Managing equine parasites in the face of anthelmintic resistance

Jacqueline Matthews qualified from the University of Glasgow in 1989. She is an RCVS-recognised Specialist in veterinary parasitology with over 25 years' experience in academia, leading research on helminth vaccines and diagnostics. She has held advisory roles for several organisations including the UK Veterinary Products Committee, Control of Worms Sustainably (COWS), and Controlling ANTiparasitic resistance in Equines Responsibly (CANTER). She is a Fellow of the RCVS and the Royal Society of Edinburgh, inventor of the small redworm blood test and is currently director of veterinary science at Austin Davis Biologics and honorary professor at the University of Edinburgh.

Background: For decades, equine parasite control has relied heavily on routine anthelmintic administration. As resistance to multiple medicine classes becomes increasingly widespread, first-opinion practitioners face the challenge of balancing effective parasite control with preserving the efficacy of the treatments that remain available.

Aim of the article: This article discusses the epidemiology of the major equine helminths, summarises current knowledge on anthelmintic resistance and provides practical guidance on implementing sustainable parasite control programmes in clinical practice.

EQUINE helminth infections remain a major health concern for grazing horses, with cyathostomins being the most prevalent parasites and a potential cause of clinical disease in young animals. Other important parasites include *Parascaris* species, *Oxyuris equi*, *Strongylus vulgaris* and the tapeworm *Anoplocephala perfoliata*, each with distinct epidemiological patterns and disease risks.

While anthelmintics have historically been used to control these parasites, widespread and increasing resistance across multiple medicines classes now threatens their long-term effectiveness. Resistance has been widely reported for benzimidazoles, tetrahydropyrimidines and macrocyclic lactones, with multiclass resistance documented in cyathostomins and *Parascaris* species, and early signs of reduced cestocidal efficacy against *A perfoliata*. The absence of validated molecular markers for resistance in these parasites further hinders early detection and management of resistance.

Sustainable control requires a more integrated and evidence-based approach combining risk assessment, diagnostic-led treatments and pasture management. Faecal egg count (FEC) monitoring and antibody-based assays for tapeworm and cyathostomin infections allow targeted treatments, reducing unnecessary anthelmintic use, while protecting susceptible horses. FEC reduction tests should also be routinely applied to assess anthelmintic efficacy and monitor medicine sensitivity in the parasite populations present. Management practices, including regular dung removal, appropriate stocking densities, pasture resting and co-grazing with non-equine species, should be applied to reduce infection pressure and to interrupt transmission. An integrated approach will provide a sustainable framework for reducing parasite-associated disease risk, while helping to maintain the effectiveness of the currently available anthelmintics.

KEY LEARNING OUTCOMES

After reading this article, you should be able to:

- ☐ Understand equine helminth epidemiology and disease risk and be able to identify the major equine parasites, their lifecycles, host age susceptibility and associated clinical signs;
- ☐ Understand current patterns of resistance across medicines classes – including multiclass resistance – in different parasites, and understand the limitations of early detection;
- ☐ Apply evidence-based parasite control strategies, by integrating risk assessment, diagnostic-led treatments and pasture management to reduce infection pressure and target treatment to high-risk individuals;
- ☐ Implement monitoring and efficacy testing by using faecal egg count reduction tests and record keeping to assess anthelmintic efficacy, guide selection of alternative medicines and detect resistance in equine helminth populations;
- ☐ Understand how stocking density, dung removal, pasture resting and co-grazing can help to reduce environmental contamination and support long-term parasite control.

Equine helminth infections

Cyathostomins

Grazing horses are exposed to a wide range of intestinal parasites. Cyathostomins (small redworms or small strongyles) are by far the most prevalent, with horses typically infected shortly after beginning to graze. Although cyathostomin-associated clinical disease is uncommon, it is most often seen in horses aged one to four years old, especially if they have a history of grazing heavily contaminated pastures (Byrne and others 2025). In such individuals, the accumulation of encysted larvae in the intestinal wall can reach hundreds of thousands or even millions of worms (Dowdall and others 2002) leading to larval cyathostominosis, a syndrome associated with diarrhoea, weight loss, colic, oedema and, in some cases, death (Matthews and Mair 2025). Adult horses on well-managed paddocks generally carry lower burdens with a correspondingly reduced disease risk, although older horses, particularly those with pituitary pars intermedia dysfunction, can remain susceptible to high burdens and clinical disease (Mair 1993).

Other nematodes

Other nematodes that infect horses include *Parascaris* species, which predominantly affect foals in the first six months. Large burdens of these parasites cause weight loss, lethargy, reduced appetite, coughing, nasal discharge and impaction colic (Clayton 1986, Fabiani and others 2016). The infective stages (eggs containing second stage larvae) are highly resilient, persisting on pastures for months leading to contamination, particularly on densely stocked paddocks on breeding farms.

O equi (pinworm) affects horses of all ages, usually subclinically, although some individuals are more prone to infection with perianal itching and tail rubbing seen (Reinemeyer and Nielsen 2014).

S vulgaris is a large strongyle whose larval migration through the cranial mesenteric artery can cause inflammation, thrombus formation and intestinal ischaemia, predisposing horses to colic and peritonitis. Its prevalence is very low where anthelmintics are used routinely, but surveys indicate that this can increase where diagnostic-led treatment programmes are applied, although, so far, this does not seem to have translated to an increased incidence in clinical disease (Nielsen 2025).

Tapeworms

The tapeworm *A perfoliata* also poses a clinical risk to horses, with burdens exceeding 20 worms shown to cause intestinal pathology (Fogarty and others 1994, Pavone and others 2010, Hreinsdóttir and others 2019). This parasite is associated with several colic syndromes, including ileal impaction, intussusception and spasmodic colic (Proudman and Edwards 1993, Proudman and others 1998). Horses of all ages can be infected (Nilsson and others 1995), although younger animals seem to be more susceptible to harbouring larger burdens (Proudman and others 1997, Burcákova and others 2023, Buono and others 2026) and thus may be more at risk of developing disease. Unlike nematodes, *A perfoliata* has an indirect lifecycle involving an oribatid mite intermediate host. In the UK, these mites increase in abundance on paddocks in spring and summer, elevating the risk of transmission in these seasons (Wickenden and others 2025).

Sustainable control of equine helminths

The pathogenic potential of these parasites underscores the need for effective and sustainable control strategies to manage burdens in susceptible individuals. Although anthelmintics have traditionally played a central role in controlling infections, the emergence of resistance now threatens their long-term efficacy across many species. It is important to recognise that the complete eradication of parasites in grazing horses is neither realistic nor desirable. Instead, the primary objectives are to reduce infection pressure and parasite burdens to levels that minimise the risk of clinical disease, while avoiding unnecessary anthelmintic treatment in order to help slow the development and spread of anthelmintic resistance.

Anthelmintics and anthelmintic resistance

In the UK, four anthelmintic classes are licensed for horses (Table 1):

- benzimidazoles;
- tetrahydropyrimidines;
- macrocyclic lactones;
- isoquinoline-pyrazines.

Regulatory approval of these anthelmintics required compounds to achieve a minimum of 90 to 95 per cent worm-killing efficacy, a level which creates strong selection for parasites carrying alleles associated with reduced drug sensitivity (Matthews 2014). Given the large, genetically diverse nature of equine helminth populations, repeated frequent use of the same compounds has inevitably selected for less-susceptible worms.

Additional drivers of resistance include whole-group treatments, suboptimal dosing, moving recently treated horses onto clean pastures and inappropriate product use. Resistance is often phenotypically silent until a high proportion of worms carry resistant alleles. Studies in sheep nematodes indicate that FEC reduction tests only detect resistance once resistant genotypes are present at relatively high levels (Königová and others 2021). As no validated molecular assays are available for the detection of anthelmintic resistance in equine helminths (apart from some putative benzimidazole resistance markers used in research settings) (Hodgkinson and others 2008), early identification of emerging resistance in field populations is currently not possible.

Current situation in the UK

In the UK and most other regions, anthelmintic resistance is now widespread in cyathostomin populations (Matthews 2014, Nielsen 2022) (Table 1). Resistance to benzimidazoles, such as fenbendazole, is well established, with single-dose efficacy markedly reduced and multiple-dose regimens used for larvicidal activity no longer reliable. Resistance to pyrantel salts is common, although the prevalence of resistance varies between regions and may be influenced by the type of anthelmintic preparations available

Table 1: Anthelmintic classes licensed for use in horses in the UK and the current known resistance status for each

Anthelmintic class (active compound)	*Parascaris* species	Cyathostomins	*Strongylus vulgaris*	*Anoplocephala perfoliata*
Benzimidazole (fenbendazole)	+ (resistance emerging)	+ (including encysted stages using five-day regime) (resistance common)	+ (no documented resistance)	NA
Tetrahydropyrimidine (pyrantel embonate)	+ (resistance emerging)	+ (resistance common)	+ (no documented resistance)	+ (resistance emerging)
Macrocyclic lactone –avermectin (ivermectin)	+ (resistance common)	+ (resistance emerging)	+ (no documented resistance)	NA
Macrocyclic lactone – milbemycin (moxidectin)	+ (resistance common)	+ (including encysted stages) (resistance emerging)	+ (no documented resistance)	NA
Isoquinoline-pyrazine (praziquantel)*	NA	NA	NA	+ (resistance emerging)

+ Labelled efficacy, NA Not applicable
*In the UK, a single-active 'extemporaneous' formulation can be prescribed by veterinary surgeons. Praziquantel is also available in combination with ivermectin or moxidectin

(Nielsen 2022). Macrocyclic lactone (ivermectin, moxidectin) resistance is emerging, as evidenced by many reports of shortened strongyle egg reappearance periods observed after treatment with these compounds (Mair and others 2023) and, in some studies, where there is low FEC reduction at two weeks following treatment (Nielsen and others 2020, Abbas and others 2021). Thus, no single anthelmintic class now maintains universal efficacy against cyathostomins. Furthermore, multiclass resistance, where parasite populations show reduced sensitivity to two or more medicines classes, is increasingly reported (Nielsen 2022).

Resistance issues are not limited to cyathostomins. There have been many reports of macrocyclic lactone resistance in *Parascaris* species, with some studies reporting reduced effectiveness of fenbendazole or pyrantel, also raising concerns about the possibility of multiclass resistance in this species (Nielsen 2022). Reduced macrocyclic lactone efficacy has also been reported in *O equi*, although the evidence base is quite limited due to few species-specific studies having been conducted and the technical challenges associated with assessing efficacy against this parasite (Nielsen 2022). To date, anthelmintic resistance has not been reported in *S vulgaris*.

Alongside widespread reports of resistance in equine nematodes, recent studies indicate emerging challenges in controlling *A perfoliata*. Reduced efficacy of both anti-tapeworm anthelmintics (praziquantel, pyrantel salt double dose regimen) was recently documented in young and adult horses on a US stud farm (Nielsen 2023). Resistance in this species is also suspected in other regions, including anecdotal reports from the UK and EU, where horses with a history of repeated cestocidal treatments have presented with clinical disease or persistently high anti-tapeworm antibody levels (Matthews and Peachey 2026).

Across these parasite groups, multiclass resistance is an increasing concern. With no new anthelmintic classes expected in the foreseeable future and, given the pathogenic potential of these parasites, preserving current anthelmintic efficacy is essential.

Addressing anthelmintic resistance in practice

Sustainable parasite control comprises three key components. First, risk assessment which provides an evidence-based evaluation of infection pressure, identifying individuals or groups at higher risk, as well as gaps in management practices. Second, diagnostic testing (coprological and antibody-based assays) which provides information about parasite prevalence and burden, and identifies which horses require treatment. Third, effective pasture management which interrupts transmission through strategies such as regular dung removal, paddock resting, low stocking densities and co- or rotational grazing with non-equine species. Integrating these elements enables control plans to be tailored to each site.

Risk assessment

A comprehensive risk assessment should form the first step in worm control planning. The assessment should integrate multiple sources of information to evaluate infection pressure. Key parameters include horse factors such as age and health status, along with knowledge of grazing patterns, management procedures (stocking density, dung removal, paddock resting/rotation, co-grazing with non-equine species and biosecurity measures), and recent test results. When horses share grazing areas, it is important to consider test results from all individuals in the group, as each contributes to the overall challenge and may influence the exposure risk of others. Together, these factors allow an evidence-based understanding of the likely infection pressure, highlighting the overall risk level and potential gaps/weaknesses in on-site management practices.

Risk should be categorised as low, moderate or high to guide actionable recommendations:

- Low-risk scenarios may require minor adjustments, such as modifying testing frequency or adding efficacy testing.
- Moderate-risk situations will benefit from targeted management improvements; for example, introducing/increasing dung removal or lowering stocking density.
- In high-risk settings, it is important to prioritise achievable interventions, such as dung removal on high-density fields or targeting paddocks with younger horses.

Risk assessments should be reviewed every six to 12 months to monitor implementation of the recommended changes, to evaluate their effectiveness and to adjust the testing strategy as necessary. Follow-up testing provides feedback on whether the interventions are reducing infection pressure. A risk assessment template is included in the UK equine parasite control guidelines (see further resources). Also available is 'What's Your Worm Risk?' (see further resources), a free online decision-support tool designed to help owners and prescribers assess parasite risk in individual horses using a structured, evidence-based framework. It categorises horses as low, moderate or high risk based on answers to nine questions on demographic characteristics, key management factors and available test results. Based on the risk level assessed, the tool provides practical guidance to support parasite control planning, including information on pasture management and diagnostic testing.

Diagnostic testing

Diagnostic-led treatments can be applied across all age groups of horses, but should account for differences in parasite epidemiology and individual susceptibility. This targeted approach supports more sustainable parasite management by reducing unnecessary anthelmintic use and preserving refugia (ie, the proportion of parasites in a population not exposed to anthelmintics at each treatment application), thereby helping to slow the development of anthelmintic resistance. In some cases, available tests may not provide sufficient information to guide treatments; for example, in foals with prepatent ascarid infections in the first four to six months of life, or in young horses at higher risk of larval cyathostominosis in autumn/winter. In these situations, strategic treatments with an appropriate anthelmintic is necessary.

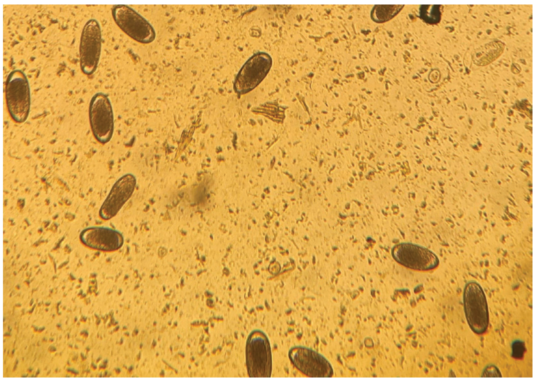


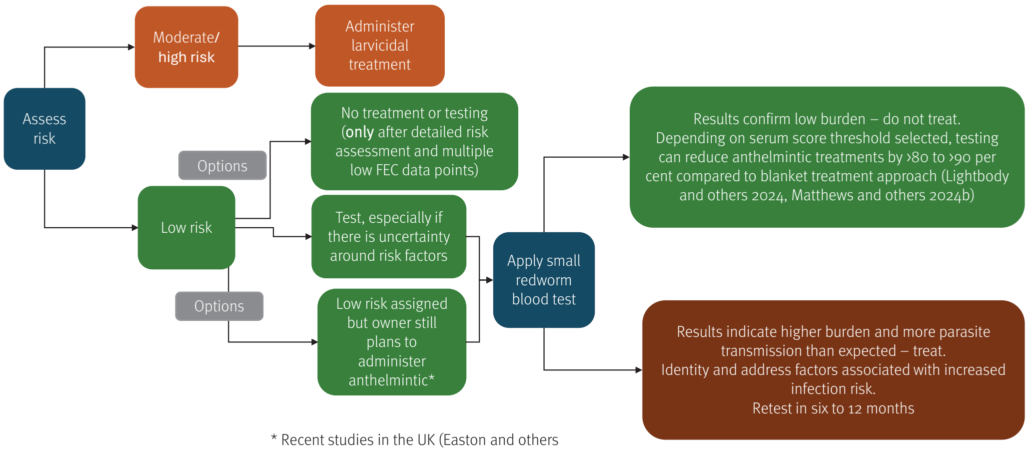
Fig 1: Strongyle eggs as observed in a faecal egg count test. Such monitoring is central to sustainable parasite control

FEC monitoring is central to sustainable parasite control (Fig 1). In healthy adult horse populations on well-managed paddocks, around 20 per cent of horses contribute approximately 80 per cent of egg shedding (Relf and others 2013, Lester and others 2018), a pattern commonly observed in helminth populations and known as overdispersion. There is evidence that individual adult horses show a high degree of consistency in their FEC profiles over time (Lester and Matthews 2014), although variation between sampling time points can occur due to factors such as:

- time since the last anthelmintic treatment;
- season;
- age;
- immunity;
- concurrent health conditions;
- management practices;
- pasture contamination.

Regular FEC monitoring allows horses to be categorised according to their strongyle egg-shedding status, enabling more evidence-based and targeted anthelmintic treatments. This approach can significantly reduce pasture contamination and infection pressure, while avoiding unnecessary blanket treatment of the entire herd. Horses at higher risk of infection (eg, those under five years of age and geriatric horses) are more likely to have elevated levels of egg shedding and thus require closer surveillance and may need more frequent interventions to reduce pasture contamination.

Testing can be performed year-round (from at least eight weeks after treatment, depending on the last anthelmintic administered), but the focus should be from spring to early autumn, with winter sampling recommended for horses with year-round grazing. Treatment thresholds typically range from 200 to 500 eggs per gram; the threshold used should be guided by a risk assessment. In foals, FEC tests can be used from around four months of age to detect ascarid infections and guide treatment decisions.



* Recent studies in the UK (Easton and others 2016, Tzelos and others 2019, Shrubb and others 2025) indicate a reluctance in the sector to move away from all-group calendar-based worming

Fig 2: Decision tree to guide the use of cyathostomin larvicidal treatments or targeted testing strategies during autumn and winter, based on the infection risk profile. FEC Faecal egg count

Testing for nematodes

For both cyathostomins and ascarids, FEC tests should be used to assess anthelmintic efficacy by measuring egg count reduction approximately two weeks after treatment (CANTER 2026). Expected mean nematode egg count reductions are:

- ≥90 per cent for benzimidazoles and pyrantel salts;
- ≥95 per cent for macrocyclic lactones.

Efficacy monitoring should include as many horses as possible within a group, assessing all horses with ≥200 strongyle eggs per gram at the screening FEC, and all ascarid-positive foals. If the mean egg count reduction falls below the above thresholds, practitioners should advise immediate changes to management to reduce infection pressure and minimise future treatment requirements, while considering alternative anthelmintic compounds where appropriate. Detailed record-keeping of FEC results and responses to treatment is essential. Efficacy testing should be a core component of all programmes to determine which anthelmintics remain effective and to detect resistance against specific compounds as early as possible.

FEC tests do not accurately reflect total cyathostomin burdens, as they fail to account for immature larvae, male worms and variation in egg shedding by individual female parasites. In the UK, particularly during autumn and winter, some horses can harbour substantial cyathostomin burdens dominated by immature encysted larvae (Ogbourne 1976, Dowdall and others 2002).

Historically, strategically timed treatments targeting these mucosal larval stages during autumn and winter have been recommended. However, blanket larvicidal treatment of all horses is unnecessary and may accelerate the development of anthelmintic resistance. Instead, targeted larvicidal treatments of young horses or other high-risk individuals can be administered to reduce mucosal larval burdens, decreasing the likelihood of subsequent clinical disease if the anthelmintic used is effective. Horses at low risk can be assessed using the small redworm blood test (Fig 2), which detects all stages of infection and allows determination of which horses do not require treatment (Tzelos and others 2019, Lightbody and others 2024). The test is particularly useful where owners are still considering administering a cyathostomin larvicidal treatment despite their horse having a low-risk classification. In these situations, this test will help identify horses with negligible or low burdens that do not require treatment, supporting more targeted and sustainable parasite control. The small redworm blood test should not be used as an indicator of disease risk as the upper reporting threshold of the test (10,000 cyathostomins) is unlikely to represent a clinically relevant burden in healthy horses.

Testing for tapeworms

FEC tests have low sensitivity for detecting tapeworm infections (Gasser and others 2005, Matthews and others 2023), whereas antibody-based assays, available in blood and saliva (EquiSal; Austin Davis Biologics) (Fig 3) formats, offer higher

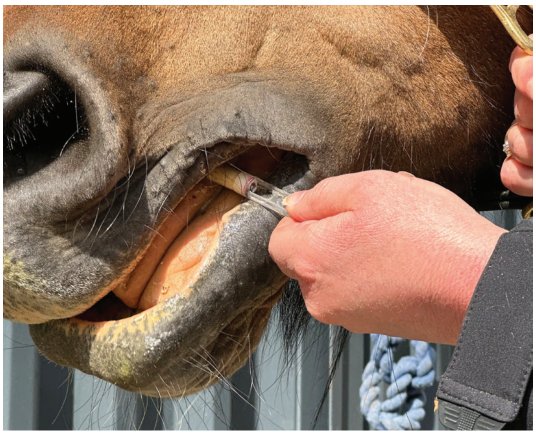


Fig 3: Saliva testing for tapeworm infection. Antibody-based assays offer higher sensitivity than faecal egg count tests and can more reliably identify infected horses

sensitivity and more reliably identify infected horses (Lightbody and others 2016). Tapeworm blood and saliva test results are categorised as ‘low’, ‘borderline’ or ‘moderate/high’, with horses that fall within the ‘borderline’ and ‘moderate/high’ categories recommended for treatment. This recommendation is based on the initial validation studies that demonstrated that a few horses harbouring potentially pathogenic burdens (ie, >20 tapeworms) were classified within the borderline category (Lightbody and others 2016).

The timing of serum and saliva ELISA testing relative to the last anthelmintic treatment is important. As these assays measure antibody responses rather than direct parasite presence, antibody levels may persist for some time following effective treatment. As a guide, it is recommended to wait at least four months after anthelmintic treatment before blood testing and at least three months before saliva testing. This will reduce the likelihood of detecting residual antibodies from prior (pretreatment) exposure.

In the UK, numbers of the intermediate host oribatid mites increase in spring and summer (Wickenden and others 2025), making spring testing key for identifying horses likely to be shedding eggs when transmission risk is highest. Autumn testing is also advisable, as tapeworm burdens are generally higher in this season (Meana and others 2005, Rehbein and others 2013); treating test-positive horses at these times reduces parasite burden and, hence, disease risk.

Tapeworm infection risk is influenced by paddock management practices, including dung removal strategies and stocking density (Matthews and others 2024a, Kukurić and others 2025). Infection intensity may also be greater in younger horses (Proudman and others 1997, Burcákova and others 2023, Buono and others 2026), although animals of all ages can harbour *A perfoliata* (Hreinsdóttir and others 2019). In low-risk horses, antibody-based testing once annually in spring or autumn is appropriate, whereas higher-risk individuals benefit from testing in both seasons.

The use of targeted diagnostic testing for tapeworms has been shown to substantially reduce unnecessary cestocidal administration when compared with routine interval-based treatment strategies. Analysis of more than 200,000 commercial EquiSal results demonstrated that only approximately one-third of horses tested were recommended for treatment (Matthews and others 2024b). These findings support the role of antibody-based testing in identifying horses most likely to benefit from treatment, while simultaneously reducing unnecessary anthelmintic exposure and supporting more sustainable parasite control practices.

Testing for Oxyuris equi and Strongylus vulgaris

O equi and *S vulgaris* require specific monitoring as necessary. *O equi* infection should be suspected when tail rubbing or perianal irritation is observed; diagnosis can be achieved using tape tests applied to the perianal region (CANTER 2026). Although *S vulgaris* is uncommon in populations regularly treated with anthelmintics, this parasite does persist ubiquitously at low levels (Krücken and others 2025) and can cause significant disease if infection levels rise. In situations where *S vulgaris* is considered a risk, larval culture is recommended to accurately identify the strongyle species present (Nielsen 2025).

Reducing parasite infection pressure on pasture

Effective parasite control should focus on reducing exposure to infective stages on pasture, thereby lowering disease risk. An effective way to reduce transmission is to regularly remove faeces from paddocks. Strongyle eggs deposited in faeces can develop to infective third-stage larvae within a week under warm (>20°C) and moist conditions (Mfitilodze and Hutchinson 1987); removing dung from paddocks twice weekly has been shown to significantly reduce pasture contamination (Herd 1986). Furthermore, decreased strongyle egg shedding has been reported in equids grazing paddocks where dung removal is applied (Corbett and others 2014, Tzelos and others 2017).

Stocking density is another important factor in paddock management, as higher numbers of horses per area increase egg deposition and overall infection pressure (Joó and others 2022). Current guidelines recommend at least 1 to 1.5 acres per horse (CANTER 2026). Extended pasture resting is also advised, as free-living strongyle eggs and larvae can survive for months in the UK, including through winter conditions (Ogbourne 1972). Ideally, resting periods should span from the end of one grazing season to the middle of the next. Ascarid eggs and tapeworm cysticercoids in oribatid mites may persist longer, although evidence in this area is limited. Rotational grazing with ruminants can further reduce infection levels, as most equine helminths cannot complete their lifecycle in non-equine hosts. Studies in the Netherlands demonstrated that ponies grazing paddocks alternated with sheep had substantially lower strongyle burdens than those grazing equine-only pastures (Eysker and others 1986). However, care must be taken to avoid inadvertently introducing other parasites, such as liver fluke, when implementing co-grazing strategies. Therefore, a thorough risk assessment of any co-grazing species should be undertaken before introduction.

Harrowing has been proposed as a method to reduce pasture burdens; however, evidence from temperate regions suggests limited benefit. Indeed, in one Nordic field study, a single harrowing under dry conditions did not reduce infective strongyle larvae compared with untreated controls and the larvae survived for prolonged periods after faecal dispersal (Osterman-Lind and others 2022). In

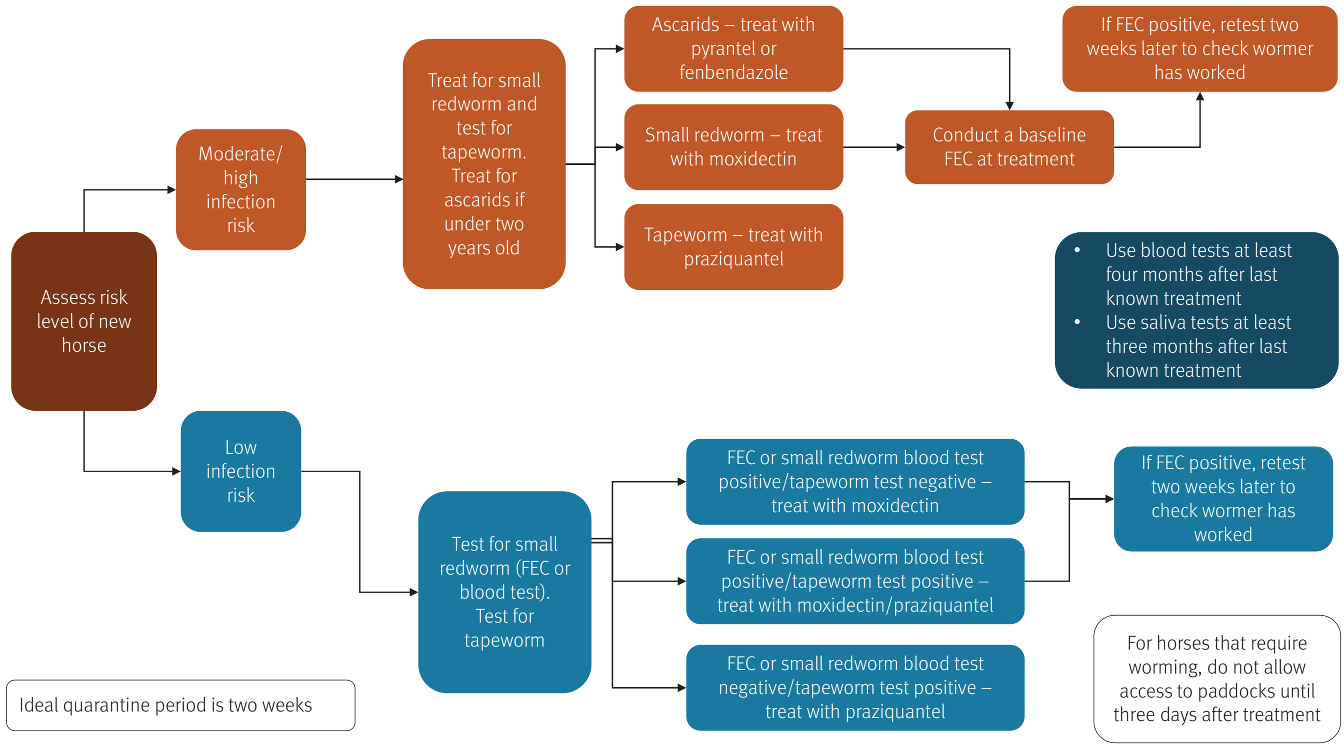


Fig 4: Decision tree illustrating quarantine strategies for horses assessed as having differing levels of risk for helminth infection. FEC Faecal egg count

the UK, where sustained hot, dry conditions are uncommon, harrowing is unlikely to meaningfully reduce pasture infectivity and should be discouraged on paddocks where horses graze.

Quarantine measures

Appropriate quarantine measures for new arrivals are essential to reduce the risk of introducing new parasite infections, including anthelmintic-resistant populations. All incoming horses should be managed under a structured quarantine protocol, combining isolation with targeted diagnostic testing and/or treatment based on an individual risk assessment (Fig 4). This assessment should consider factors such as age, management approaches at the previous yard and anthelmintic treatment history, including the likelihood of exposure to resistant parasite populations. Where anthelmintic treatment is administered, horses should be kept off grazing for at least three days following treatment to minimise pasture contamination with parasite stages and residues of pharmacologically active compounds. If this is not possible, horses should be placed in small, easily managed paddocks, with strict removal of all dung to limit parasite transmission and ecotoxic effects associated with anthelmintic residues. Where relevant, treatments during quarantine should include FEC reduction testing to confirm anthelmintic effectiveness or help identify treatment failure. This approach helps prevent the introduction of resistant parasites into the resident population.

Summary

Sustainable equine helminth control requires an integrated approach. Combining risk assessment, diagnostic testing and, where necessary, strategic treatments, with effective pasture management will help achieve sustainable control. While these approaches are increasingly advocated, further research will be required to evaluate their long-term impact and effectiveness across different equine populations.

Conflict of interest statement

I am an employee of Austin Davis Biologics, the company that provides the tapeworm and cyathostomin antibody tests as diagnostic services, and a lead inventor of the cyathostomin antibody test, and so have a financial interest in the some of the content of this review.

References

ABBAS, G., GHAFAR, G., HURLEY, J., BAUQUIER, J., BEASLEY, A., WILKES, E. J. A. & OTHERS (2021) Cyathostomin resistance to moxidectin and combinations of anthelmintics in Australian horses. *Parasites & Vectors* 14, 597

BUONO, F., MATTHEWS, J. B., AUSTIN, C. J., LIGHTBODY, K. L., PEZCAK, S., ENGEHAM, S. & VENEZIANO, V. (2026) Seroprevalence survey of cyathostomin and tapeworm infections in Italy and risk factors for infection. *Journal of Equine Veterinary Science* 157, 105763

BURCÁKOVA, L., KÖNIGOVÁ, A., KUZMINA, T. A., AUSTIN, C. J., MATTHEWS, J. B., LIGHTBODY, K. L. & OTHERS (2023) Equine tapeworm (*Anoplocephala* spp) infection: evaluation of saliva- and serum-based antibody detection methods and risk factor analysis. *Parasitology Research* 122, 3037–3052

BYRNE, O., O'DWYER, S., JAHNS, H., MATTHEWS, J. B., LIGHTBODY, K. L., AUSTIN, C. J. & OTHERS (2025) Acute larval cyathostominosis in Thoroughbred horses: a case series highlighting innovative diagnostic techniques. *Veterinary Record Case Reports* 13, e70222

CANTER (2026) The CANTER Guidelines for sustainable equine parasite control (2nd edn). 2026. https://canterforhorses.org.uk/guidelines (accessed

4 August 2026)
CLAYTON, H. M. (1986) Ascarids: recent advances. *Veterinary Clinics of North America: Equine Practice* 2, 313–328
CORBETT, C. J., LOVE, S., MOORE, A., BURDEN, F. A., MATTHEWS, J. B. & DENWOOD, M. J. (2014) The effectiveness of faecal removal methods of pasture management to control the cyathostomin burden of donkeys. *Parasites & Vectors* 7, 48
DOWDALL, S. M. J., MATTHEWS, J. B., MURPHY, D., LOVE, S. & PROUDMAN, C. J. (2002) Antigen-specific IgG(T) responses in natural and experimental cyathostomin infection. *Veterinary Parasitology* 106, 225–242
EASTON, S., PINCHBECK, G. L., TZELOS, T., BARTLEY, D. J., HOTCHKISS, E., HODGKINSON, J. E. & MATTHEWS, J. B. (2016) Interactions between horse owners' and prescribers of anthelmintics in the UK. *Preventive Veterinary Medicine* 135, 17–27
EYSKER, M., JANSEN, J. & MIRCK, M. H. (1986) Control of strongylosis in horses by alternate grazing of horses and sheep and some aspects of the epidemiology of *Strongylidae* infections. *Veterinary Parasitology* 19, 103–115
FABIANI, J. V., LYONS, E. T. & NIELSEN, M. K. (2016) Dynamics of *Parascaris* and *Strongylus* spp. parasites in untreated juvenile horses. *Veterinary Parasitology* 230, 62–66
FOGARTY, U., DEL PIERO, F., PURNELL, R. E. & MOSURSKI, K. R. (1994) Incidence of *Anoplocephala perfoliata* in horses examined at an Irish abattoir. *Veterinary Record* 134, 515–518
GASSER, R. B., WILLIAMSON, R. M. C. & BEVERIDGE, I. (2005) *Anoplocephala perfoliata* of horses – significant scope for further research, improved diagnosis and control. *Parasitology* 131, 1–13
HERD, R. P. (1986) Epidemiology and control of equine strongylosis at Newmarket. *Equine Veterinary Journal* 18, 447–452
HREINSDÓTTIR, I., HREINSDÓTTIR, A., EYDAL, M., TYSNES, K. R. & ROBERTSON, L. J. (2019) *Anoplocephala perfoliata* infection in horses in Iceland: investigation of associations between intensity of infection and lesions. *Journal of Parasitology* 105, 379–386
HODGKINSON, J. E., CLARK, H. J., KAPLAN, R. M., LAKE, S. L. & MATTHEWS, J. B. (2008) The role of polymorphisms at beta tubulin isotype 1 codons 167 and 200 in benzimidazole resistance in cyathostomins. *International Journal for Parasitology* 38, 1149–1160
JOÓ, K., TRÚZSI, R. L., KÁLMÁN, C. Z., ÁCS, V., JAKAB, S., BÁBA, A. & NIELSEN, M. K. (2022) Evaluation of risk factors affecting strongylid egg shedding on Hungarian horse farms. *Veterinary Parasitology: Regional Studies and Reports* 27, 100663
KÖNIGOVÁ, A., URDA DOLINSKÁ, M., BABJÁK, M., VON SAMSON-HIMMELSTJERNA, G., KOMÁROMYOVÁ, M. & VÁRADY, M. (2021) Experimental evidence for the lack of sensitivity of in vivo faecal egg count reduction testing for the detection of early development of benzimidazole resistance. *Parasitology Research* 120, 153–159
KRÜCKEN, J., DIEKMANN, I., ANDREOTTI, S., BRETTMANN, C., MBEDI, S., SPARMANN, S. & OTHERS (2025) Cytochrome c oxidase I deep amplicon sequencing for metabarcoding of equine strongyle communities: unexpectedly high *Strongylus* spp burden in treated horses. *International Journal for Parasitology* S0020-7519(25)00182-1
KUKURIĆ, T., ERDELJAN, M., MATTHEWS, J. B., LIGHTBODY, K. L., AUSTIN, C. J., PEZCAK, N. & OTHERS (2025) A prevalence study on *Anoplocephala* spp. in Serbian horses: navigating diagnostic challenges and understanding infection risks. *Animals (Basel)* 15, 2094
LESTER, H. E. & MATTHEWS, J. B. (2014) Faecal worm egg count analysis for targeting anthelmintic treatment in horses: points to consider. *Equine Veterinary Journal* 46, 139–145
LESTER, H. E., MORGAN, E. R., HODGKINSON, J. E. & MATTHEWS, J. B. (2018) Analysis of strongyle egg shedding consistency in horses and factors that affect it. *Journal of Equine Veterinary Science* 60, 113–119
LIGHTBODY, K. L., AUSTIN, A., LAMBERT, P. A., VON SAMSON-HIMMELSTJERNA, G., JÜRGENSCHELLERT, L., KRÜCKEN, J. & OTHERS (2024) Validation of a serum ELISA test for cyathostomin infection in equines. *International Journal for Parasitology* 54, 23–32
LIGHTBODY, K. L., DAVIS, P. J. & AUSTIN, C. J. (2016) Validation of a novel saliva-based ELISA test for diagnosing tapeworm burden in horses. *Veterinary Clinical Pathology* 45, 335–346
MAIR, T. S. (1993) Recurrent diarrhoea in aged ponies associated with larval cyathostomiasis. *Equine Veterinary Journal* 25, 161–163
MAIR, T. S., OPIE, R., MORETON-CLACK, M., PARKIN, T. D. & MATTHEWS, J. B. (2023) Strongyle egg reappearance periods following moxidectin treatment in horses in Southeast England. *Equine Veterinary Education* 36, 36–41
MATTHEWS, J. B. (2014) Anthelmintic resistance in equine nematodes. *International Journal for Parasitology: Drugs and Drug Resistance* 4, 310–315
MATTHEWS, J. B., LIGHTBODY, K. L., PEZCAK, N. & AUSTIN, C. J. (2024a) An update on the use of saliva-based diagnostics for *Anoplocephala perfoliata* infections in horses. *Equine Veterinary Education* 36, S13:14–15
MATTHEWS, J. B. & MAIR, T. S. (2025) Sustainable control of cyathostomin infections in practice. *Equine Veterinary Education*. doi.org/10.1111/eve.14182
MATTHEWS, J. B. & PEACHEY, L. (2026) An update on equine tapeworm control in light of reports of anthelmintic resistance. *Equine Veterinary Education*. In Press. doi.org/10.1111/eve.70079
MATTHEWS, J. B., PEZCAK, N. & ENGEHAM, S. (2024b) An update on the latest developments in testing for equine helminths. *In Practice* 46, 34–41
MATTHEWS, J. B., PEZCAK, N. & LIGHTBODY, K. L. (2023) The use of innovative diagnostics to inform sustainable control of equine helminth infections. *Pathogens* 12, 1233
MEANA, A., PATO, N., MARTÍN, R., MATEOS, A., PÉREZ-GARCÍA, J. & LUZÓN, M. (2005) Epidemiological studies on equine cestodes in central Spain: infection pattern and population dynamics. *Veterinary Parasitology* 130, 233–240
MFITILODZE, M. W. & HUTCHINSON, G. W. (1987) Development and survival of free-living parasites of equine parasites under laboratory conditions. *Veterinary Parasitology* 23, 121–123
NIELSEN, M. K. (2022) Anthelmintic resistance in equine nematodes: Current status and emerging trends. *International Journal for Parasitology: Drugs and Drug Resistance* 20, 76–88
NIELSEN, M. K. (2023) Apparent treatment failure of praziquantel and pyrantel pamoate against anoplocephalid tapeworms. *International Journal for Parasitology: Drugs and Drug Resistance* 22, 96–101
NIELSEN, M. K. (2025) *Strongylus vulgaris* – an ancient threat revisited. *Equine Veterinary Education*. doi.org/10.1111/eve.70023
NIELSEN, M. K., BANAHAN, M. & KAPLAN, R. M. (2020) Importation of macrocyclic lactone resistant cyathostomins on a US Thoroughbred farm. *International Journal for Parasitology: Drugs and Drug Resistance* 14, 99–104
NILSSON, O., LJUNGSTRÖM, B. L., HÖGLUND, J., LUNDQUIST, H. & UGGALA, A. (1995) *Anoplocephala perfoliata* in horses in Sweden: prevalence, infection levels and intestinal lesions. *Acta Veterinaria Scandinavica* 36, 319–328
OGBOURNE, C. P. (1972) Observations on the free-living stages of strongylid nematodes of horses. *Parasitology* 64, 461–477
OGBOURNE, C. P. (1976) The prevalence, relative abundance and site distribution of nematodes of the subfamily Cyathostominae in horses killed in Britain. *Journal of Helminthology* 50, 203–213
OSTERMAN-LIND, E., HEDBERG ALM, Y., HILLEVI HASSLER, H., WILDEROTH, H., THOROLFSON, H. & TYDÉN, E. (2022) Evaluation of strategies to reduce equine strongyle infective larvae on pasture and study of larval migration and overwintering in a Nordic climate. *Animals (Basel)* 12, 3093
PAVONE, S., VERONESI, F., PIERGILI FIORETTI, D. & MANDARA, M. T. (2010) Pathological changes caused by Anoplocephala perfoliata in the equine ileocecal junction. *Veterinary Research Communications* 34 (suppl S1), S53–S56
PROUDMAN, C. J. & EDWARDS, G. B. (1993) Are tapeworms associated with equine colic? A case control study. *Equine Veterinary Journal* 25, 224–226
PROUDMAN, C. J., FRENCH, N. P. & TREES, A. J. (1998) Tapeworm infection is a significant risk factor for spasmodic colic and ileal impaction colic in the horse. *Equine Veterinary Journal* 30, 194–199
PROUDMAN, C. J., HOLMES, M. A., SHEORAN, A. S., EDWARDS, S. E. R. & TREES, A. J. (1997) Immunoepidemiology of the equine tapeworm *Anoplocephala perfoliata*: age-intensity profile and age-dependency of antibody subtype responses. *Parasitology* 114, 89–94
REHBEIN, S., VISSER, M. & WINTER, R. (2013) Prevalence, intensity and seasonality of gastrointestinal parasites in abattoir horses in Germany. *Parasitology Research* 112, 407–413
REINEMEYER, C. R. & NIELSEN, M. K. (2014) Biology and control of *Oxyuris equi*. *Equine Veterinary Education* 26, 584–591
RELF, V. E., MORGAN, E. R., HODGKINSON, J. E. & MATTHEWS, J. B. (2013) Helminth egg excretion with regard to age, gender and management practices on UK Thoroughbred studs. *Parasitology* 140, 641–652
SHRUBB, J., ROBINSON, N., RENDLE, D., SCHOFIELD, I., SCOTT, C., CRABTREE, J. & OTHERS (2025) Project WORMS (working to overcome resistance and make for a sustainable future): Horse owner survey of equine parasite control. Part 2. Anthelmintic use. *Equine Veterinary Education* 00, 1–12. Available from: https://doi.org/10.1111/eve.14116
TZELOS, T., BARBEITO, J. S. G., NIELSEN, M. K., MORGAN, E. R., HODGKINSON, J. E. & MATTHEWS, J. B. (2017) Strongyle egg reappearance period after moxidectin treatment and its relationship with management factors in UK equine populations. *Veterinary Parasitology* 237, 70–76
TZELOS, T., MORGAN, E. R., EASTON, S.,HODGKINSON, J. E. & MATTHEWS, J. B. (2019) A survey of the level of horse owner uptake of evidence-based anthelmintic treatment protocols for equine helminth control in the UK. *Veterinary Parasitology* 274, 108926
WICKENDEN, H., LIGHTBODY, K. L., PEZCAK, N., AUSTIN, C. J., STEVENS, K. B., BLAKE, D. P. & OTHERS (2025) A study of the epidemiology of *Anoplocephala perfoliata* infection in horses and the oribatid mite vector in southern England. *International Journal for Parasitology* 14, 783–794

Further resources

Risk assessment template: CANTER Guidelines (2nd edn). 2026. https://canterforhorses.org.uk/guidelines
What's Your Worm Risk? whatsyourwormrisk.com

Scan the QR code in the RCVS 1CPD app to log reading this article