

POSTMORTEM EXAMINATION PROGRAM

Conducted for the California Horse Racing Board
July 1, 2018–June 30, 2019



UC DAVIS

VETERINARY MEDICINE

*California Animal Health and
Food Safety Laboratory System*

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 7,205 horses as of June 30, 2019. 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 developed involving the establishment 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, 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, UC Davis, and by private sources.

Information from the tests and data gathered are analyzed in order to elucidate the specific cause of catastrophic injuries. In addition to musculoskeletal injuries, which comprise between 70 and 80% of the submissions, medical causes of disease and/or death (colic, pneumonia, etc.) are also studied.



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SUBMISSIONS

General Submission Information

During the 2018-19 fiscal year, 144 horses were submitted to CAHFS as part of the CHRB Postmortem Program. With only six cases over the 138 horses received during fiscal year 2017–18, the numbers continue to show a significant reduction in fatalities compared to several years ago. This was also the second 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 an overall decline in submissions occurred and continues to date.

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

Table 1. Activity at Time of Injury/Fatality

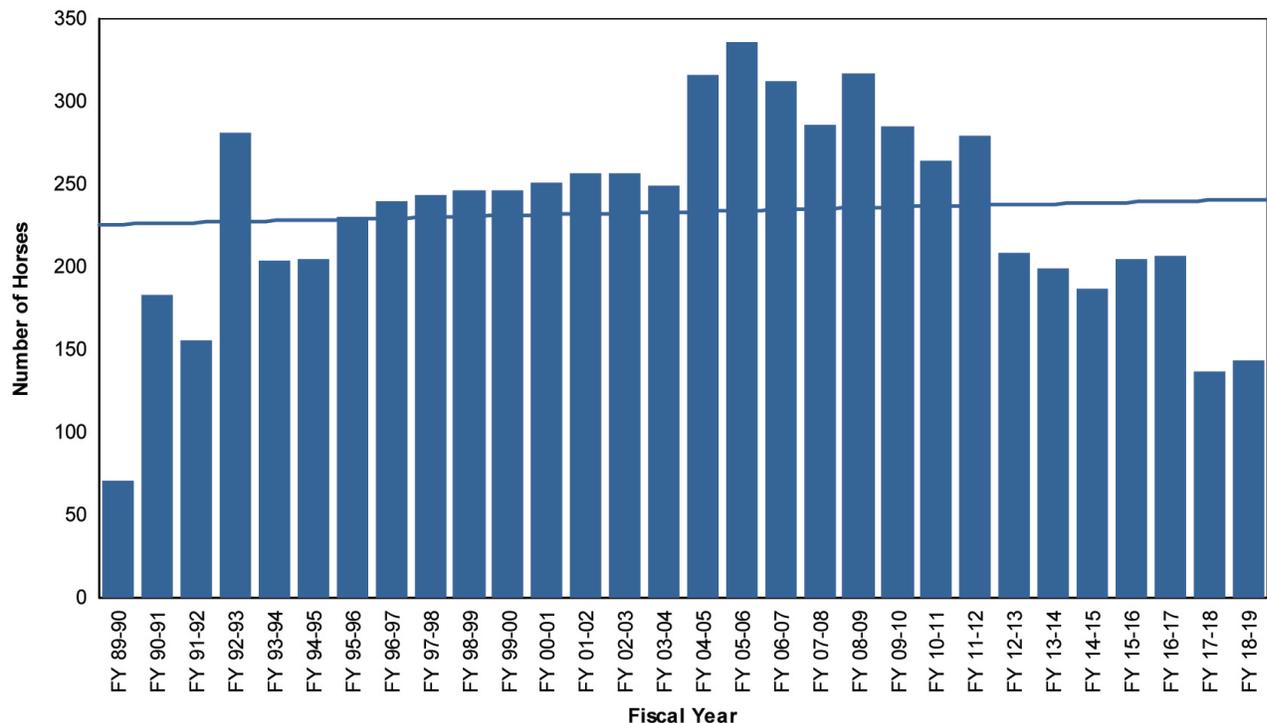
Non-Exercise	34 (24%)
Racing	53 (37%)
Training	57 (39%)
Total	144 (100%)

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

The vast majority of catastrophic injuries (76%) 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 24% of submissions, included horses in the non-exercise

Continued

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



SUBMISSIONS • continued

group. These were horses 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, for FY 2018–19 the vast majority of submissions (126; ~87%) were Thoroughbreds (Table

2). Eighteen of the horses submitted (~13%) were Quarter Horses. No other breed of horse was submitted. This is similar to the past few prior fiscal years.

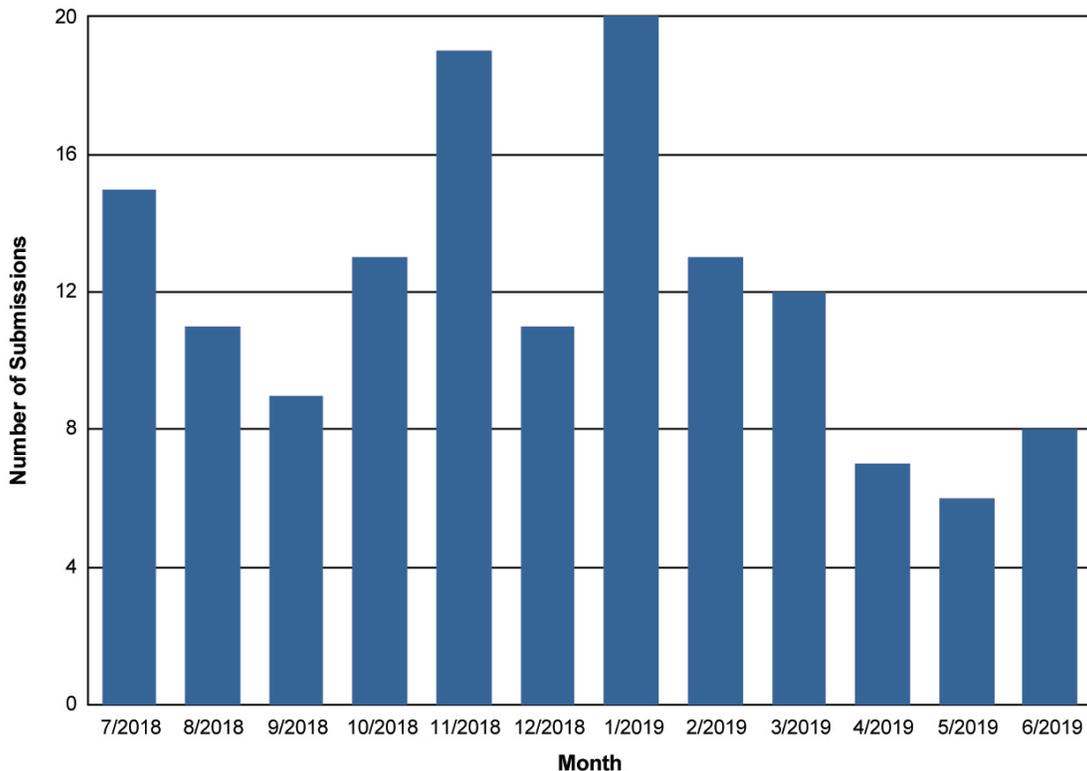
The number of horses submitted per month was variable (Table 2 and Figure 2). This is very similar to submission patterns over the last few years.

Continued

Table 2. Submissions by Breed and Month

Breed	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Total
Quarter Horse	6	0	0	3	4	0	1	1	0	2	1	0	18
Thoroughbred	9	11	9	10	15	11	19	12	12	5	5	8	126
Grand Total	15	11	9	13	19	11	20	13	12	7	6	8	144

Figure 2. Number of Horses Examined by Month



SUBMISSIONS • continued

The largest proportion of submissions (~77%) were horses between 2 and 4 years old (Table 3). Approximately 23% of all racehorses submitted were 2 years of age 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

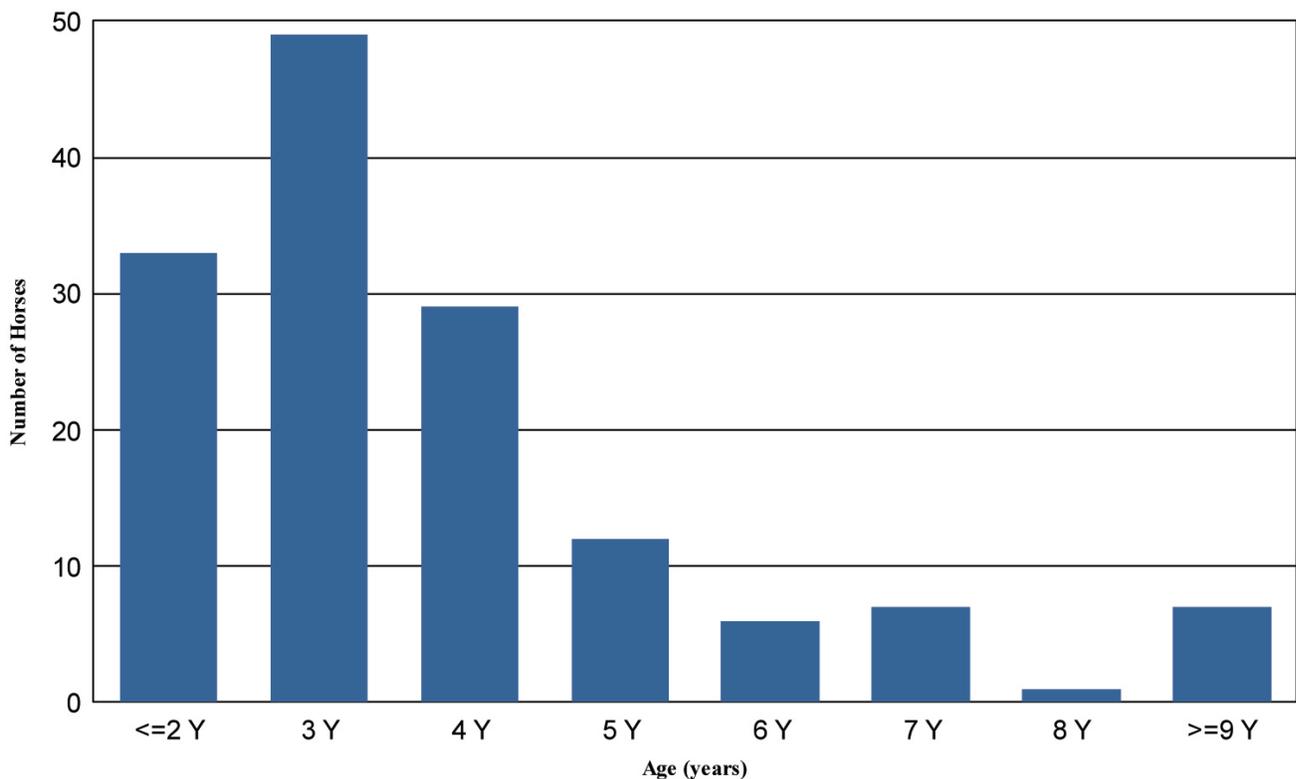
distribution that was seen in prior years. We cannot conclude if horses 5 years of age and greater are less susceptible to the injuries of racing, because the total number of horses in each age group that are racing and training on facilities controlled by CHRB are not known to us. Pony horses accounted for most of the submissions for horses 9 or older with gastrointestinal disease being the most common diagnosis.

Submissions By Breed and Age

Table 3. Submissions by Breed and Age

Breed/Age	<=2	3	4	5	6	7	8	>=9	Total
Quarter Horse	8	4	4	0	0	0	0	2	18
Thoroughbred	25	45	25	12	6	7	1	5	126
Total	33	49	29	12	6	7	1	7	144

Figure 3. Number of Horses Examined by Age



SUBMISSIONS • continued

Submissions By Gender

The gender distribution of the horses submitted during 2018–19 is shown in Table 4. Males represented ~60% of the total group, with 26% of males being intact (stallions), and 74% geldings. Females comprised ~40% of the group, all of them being intact.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Racing	Training	Total
Female	14	25	19	58
Male	4	4	14	22
Gelding	16	24	24	64
Total	34	53	57	144

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, ~77%, occurred in 2-, 3-, and 4-year-old racehorses (Figure 3 and Table 5). Non-exercise related deaths occurred in most age groups (Table 5).

Table 5. Category of Injury/Fatality by Age

Category/Age	<=2	3	4	5	6	7	8	>=9	Total
Non-Exercise	7	11	3	6	2	0	0	5	34
Racing	9	21	15	3	2	1	1	1	53
Training	17	17	11	3	2	6	0	1	57
Total	33	49	29	12	6	7	1	7	144

During this fiscal year, Thoroughbred horses suffered more training (57) than racing (39) catastrophic injuries (Table 6). This is different from most previous years when the percentage of racing fatalities was higher than that of training catastrophic injuries.

Quarter Horses suffered no catastrophic injuries during training in this period. This continues the trend down during the previous three years, and is similar to the years before when catastrophic injuries of Quarter Horses during a training session were infrequent.

Continued



INJURIES • continued

The number of Quarter Horse submissions during 2018–19 (n=18) was lower than the previous years (25 in 2017–2018), continuing the decline that had started several years ago. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

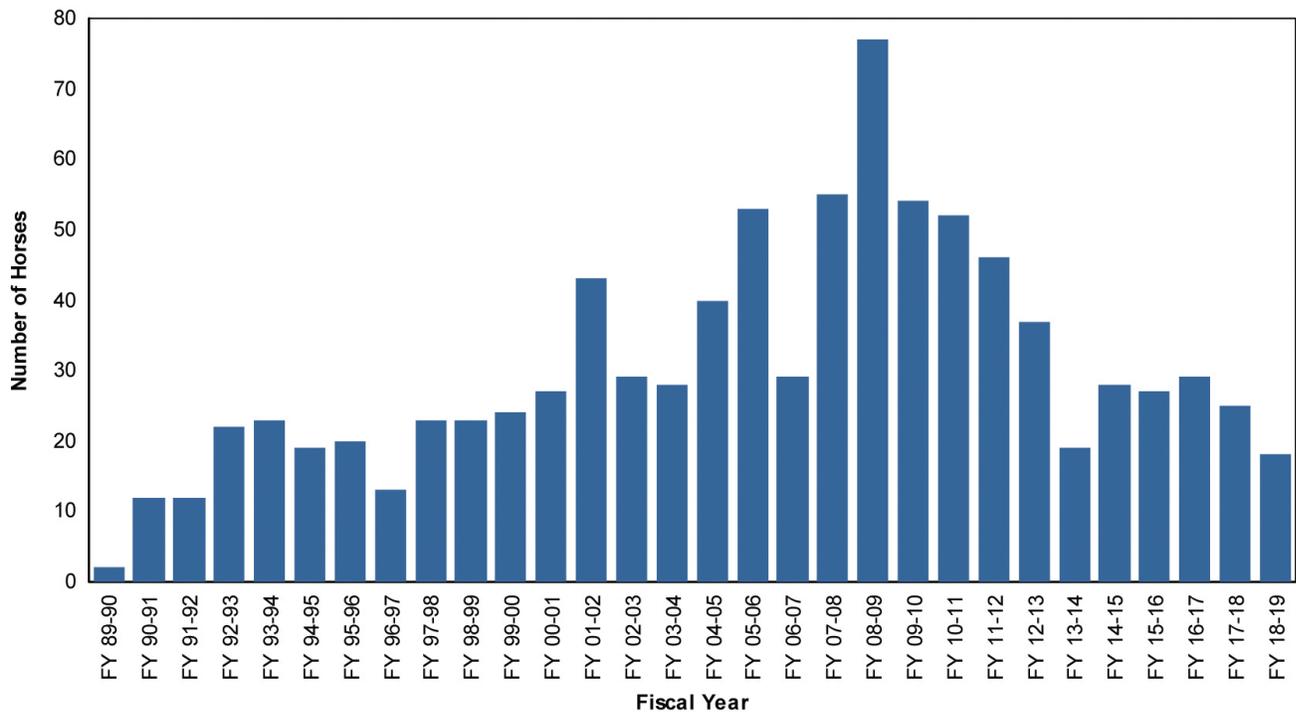
In 2018–19, ~79% of the total primary injuries or conditions in all breeds were due to musculoskeletal problems (Table 7), which is consistent with what has been observed in previous years. Of this group, ~82% of injuries affected the front or rear legs (Table 8). The injuries listed in these tables represent the

Continued

Table 6. Category of Injury/Fatality by Breed

Injury Class by Breed	Non-Exercise	Racing	Training	Total
Quarter Horse	4	14	0	18
Thoroughbred	30	39	57	126
Total	34	53	57	144

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



INJURIES • continued

primary injury to the horse. 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, the investigative efforts at

the University of California, Davis, have focused more on causes and prevention of limb injuries.

Table 8 lists catastrophic injuries by limb and other axial locations. The number of front limb injuries sustained during racing (37) was lower than those injuries sustained during training (41). There were variable numbers of right and left rear limb injuries, but very similar numbers of right (18) and left front (19) limb injuries during racing.

Table 9 (on page 9) lists the specific type of musculoskeletal injuries by breed.

Table 7. Organ Systems Affected

Breed	GI	MS	Nerv	Resp	Inte	WB	Total
Quarter Horse	2	16	0	0	0	0	18
Thoroughbred	8	98	3	1	3	13	126
Total	10	114	3	1	3	13	144

(GI= Gastrointestinal; MS= Musculoskeletal; Nerv= Nervous; Resp= Respiratory; Inte= Integumentary; WB= Whole body.)

Table 8. Musculoskeletal Structures Affected

Structure Affected	Non-Exercise	Racing	Training	Total
Left Front	2	19	23	44
Left Rear	0	3	4	7
Right Front	0	18	18	36
Right Rear	1	2	3	6
Pelvis	0	3	3	6
Skull	5	1	1	7
Vertebra	3	6	2	11
Various Structures*	2	1	1	4
Total	13	53	55	121

* Includes tenosynovitis and laminitis of more than one limb.



INJURIES • continued

Table 9. Musculoskeletal Injury Type by Breed

Diagnosis	Quarter Horse	Thorough- bred	Total
Carpal Fracture – Left	1	3	4
Carpal Fracture – Right	4	4	8
Fedlock Failure – Left Front	2	30	32
Fedlock Failure – Left Rear	0	4	4
Fedlock Failure – Right Front	2	24	26
Fetlock Failure – Right Rear	0	2	2
Humerus Fracture – Left	0	4	4
Humerus Fracture – Right	0	2	2
Laminitis	0	1	1
Metacarpus III Fracture – Left	0	3	3
Metacarpus III Fracture – Right	0	1	1
Metatarsus III Fracture – Left	0	1	1
Metatarsus III Fracture – Right	0	2	2
P1 Fracture – Left Front	0	1	1
P1 Fracture – Left Rear	0	1	1
P1 Fracture – Right Rear	0	1	1
Pelvis Fracture	0	6	6
Radius Fracture – Right	1	0	1
Skull Fracture	0	7	7
Tarsus Fracture – Left	1	0	1
Tenosynovitis	1	0	1
Tibia Fracture – Right	0	1	1
Vertebra Fracture	6	5	11
Total	18	103	121



INJURIES • continued

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, this data shows 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	27	11	4	2	44
Left Rear	5	1	1	0	7
Pelvis	4	2	0	0	6
Right Front	30	3	3	0	36
Right Rear	2	1	2	1	6
Skull	2	0	0	5	7
Vertebra	6	1	1	3	11
Various Structures**	2	0	0	2	4
Total	78	19	11	13	121

*Injuries that did not occur on a racing/training surface. **Includes tenosynovitis and laminitis of more than one limb, and diaphragmatic rupture.

Other Organ Systems Affected by Injuries

Gastrointestinal:

Of the gastrointestinal system diagnoses, colitis and intestinal displacements were the most frequently observed problems. The causes of the three colitis cases were non-steroidal anti-inflammatory drugs and *Clostridioides difficile*. Both are listed among the most common causes of colitis of horses in California and elsewhere. Displacements included small and large intestinal torsion, strangulation, volvulus, colonic impaction, and entrapment, which are listed as some of the most common intestinal displacements in horses.

Diagnosis	Total
Colitis	3
Intestinal Displacement	8
Total	11



Other Organ Systems Affected by Injuries continued

Integumentary:

As usual, diseases of the integumentary system were rare during this reporting period. The cellulitis cases were of bacterial etiology, including *Staphylococcus aureus* and other unspecified bacteria. The predisposing factor and port of entry of these infections was not determined in any of the cases.

Diagnosis	Total
Cellulitis	3
Total	3

Nervous:

Equine protozoal myelitis keeps occurring in racehorses, although at low prevalence. An unusual case of equine herpes virus type 1 myelopathy also occurred. Wobbler syndrome (compressive myelopathy) is another neurological disease seen occasionally in racehorses.

Diagnosis	Total
Equine Protozoal Myelitis	1
Wobbler Syndrome	2
Equine herpes virus type 1 myelopathy	1
Total	4

Respiratory:

The number of respiratory disease cases in 2018–19 was low and consisted of a single case of pneumonia, the cause of which was bacterial although the species was not determined.

Diagnosis	Total
Pleuropneumonia	1
Total	1

Whole Body:

The number of unexplained sudden deaths in horses was slightly higher than in the previous year (7 cases reported in 2017–2018; 9 cases reported in 2018–2019).

Diagnosis	Total
Anaphylaxis	1
Anesthesia	2
Diaphragmatic rupture	2
Unexplained sudden death	9
Total	14



RESEARCH SUPPORT

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 - Pacific Coast Quarter Horse Racing Association

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	Lucy Gomez	Susan Stover
	Omar Gonzales	Jennifer Symons
	Viviana Gonzalez	Shrini Upadhyaya
	Dave Hawkins	Francisco Uzal
	Ashley Hill	Leslie Woods
	Linda Huang	

During this period, CAHFS implemented a Fellowship Training Program on the musculoskeletal system of horses, created in collaboration with CHRB. Dr. Monika Samol joined the CAHFS San Bernardino laboratory on August 1, 2018. Under the supervision of a pathologist, Dr. Samol performed the majority of CHRB necropsies of horses submitted to the San Bernardino laboratory that had sustained catastrophic musculoskeletal injuries. In addition, she performed a detailed examination of musculoskeletal specimens from CHRB horses necropsied in the Davis laboratory of CAHFS and shipped to San Bernardino for this purpose. 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. The first year of this program was very successful, and significant improvements were made in the consistency of case description, case documentation, and turnaround time of the reports.



OUTREACH AND PRESENTATIONS TO SCIENTIFIC MEETINGS

- Postmortem Program of CAHFS for the CHRB. Monika Samol. Meet the experts outreach meeting, South Coast Research and Extension Center, University of California, Irvine, CA. June 15, 2019.
- Musculoskeletal Fellowship at CAHFS. Monika Samol. Meeting for official CHRB racetrack veterinarians. Davis, CA. June 18, 2019.
- Considerations for Injury Prevention, California Horse Racing Board Regulatory Veterinarians, Stewards, Investigators; California Animal Health and Food Safety Laboratory System. Susan Stover. Davis, CA. June 18, 2019.
- Evidence of Subchondral Lesions Preceding Proximal Sesamoid Bone Fracture in Thoroughbred Racehorses. Susan Stover. Veterinary Orthopedic Society, Breckenridge, CO. February 4, 2019.
- Surface Consideration for Injury Prevention, Bisphosphonates in Athletes. Susan Stover. Tahoe Equine Conference, Incline Village, NV. January 28, 2019.
- Pathology of Racehorses With Dry Specimen Presentation. Racing Regulatory Meeting. Susan Stover. San Francisco, CA. November 30, 2018.
- Training Considerations for Injury Prevention. Susan Stover. Moonee Valley Racecourse, Racing Victoria, Melbourne, Australia. November 19, 2018.
- Training for Injury Prevention, Beyond the Wire. Susan Stover. Laurel Park Racetrack, Laurel, MD. November 6, 2018.
- The Path to Injury Prevention. Susan Stover. American College of Veterinary Surgeons Surgical Summit, Phoenix, AZ. October 26, 2018.
- Strides for Injury Prevention (justification for PET imaging). Susan Stover. Southern California Equine Foundation, Santa Anita Racetrack, Arcadia, CA. October 12, 2018.
- Anatomy, Anatomic Nomenclature, Biomechanics and Fracture Classification. Catastrophic fractures and associated preexisting injuries in racehorses. Lecture and gross pathology workshop. Susan Stover. XI Argentine Meeting of Veterinary Pathology and 12th Seminar of The C.L. Davis / S.W. Thompson Foundation in Argentina. La Plata, Argentina. August 8, 9, 10, 2018.
- Postmortem Program of CAHFS for the CHRB. Francisco Uzal. Meeting for official CHRB racetrack veterinarians. Davis, CA. June 18, 2019.
- Annual Report; Postmortem Program for the CHRB. Francisco Uzal. Santa Anita Racetrack, Arcadia, CA. October 2019.
- The Postmortem Program of the California Horse Race Board. Lecture and gross pathology workshop. Francisco Uzal. XI Argentine Meeting of Veterinary Pathology and 12th Seminar of The C.L. Davis / S.W. Thompson Foundation in Argentina. La Plata, Argentina. August 8, 9, 10, 2018.



SCIENTIFIC PUBLICATIONS

Hitchens PL, Hill AE, Stover SM. 2018. Relationship between historical lameness, medication usage, surgery, and exercise with catastrophic musculoskeletal injury in racehorses. *Frontiers in Veterinary Science*, 5:217

Spriet M, Espinosa-Mur P, Cissell DD, Phillips KL, Arino-Estrada G, Beylin D, Stepanov P, Katzman SA, Galuppo LD, Garcia-Nolen T, Murphy B, Stover SM. 2019. F-sodium fluoride positron emission tomography of the racing Thoroughbred fetlock: Validation and comparison with other imaging modalities in nine horses. *Equine Veterinary Journal*, 51:375-383.

Huang W, Yaraghi NA, Yang W, Velazquez-Olivera A, Li Z, Ritchie RO, Kisailus D, Stover SM, McKittrick J. 2019. A natural energy-absorbent polymer composite: The equine hoof wall. *Acta Biomaterialia*, 90:267-277.





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