through impaired strength and decision making.

1) Preparation

When competing abroad check average temperatures and humidity at the venue. There are many websites and Apps where this can be accessed such as Weather Underground https://www.wunderground.com/

- **Acclimatisation** is the ideal preparation: Exercise at the venue for at least two weeks increases volume of sweat, dilution of sweat and early onset of sweating leading to increased ability to tolerate heat.

- **Alternative strategies if acclimatisation is not possible**: Exercise in a climate similar to that at the competition venue (i.e. in heat chambers and using exercise bicycles, treadmills or travelling to train in another hot country). Exercising in impermeable clothing can help. These forms of exercise can only assist acclimatisation and should be used for approximately three hours a day.

- **Prepare for hot weather**: Investigate what lightweight and light-coloured clothing is available depending upon your equestrian discipline.

- **Hydration**: Decide on your favourite drink, that you can obtain at the competition, and use during training. Water is good for hydration but, electrolytes (sodium and potassium) are lost in sweat and using an isotonic (similar electrolyte concentration as body fluids) sports drinks replace these as well as giving some sugar to help with energy. Sports drinks are expensive and it is easy to make your own. Mix together and refrigerate 200ml ordinary fruit squash, 800ml water and a pinch of salt.

- **Fitness & Body Condition**: General athlete "fitness" and not carrying excessive weight will aid acclimatisation.

2) Active Management

Before and during exercise

- **Pre-cooling** (cooling the body before exercise) is used in some sports. Cooling vests are available but use of an air-conditioned room immediately before exercise can also help.
- **Exercise in lightweight and light-coloured clothing:** white clothing reflects heat.

- **Do not expose arms/shoulders to strong sunlight** - this will cause sunburn and also absorb more heat.
- **Avoid sunburn** – apply sun block / high skin protection factor to any exposed skin area – forearms, face and neck) and if appropriate wear a hat. Sunburn and heat stroke can lead to severely impaired ability to deal with the heat for 3-4 weeks.
- **Thin cotton clothing** allows sweat evaporation.

After exercise, cooling strategies must be practiced:

- Sips of cold drinks
- Remove jackets and especially dark clothing
- Remove hats and body protectors if worn
- Loosen clothing if possible/appropriate
- Move to an air-conditioned room or shade when possible
- Cold sponging of body
- Use of air fans

3) Hydration

Hydration is vital. Even a small degree of dehydration affects performance, increasing fatigue and decreasing concentration.

- Make sure you are well hydrated **before competition**.

Frequent small drinks during training and competition are vital, using a preparation (e.g. specific brand or custom-made drink) the athlete is used to drinking.

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- **Electrolytes** should be used especially in endurance events, when warm-up is prolonged and during prolonged training.
- **Practice** your hydration strategy during training.
- **Do not over-drink**; high volumes (750ml per hour for 4 hours) can lead to a fall in important electrolytes in the blood.
- Use the **urine colour chart** below to check hydration.
- **Athletes should not exceed their normal tea or coffee consumption** when competing in a hot climate and should not use high caffeine content sports energy drinks as part of a hydration strategy.

4) Precautions

Some medical conditions can be seriously affected by heat. If any athlete is on medication or has a chronic medical condition, medical advice must be sought before final selection/entry. Even minor viral illnesses should be discussed with a team doctor or local physician. Check for heat illness/heat stroke signs and symptoms:

- Tiredness and weakness
- Feeling faint or dizzy
- Headache
- Muscle cramps
- Nausea and vomiting

- Heavy sweating
- Intense thirst
- Fast pulse
- More severe heatstroke can result in loss of consciousness and convulsions.

If an athlete is displaying any of these symptoms, cool them as described above and seek medical advice.

Urine Colour Chart

Urine Colour	Possible Meaning
Clear	Good hydration, overhydration or mild dehydration
Pale Yellow	Good hydration or mild dehydration
Bright Yellow	Mild or moderate dehydration or taking vitamin supplements
Orange, Amber	Moderate or severe dehydration
Tea-Coloured	Severe dehydration