# Forensic Aspects of Horseracing

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The sport of horseracing may not at first sight have a link to forensic science. But it is instructive, look across the English language for the definitions, dictionary examples, and origins, of certain words. "Ringer": An athlete or horse fraudulently substituted for another in a competition or event; "it was discovered that the winning horse was a ringer." "Dope": Administer drugs to (a racehorse, greyhound, or athlete) in order to inhibit or enhance sporting performance; "the horse was doped before the race". "Fix": To influence the actions, outcome, or effect of by improper or illegal methods: "the race had been fixed". "Nobble": tamper with a racehorse to prevent it from winning a race, especially by giving it a drug; a doping ring nobbled . . . the trainer's horses. The centuries old association of horse racing and betting has encouraged the unscrupulous, and in response elements of forensic science have been utilized to support the integrity of the sport of horseracing.

Horseracing, as now developed internationally around the world, has a long history, originating as match racing of two horses between the rich and powerful, and developing into more formally organized multi-horse races overseen by the British and then other Jockey Clubs from around 1750. Worldwide, the sport is dominated by racing the thoroughbred breed in flat races, with jump racing also common in France Britain and Ireland, and harness racing also seen in many countries. Other breeds are also raced, such as quarter horses in the USA [1].

### *Regulation*

There are no fully uniform international Rules. Regulations have developed at a national (e.g., France), federal (e.g., Australia), or local (e.g., individual US states) level. In some of these racing jurisdictions, government is in full control (most US states), in others it is a hybrid of government and nongovernment organizations (e.g., across much of Europe), but it can also be entirely nonstatutory, as in Britain and Ireland. Indeed the long history of horseracing is illustrated by racing in Northern Ireland, part of the United Kingdom, remaining regulated by the Turf Club in the Republic of Ireland, reflecting the historical role when all of the island of Ireland was part of the United Kingdom.

Harmonization of Rules, especially to allow international competition and raise standards, is effected through the federal structure of the International Federation of Horseracing Authorities (IFHA), headquartered in France (http://www.ifhaonline.org). This harmonization of Rules is complemented by IFHA technical committees, which by bringing together experts from around the world on issues such as identification, genetic technologies, and medication control, act as a powerful indirect force for raising standards back to individual racing jurisdictions.

### *Economic Impact*

The worldwide economic impact of horseracing has not been systematically quantified but can be inferred from worldwide betting turnover reported by the IFHA in 2012 of €95 billion. In broad terms, at least 75% of this is returned to those betting, with the remainder being distributed in highly variable combinations to governments, betting operators, and the horseracing industry: owners, breeders, trainers, regulators, racecourses. As an example of understanding more detailed national impact, a recent economic assessment of British horseracing gave a figure of £3.45 billion of direct, indirect, and induced expenditure in 2012 [2].

From this economic footprint can be interfered a wide range of employment and capital activities, underpinned by betting, that require robust regulation to assure that the right horses race fairly and safely, and that the interests of all concerned, including horses, and people and organizations, are protected. Such regulation utilizes a range of modern forensic tools and techniques.

### *Horse Identification*

With the sport dominated by a specific horse breed, the thoroughbred, maintaining both breed integrity and assuring individual horse identification is crucial.

The value of breeding animals after a successful racing career can soar to tens of millions, and their progeny can be sold for large sums before their racing careers. Those betting need to be assured that are putting their money on the correct horse. Those who wish to substitute a "ringer" need to be deterred and caught.

The long-established tool for animal breed integrity is to maintain a studbook and for thoroughbred racing this is kept by the "mother" studbook Weatherbys (http://www.weatherbys.co.uk) in Great Britain, with subsidiary national studbooks. These studbooks are responsible for the formal registration of mares, foals, and stallions to ensure the integrity of bloodlines.

Horses can be identified individually by their colors and markings. As far back as in 1928, Royal College of Veterinary Surgeons in the United Kingdom was publishing guidance to ensure uniformity and these methods are still used today [3]. These rely on recording, by narrative and drawings, the horse's color, any white markings on legs, head, and body, and the site and description of whorls (distinctive circular patterns of hair) in coat hair, as well as any other distinguishing marks.

After trials in the 1970s, parentage verification using blood typing technology was introduced by Weatherbys in 1986 and this was superseded by DNA verification in 2001. From 1999 in Great Britain, from 2008 for all horses in the European Union, and now in many other parts of the world, additional individual racehorse identification has been provided by permanent implantation of small transponders, "microchips", implanted deep into the main ligament of the neck. In some countries, tattoos on the lip are still used.

Foals are identified, microchips implanted, and drawings made by a veterinarian after birth. An identity document is issued by the studbook, commonly known as a *horse passport*. Any disputes on foal identity are resolved using the stored DNA samples for sire and dam. When horses go racing their identities are checked against the passport information, including the visual description, and their microchip or tattoo numbers are read. Discrepancies can be referred for investigation by the regulator, and this can include the use of DNA parentage verification of stored and contemporaneous samples (*see* **Missing Persons and Paternity: DNA**). Most discrepancies at racecourses are cases of accidental mixing of visually similar horses at their first run, but substitutions of horses with a poor racing history with a superior performer still occur, especially in types of racing where horses can transfer across different codes of racing or jurisdictions.

### *Doping and Medication Control*

As more substances that can affect horses have become available, analytical methods developed, and betting products have evolved, the traditional perspectives on doping have changed.

**Doping Control.** Before the advent of modern veterinary medicines in the early 20th century, medicines for animals were often ineffective. The main substances of interest were those regarded as stimulants to help winning, such a weak solutions of strychnine, or larger doses of poisons to "nobble" the horse so it did not win, such as arsenic.

Today doping has come to mean substances that have no established therapeutic indication and substances of abuse, and often these have real or potential ability to alter performance. This category includes anabolic steroids, $\beta$-adrenergic agonists that move bulk from fat to muscle, erythropoietin, substances that enhance the oxygen capacity of the blood, and peptide growth-promoting hormones. Also included are drugs of abuse that may result from direct administration or cross-contamination from human use. Examples are amphetamines, cocaine, and other stimulants.

Control of doping substances is by sampling and a policy of zero tolerance; i.e., if the substance is identified in any amount, the person responsible for the horse, usually its trainer, is brought before a disciplinary tribunal by the regulator. Positive findings attract high penalties, reflecting the fact that this is regarded as cheating.

**Medication Control.** There are a wide range of medications that can be used to treat racehorses. Effective veterinary treatment is not only required for good animal welfare but also racehorses are working performance animals whose owners pay fees to keep them in training. However, such medications carry several risks. They may directly or indirectly affect performance, or allow the need to rest recuperate before continuing training to be avoided. This latter

scenario poses primarily welfare risk to the horse, and secondarily a reputational risk to the horseracing industry.

Given the capability of modern analytical techniques to detect ever smaller amounts of substances, it is not possible to control these medications by a zero-tolerance approach; i.e., there has to be sensitivity control on the analytical techniques used. Such sensitivity control has to be objectively determined to ensure that industry integrity and horse welfare needs are properly served. The approach taken around the world is generally based upon work produced by Toutain and Lassourd in 2002 [4]. In essence, following administration of the medication to a group of horses, samples are taken, and drug levels measured. There are then calculations made, based on what is known about effective therapeutic levels of the medication, to decide when only irrelevant concentrations remain. Some risk factors are then applied, to account for variation in the administration studies and wider horse population. Finally, the resultant screening levels for sensitivity control are determined, and withdrawal and detection times published.

This approach, pioneered by the European Horseracing Scientific Liaison Committee (EHSLC: http://www.ehslc.com), is broadly similar around the world, with harmonized screening limits published by the IFHA. Approaches in Asia, from the Asian Racing Federation (ARF: http://www.asianracing.org) are very similar. There are however, some differences in North American racing jurisdictions implemented by the Racing Medication and Testing Consortium (RMTC: http://www.rmtcnet.com). These North American jurisdictions generally are more permissive in their medication control policies, although this is slowly changing

This approach to medication control has the practical result that trainers can use medication on their horses, but they need to withdraw medication use for an appropriate time before racing. Sampling and analysis are used to enforce these policies.

**Sampling.** Before the advent of modern analytical techniques, limits to the ability to detect led to the use of urine sampling to detect either doping or inappropriate use of medication. Urine today remains the mainstay of regulatory control, as it continues to allow the longer-term and more sensitive detection of substances and their metabolites. However, increased analytical sensitivity, and more flexible sampling regimes are driving the increasing use of other matrices such as blood or hair.

Generally, most of these samples are urine, or blood, taken after a race, based on a formulaic approach that selects winners, beaten favorites, or unusual circumstances. The horses are taken to a secure collection area, the sample collected by veterinary or technical staff, and introduced into a chain of custody for transport to the analytical laboratory. The methods and principles used utilize the approaches taken at crime scenes (*see* **Crime Scene Documentation**) to avoid cross-contamination and ensure sample identity [5].

However, these sampling strategies are changing. Prerace testing has been introduced, especially blood carbon dioxide analysis to counter the threat of the use of oral alkalizing agents that manipulate the horse's acid–base balance and so enhance performance.

Increasingly, out-of-competition testing, as used in human athletes, is now also being used, particularly for doping control of substances such as anabolic steroids that are banned at all times, including whilst the horse is in training. In addition, in some jurisdictions the selection of horses for sampling is starting to become more targeted, implemented by modern intelligence and tasking techniques adapted from law enforcement.

**Analytical Techniques.** The analytical techniques used to detect the presence of doping agents or medications are in general similar to those used for similar testing in human athletes, drug testing (*see* **Drug Testing: Urine**), or in pharmacological and pharmacokinetic research. However, there are some special considerations when considering such analyses for horseracing.

The majority of the samples collected are urine, with blood as second most common sample matrix. Whilst analytical techniques are generally similar, a key difference is the challenges faced in the preliminary extraction methodologies required for the complex matrix that is equine urine [6]. Emerging techniques are now using modern technologies to extract substances present in very low concentrations from saliva and hair [7].

In the past, technology limitations of methods such as thin layer chromatography meant the primary challenge was to actually detect substances of interest with sufficient sensitivity. As technology developed, such as high performance liquid chromatography (HPLC) and enzyme-linked immunosorbent assay (ELISA), sensitivity increased. In recent years, the leading laboratories have moved to principally using mass spectrometry. Such increases in sensitivity made the introduction of policies to implement sensitivity control, to allow appropriate veterinary treatment, essential.

Most recently, accurate mass techniques have greatly assisted the identification of new doping or medication substances. Some of these newer machines have the ability to store historical spectral outputs. These developments bring several advantages when a new threat occurs. An unknown and identified specific spectral peak can be more easily identified, such that novel substances are detected. Also, historical spectra can be re-examined to see if the threat has been present before, or is being found in other jurisdictions [8].

New integrity challenges come from the advent of large biological molecules as therapies or doping agents. These can be detected by individual immunological based, and other, tests. But single tests for a single substance are both expensive and do not detect other substances. Generic mass spectrometry techniques are being developed to identify, in one analysis, sets of biological substances that pose threats [9].

Finally, the "athletes passport" approach, where samples are taken at regular intervals and metabolic profiles regularly reviewed for changes, has been trialed for racehorses. This approach looks for secondary changes in gene expression following substance use. Primary changes in gene expression may follow genetic therapies, or "gene doping". These aspects are at the scientific frontier of equine doping and medication control [10].

**Regulatory Action.** Bringing together the policy, sampling, and analysis, all these underpin the regulations which generally impose strict liability on those responsible for the horse: the racehorse trainer. Investigations and then tribunals are used to implement regulation with a very variable range of penalties that include fines, disqualification of the horses from the race, and less commonly suspension or disqualification of the trainer.

*Equine Issues*

It is possible to apply physical treatments, ranging from established physiotherapy to more exotic and unproven methods, that can affect the welfare of the horse or its performance. For example, most racing jurisdictions place restrictions on the application of extracorporeal shockwave therapy to limbs before racing, to prevent its claimed analgesic effects, which may affect horse welfare or performance. It is also possible that abusive techniques to affect performance, or gross neglect, may less commonly occur.

Once allegations pertaining to such abuses are made, standard investigation techniques and expert examination as in other cases of animal abuse or wildlife crime are required (*see* **Wildlife**). Racing jurisdictions retain veterinary experts for day-to-day regulation. They may be utilized, but may well require guidance on forensic techniques and robust chain of custody from other suitably trained persons. Again, in many racing jurisdictions, former law enforcement officers are often employed as investigators and can serve this purpose.

## Intelligence Analysis and Investigation

The involvement of former law enforcement personnel has historically meant that standard techniques on investigation and evidence have been used. However, both the challenges posed by new betting products and technologies, and the evolution of law enforcement techniques have influenced the regulation of horseracing.

Instead of the historical arrangement of bookmaker on a racecourse, or a local regulated pool betting operation, there has been a transformation of betting products. Companies offer an online service that can be delivered through mobile devices. Such companies are often based offshore, outside the national laws of the country where the race occurs. National pool betting monopolies have been challenged. Probably of most significance has been the introduction of online betting exchanges, where individuals bet against each other and there can be bets not only to win but also to lose. It is the latter that poses a particular threat. Corrupt activities can spread from within the sport to wider organized networks [11].

As a result, racing has had to develop deeper links with betting operators, sharing intelligence formally and even sharing access to online betting platforms. Tools to obtain and analyze information have had to become more sophisticated. Sophisticated betting pattern analysis, often in real time, is essential as transactions are international and money can move rapidly. Access to mobile phone records and even their further analysis (*see* **GSM Analysis and PDAs**) may be required. Intelligence management models, such as the National Intelligence Model used in the UK, and associated software (*see* **Use of Knowledge-Based Systems in Forensic Science**), are now being used.

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