The potential impact of artificial intelligence in equine practice

Artificial intelligence has the potential to impact the veterinary industry. This article outlines the current and potential uses of artificial intelligence tools in equine veterinary practice across both clinical and non-clinical aspects of working with horses. Examples of wider uses across the industry by horse owners and trainers are also summarised and discussed. The use-case example of the pre-purchase examination is discussed as an area highlighting how artificial intelligence could have multiple impacts, increasing confidence and improving efficiency and outcomes for equine vets. Additionally, important considerations including potential risks and ethical concerns of the development and use of artificial intelligence as a currently unregulated technology are also discussed.

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It is increasingly difficult to ignore the discussion around artificial intelligence and the potential of this technology to impact many areas of life and work with horses. There is potential for artificial intelligence to modernise the equine world, from how vets interact with their clients and practise clinical medicine, to the very fabric of the industry through breeding. This article explores the current and potential uses of artificial intelligence tools for owners, trainers and veterinary teams, using the pre-purchase examination as a use-case example. It also discusses some of the dangers and ethical concerns of using a potentially hugely powerful, yet unregulated technology.

Current and potential applications

Artificial intelligence has the potential to play a significant role in equine welfare, from disease prevention to early detection and individualised treatment. Some tools are already widely used by practitioners, whereas many more are in the early phases of development following the trends in small animal, livestock and human sectors. Artificial intelligence could impact almost every aspect of working with horses and it is vital to ensure that there is veterinary input into the development and use of these technologies for the benefit of equine health and welfare. The following overview discusses some current and potential beneficial uses of artificial intelligence:

Prevention: By analysing large amounts of data from various sources such as veterinary records, weather patterns and horse movement, artificial intelligence could identify patterns and predict the likelihood of disease outbreaks, enabling proactive disease management strategies. This could potentially aid the prevention of spread of both transmissible disease and likelihood of environmentally-related disease, such as spasmodic colic and laminitis.

Diagnosis: Artificial intelligence-powered diagnostic tools can assist vets in detecting diseases and abnormalities at an early stage, facilitating timely treatment and potentially reducing spread of disease within a population (Nath et al, 2021; May et al, 2022), such as identification of worm eggs in an automated, cost-effective way (Slusarewicz et al, 2016) and improving outcomes for affected individuals.

Treatment: Following the trend of personalised treatment in human medicine, in future there is the potential to develop artificial intelligence tools that could create individualised treatment plans that take into account a horse's use, condition, history, signalment and response to medications.

Prognosis: Artificial intelligence can be used to predict the survivability likelihood and need for surgery of horses suffering from colic with high accuracy. Algorithms were able to predict the need for surgery and survivability of horses presented with acute abdomen pain with 76% and 85% accuracy, respectively (Fraiwan and Abutarbush, 2020). Such tools can help to inform decision making, especially in such high cost, high stress situations for both the vet and the owner.

Wearable technology: Smart wearables, such as sensors and trackers, could collect real-time data on a horse's vital signs, activity

levels and behaviour. Artificial intelligence algorithms could then analyse these data to provide insights and alerts – for example tracking heart rate through exercise and recovery phases, or sending an alert to warn of changes in parameters that may be associated with pain, oestrus or proximity to parturition.

Nutrition and feeding: Artificial intelligence algorithms could analyse data on individual horses and provide customised feeding plans, considering factors such as age, activity level and specific nutritional requirements.

Breeding and genetics: Through the use of advanced algorithms and machine learning, artificial intelligence could process vast amounts of data on individual horses and their lineage to predict their genetic potential. It could be used to analyse and interpret genomic data, helping to identify specific genes associated with desirable traits such as athleticism, temperament and disease resistance. With this information, breeders could make more informed decisions, leading to improvements in the overall quality of horses produced (Hill et al, 2010).

Behaviour: Interpretation of data from both image capture and wearable technologies, such as accelerometers, have fed into research and understanding of behaviour across many species, from oestrus detection in cattle to the behaviour of juvenile lemon sharks in the Bahamas (Brewster et al, 2018). Research using a deep learning-based approach for activity detection of equines was able to distinguish seven different behaviours with 99% accuracy (Eerdekens et al, 2020). The potential of this technology to inform human understanding of such a vast array of species is enormous and can inform both veterinary care and husbandry of domestic species and wildlife conservation efforts.

Training and performance optimisation: Artificial intelligence could help trainers create personalised training plans, monitor progress and identify areas for improvement. Biomechanics analysis and motion capture technology can also provide valuable insights into a horse's movement, helping to optimise performance, and the potential to identify pre-injury locomotion changes as well as adapt training programs to minimise injury risk (Marlin et al, 1999; Marcellin, 2016). Moreover, data on individual performance, such as training times, racing history and environmental factors, can be analysed by machine learning algorithms to develop individualised training programs and race strategies.

Race prediction and betting: In addition to informing training methods, reducing injury risk and optimising race strategies, artificial intelligence algorithms can be used to analyse historical race data, track conditions and individual horse performance to predict race outcomes more accurately and inform wagering strategies (Benter, 1994).

Facilities management: As with many industries, artificial intelligence could increasingly be used to optimise farm and stable operations, such as monitoring and automating various tasks related to horse care, energy consumption and waste management.

Chatbots: Artificial intelligence-powered virtual assistants can be used to answer common questions, provide training and guidance and offer support related to equine care and management. This could be hugely powerful when deployed in remote regions where working equids are vital to the survival and culture of rural communities, but access to veterinary knowledge and care is limited.

Artificial intelligence and the pre-purchase examination

Pre-purchase examinations are frequently performed in equine practice to provide purchasers with the reassurance that the horse they are buying will be fit for intended purpose and reduce the emotion, time and cost associated with managing an unfit animal. However, pre-purchase examinations can provide a significant source of stress for vets, especially when assessing high value horses or where the purchaser or the vendor is a client.

Many skilled practitioners choose not to perform pre-purchase examinations due to the potential pitfalls in managing client expectations and liability or reputational risk exposure. Indeed, around two-thirds of all equine claims made to the Veterinary Defence Society arise from pre-purchase examinations (Burrows, 2022). Communication is key to a successful outcome, yet there can be complexities in achieving timely, co-ordinated communication between all parties (Werner, 2012).

Pre-purchase examinations are typically based on a physical examination. Further additional procedures undertaken during a pre-purchase examination may include clinical pathology, radiographic examination, endoscopic examination of the airway, cardiovascular and breeding soundness examinations – these may be performed depending on the value and intended use of the animal. When performed successfully, whether a decision is made to purchase the horse or not, the buyer should be satisfied that the examination was accurate, and the information provided by the attending vet was clear and concise (Suslak-Brown, 2004).

Artificial intelligence tools could be used not only to assist with the assessment, but also to ease the burden of record keeping, form completion and communication between the parties, which in itself is a source of burnout among medical professionals (West et al, 2018). In addition, remote, continuous monitoring tools can overcome the limitations of 'while you were here' observation, where an animal can only be assessed at one point in time.

Artificial intelligence could be used in the following aspects of pre-purchase examinations:

1. Lameness analysis

One study showed that owners are often unable to recognise lameness in their own horses (Müller-Quirin, 2020). Among veterinary staff, subjective lameness analysis is influenced by experience and there is often lack of agreement even amongst experienced veterinarians with subtle lameness cases.

Traditional technology-based analysis of gait require force plate analysis or physical markers to be placed on the body with specialised image capture equipment. Today, the almost ubiquitous access to a smartphone camera means the necessary data can be obtained at any chosen location, non-invasively, without the requirement for additional equipment or expertise. Artificial neural networks are widely used in image analysis applications, from facial recognition to live motion analysis of horses to assess lameness, such as the Sleip application (Sleip, 2023). Another technology based on pose estimation, which is already used in human and veterinary science to study movement without the need to fix any devices onto the object of interest, has also been trialled (Feuser et al, 2022). This application was used to determine and mark specific anatomical

reference points using smartphone videos of horses being lunged in a circle.

These technologies enable assessment in the home environment, reducing the likelihood of unfamiliar ground or surroundings impacting behaviour. Increasing accessibility and reducing cost of lameness assessment in this way should enable more horses to be diagnosed sooner, benefitting horse welfare and providing a diagnostic aid for the equine vet.

2. Ocular examination

A deep learning tool has been developed that can detect changes due to uveitis and other ophthalmic diseases in the equine eye from a smartphone photograph (May et al, 2021). High classification accuracy can be achieved due to many of the pathological changes being visible, even in photographs. Interestingly, the programme was found to concentrate on areas of the equine eye that are less noted by the human examiner – this is a good example of how humans and machines can augment one another, through the different focuses of human biological neural networks versus the artificial intelligence's computational neural networks.

Such tools could certainly help vets as part of ocular examination, provided the specific use and limitations of the tool are taken into account. For example, if there is any doubt in the clinician's mind as to the health of the anterior chamber, this could provide reassurance or confirmation.

However, the tool only evaluates the anterior segment of the eye and diseases of the posterior segment would be missed in most cases. Putting such tools in the hands of owners requires careful understanding of the limitations. If acute eye conditions are misdiagnosed, such as retinal detachment, treatment could be delayed with negative impacts on outcome (May et al, 2021).

3. Radiographic analysis

The quantity of radiographic views frequently performed at pre-purchase examinations provide the ideal data source for informing the training and application of an artificial intelligence algorithm, especially where the images are accurately and consistently labelled. Radiographic interpretation creates a significant burden during the pre-purchase examination process, with conditions often being less than ideal to read the images and the pressure on a lone practitioner to make accurate assessments.

Pre-purchase examination radiographic interpretation is more frequently being outsourced to specialists in equine diagnostic imaging, with the increasing popularity and availability of teleradiology services saving time for the practitioner and giving them peace of mind with the interpretation. At VetCT, pre-purchase examination imaging series are read by two equine radiologists to provide the reassurance of the robustness of the reported opinion. As such services increase in popularity globally, any time savings and efficiencies that technology can offer will be a welcome development. Validated artificial intelligence tools can also provide computational assessment to augment diagnostic interpretation and inform a radiologist's recommendations. In human medicine, this additional clarification has been shown to improve accuracy and agreement rate between physicians (Nehrer et al, 2021), which could in turn reduce the risk of human error and provide reassurance to all parties. Conversely, radiology reports generated solely by artificial intelligence are less trusted by clinicians than a report generated by a radiologist and artificial intelligence (Lim et al, 2022), highlighting the importance of keeping a human in the loop.

Machine learning has been used in research for the automation of segmentation tasks that would otherwise have required laborious manual outlining, including identifying and outlining osseous structures of the equine distal limb on radiographs (Van Houtte et al, 2019). Studies have shown the potential for machine learning algorithms and quantitative analysis to aid in the interpretation of musculoskeletal injury in magnetic resonance imaging (El-Khamary et al, 2022). As these radiological artificial intelligence aids become more widely available, the speed and efficiency of radiology reporting will increase.

When looking to the more advanced human field, artificial tools are still restricted to the field of narrow artificial intelligence: asking and answering a specific question, such as the probability of a particular pathology in a defined area being present or absent (Hosny et al, 2018). Technology is some way off general artificial intelligence, where these narrow tools can be integrated to enable fully automated interpretation of images and take into account the history, signalment and environmental and other factors. In other words, artificial intelligence can be used to answer specific, defined questions – such as automated measurements and highlighting areas of abnormality – to help inform the radiologist in human medicine. When sticking to science-fact, rather than science-fiction, there will always be a place for the real-life human radiologist to empathise with the clinician and their client, understand the emotive aspects involved in equine practice and the bigger picture of the horse's overall suitability for purchase, and tailor their advice to support the best outcomes for the vet, their client and the horse.

4. Cardiac monitoring

While cardiac monitors for horses have been available for decades, the veterinary industry is only just accessing the tools to be able to collate and process the data in a meaningful way through artificial intelligence.

The early detection of atrial fibrillation was one of the first applications of artificial intelligence in human medicine (Briganti and Le Moine, 2020). The potential for wearable devices to provide alerts to smartphones in the presence of arrhythmias during a period of continuous monitoring would help to pick up intermittent atrial fibrillation in racehorses, which can impact their career longevity (Nath et al, 2021).

5. Genetics

Applications in genetics can identify certain genetic markers of performance potential specific to different breeds and types of work. Commercial tools are already available that claim to collate and analyse data from physical health and genetic biomarkers to identify potential high-performance racehorses (Performance Genetics, 2023). Where the practitioner may not be recommending or using these tools, purchasers may be employing them directly. Understanding the strengths and limitations of these technologies will

KEY POINTS

- Artificial intelligence currently has various applications in equine practice and the wider equine industry.
- Artificial intelligence has the potential to impact equine practice and the equine industry in the future, for example in pre-purchase examinations.
- There are potential risks and ethical considerations around the development and use of artificial intelligence tools.
- Input from equine veterinary professionals is required to make sure the technology benefits veterinary teams and equine welfare.

be increasingly important where veterinary opinion on the technology is sought during the pre-purchase examinations of sports and racehorses alike.

6. 'Paperwork'

While working on paper is rapidly becoming consigned to the history books, completing either written or electronic health records can be a significant administrative burden (Chaiyachati et al, 2019). Artificial intelligence solutions, specifically natural language processing tools such as ChatGPT, are becoming increasingly capable of helping medical professionals complete medical records. Such tools could aid in the reporting of specific elements of the pre-purchase examination, such as a radiological report in addition to the overall report, providing significant overall time saving.

However, caution must be exercised around data privacy and security, especially when utilising web-based software that can assimilate data to inform the algorithm and could be used elsewhere with no human control over where and how.

Risks and ethical considerations

As artificial intelligence systems collect and process large amounts of data, privacy and security become major ethical concerns. The more representative data an algorithm can access for training and refinement, the more likely it is to be accurate and unbiased, and consequently the more likely it is to support good outcomes and foster trust in technology.

However, where informed consent is required from owners to share patient data, it must be understood and explained how these data will be shared and used by an algorithm. This can be challenging where the data is assimilated and processed in ways that cannot always be predicted and where the outcomes are unknown. Artificial intelligence developers need to work closely with veterinary teams, horse owners and trainers to ensure transparency, validation and use of data sets to enable informed consent to be obtained to create accurate, useful tools. In addition, veterinary technology is not subject to the same regulation and human medical devices. Therefore, companies bringing equine artificial intelligence products to market are not required to report validity and performance data (Cohen and Gordon, 2022). It is the responsibility of the companies developing tools that may ultimately impact animal welfare to exercise self-regulation and be transparent in their data use, algorithm validation and training, calibration, outcomes, accuracy and errors.

Ideally, artificial intelligence products should be accompanied by peer-reviewed evidence based publication. Additionally, as is the requirement in human medicine, post-market surveillance should be part of ongoing quality improvement following the launch of an artificial intelligence tool. This is vital to monitor both intended and unexpected outputs, and report on how continued learning and development of the algorithm impacts the accuracy and validity of the outputs.

Automation bias is the human tendency to believe the machine over and above our own or another human opinion (Goddard et al, 2012). Veterinarians must be mindful of this when there is disagreement, seeking additional clarification rather than assuming the artificial intelligence is right. This will be particularly important with more artificial intelligence tools becoming available directly to horse owners.

Additionally, artificial intelligence tools in the hands of owners could create conflict where the artificial intelligence output differs from the opinion of the vet. For example, a purchaser might believe they can use objective gait analysis to help them make a decision about the purchase of a horse, without seeking veterinary advice. A purchaser or seller could also use the technology to question veterinary opinion, which may be especially challenging for inexperienced vets to confidently refute. Artificial intelligence tools therefore have the potential to either reduce stress and improve confidence for equine practitioners, but it may have the opposite effect if owners equipped with technology they do not fully understand use it to challenge the vet.

Another ethical challenge with artificial intelligence is determining who is responsible and liable in the event of an error or harmful outcome. This becomes especially problematic in scenarios where artificial intelligence systems inform decisions that have significant consequences – in this case, whether or not to purchase a horse. In the field of veterinary medicine, the only regulated entity is the vet and therefore the responsibility for errors – whether human or machine – lie solely with the veterinary surgeon.

In the absence of standards and regulations for the development and licencing of veterinary medical tools (including artificial intelligence), clear and transparent guidelines must be provided for best-practice use, including understanding of the limitations and potential for error, to enable these tools to be applied appropriately and with confidence, and indeed to explain their use to owners to obtain informed consent. Otherwise, there is a risk of eroding trust not only in the technology by vets, but also the clients trust towards the vets using it.

Conclusions

The integration of artificial intelligence into the equine industry offers the potential for enhanced disease management strategies, more efficient breeding practices, improved training methods and husbandry optimisation. These advancements have the potential to increase the overall quality, health, welfare and performance of horses, ultimately benefiting the entire industry and the communities and societies that rely on them.

In the case of the pre-purchase examination, tools to support assessment and completion of the examination and report could

both improve the efficiency and provide confidence and reassurance for the equine vet and their prospective purchaser.

However, it must be ensured that appropriate training and education is provided for practitioners to understand the correct clinical application and limitations of artificial intelligence in the field. Veterinarians must also champion standards and self-regulation by the industry, providing transparency, data security and safeguarding and prioritising animal welfare. For easy and quick adoption of this technology, clear, thorough information needs to be provided with intuitive tools that can aid everything from diagnosis to clinical notes and reports.

With such measures in place, artificial intelligence could not only benefit horses and their owners and trainers, but also provide a significant boost to the working life and morale of equine vets. EQ

Conflicts of interest

The author is an employee of VetCT. VetCT is a provider of equine teleradiology services, including review of prepurchase examination radiographs. However, the company is not developing any commercially available artificial intelligence tools at the current time.

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