POSTMORTEM EXAMINATION PROGRAM

Conducted for the California Horse Racing Board
July 1, 2021–June 30, 2022

UCDAVIS
VETERINARY MEDICINE
California Animal Health & 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 7,462 horses, as of June 30, 2022. 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 establishing a contract with 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 horse 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 private sources.

Information from the tests and data gathered are analyzed in an effort 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% of the submissions also are studied.

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SUBMISSIONS

General Submission Information

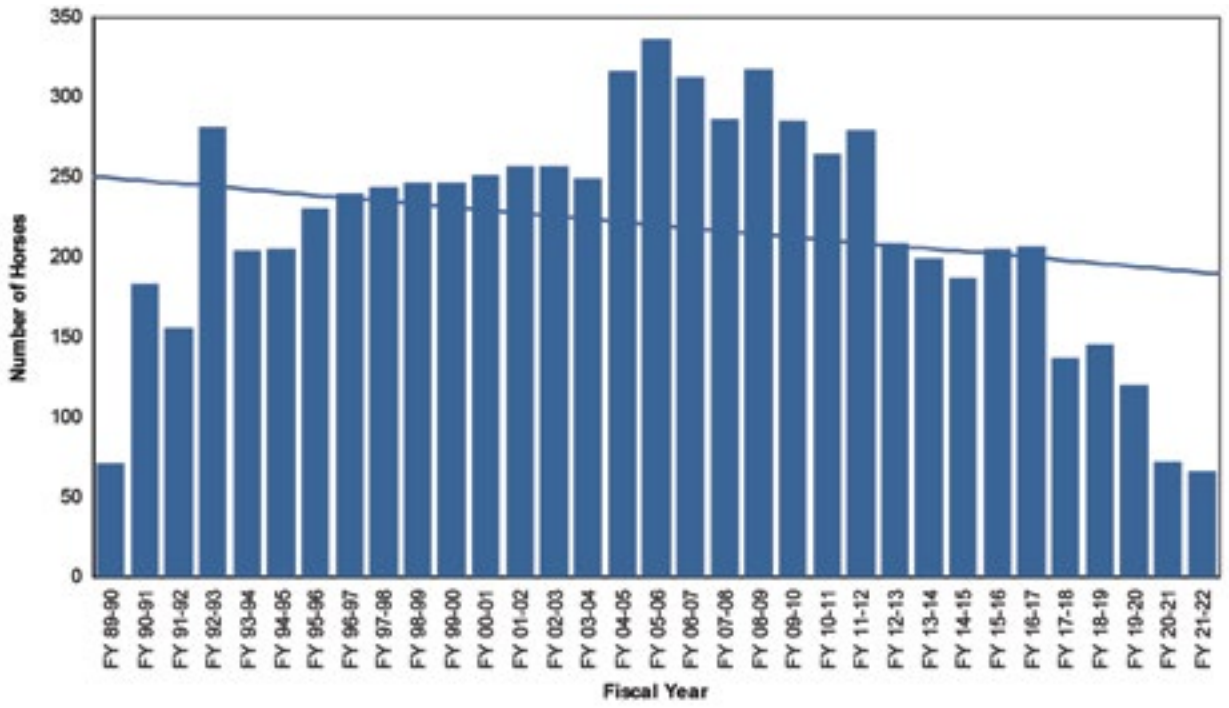
During the 2021–22 fiscal year, 66 horses were submitted to CAHFS as part of the CHRB Postmortem Program. This number, six cases below the 72 horses received during fiscal year 2020–21, continues the trend of significant reduction in fatalities initiated several years ago. This also was the lowest number 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 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 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	14 (21.2%)
Racing	20 (30.3%)
Training	32 (48.5%)
Total	**66** (100%)

The vast majority of catastrophic injuries (78.8%) 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 21.2% of submissions, included horses in the non-exercise 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.

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



SUBMISSIONS • continued

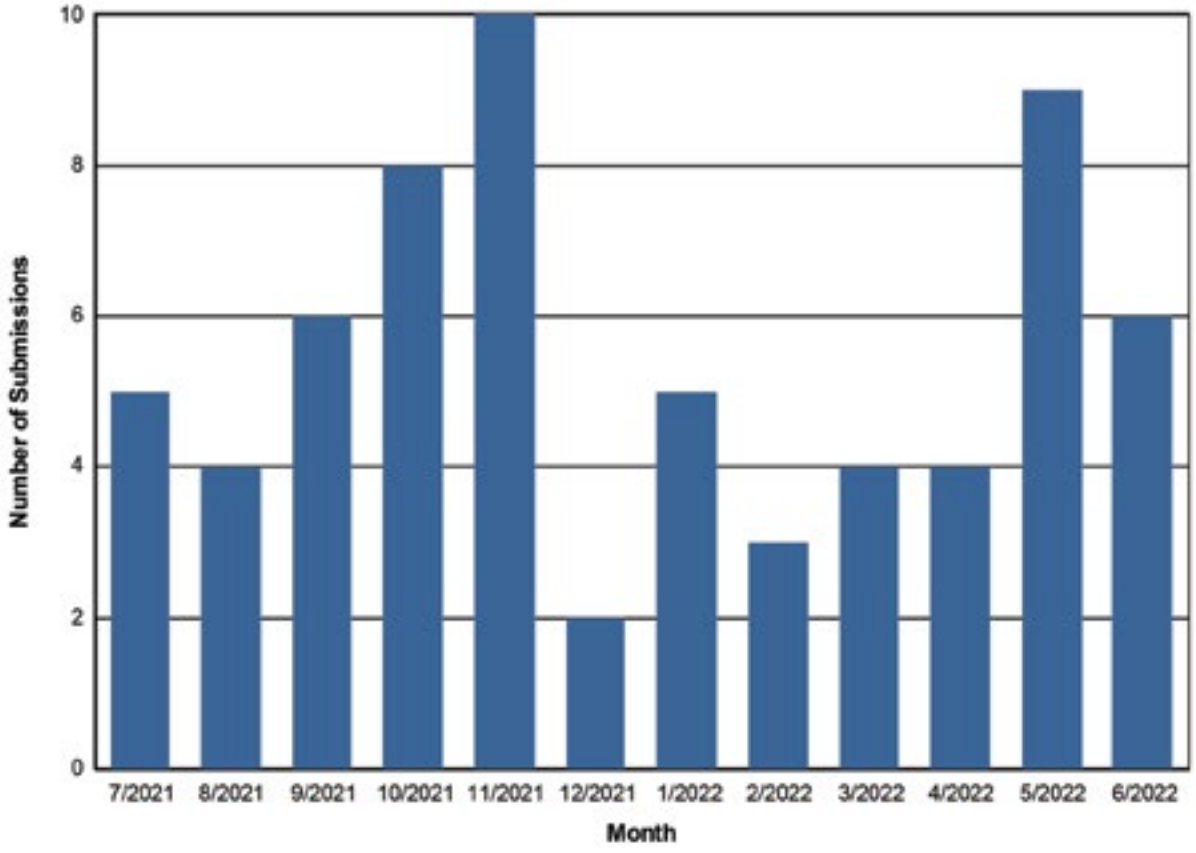
As in the past, for FY 2021–22 the vast majority of submissions (56; ~85%) were Thoroughbreds (Table 2). Eight horses submitted (~12%) were Quarter Horses. One Standardbred horse was submitted, and the breed was not reported in one animal.

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

Table 2. Submissions by Breed and Month

Breed	Jul 21	Aug 21	Sep 21	Oct 21	Nov 21	Dec 21	Jan 22	Feb 22	Mar 22	Apr 22	May 22	Jun 22	Total
Quarter Horse	0	0	0	1	1	1	1	0	3	0	0	1	**8**
Standardbred	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Thoroughbred	5	3	6	7	9	1	3	3	1	4	9	5	**56**
Not Reported	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Grand Total	**5**	**4**	**6**	**8**	**10**	**3**	**4**	**3**	**4**	**4**	**9**	**6**	**66**

Figure 2. Number of Horses Examined by Month



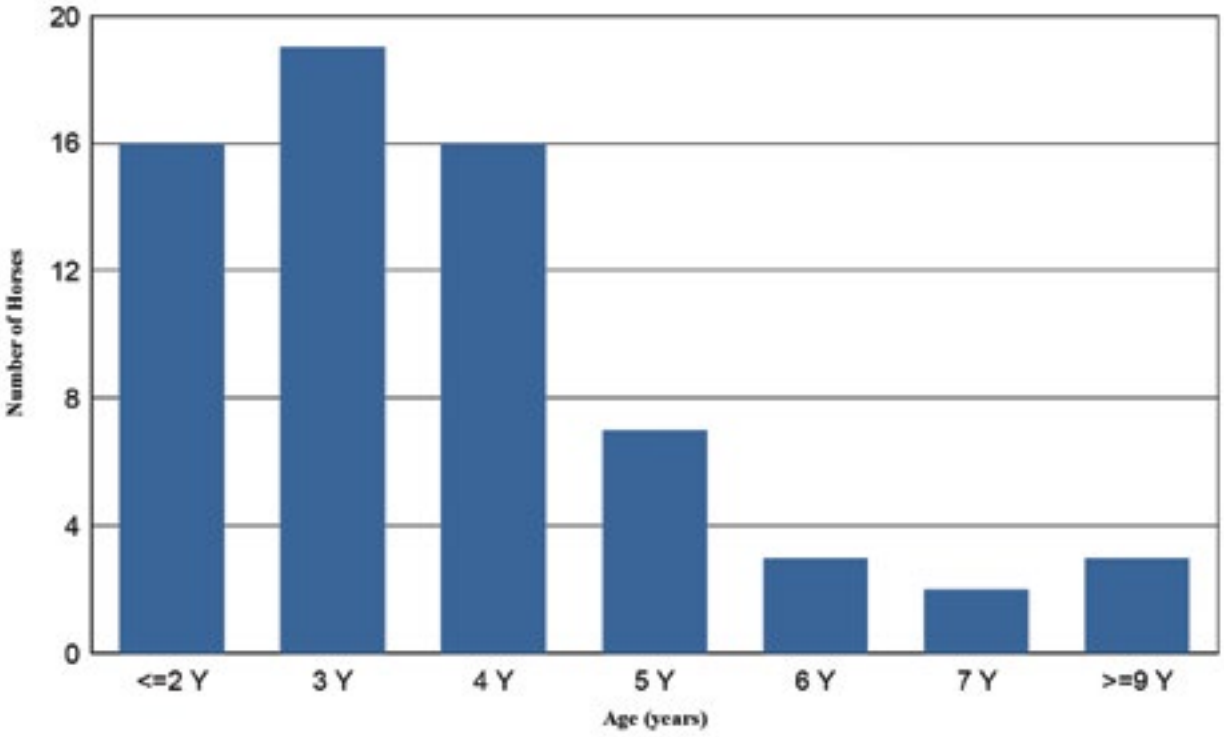
The largest proportion of submissions (~77 %) were horses between 2 and 4 years of age (Table 3). Approximately 24% of all racehorses submitted were 2 years of age or less. The number of horses submitted with catastrophic injuries or death dropped dramatically after the fourth year of age (Table 3 and 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.

Submissions By Breed and Age

Table 3. Submissions by Breed and Age

Breed/Age	<=2	3	4	5	6	7	>=9	Total
Quarter Horse	3	2	2	1	0	0	0	**8**
Thoroughbred	13	17	14	6	3	2	1	**56**
Standardbred	0	0	0	0	0	0	1	**1**
Not Reported	0	0	0	0	0	0	1	**1**
Total	**16**	**19**	**16**	7	**3**	**2**	**3**	**66**

Figure 3. Number of Horses Examined by Age



Submissions By Gender

The gender distribution of the horses submitted during 2021–22 is shown in Table 4. Males represented ~48% of the total group, with ~44% of males being intact (stallions) and 56% geldings. Females comprised ~ 52% of the group, all of them being intact.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Racing	Training	Total
Female	8	9	17	**34**
Intact Male	3	4	7	**14**
Gelding	3	7	8	**18**
Total	**14**	**20**	**32**	**66**

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	>=9	Total
Non-Exercise	4	4	2	1	0	0	3	**14**
Racing	5	2	6	3	2	2	0	**20**
Training	7	13	8	3	1	0	0	**32**
Total	**16**	**19**	**16**	**7**	**3**	**2**	**3**	**66**

During this fiscal year, Thoroughbred horses suffered more training (31) than racing (14) catastrophic injuries (Table 6). This is different from most previous years in which the percentage of racing fatalities was higher than that of training catastrophic injuries.

Only one Quarter Horse suffered a catastrophic injury during training in this period. This continues the trend down during the previous four years, and is similar to the years before when catastrophic injuries of Quarter Horses during a training session were infrequent.

Continued

Quarter Horse submissions during 2021–22 (n=8) were lower than the previous years (18 in 2018–2019, 32 in 2019–2020, and 17 in 2020–2021), continuing the downward trend which started several years ago, with only a temporary interruption in 2019–2020. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

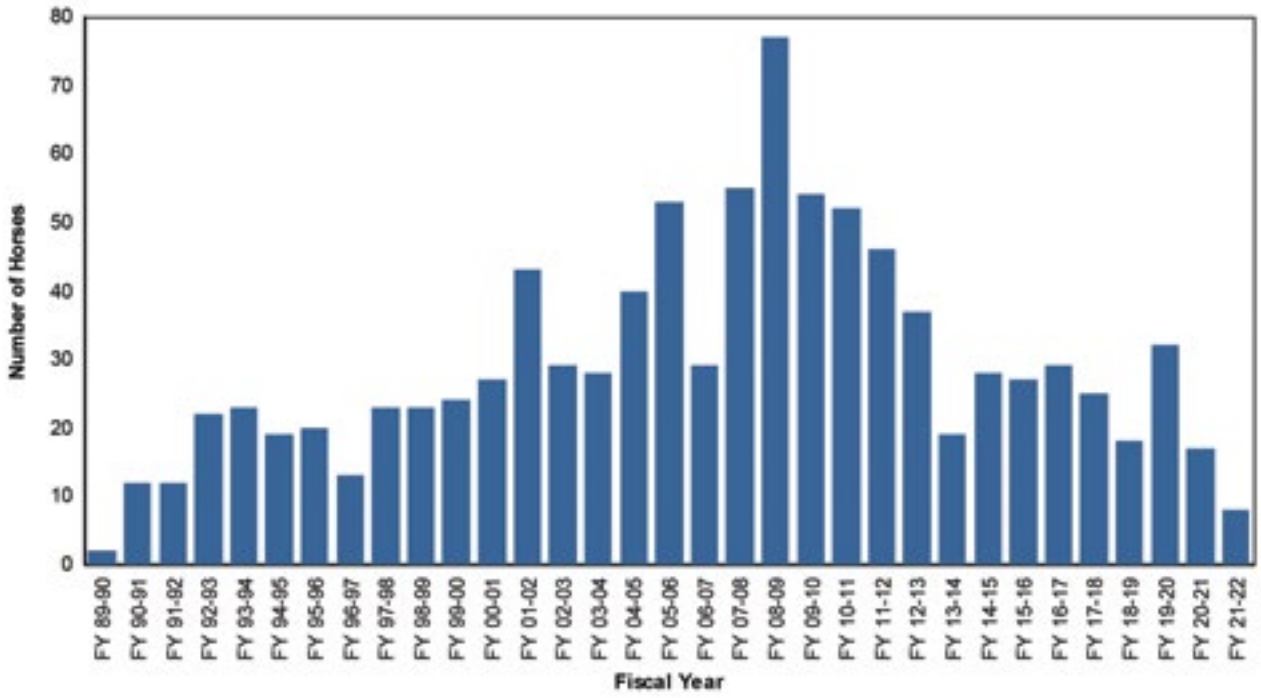
In 2021–22, ~71% of the total primary injuries or conditions in all breeds were due to musculoskeletal problems (Table 7), which is similar to what has been observed in previous years. Of this group, ~ 81% of injuries affected the front or rear legs (Table 8). The injuries listed in these tables represent the primary

Continued on page 8

Table 6. Category of Injury/Fatality by Breed

Injury Class by Breed	Non-Exercise	Racing	Training	Total
Quarter Horse	1	6	1	**8**
Thoroughbred	11	14	31	**56**
Standardbred	1	0	0	**1**
Not Reported	1	0	0	**1**
Total	**14**	**20**	**32**	**66**

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



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, most of the investigative efforts at the University of California, Davis, have focused 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 (12) was lower than those injuries sustained during training (19). Variable numbers of right and left rear limb injuries were reported, but similar numbers of right (14) and left front (17) limb injuries occurred.

Table 7. Organ Systems Affected

Breed	CV	GI	MS	Nerv	Inte	WB	Total
Quarter Horse	0	0	6	0	0	2	**8**
Thoroughbred	2	1	41	1	1	10	**56**
Standardbred	0	0	0	1	0	0	**1**
Not Reported	1	0	0	0	0	0	**1**
Total	**3**	**1**	**47**	**2**	**1**	**12**	**66**

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

Table 8. Musculoskeletal Structures Affected

Structure Affected	Non-Exercise	Racing	Training	Total
Left Front	0	5	12	**17**
Left Rear	3	0	2	**5**
Right Front	0	7	7	**14**
Right Rear	0	1	1	**2**
Pelvis	0	0	2	**2**
Skull	2	0	0	**2**
Vertebra	0	5	0	**5**
Various Structures	0	0	1	**1**
Total	**5**	**18**	**25**	**48**

Table 9 lists the specific type of musculoskeletal injuries by breed.

Table 9. Musculoskeletal Injury Type by Breed

Diagnosis	Quarter Horse	Thorough-bred	Total
Fetlock Failure – Left Front	0	9	**9**
Fetlock Failure – Right Front	0	9	**9**
Fetlock Failure – Right Rear	0	1	**1**
Humerus Fracture – Left	0	5	**5**
Humerus Fracture – Right	0	3	**3**
Muscle Laceration	0	1	**1**
Metacarpus III Fracture – Left	1	0	**1**
Metacarpus III Fracture – Right	0	1	**1**
Metatarsus III Fracture – Left	0	1	**1**
P1 Fracture – Left Front	0	1	**1**
P1 Fracture – Right Front	0	1	**1**
Pastern Joint Luxation – Left Front	1	0	**1**
Pelvis Fracture	0	2	**2**
Skull Fracture	0	2	**2**
Tibia Fracture – Left	0	4	**4**
Tibia Fracture – Right	0	1	**1**
Vertebra Fracture	4	1	**5**
Total	**6**	**42**	**48**

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	12	4	1	0	**17**
Left Rear	1	1	0	3	**5**
Pelvis	1	1	0	0	**2**
Right Front	6	4	4	0	**14**
Right Rear	2	0	0	0	**2**
Skull	0	0	0	2	**2**
Vertebra	5	0	0	0	**5**
Various Structures	1	0	0	0	**1**
Total	**28**	**10**	**5**	**5**	**48**

*Injuries that did not occur on a racing/training surface.

Other Organ Systems Affected by Injuries

Gastrointestinal:

Unusually, only one diagnosis of gastrointestinal system disease was made during 2021–2022. The cause of this colonic rupture was not determined.

Diagnosis	Total
Colon Rupture	1

Other Organ Systems Affected by Injuries continued

Integumentary:

As usual, diseases of the integumentary system were rare during this reporting period. The only cellulitis case diagnosed during this year was of presumptive bacterial etiology, although the specific agent was not determined. The predisposing factor and port of entry of this infection was not determined in this case.

Diagnosis	Total
Cellulitis	1

Nervous:

The case of encephalitis was due to *Sarcocystis neurona* (Equine Protozoal Myeloencephalopathy), while the cause of encephalopathy was not definitely confirmed, although it was suspected to be associated with septicemia and disseminated intravascular coagulation.

Diagnosis	Total
Encephalitis	1
Encephalopathy	1
Total	**2**

Cardiovascular:

The causes of the three cardiovascular syndromes listed here were not determined.

Diagnosis	Total
Aortic Rupture	1
Iliac Artery Rupture	1
Myocardial Infarction	1
Total	**3**

Whole Body:

The number of unexplained sudden deaths in horses continues to be significant (11 cases reported in 2019–2020; 11 cases reported in 2020–2021; and 12 cases reported during this period). The causes of the two hemoabdomen cases and of the one case of anaphylaxis were not determined.

Diagnosis	Total
Unexplained sudden death	9
Hemoabdomen	2
Anaphylaxis	1
Total	**12**

RESEARCH SUPPORT

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- Center for Equine Health, with funds provided by:
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During this period, Dr. Samol, CAHFS musculoskeletal fellow, performed the majority of CHRB horse necropsies with a history of catastrophic musculoskeletal injuries submitted to the San Bernardino laboratory. In addition, she performed a detailed examination of musculoskeletal specimens from CHRB horses necropsied in the CAHFS Davis laboratory, which were 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 program continues to be a success, and has brought significant improvement in the consistency of case description, case documentation and turnaround time of the reports.

OUTREACH AND PRESENTATIONS TO SCIENTIFIC MEETINGS

Samol M., Stover S., Arthur R., Uzal F.A. Complex fetlock breakdowns in California racehorses. 64th Meeting of the American Association of Veterinary Laboratory Diagnosticians. Denver, CO. October 2021

Samol M. Complex fetlock breakdowns in California racehorses. Veterinary Intern and Resident Research Symposium, Davis, CA. March 2022

Samol M. Musculoskeletal injuries in California racehorses. Continuing education module for racehorse trainers licensed in California (CHRB). Webinar, April 2021

Samol M., Stover S., Hill A., Arthur A., Uzal F.A. Characteristics of complete tibial fractures in California racehorses. American Association of Equine Practitioners Virtual Convention & Trade show, December 2020

Samol M., Stover S., Hill A., Arthur A., Uzal F.A. Characteristics of complete tibial fractures in California racehorses. British Equine Veterinary Association Virtual Congress. September 2021

Stover S. Panel Member – Equine high-performance sports group monitoring athletes, Zoom. July 2021

Stover S. Humeral fractures in racehorses, California Horse Racing Board continuing education for trainers – Webinar. August 3 2021

Stover S. Bone edema 2 panelist, Equine Orthobiologics and Regenerative Medicine Symposium. October 2021

Stover S. Hoof surface interactions – 2.5 hr webinar, Colorado State University Equine Sports Medicine Course. November 2021

Stover S. Report from the HISA (Horseracing Integrity and Safety Authority) Racetrack Safety Committee, 47th Annual Global Symposium of Racing, University of Arizona, Tucson, AZ. December 2021

Stover S. Training for injury prevention, Lake Tahoe Equine Conference, Incline Village, NV. January 2022

Stover S. Protecting our horses – What we know, Racing Commissioners International Conference, Lexington, KY. April 2022

Stover S. Lumbar vertebral fractures, webinar for trainers, Veterinarians at Los Alamitos Racetrack, CA. June 2022

Uzal F.A., Stover S., Finno C., Morgan J. Sudden death of race horses. Santa Anita Race Park. April 2022

Uzal F.A. Necropsy program of the California Horse Racing Board. USADA Meeting. UC Davis November 2021

SCIENTIFIC PUBLICATIONS

Knych H.K., Janes J., Kennedy L., McKemie D.S., Arthur R.M., Samol M.A., Uzal F.A., Scollay M. Detection and residence time of bisphosphonates in bone of horses. *J Vet Diagn Invest.* 2022 Jan;34(1):23-27.

Rocchigiani G., Ricci E., Navarro M.A., Samol M.A., Uzal F.A. Leukocyte numbers and intestinal mucosal morphometrics in horses with no clinical intestinal disease. *J Vet Diagn Invest.* 2022 May;34(3):389-395

Asin J., Murphy B.G., Samol M.A., Polanco J., Moore J.D., Uzal F.A. Rickets in a Thoroughbred-cross foal: case report and review of the literature. J *Vet Diagn Invest.* 2021 Sep;33(5):987-992

Samol M.A., Uzal F.A., Blanchard P.C., Arthur R.M., Stover S.M. Sudden death caused by spinal cord injury associated with vertebral fractures and fetlock failure in a Thoroughbred racehorse. *J Vet Diagn Invest.* 2021 Jul;33(4):788-791

Samol M.A., Uzal F.A., Hill A.E., Arthur R.M., Stover S.M. Characteristics of complete tibial fractures in California racehorses. *Equine Vet J.* 2021 Sep;53(5):911-922

Shaffer S.K., Shelly K., Garcia T.C., Samol M.A., Hill A.E., Fyhrie D.P., Stover S.M. 2022. In vitro motions of the medial and lateral proximal sesamoid bones under mid-stance load conditions are consistent with racehorse fracture configurations. *J Biomech* 2022 Jan;130:110888