

POSTMORTEM EXAMINATION PROGRAM

**Conducted for the California Horse Racing Board
July 1, 2009–June 30, 2010**

California Animal Health and Food Safety Laboratory System

J.D. Wheat Veterinary Orthopedic Research Laboratory

School of Veterinary Medicine

University of California, Davis

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Postmortem

Examination

Program

California Animal Health and Food Safety Laboratory System

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POSTMORTEM EXAMINATION PROGRAM

Introduction

The Postmortem Examination Program has been in operation since February 1990 and has performed examinations on 5,374 horses, as of June 30, 2010. Initiated by the California Horse Racing Board (CHRB), the program is a partnership with the California Animal Health and Food Safety Laboratory System (CAHFS) and the Veterinary Orthopedic Research Laboratory at UC Davis, to meet three primary objectives: 1) to determine the nature of injuries occurring in racehorses, 2) to determine the reasons for these injuries, and 3) to develop injury prevention strategies. To accomplish this, a broad, cooperative approach was organized involving the development of a contract with the CAHFS to perform a necropsy on every horse that died spontaneously or was euthanized on racetracks or training facilities under the jurisdiction of the CHRB. This visionary partnership has become a national model for the racing industry in an effort to improve the safety and welfare of racehorses.

Pathologists at the CAHFS' Davis, Tulare and San Bernardino laboratories conduct postmortem examinations and compile detailed information on each horse, which is then reported to the CHRB. A broad range of specimens are collected and shared with veterinary scientists at the Veterinary Orthopedic Research Laboratory. In-depth analyses of these specimens helps to more precisely determine the causes and risk factors that lead up to catastrophic injuries in racehorses resulting in their death or euthanasia. Funding for postmortem examinations and ancillary testing was provided by the CHRB. Racing associations provide transportation of the horses to the nearest laboratory facility and additional studies are funded by the Center for Equine Health at UCD and private sources.

Information from the tests and data gathered from the postmortem examinations are analyzed in efforts

to elucidate the specific cause of catastrophic injuries. An advisory board, composed of horse owners, trainers, veterinarians, track maintenance people and CHRB officials, gives insight into injury investigations as well as sharing program findings and prevention strategies with the horse racing industry. In-depth studies of catastrophic musculoskeletal injuries in Thoroughbred horses have prompted studies by the J.D. Wheat Veterinary Orthopedic Research Laboratory within the UC Davis School of Veterinary Medicine to focus on a variety of fractures and failures of the suspensory apparatus of the front limb.

With a detailed database representing more than 11,000 diagnostic findings, a valuable resource is available to help develop preventive strategies on race horse injuries. Other states have begun their own programs using the CAHFS Postmortem Examination Program as their model.



¹ CAHFS provides descriptive pathology reporting only. Due to the lack of descriptive, population and environmental information provided to the laboratory, CAHFS does not make recommendations on interventions or identify risk factors associated with injury or disease.



SUBMISSIONS

General Submission Information

During the 2009-10 fiscal year, 286 horses were submitted to CAHFS as part of the CHRB Postmortem Program. This number is a decrease of 10.6 percent (34 horses) over the fiscal year 2008-09 count of 320 horses. It is however higher than the average number of horses submitted per year since the program began. The graph below (Figure 1) shows the number of horses that have been submitted to the program since 1990 by fiscal year. The first year of the program (1990) began in February and does not represent a full fiscal year. The trend line shows that the number of horses submitted for the CHRB program have been increasing on average of between seven and eight horses per year.

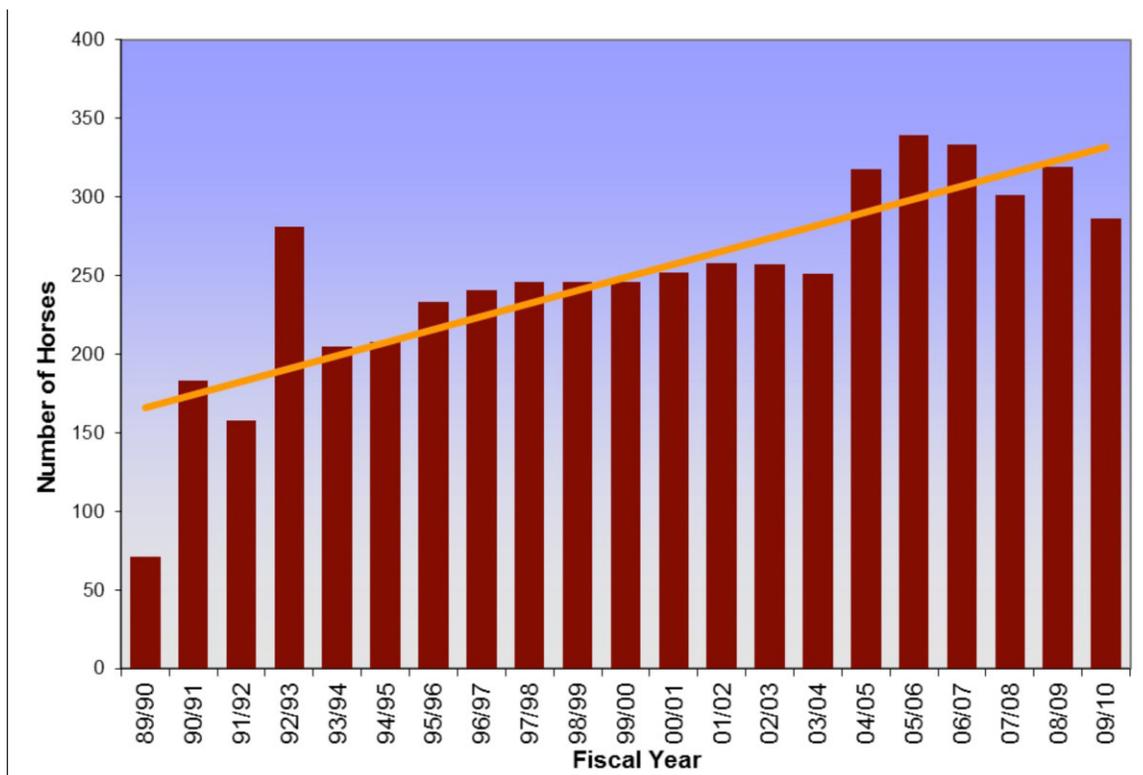
The CAHFS' Davis, Tulare and San Bernardino laboratories performed the necropsies, with horses being brought directly to the closest CAHFS facility. At the time of submission, the CHRB official at the track categorized the activity of the horse at the time

of injury into one of three types: non-exercise, racing or training (Table 1). The majority of catastrophic injuries, 42.6 percent, occurred during a race or immediately following a race. A total of 33.9 percent of the fatal injuries occurred during or immediately following a training session. The third most frequent category of fatalities, accounting for 23.4 percent of submissions, included horses in the non-exercise group. These were horses suffering primarily from medical conditions, including colic, infectious diseases or other diseases.

Table 1. Activity at Time of Injury

Non-exercise	67
Racing	122
Training	97
Total	286

Figure 1. Number of Horses Submitted to the CHRB Postmortem Program by Fiscal Year



SUBMISSIONS BY BREED AND MONTH

Table 2. Submissions by Breed and Month

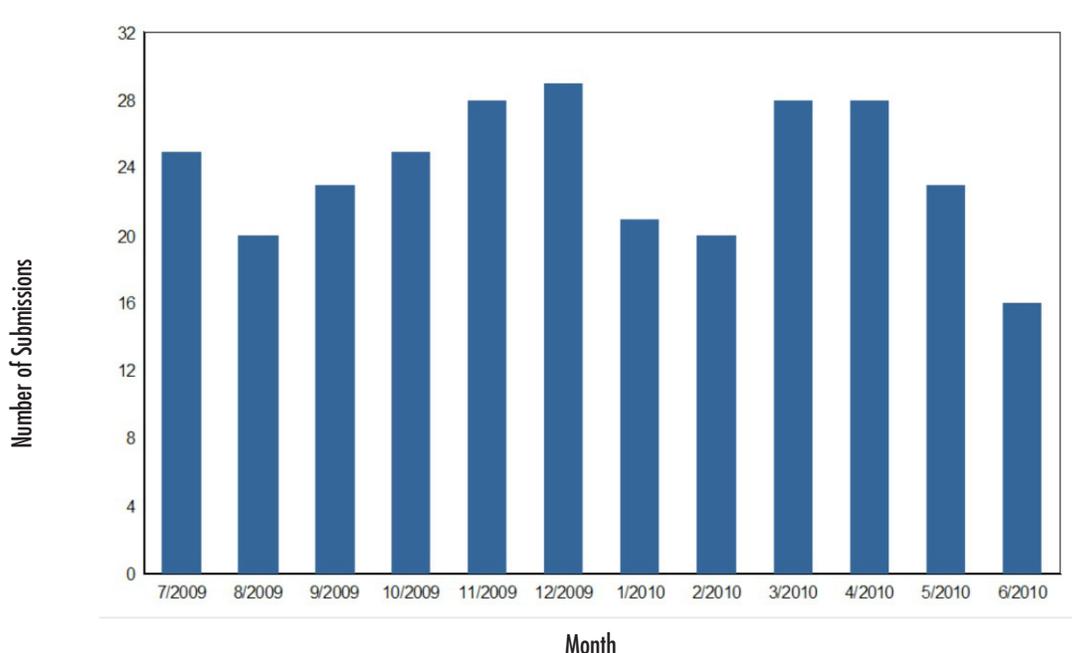
Breed	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09	Dec 09	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Total
Appaloosa	0	0	0	0	1	0	0	0	0	0	0	0	1
Pony	0	0	0	0	0	0	0	0	1	0	1	0	2
Quarter Horse	3	2	6	8	5	2	3	3	6	7	3	7	55
Standardbred	0	0	1	1	0	1	0	1	1	0	1	0	6
Thoroughbred	22	18	16	16	22	26	18	16	20	21	18	9	222
Grand Total	25	20	23	25	28	29	21	20	28	28	23	16	286

The vast majority of submissions (77.6 percent) during FY2009-10 were Thoroughbreds (Table 2). Fifty five of the horses submitted in 2009-10 (19.2 percent) were Quarter Horses. This is a ~ 5 percent decrease over the prior fiscal year which represents an interruption of the continuing increase in Quarter Horse submissions observed over the previous two years. With very small numbers of

the other breeds racing, not enough data exists to allow comparison of injury rates among breeds for any predisposition to any particular type of injury.

The number of horses submitted per month was variable, although there were not obvious clusters of submissions at any given month of the year (Table 2 and Figure 2). This is very similar to submission patterns over the last few years.

Figure 2. Number of Horses Examined by Month



SUBMISSIONS BY BREED AND AGE

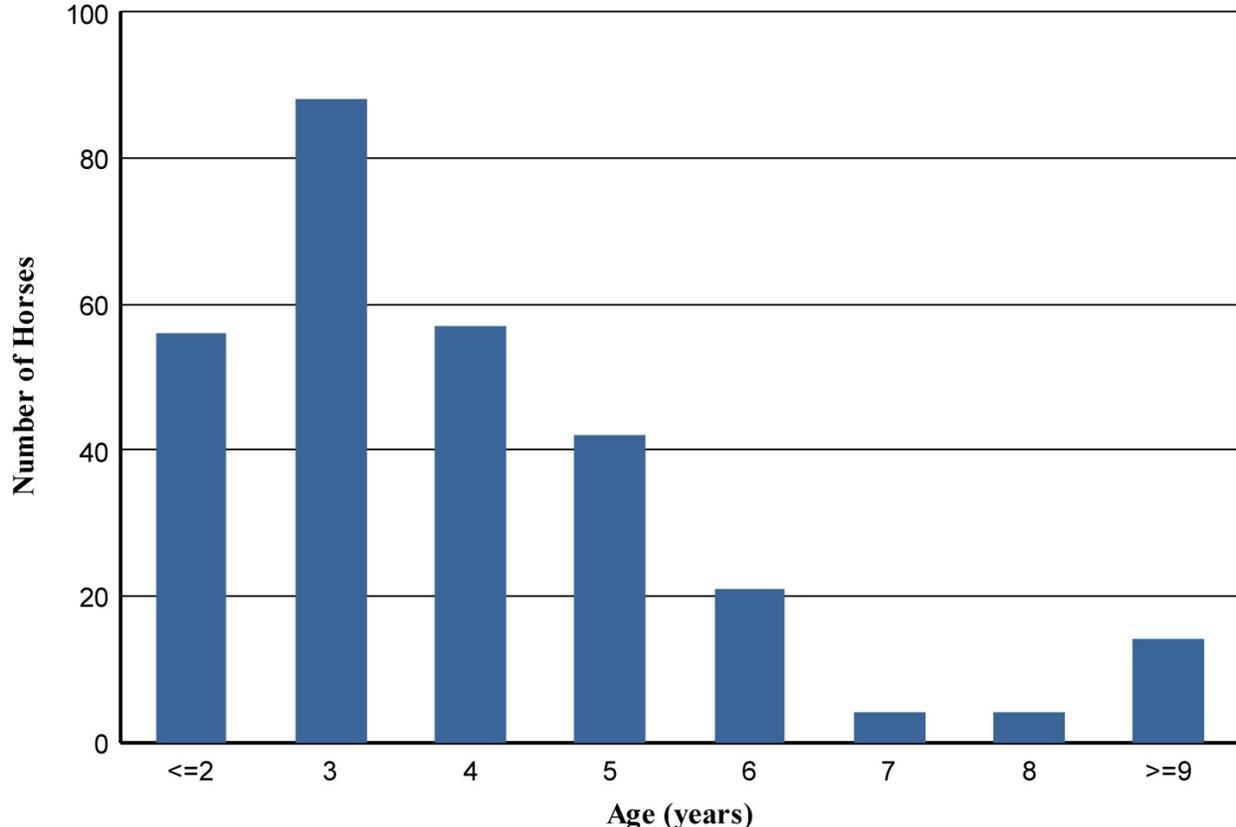
Table 3. Submissions by Breed and Age

Breed/Age	<=2	3	4	5	6	7	8	>=9	Total
Appaloosa	0	0	0	0	0	0	0	1	1
Pony	0	0	0	0	0	0	0	2	2
Quarter Horse	20	21	7	1	3	1	0	2	55
Standardbred	0	0	0	2	1	0	2	1	6
Thoroughbred	36	67	50	39	17	3	2	8	222
Total	56	88	57	42	21	4	4	14	286

The largest proportion of submissions (>50.0 percent) were 3- or 4-year-old horses (Table 3). Only 19.6 percent of all racehorses submitted were 2-years-old or less. The number of horses submitted with catastrophic injuries or death drops dramatically after the fifth year of age (Table 3 and Figure 3). This distribution is consistent with the

age distribution that has been seen in prior years of the program. We cannot conclude if horses 5 years of age and greater are much less susceptible to the athletic injuries of racing because the total number of horses in each age group that are racing and training on facilities controlled by CHRB are not known to us.

Figure 3. Number of Horses Examined by Age



SUBMISSIONS BY GENDER

The gender distribution of the horses submitted during 2009-10 is shown in Table 4 below. Males represented 62.5 percent of the total group with 26.8 percent of males being intact (stallions) and 73.2 percent geldings. Females comprised

37.4 percent of the group. As in years before, geldings were injured nearly twice as often during racing than during training, while stallions and mares were injured at similar proportions during these two activities.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Race	Training	Total
Female	24	40	43	107
Male	10	20	18	48
Neutered Males	33	62	36	131
Total	67	122	97	286



INJURIES

As mentioned earlier, the categories of injury represent the activity of the horse or circumstances at the time of the fatal or catastrophic injury. The largest cluster of fatal injuries, ~60 per-

cent, occurred during racing and training in 2-, 3- and 4-year-old racehorses (Table 5). The age of the horses submitted for non-exercise related fatalities was concentrated between 2 and 5 years of age.

Table 5. Category of Injury by Age

Category/Age	<=2	3	4	5	6	7	8	>=9	Total
Non-Exercise	14	18	9	10	7	1	2	6	67
Race	23	44	25	15	7	1	2	5	122
Training	19	26	23	17	7	2	0	3	97
Total	56	88	57	42	21	4	4	14	286

Thoroughbred horses suffered nearly equal proportions of racing (36.9 percent) and training (40 percent) catastrophic injuries, although training injuries were more likely in younger horses (Table 5). Typical of previous years, Quarter Horses infrequently suffered a catastrophic injury during a training session.

Quarter Horse submissions during 2009-10 were lower than the previous year, but they were still higher than the historical average submission for this breed. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

Figure 4. Number of Quarter Horses Submitted to the CHRBP Postmortem Program by Year

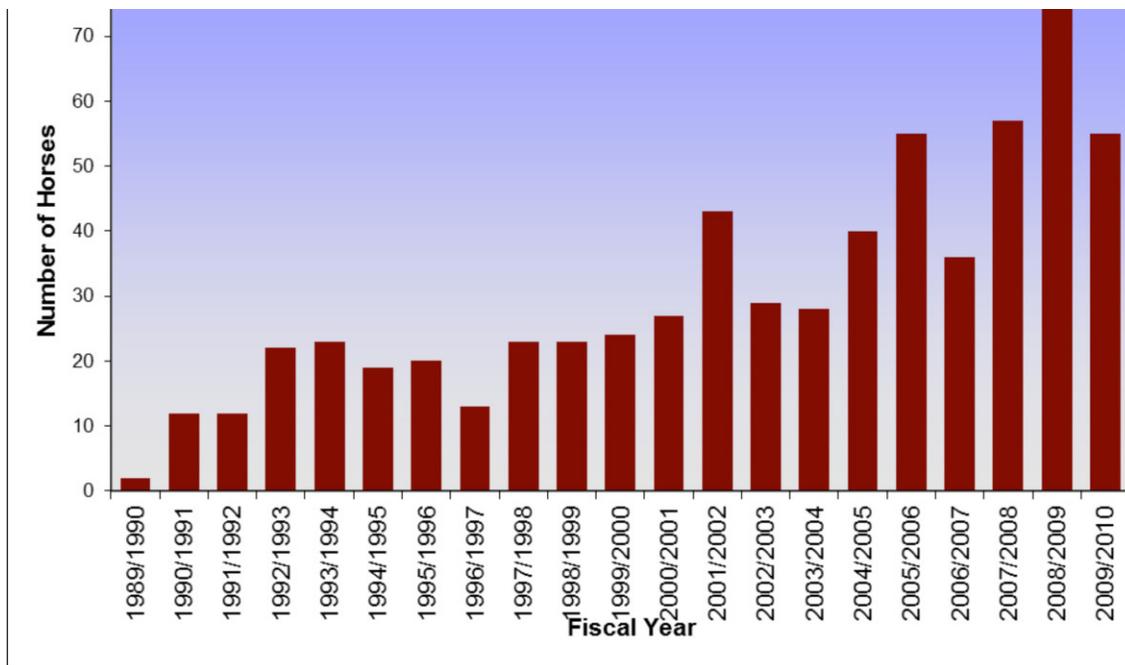


Table 6. Category of Injury by Breed

Injury Class by Breed	Non-Exercise	Race	Training	Total
Appaloosa	1	0	0	1
Pony	2	0	0	2
Quarter Horse	10	38	7	55
Standardbred	3	2	1	6
Thoroughbred	51	82	89	222
Total	67	122	97	286

In 2009-10, approximately 80.6 percent of the total primary injuries or conditions in all breeds were due to musculoskeletal problems (Table 7). Of this group, 73.2 percent of injuries affected the front or rear legs (Table 8). The injuries listed in these tables represent the primary injury to the horse.

For this report, several primary findings for each horse submitted were recorded. Thus, the total number of reported injury types exceeds the total number of horses submitted. This is especially true in severe

injuries involving multiple bones in the fore- or hind-limbs. In these cases, multiple related injuries, such as tendon and ligament ruptures are identified concomitantly.

Musculoskeletal injuries are most likely to occur during racing or training. Because these injuries are by far the most common, most of the investigative efforts at the Veterinary Orthopedic Research Laboratory of UC Davis, have focused on causes and prevention of limb injuries.

Table 7. Organ Systems Affected

Organ System Affected/Breed	GI	Hemo	MS	Nerv	Resp	WB	Total
Appaloosa	1	0	0	0	0	0	1
Pony	1	0	1	0	0	0	2
Quarter Horse	3	0	43	1	2	4	53
Standardbred	1	0	2	2	0	1	6
Thoroughbred	10	1	183	4	17	7	222
Total	16	1	229	7	19	12	284*

(GI= Gastrointestinal system; Hemo= hemolymphatic system; MS= Musculoskeletal; Nerv= Nervous system; Resp= Respiratory system; WB= Whole body).

* Two horses were not submitted to the CAHFS labs and the affected system could therefore not be determined.

Table 8 compares limb-specific catastrophic injuries. There were more front limb injuries sustained during racing when compared to those injuries sustained during training. There were

nearly equal numbers of right and left front limb injuries as well as equal numbers of right and left rear limb injuries. Table 9 lists the specific type of musculoskeletal injuries by breed.



Table 8. Injury by Primary Limb Affected

Limb Affected	Non-Exercise	Race	Training	Total
Bilateral Hind	0	1	1	2
Bilateral Front	5	2	1	8
Left Front	1	45	39	85
Left Rear	1	7	5	13
Right Front	5	45	35	85
Right Rear	4	6	5	15
Total	16	106	86	208

Table 9. Musculoskeletal Injuries by Breed

Finding	Pony	Quarter Horse	Standard-bred	Thoroughbred	Total
Arthritis	0	0	0	1	1
Arthrosis	0	0	0	1	1
Bone Disease	0	0	0	1	1
Carpal Fracture – Left Front	0	5	0	4	9
Carpal Fracture – Right Front	0	10	0	4	14
Cervical Vertebra Fracture	0	2	0	3	5
Femur Fracture – Left	0	0	0	1	1
Fetlock Joint Luxation – Left Front	0	1	0	3	4
Humerus Fracture – Left	0	0	0	8	8
Humerus Fracture – Right	0	0	0	6	6
Joint Disarticulation	0	0	0	4	4
Laminitis	0	3	0	5	8
Lateral Proximal Sesamoid Fracture – Left Front	0	0	0	8	8
Lateral Proximal Sesamoid Fracture – Left Rear	0	0	0	2	2
Lateral Proximal Sesamoid Fracture – Right Front	0	0	0	6	6
Lateral Proximal Sesamoid Fracture – Right Rear	0	0	0	2	2
Medial Proximal Sesamoid Fracture – Left Front	0	0	0	9	9
Medial Proximal Sesamoid Fracture – Right Front	0	5	0	11	16
Medial Proximal Sesamoid Fracture – Right Rear	0	0	0	1	1

Table 9 continues on next page


Table 9. Musculoskeletal Injuries by Breed (continued)

Finding	Pony	Quarter Horse	Standard-bred	Thoroughbred	Total
Metacarpus III Fracture – Left	0	0	0	19	19
Metacarpus III Fracture – Right	0	2	0	15	17
Metacarpus IV Fracture – Left	0	0	0	1	1
Metacarpus IV Fracture – Right	0	1	0	0	1
Metatarsus Fracture – Right Rear	0	0	0	3	3
Metatarsus Fracture – Left Rear	0	0	0	5	5
Muscle Laceration	0	1	0	1	2
P1 Fracture	0	1	1	16	18
P2 Fracture	0	0	1	1	2
Pastern Joint Luxation – Left Front	0	1	0	0	1
Patella Fracture – Right	0	0	0	1	1
Pelvis Fracture	0	0	0	10	10
Radius Fracture – Left	0	1	0	2	3
Radius Fracture – Right	0	1	0	2	3
Scapula Fracture – Left	0	3	0	3	6
Scapula Fracture – Right	0	2	0	5	7
Sesamoid Fracture, Biaxial – Left Front	0	0	0	23	23
Sesamoid Fracture, Biaxial – Right Front	0	1	0	18	19
Sesamoid Fracture, Biaxial – Right Rear	0	0	0	1	1
Skull Fracture	0	0	0	5	5
Suspensory Apparatus Failure – Left Front	0	0	0	4	4
Suspensory Apparatus Failure – Left Rear	0	0	0	1	1
Suspensory Apparatus Failure – Right Front	0	0	0	1	1
Tarsus Fracture – Left	0	1	0	0	1
Tendon Injury	0	0	0	2	2
Tendon Rupture – Left Front	0	0	0	3	3
Tendon Rupture – Right Front	0	1	0	0	1
Tibia Fracture – Left	1	1	0	1	3
Tibia Fracture – Right	0	1	0	2	3
Ulna Fracture – Left	0	0	0	1	1
Vertebra Fracture	0	3	0	1	4
Total	1	47	2	227	277

Track Surface and Musculoskeletal Injuries in Thoroughbreds

The distribution of musculoskeletal injuries in Thoroughbreds was evaluated when comparing the three types of track surfaces in which these horses performed. Table 10 shows the limb distribution of injuries. The data show that for the current fiscal year, the absolute number of injuries on

synthetic surfaces was slightly higher than on other surfaces. Because the total number of horses racing on each surface is not known to CAHFS, it cannot be determined from this data whether the injury rates differ by track surface.

Table 10. Musculoskeletal Injury: Affected Limb by Track Type

Limb	Dirt	N/A	Synthetic	Turf	Total
Left Front	27	1	48	9	85
Left Rear	3	0	7	3	13
Right Front	35	5	39	6	85
Bilateral Hind	1	0	0	1	2
Bilateral Front	2	4	1	1	8
Right Rear	5	4	5	1	15
Total	73	14	100	21	208

Other Organ Systems Affected by Injuries**Cardiovascular:**

In this period there were six cases of sudden death for which a final cause was not established, but that were attributed to acute heart failure. This represents an increase from four horses with this diagnosis during 2008-2009. No horses diagnosed with confirmed primary cardiovascular causes of death were reported during this period.



Integumentary (Skin):

No diagnosis of diseases of the skin was made on horses submitted to CAHFS during 2009-2010. This is consistent with the reduced number of horses with diseases of the skin submitted regularly to CAHFS as part of the CHRB necropsy program. The few cases received in previous years were euthanized, due to non-responsive skin conditions that reduced the quality of life of the animal.

Gastrointestinal:

Of the digestive system diagnoses, gastrointestinal displacements/ruptures were the most frequently observed findings. Severe enteritis or colitis (inflammation of the small and large intestines) were also frequently identified. Most cases of enterocolitis were due to infection with *Clostridium difficile* or *Clostridium perfringens*.

Diagnosis	Total
Enterotoxemia	1
Entero-Colitis	8
Gastrointestinal displacement/rupture	9
Oral ulcers	2
Total	20

Respiratory:

There were slightly fewer cases of respiratory diseases identified in FY 2009-10 than had been seen in previous years. By far the main cause for pneumonia was bacterial and within this, *Streptococcus zooepidemicus* was the most prevalent etiology. Other less represented etiologies included *Actinobacillus equuli* and *Actinomyces pyogenes*. Twelve horses had miscellaneous respiratory disease of mostly bacterial etiology. Five horses demonstrated severe pulmonary hemorrhage, two of which were exercise-induced. One horse succumbed to pulmonary edema.

Diagnosis	Total
Exercise Induced Pulmonary Hemorrhage	3
Pneumonia	9
Respiratory disease	12
Pulmonary edema	1
Total	25

Nervous System:

Horses with neurological disorders were identified infrequently during 2009-10. There were two cases of Equine Protozoal Myelitis, caused by the protozoal parasite *Sarcocystis neurona*; this represents 75 percent fewer cases than in the previous years, when there were eight diagnoses of this disease. There were also three cases of miscellaneous neurological disease, two were of unknown etiology.

Diagnosis	Total
West Nile Virus	2
Equine Protozoal Myelitis	2
Miscellaneous nervous disease	3
Total	7

Hemolymphatic System:

This included one horse with a hemangiosarcoma.

Whole Body:

The number of unexplained sudden deaths in horses was substantially smaller during this reporting period than the previous year. In none of these cases a definite cause of death could be determined. Six horses succumbed to systemic bacterial or fungal infections; of these, four were affected by *Streptococcus zooepidemicus*.

Diagnosis	Total
Anaphylaxis	1
Septicemia	6
Unexplained Death	7
Total	14

MILESTONES

- Publications** Diab, S., Pascoe, J., Shahriar, M., Read, D., Kinde, H., Moore, J., Odani, J. & Uzal, F.A. (2009). Pathological study of laryngopharyngeal lesions in Thoroughbred horses in Southern California. *Eq Vet J* 41, 903-907
- Setterbo, J.J., Garcia, T.C., Campbell, I.P., Reese, J.L., Morgan, J.W., Kim, S.Y., Hubbard, M., & Stover, S.M. (2009). Hoof accelerations and ground reaction forces of Thoroughbred racehorses measured on dirt, synthetic, and turf track surfaces. *Am J Vet Res*, 70, 1220-1229.
- Anthenill, L.A., Gardner, I.A., Pool, R.R., Garcia, T.C., Stover, S.M. (2010). Comparison of macrostructural and microstructural bone features in Thoroughbred racehorses with and without midbody fracture of the proximal sesamoid bone. *Am J Vet Res*, 71, 755-765.
- Harrison, S.M., Whitton, R.C., Kawcak, C.E., Stover, S.M., Pandey, M.G. (2010). Relationship between muscle forces, joint loading and utilization of elastic strain energy in equine locomotion. *J Exp Biol*, 213(Pt 23):3998-4009.

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 - Pacific Coast Quarter Horse Racing Association

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