

POSTMORTEM EXAMINATION PROGRAM

Conducted for the California Horse Racing Board
July 1, 2017–June 30, 2018

California Animal Health and Food Safety
Laboratory System

J.D. Wheat Veterinary Orthopedic
Research Laboratory

School of Veterinary Medicine
University of California, Davis
June 2019



Postmortem

Examination

Program

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J.D. Wheat Veterinary Orthopedic Research Laboratory

School of Veterinary Medicine
University of California, Davis
Davis, CA 95616
(916) 752-8700

June 2019

Equine Welfare and Racing Injury Prevention Committee

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TABLE OF CONTENTS

Introduction	2
General Submission Information	3–5
Table 1. Activity at Time of Injury/Fatality	
Figure 1. Number of Horses Submitted by Year	
Table 2. Submissions by Breed and Month	
Figure 2. Number of Horses Examined by Month	
Submissions by Breed and Age	5
Table 3. Submissions by Breed and Age	
Figure 3. Number of Horses Examined by Age	
Submissions by Gender	6
Table 4. Distribution by Gender and Category	
Injuries	
Categories of Injury	6–7
Table 5. Category of Injury/Fatality by Age	
Table 6. Category of Injury by Breed	
Figure 4. Number of Quarter Horses Submitted	
Organ Systems Affected by Injuries	8–9
Table 7. Organ Systems Affected	
Table 8. Musculoskeletal Structures Affected	
Table 9. Musculoskeletal Injury Type by Breed	
Track Surface Injuries	10
Table 10. Musculoskeletal Injury by Track Type	
Other Organ Systems Affected	10–11
Cardiovascular	
Gastrointestinal	
Integumentary	
Nervous	
Reproductive	
Respiratory	
Whole Body	
Research Support	12
Outreach and Presentations	13
Scientific Publications	13



POSTMORTEM EXAMINATION PROGRAM

Introduction

The Postmortem Examination Program has been in operation since February 1990, and has performed examinations on 7,061 horses, as of June 30, 2018. Initiated by the California Horse Racing Board (CHRB), the program is a partnership with the California Animal Health and Food Safety Laboratory System (CAHFS) 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 at training facilities under the jurisdiction of the CHRB. This visionary partnership has become a national and international 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 in other departments of the School of Veterinary Medicine at the University of California, Davis (UC Davis). Specimens from selected cases from CHRB horses necropsied at CAHFS laboratories are frequently shipped to the J.D. Wheat Veterinary Orthopedic Research Laboratory at UC Davis for in-depth analyses. This helps to more precisely determine the causes and risk factors that

led up to catastrophic injuries in racehorses resulting in their death or euthanasia. Funding for postmortem examinations and ancillary testing is provided by the CHRB. Racing associations provide transportation of the horses to the nearest laboratory facility, and additional studies are frequently funded by the Center for Equine Health at UC Davis, and by 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. In addition to musculoskeletal injuries, medical causes of disease and/or death of racehorses (colic, pneumonia, etc.), which comprise between 70 and 80 percent of the submissions are also studied.



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SUBMISSIONS

General Submission Information

During the 2017-18 fiscal year, 138 horses were submitted to CAHFS as part of the CHRB Postmortem Program. This number is a significant decrease from the 207 horses over the fiscal year 2016-17, and continues with a significant reduction in fatalities initiated several years ago. This was also the lowest number of fatalities since the beginning of the program.

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 bar graph below shows that the number of horses submitted for the CHRB program had been increasing slightly almost every year until 2005-06, after which a decline, interrupted temporarily only during a few years, occurred.

The CAHFS' Davis and San Bernardino laboratories performed all the necropsies during this fiscal year. At the time of submission, the CHRB track official

categorizes the activity of the horse at the time of injury into one of three types: non-exercise, racing or training (Table 1).

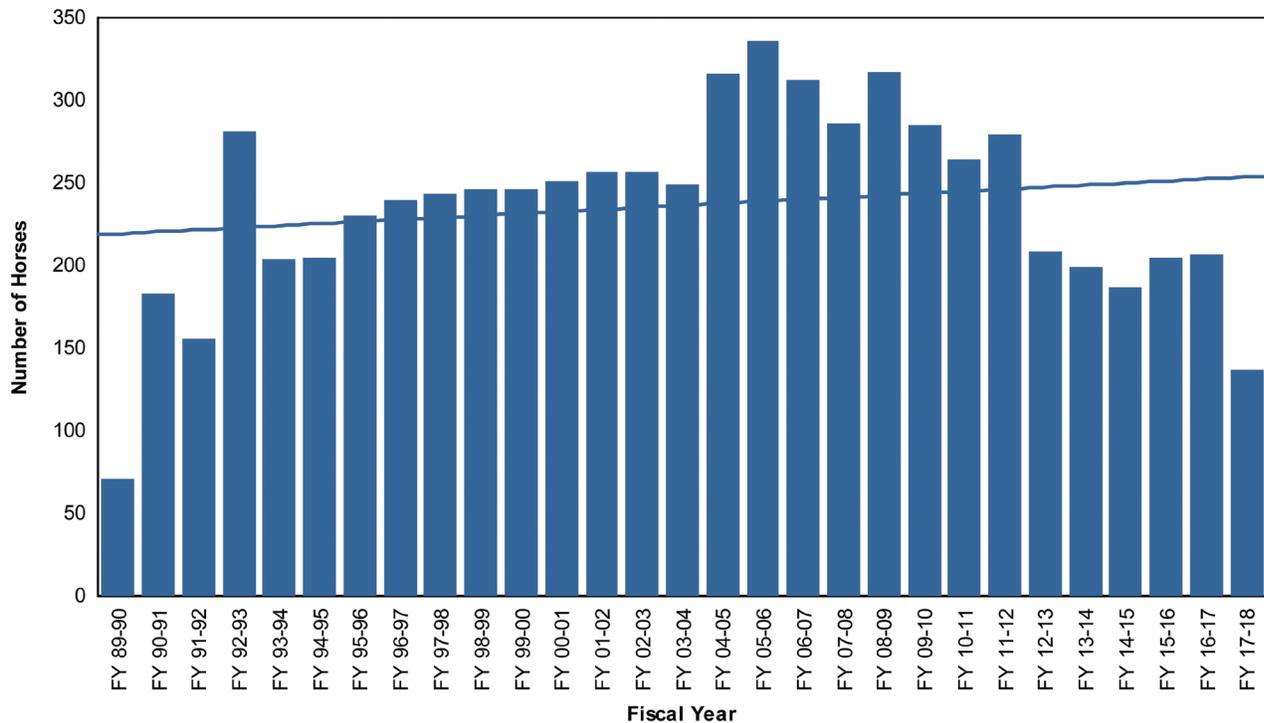
Table 1. Activity at Time of Injury/Fatality

Non-Exercise	26 (19%)
Racing	65 (47%)
Training	47 (34%)
Total	138 (100%)

The vast majority of catastrophic injuries (81 percent), occurred during or immediately following training or racing. This is in agreement with previous years, in which most fatalities were exercise-related. The third category of fatalities, accounting for 19 percent of submissions, included horses in the non-exercise group. These were horses

Continued

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



SUBMISSIONS • continued

suffering primarily from medical conditions, such as colic, infectious diseases or other conditions, although a few musculoskeletal injuries occurred in the non-exercise group of horses.

As in the past, the vast majority of submissions (109; ~80 percent) during FY 2017-18 were Thoroughbreds (Table 2). Twenty-five of the horses submitted in 2017-18 (~18 percent) were Quarter Horses. This is a slight increase over the past two prior fiscal years (13 and 14 percent, respectively).

With very small numbers of other breeds, not enough data exists to allow comparison of injury rates among breeds for any predisposition to any particular type of injury or disease.

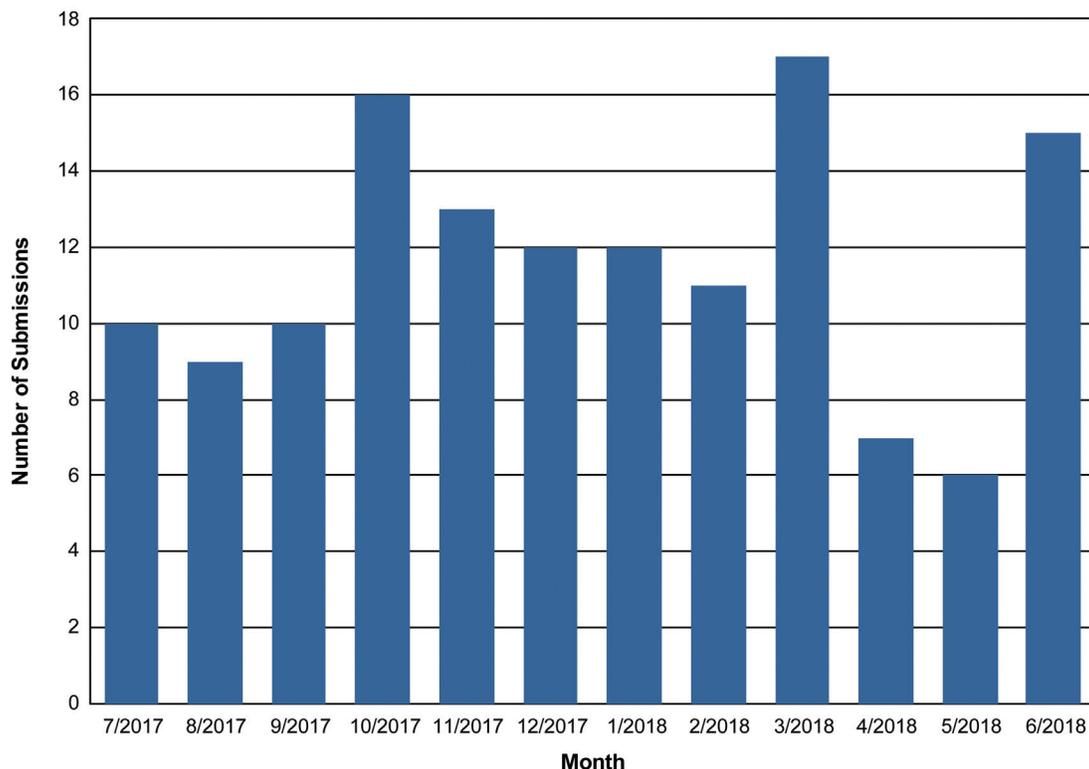
The number of horses submitted per month was variable, although there were no obvious clusters of submissions at any given month of the year (Table 2 and Figure 2). This is very similar to submission patterns over the last few years.

Continued

Table 2. Submissions by Breed and Month

Breed	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Total
Other Breeds	0	0	0	0	0	0	1	0	0	0	0	1	2
Quarter Horse	0	2	4	6	1	2	1	4	3	0	0	2	25
Standardbred	0	0	0	0	1	0	1	0	0	0	0	0	2
Thoroughbred	10	7	6	10	11	10	9	7	14	7	6	12	109
Grand Total	10	9	10	16	13	12	12	11	17	7	6	15	138

Figure 2. Number of Horses Examined by Month



SUBMISSIONS • continued

The largest proportion of submissions (~71 percent) were horses between 2- and 4-years-old (Table 3). Approximately 17 percent of all racehorses submitted were 2-years-old or less. The number of horses submitted with catastrophic injuries or death dropped dramatically after the fourth year of age (Table 3 and Figure 3). This distribution is consistent

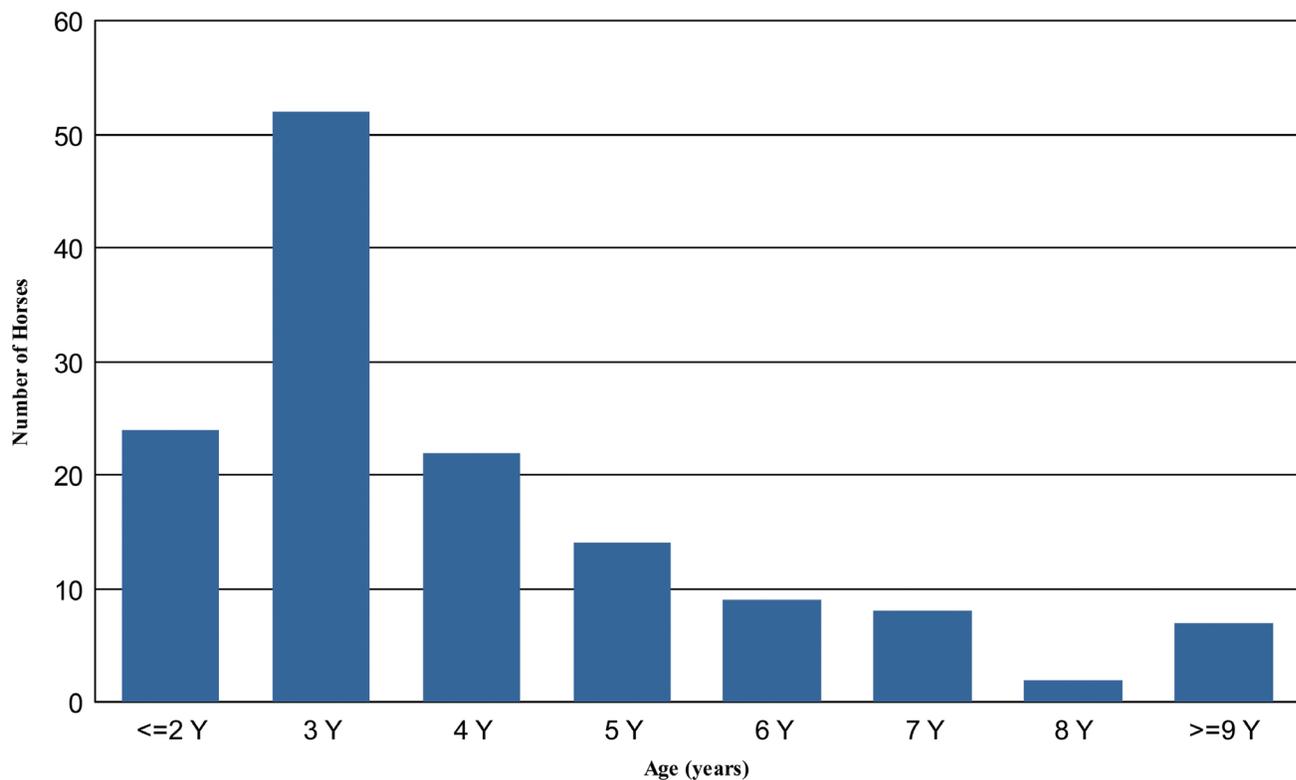
with the age distribution that has been seen in prior years of the program. We cannot conclude if horses 5 years of age and greater are less susceptible to the injuries of racing because the total number of horses in each age group that are racing and training on facilities controlled by CHRB are not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

Submissions By Breed and Age

Table 3. Submissions by Breed and Age

Breed/Age	<=2	3	4	5	6	7	8	>=9	Total
Other Breeds	0	0	0	0	0	1	0	1	2
Quarter Horse	10	5	3	0	0	2	0	5	25
Standardbred	0	1	0	0	1	0	0	0	2
Thoroughbred	14	46	19	14	8	5	2	1	109
Total	24	52	22	14	9	8	2	7	138

Figure 3. Number of Horses Examined by Age



SUBMISSIONS • continued

Submissions By Gender

The gender distribution of the horses submitted during 2017-18 is shown in Table 4 below. Males represented ~57 percent of the total group with 28 percent of males being intact (stallions) and 72 percent geldings. Females comprised ~ 43 percent of the group, with the majority of them being intact, but one animal being neutered.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Racing	Training	Total
Female	11	29	19	59 (43%)
Male	3	5	14	22 (16%)
Gelding	12	31	14	57 (41%)
Total	26	65	47	138 (100%)

INJURIES

As previously mentioned, 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, ~71 percent, occurred in 2-, 3- and 4- year-old racehorses (Table 5). The age of the horses submitted for non-exercise related fatalities was also concentrated between 2 and 3 years of age and in horses 9 years of age or older (ponies).

Table 5. Category of Injury/Fatality by Age

Category/Age	<=2	3	4	5	6	7	8	>=9	Total
Non-Exercise	5	4	2	3	3	3	0	6	26
Racing	5	29	13	7	6	3	1	1	65
Training	14	19	7	4	0	2	1	0	47
Total	24	52	22	14	9	8	2	7	138

During this fiscal year, Thoroughbred horses suffered more racing (54) than training (44) catastrophic injuries (Table 6). This is similar to most previous years when the percentage of racing fatalities was comparable to that of training catastrophic injuries.

Quarter Horses suffered only two (8 percent) catastrophic injuries during training in this period. This is lower than the previous two years (18 and 17 percent, respectively), and similar to the years before when Quarter Horses' catastrophic injuries

Continued



INJURIES • continued

during a training session were infrequent. Quarter Horse submissions during 2017-18 were slightly lower than the previous year (27 in 2015-16 and 29 in 2016-2017), in keeping with the slight decline that started several years ago. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

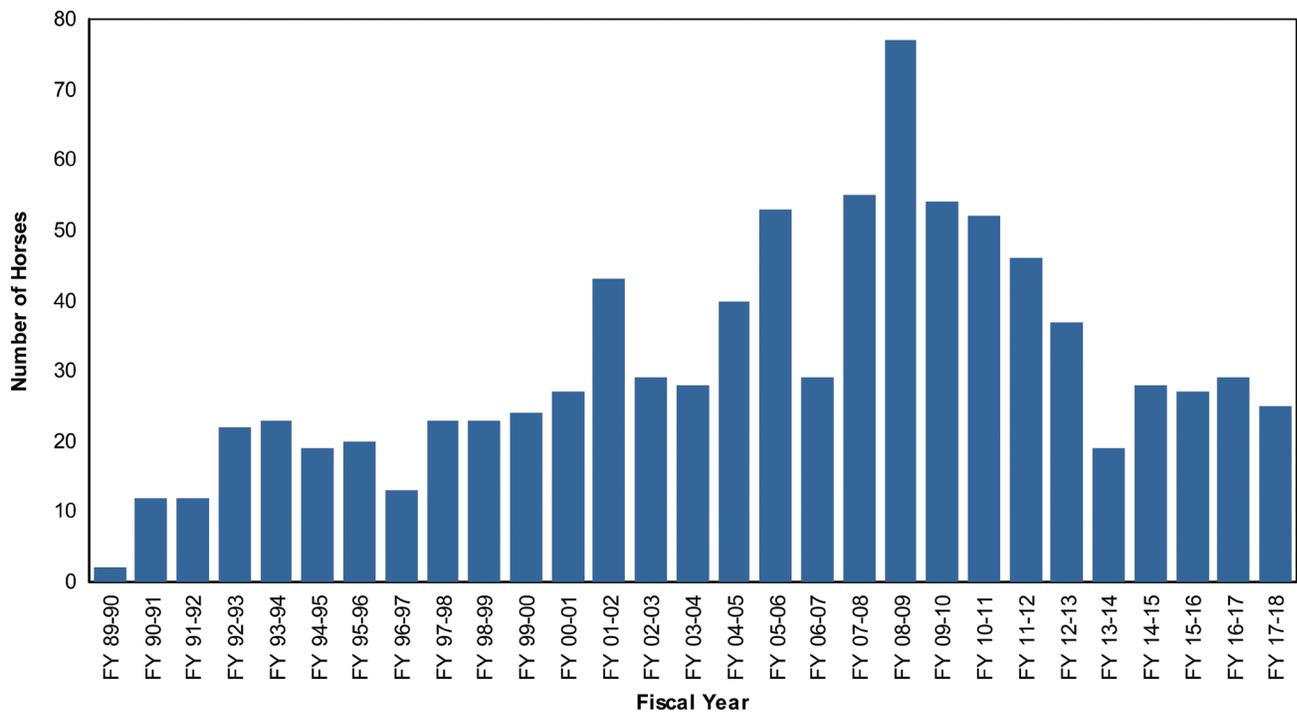
In 2017-18, ~82 percent of the total primary injuries or conditions in all breeds were due to musculoskeletal problems (Table 7, pg. 8), which is consistent with what has been observed in previous years. Of this group, ~ 86 percent of injuries affected the front or rear legs (Table 8, pg. 8). The injuries listed in these tables represent the primary injury to the horse.

Continued

Table 6. Category of Injury/Fatality by Breed

Injury Class by Breed	Non-Exercise	Racing	Training	Total
Other Breeds	2	0	0	2
Quarter Horse	12	11	2	25
Standardbred	1	0	1	2
Thoroughbred	11	54	44	109
Total	26	65	47	138

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



INJURIES • continued

In many cases, several primary findings for each horse submitted were recorded. Thus, the total number of reported injury types exceeds the number of horses submitted. This is especially true in severe injuries involving multiple bones in the 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 University of California, Davis, have focused on causes and prevention of limb injuries.

Table 7. Organ Systems Affected

Breed	CV	GI	MS	Nerv	Resp	Inte	Uro	WB	Total
Other Breeds	1	1	0	0	0	0	0	0	2
Quarter Horse	1	2	17	0	0	2	0	3	25
Standardbred	0	0	0	1	1	0	0	0	2
Thoroughbred	0	3	96	1	1	0	1	7	109
Total	2	6	113	2	2	2	1	10	138

CV = Cardiovascular; GI= Gastrointestinal; MS= Musculoskeletal; Nerv= Nervous; Resp= Respiratory; Inte= Integumentary; Uro= Urogenital; WB= Whole body).

Table 8. Musculoskeletal Structures Affected

Structure Affected	Non-Exercise	Racing	Training	Total
Left Front	0	26	20	46
Left Rear	2	2	3	7
Right Front	0	25	12	37
Right Rear	0	3	4	7
Pelvis	0	2	3	5
Skull	2	0	0	2
Vertebra	0	2	2	4
Various Structures*	6	0	1	7
Total	10	60	45	115

* Includes laminitis and/or tendinitis of one or more legs



INJURIES • continued

Table 9. Musculoskeletal Injury Type by Breed

Diagnosis	Quarter Horse	Thorough- bred	Total
Arthritis	1	0	1
Carpal Fracture – Left	1	1	2
Carpal Fracture – Right	4	3	7
Fedlock Failure – Left Front	1	29	30
Fedlock Failure – Left Rear	0	1	1
Fedlock Failure – Right Front	1	20	21
Fetlock Failure – Right Rear	0	1	1
Femur Fracture – Right	0	2	2
Humerus Fracture – Left	0	2	2
Laminitis	2	1	3
Metacarpus II Fracture – Left	0	1	1
Metacarpus III Fracture – Left	0	7	7
Metacarpus III Fracture – Right	0	3	3
Metatarsus III Fracture – Left	0	2	2
Metatarsus III Fracture – Right	0	2	2
Myopathy	1	0	1
Neoplasm	1	1	2
P1 Fracture – Left Front	0	2	2
P1 Fracture – Right Front	0	1	1
P1 Fracture – Right Rear	0	1	1
Pastern Luxation – Left Front	1	0	1
Pelvis Fracture	0	5	5
Radius Fracture – Right	0	1	1
Rib Fracture	0	1	1
Scapula Fracture – Left	0	1	1
Scapula Fracture – Right	0	2	2
Skull Fracture	1	1	2
Tarsus Fracture – Right	0	1	1
Tibia Fracture – Left	1	3	4
Tibia Fracture – Right	0	2	2
Vertebra Fracture	3	1	4
Total	18	98	116



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 in horses running on different surfaces. As before, these data show that for the current fiscal year the absolute number of injuries on dirt surfaces was 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

Structure Affected	Dirt	Synthetic	Turf	N/A*	Total
Left Front	28	12	6	0	46
Left Rear	2	2	0	2	6
Pelvis	4	1	0	0	5
Right Front	26	6	5	0	37
Right Rear	4	1	2	0	7
Skull	0	0	0	2	2
Vertebra	4	0	0	0	4
Various Structures**	0	1	0	6	7
Total	68	23	13	10	114

*Injuries that did not occur on a racing/training surface. **Includes laminitis and/or tendinopathies of one or more legs.

Other Organ Systems Affected by Injuries

Cardiovascular:

Although heart failure is usually suspected in many cases of sudden death, this is rarely confirmed. The case listed as heart failure in this section is a rare case in which the condition was confirmed. The case of jugular thrombophlebitis was a horse in which a primary vein infection presumably associated with an intravenous injection, progressed to sepsis.

Diagnosis	Total
Heart Failure	1
Jugular Vein Thrombophlebitis and Sepsis	1
Total	2

Gastrointestinal:

Of the gastrointestinal system diagnoses, intestinal displacements and colitis were the most frequently observed problems. The causes of the two colitis cases were thromboembolism and non-steroidal anti-inflammatory drugs.

Diagnosis	Total
Colitis	2
Intestinal Displacement	3
Enteropathy	1
Total	6



INJURIES • continued

Other Organ Systems Affected by Injuries continued

Integumentary:

As usual, diseases of the integumentary system were rare during this reporting period.

Diagnosis	Total
Cellulitis	1
Total	1

Nervous:

Equine protozoal myelitis keeps occurring in racehorses, although at low prevalence.

Diagnosis	Total
Equine Protozoal Myelitis	1
Undiagnosed Nervous Disease	1
Total	2

Reproductive:

Diseases of the male reproductive system are rare occurrences in racehorses submitted for postmortem. This horse had spermatic corditis, likely secondary to castration, which progressed to peritonitis. This condition was caused by *Streptococcus equi* subs. *zooepidemicus*.

Diagnosis	Total
Male Reproductive Disease	1
Total	1

Respiratory:

The number of respiratory disease cases in 2017-18 was low when compared with previous years. The cause of pneumonia in this case was determined to be bacterial although the species was not determined. Pulmonary hemorrhage is frequent in race horses, although these lesions are usually not severe enough to cause death of the horse.

Diagnosis	Total
Pneumonia	1
Pulmonary Hemorrhage	1
Total	2

Whole Body:

The number of unexplained sudden deaths in horses was lower than previous years (12 cases reported in 2016-2017).

Diagnosis	Total
Anaphylaxis	2
Hypovolemic shock	1
Unexplained sudden death	7
Total	10



RESEARCH SUPPORT

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 - Southern California Equine Foundation
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 - Dolly Green Foundation
 - Grayson-Jockey Club Research Foundation, Inc.
 - Pacific Coast Quarter Horse Racing Association

Pathologists and Collaborators:	Mark Anderson	Janet Moore
	Rick Arthur	Akinyi Nyaoke
	Francisco Carvallo	Sarah Puchalski
	Peter Chu	Meredith Rhea
	Vanessa Dahl	Kanako Sakaguchi
	Karina Fresneda	Tiffany Sarrafian
	David Fyhrie	Matt Sheley
	Patty Gaffney	Susan Stover
	Tanya Garcia	Jennifer Symons
	Lucy Gomez	Shrini Upadhyaya
	Dave Hawkins	Francisco Uzal
	Ashley Hill	Leslie Woods
	Linda Huong	

During this period, CAHFS worked with CHRB in developing a Fellowship Training Program on the musculoskeletal system of horses. After a call for applications was made, a very enthusiastic and well-qualified candidate was selected and began work on August 1, 2018. Under the supervision of a pathologist, this fellow, who is based in the San Bernardino lab of CAHFS, performs all necropsies of CHRB horses submitted to the San Bernardino laboratory with a history of catastrophic musculoskeletal injuries. In addition, the fellow performs detailed examinations of musculoskeletal specimens from CHRB horses necropsied in Davis and Tulare, which are shipped to San Bernardino. The main goals of this program are to train veterinarians in the examination of the musculoskeletal system of racehorses, and to improve consistency and case documentation for the CHRB necropsy program.



OUTREACH AND PRESENTATIONS TO SCIENTIFIC MEETINGS

Racehorse pathology/Diagnostic special session. 60th Annual meeting of the American Association of Veterinary Laboratory Diagnosticians. San Diego, CA, October 2017. Chair: F. Uzal, L. Kennedy

SCIENTIFIC PUBLICATIONS

- Gray S, Spriet M, Garcia TC, Uzal FA, Stover SM. Preexisting lesions associated with complete diaphyseal fractures of the third metacarpal bone in 12 Thoroughbred racehorses. *Journal of Veterinary Diagnostic Investigation*, 29(4): 437-441.
- Diab SS, Stover S, Carvallo F, Nyaoke AC, Moore J, Hill A, Arthur R, Uzal FA. Diagnostic approach to catastrophic musculoskeletal injuries in racehorses. *Journal of Veterinary Diagnostic Investigation*, 29(4): 405-413.
- Stover, SM. Nomenclature, classification, and documentation of catastrophic fractures and associated pre-existing injuries in racehorses. *Journal of Veterinary Diagnostic Investigation*, 29(4): 396-404.
- Symons J, Hawkins D, Fyhrie D, Upadhyaya S, Stover SM. Modeling the effect of race surface and racehorse limb parameters on in silico fetlock motion and propensity for injury. *Equine Veterinary Journal*, 49(5): 681-686.





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J.D. Wheat Veterinary
Orthopedic Research Laboratory

School of Veterinary Medicine
University of California, Davis
West Health Sciences Drive
Davis, California 95616

