

# Salmonellosis in adult horses

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There are very few infectious causes of diarrhoea in adult horses. The most common infectious causes of diarrhoea are *Salmonella* spp., intestinal parasitic worms, rotavirus and *Clostridium* spp. Of these causes, *Salmonella* is the most common (Astorga et al, 2004; Kolk and Kroeze, 2013).

*Salmonella* is a gram-negative facultative anaerobic bacterium. It can be found colonising the small intestine, cecum and colon of both cold- and warm-blooded animals. The most common strain in horses is *Salmonella enterica* serovar *typhimurium*. Other *Salmonella* species can also be found in horses, such as *S. abortusequi* sp. and *S. enteritidis* sp. Many strains of *S. enterica* are potentially zoonotic (Duijkeren et al, 2002; Astorga et al, 2004; Leon et al, 2018).

## Risk factors

Horses have a greater susceptibility for salmonellosis while undergoing antibiotic treatment. Other risk factors are abdominal surgery, stress (for example as a result of transport or heat), concurrent disease and change of diet (Astorga et al, 2004; Kolk and Kroeze, 2013).

*Salmonella* can be transferred through direct contact with an infectious animal (other animals like birds can also transfer *Salmonella*), indirectly via contaminated environment, food and water, or transported via human contact such as the handler or veterinarian. The incubation time can be 24 hours or less (Kolk and Kroeze, 2013; Burgess and Morley, 2014).

## Clinical signs

In adult horses there are three different levels of symptoms.

### Latent or subclinical carrier:

These horses have an intermittent shedding of *Salmonella*, and can infect other horses as a result of this. Subclinical carriers can develop symptoms after stress (Kolk and Kroeze, 2013; Burgess and Morley, 2014). The prevalence of latent carriers is <2% in the general equine population (Waldrige et al, 2011) and in

hospitalised animals, a prevalence of 13% is reported (Ernst et al, 2004). When using polymerase chain reaction to test for *Salmonella*, up to 40% of horses test positive (Amavisit et al, 2001).

### Mild clinical symptoms:

Horses show lethargy, have a fever and loss of appetite. Faeces are soft but they do not have diarrhoea. Clinical symptoms disappear without treatment within five days. These horses can still shed *Salmonella* bacteria for months after the symptoms have disappeared (Kolk and Kroeze, 2013; Burgess and Morley, 2014).

### Acute and severe salmonellosis:

Horses are acutely depressed, anorexic, have a fever, are prone to colic and diarrhoea can be seen within 24 hours after the onset of the first symptoms. Faeces are fluid and have a strong and abnormal smell. In conjunction with dehydration, the diarrhoea can cause a metabolic acidosis (Naylor and Dunkel, 2009; Shaw and Stämpfli, 2018). Horses with acute salmonellosis can have symptoms of septic shock. Colic severity can be from mild to severe because of an ileus (obstruction), tympani (excess gas) or colitis. In bloodwork, the white blood cells show a severe neutropenia and the albumin concentration can also drop because of a protein-losing enteropathy. Because of bacteraemia and toxemia, abnormal clotting and laminitis can be seen (Kolk and Kroeze, 2013; Burgess and Morley, 2014).

## Diagnosis

Clinical signs will already be enough to suggest salmonellosis. *Salmonella* can be cultured out of faeces samples, but even horses with clinical signs of *Salmonella* infection may only have an intermittent shedding of the bacteria in the faeces. When creating cultures, it is advised to sample faeces for 3–5 consecutive days. If a horse has signs of bacteraemia, blood culture can also be positive. Polymerase chain reaction tests for *Salmonella* from faeces or blood can be a quick alternative to regular cultures. Be aware

that this test can give a false positive as a result of DNA fragments from dead bacteria. Susceptibility to antibiotic treatment can only be found via cultures (Duijkeren et al, 2002; Kolk and Kroeze, 2013; Burgess and Morley, 2014).

## Treatment

Primary treatment of an adult horse with salmonellosis starts with stabilising the patient and treating the dehydration via intravenous infusion – a polyionic isotonic infusion is preferred to replace electrolytes lost through the diarrhoea. Based on the severity of the dehydration and the diarrhoea, the volume of infusion can go up to 80 litres a day. In conjunction with the infusion, oral fluid with extra electrolytes and bicarbonate can be given to treat the metabolic acidosis. In case of severe hypoproteinaemia and decreased clotting, blood plasma is the treatment of choice; this could also contain immunoglobulins for *Salmonella*, which would be of benefit as it would provide some immunity via specific antigen binding.

A less expensive alternative for plasma is colloidal fluids. Antibiotic treatment is only advised in cases with bacteraemia; antibiotics do not work as treatment for colitis or against shedding of *Salmonella*. Antibiotic resistance is a problem and antibiotic susceptibility can change during a clinical episode of salmonellosis. Multi-resistant *Salmonella* species are very common in horses. If a veterinarian chooses to give antibiotics, they should keep in mind that aminoglycosides (for example gentamicin) are nephrotoxic in dehydrated horses (Duijkeren et al, 1995; Astorga et al 2004; Kolk and Kroeze, 2013; Leon et al, 2018). An important part of treatment should focus on eliminating toxins. There are different products commercially available for oral treatment: biosponge, bismuth salicylate and activated charcoal (such as NORIT) can all bind toxins (Naylor and

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Dunkel, 2009; Shaw and Stämpfli, 2018). Non-steroidal anti-inflammatory drugs, and most importantly flunixin meglumine, can treat the toxæmia, fever and pain. This could prevent laminitis; however, non-steroidal anti-inflammatory drugs are also potentially nephrotoxic and can cause stomach and intestinal ulcers (Naylor and Dunkel, 2009; Kolk and Kroeze, 2013; Shaw and Stämpfli, 2018).

Different therapies are proposed for restoring normal intestinal flora, such as prebiotics and probiotics and faecal microbiota transplant. The effect of faecal microbiota transplant for the restoration of the flora is uncertain. Faecal microbiota transplant involves transferring the faeces of a healthy horse orally to a patient. These faeces could contain harmful pathogens like *Salmonella*, *C. difficile* or equine anaemia virus, so screening of the healthy donor before using the faeces for transplant is advised (Kolk and Kroeze, 2013; Schoster et al, 2014; Mullen et al, 2018). Prebiotics and probiotics do not have any harmful side effects (Schoster et al, 2014).

## Prevention

Prevention of salmonellosis is very difficult because of the amount of latent carriers in the general population. Once shed, the bacteria can survive for a long time in the environment without a host. Maintaining good general hygiene (for example, hand washing, using gloves, cleaning shoes and boots and avoiding different horses sharing one stable) is essential to prevent infection. Because of its zoonotic potential, a veterinarian should warn the owner

## KEY POINTS

- *Salmonella* is a frequent cause of diarrhoea in adult horses.
- Diagnosis can be difficult because of the intermittent shedding of the bacteria and the false positive results of polymerase chain reaction tests.
- Treatment should be focused on treating symptoms and antibiotics should be used with caution.
- Management should not only focus on the prevention of infecting other horses, but also humans due to the zoonotic potential of *Salmonella*.

and other personnel if a horse is diagnosed with salmonellosis (Kolk and Kroeze, 2013; Rothers et al, 2020). [EQ](#)

## Conflicts of interest

The author declares that there are no conflicts of interest.

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