POSTMORTEM EXAMINATION PROGRAM

Conducted for the California Horse Racing Board
July 1, 2020–June 30, 2021

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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2020–2021 Annual Report

Cover, Page 2, and Page 14 photos by Francisco Uzal

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POSTMORTEM EXAMINATION PROGRAM

Introduction

The Postmortem Examination Program has been in operation since February 1990, and has performed examinations on 7,395 horses as of June 30, 2021. 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 that involved establishing 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 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 are also studied.

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SUBMISSIONS

General Submission Information

During the 2020–21 fiscal year, 72 horses were submitted to CAHFS as part of the CHRB Postmortem Program. This number, 48 cases below the 120 horses received during fiscal year 2019–20, continues the marked 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.

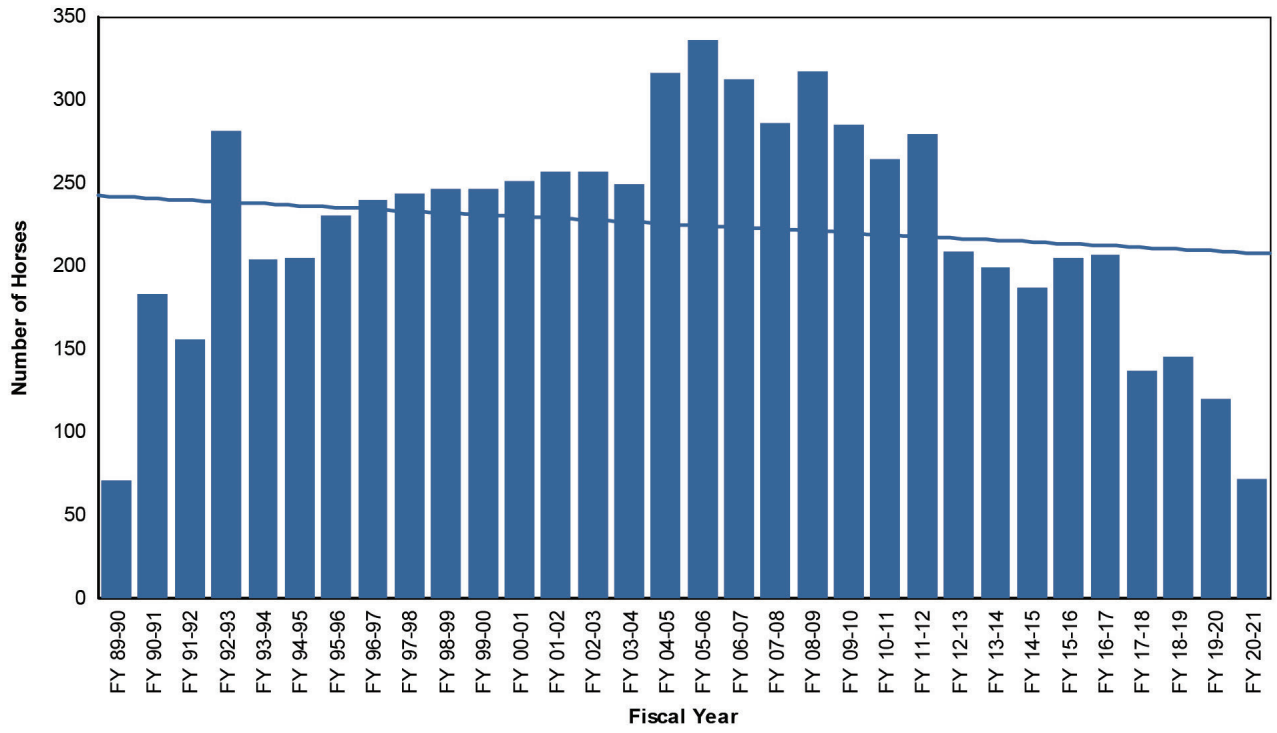
The CAHFS' Davis and San Bernardino laboratories performed the majority of the necropsies during this fiscal year. At the time of submission, the CHRB track official categorizes the activity of the horse at the time of injury into one of three types: non-exercise, racing or training (Table 1).

The vast majority of catastrophic injuries (72%) 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 28% 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.

Table 1. Activity at Time of Injury/Fatality

Non-Exercise	20 (28%)
Racing	30 (42%)
Training	22 (30%)
Total	72 (100%)

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



SUBMISSIONS • continued

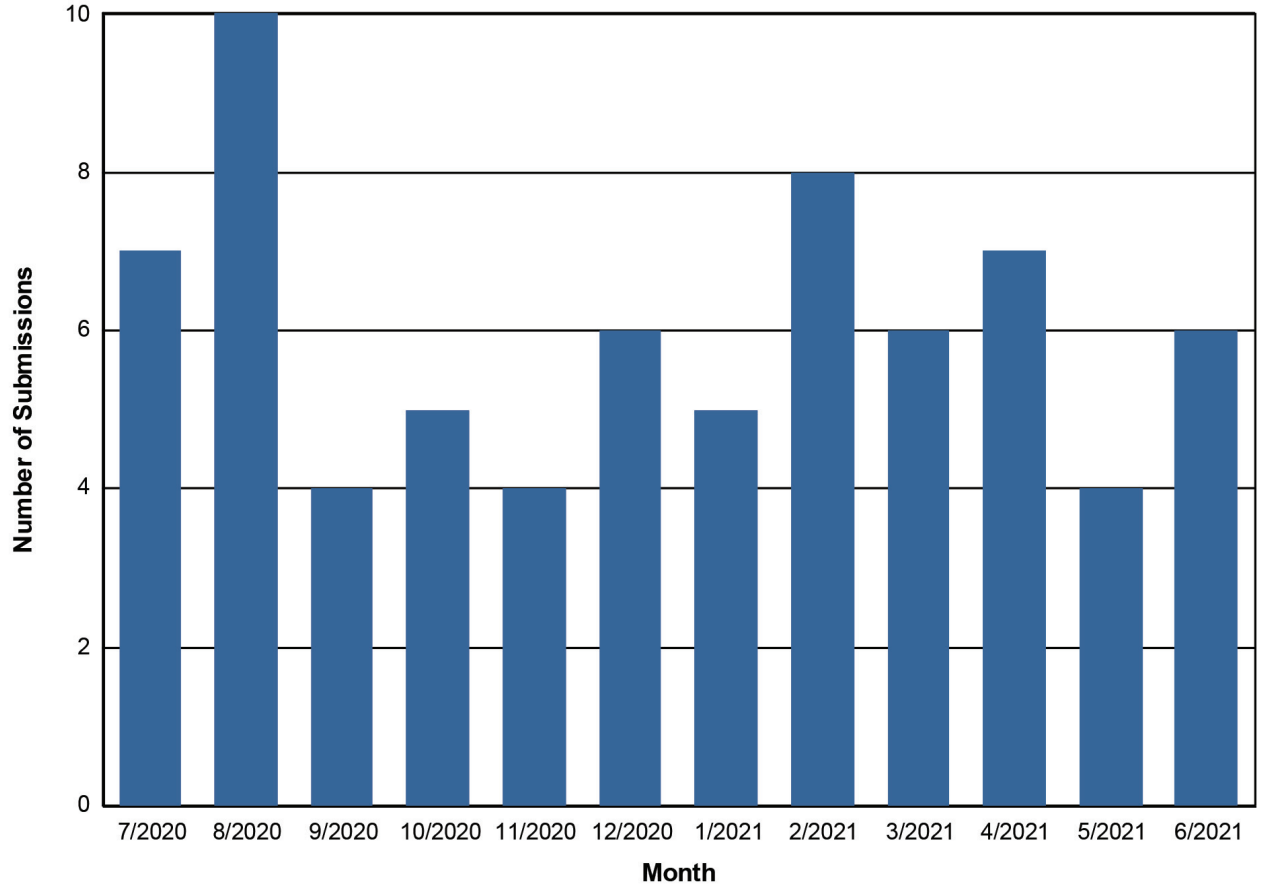
As in the past, for FY 2020–21 the vast majority of submissions (55; ~76%) were Thoroughbreds (Table 2). Seventeen of the horses submitted (~24%) were Quarter Horses. No other breed of horse was submitted. This represents a mild decrease in Quarter Horses from the previous year.

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.

Table 2. Submissions by Breed and Month

Breed	Jul 20	Aug 20	Sep 20	Oct 20	Nov 20	Dec 20	Jan 21	Feb 21	Mar 21	Apr 21	May 21	Jun 21	Total
Quarter Horse	4	3	1	2	1	2	0	0	2	0	1	1	17
Thoroughbred	3	7	3	3	3	4	5	8	4	7	3	5	55
Grand Total	7	10	4	5	4	6	5	8	6	7	4	6	72

Figure 2. Number of Horses Examined by Month



The largest proportion of submissions (~72 %) were horses between 2 and 4 years of age (Table 3). Approximately 19% 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).

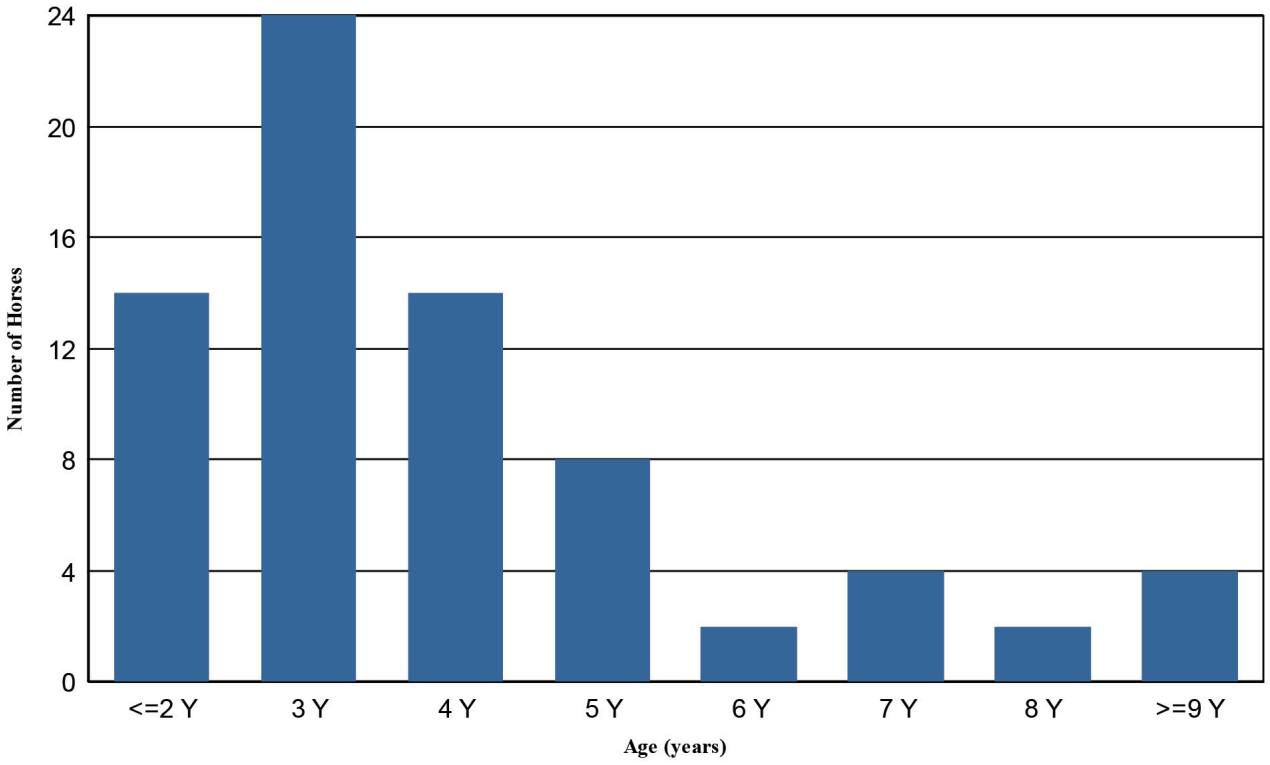
This distribution is consistent with the age distribution that was seen in prior years. We cannot conclude if horses 5 years of age and greater are less susceptible to the injuries of racing because the total number of horses in each age group that are racing and training on facilities controlled by CHRB are unknown 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
Quarter Horse	5	8	1	1	0	0	0	2	17
Thoroughbred	9	16	13	7	2	4	2	2	55
Total	**14**	**24**	**14**	**8**	**2**	**4**	**2**	**4**	**72**

Figure 3. Number of Horses Examined by Age



Submissions By Gender

The gender distribution of the horses submitted during 2020–21 is shown in Table 4. Males represented ~55% of the total group with 15% of males being intact (stallions) and 85% geldings. Females comprised ~45% of the group, all of them being intact.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Racing	Training	Total
Female	9	14	9	**32**
Intact Male	2	2	2	**6**
Gelding	9	14	11	**34**
Total	**20**	**30**	**22**	**72**

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, ~72%, occurred in 2-, 3- and 4-year-old racehorses (Figure 3 and Table 5). Non-exercise related deaths occurred in half of the 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	5	3	4	0	1	2	2	3	**20**
Racing	6	13	4	5	0	2	0	0	**30**
Training	3	8	6	3	1	0	0	1	**22**
Total	**14**	**24**	**14**	**8**	**2**	**4**	**2**	**4**	72

During this fiscal year, Thoroughbred horses suffered slightly more training (20) than racing (19) catastrophic injuries (Table 6). This is similar to last year but different from most previous years when the percentage of racing fatalities was higher than that of training catastrophic injuries.

Quarter Horses suffered a small number of catastrophic injuries during training (2) in this period and a larger number of racing injuries (11). This continues the decline in training injuries that started four years ago.

Continued

Quarter Horse submissions during 2020–21 (n=17) were lower than the previous year (32 in 2019–2020), continuing the decline that had started several years ago, but had peaked temporarily in 2019–2020. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

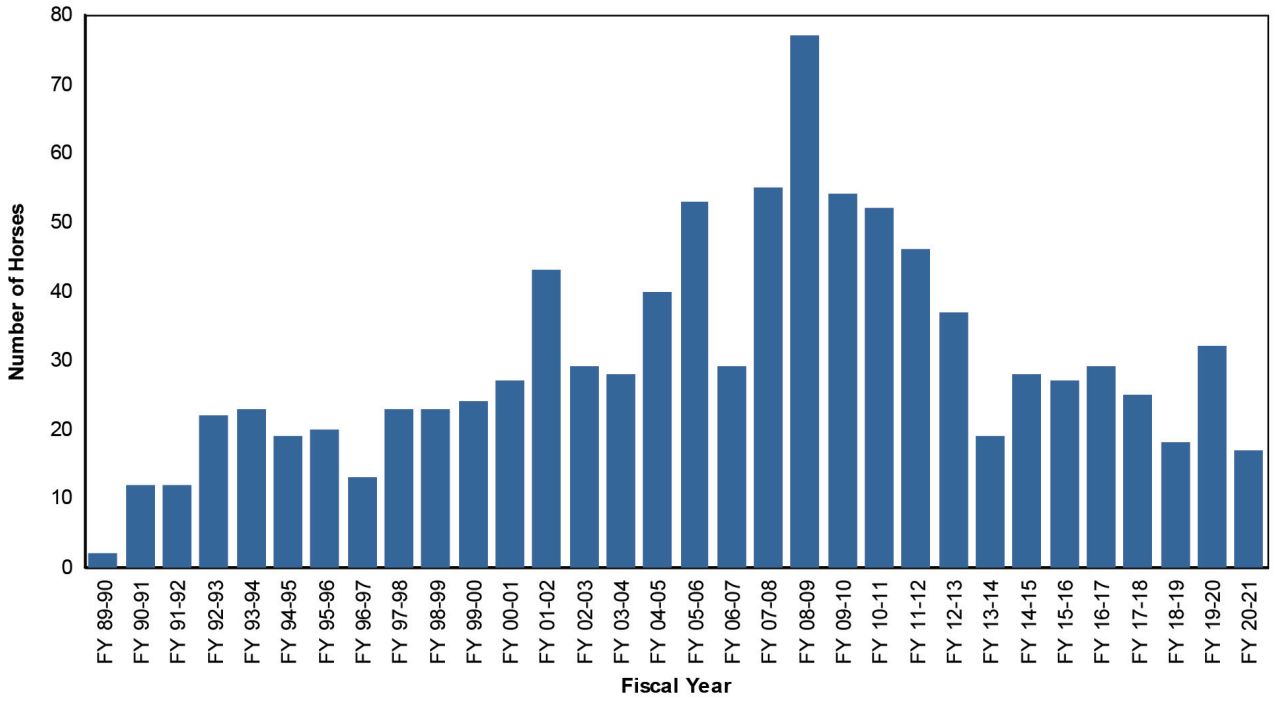
In 2020–21, ~71% of the total primary injuries or conditions in all breeds were due to musculoskeletal problems (Table 7), which is slightly higher in 2019–2020, but lower than what has been observed in previous years. Of this group, ~88% of injuries affected the front or rear legs (Table 8). The injuries listed in

Continued on page 8

Table 6. Category of Injury/Fatality by Breed

Injury Class by Breed	Non-Exercise	Racing	Training	Total
Quarter Horse	4	11	2	17
Thoroughbred	16	19	20	55
Total	20	30	22	72

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



these tables represent the 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, 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 (25) was higher than those injuries sustained during training (15). There were variable numbers of right and left rear limb injuries, but very similar numbers of right (21) and left front (19) limb injuries.

Table 7. Organ Systems Affected

Breed	CV	GI	MS	Resp	WB	Total
Quarter Horse	1	1	12	0	3	**17**
Thoroughbred	0	4	39	1	11	**55**
Total	**1**	**5**	**51**	**1**	**14**	**72**

(CV=Cardiovascular; GI=Gastrointestinal; MS=Musculoskeletal; Resp=Respiratory; WB=Whole body.)

Table 8. Musculoskeletal Structures Affected

Structure Affected	Non-Exercise	Racing	Training	Total
Left Front	0	11	8	**19**
Left Rear	1	1	1	**3**
Right Front	0	14	7	**21**
Right Rear	0	1	0	**1**
Pelvis	0	1	0	**1**
Skull	3	0	0	**3**
Vertebra	2	4	0	**6**
Various Structures	0	0	1	**1**
Total	**6**	**32**	**17**	**55**

Table 9. Musculoskeletal Injury Type by Breed

Diagnosis	Quarter Horse	Thoroughbred	Total
Carpal Fracture – Right	1	0	**1**
Femur Fracture – Left	0	1	**1**
Fetlock Failure – Left Front	2	11	**13**
Fetlock Failure – Right Front	2	9	**11**
Humerus Fracture – Left	1	2	**3**
Humerus Fracture – Right	0	4	**4**
Metacarpus III Fracture – Left	0	1	**1**
Metacarpus III Fracture – Right	0	1	**1**
Muscle Laceration	0	1	**1**
P1 Fracture – Left Front	0	2	**2**
P1 Fracture – Right Front	0	1	**1**
Pelvis Fracture	0	1	**1**
Radius Fracture – Right	0	1	**1**
Scapula Fracture – Right	1	0	**1**
Skull Fracture	1	2	**3**
Suspensory Apparatus Failure	0	1	**1**
Tendon Rupture – Left Rear	0	1	**1**
Tibia Fracture – Left	0	1	**1**
Tibia Fracture – Right	0	1	**1**
Vertebra Fracture	5	1	**6**
Total	**13**	**42**	**55**

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 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	9	5	5	0	**19**
Left Rear	0	2	0	1	**3**
Pelvis	1	0	0	0	**1**
Right Front	12	6	3	0	**21**
Right Rear	0	1	0	0	**1**
Skull	0	0	0	3	**3**
Vertebra	4	0	0	2	**6**
Various Structures	0	1	0	0	**1**
Total	**26**	**15**	**8**	**6**	**55**

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

Other Organ Systems Affected by Injuries

Gastrointestinal:

The cause of the colitis case and one of the enteritis cases was undetermined, not an uncommon outcome of enterocolitis disease investigation in horses. The cause of the other enteritis case was *Clostridioides difficile*, one of the leading causes of enterocolitis in horses. The etiology of the colon and gastric rupture cases was undetermined.

Diagnosis	Total
Colitis	1
Colon Rupture	1
Enteritis	2
Gastric Rupture	1
Total	**5**

Other Organ Systems Affected by Injuries continued

Respiratory:

The cause of the pleuropneumonia in one horse was *Streptococcus equi* subsp. *zooepidemicus*, which is the most common cause of pneumonia in horses.

Diagnosis	Total
Pleuropneumonia	1

Whole Body:

The number of unexplained sudden deaths in horses continues to be significant (11 cases reported in 2018–2019 and the same number each, in 2019–2020 and 2020–2021). The septicemia case was produced by *Streptococcus equi* subsp. *zooepidemicus*. The cause of hemoabdomen was anticoagulant rodenticide intoxication, while the case of exsanguination was associated with an arterial rupture of undetermined etiology.

Diagnosis	Total
Hemoabdomen	1
Septicemia	1
Unexplained Sudden Death	11
Exsanguination	1
Total	**14**

RESEARCH SUPPORT

Sponsors:

- Center for Equine Health, with funds provided by:
  - State of California Satellite Wagering Fund
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- Grayson-Jockey Club Research Foundation, Inc.
- Pacific Coast Quarter Horse Racing Association

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During this period, Dr. Samol, CAHFS musculoskeletal fellow, performed the majority of CHRB horse necropsies submitted to the San Bernardino laboratory with a history of catastrophic musculoskeletal injuries. 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 it 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. Continuing education module for racehorse trainers licensed in California (CHRB): Musculoskeletal injuries in California racehorses. April 2021. Webinar.

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

Stover S. Conditions that predispose to catastrophic skeletal injuries in racehorses, Santiago, Chile – Chilean Association of Equine Veterinarians – Webinar. July 2020.

Stover S. Invited Panelist, Conclusions: How do we choose? How do we improve? Equine Regenerative Medicine and Orthobiologics Summit – WHOVA Webinar. November 2020.

Stover S. Development of injuries in sport horses, Washington State University Continuing Education (webinar). November 2020.

Stover S. Physical examination and imaging for injury detection, Washington State University Continuing Education (webinar). November 2020.

Stover S. Manageable factors for injury prevention, Washington State University Continuing Education (webinar). November 2020.

Stover S. Training for injury prevention, Washington State University Continuing Education (webinar). November 2020.

Stover S. Significance of radiographic findings in racehorses, American Association of Equine Practitioners – Annual Meeting (webinar). December 2020.

Stover S. Biomechanical influences on the fetlock suspensory apparatus, American College of Veterinary Surgeons – Annual Symposium (webinar). December 2020.

Stover S. The hoof, shoe, arena surface, Heumphreus Memorial Lecture – UC Davis, Davis, CA. February 2021.

Stover S. Bone Biomechanics, ACVS Board Prep – Small Animal Surgery Residents. March 2021.

Stover S. The equine fetlock, webinar to racehorse trainers – California Horse Racing Board. April 2021.

Stover S. Panel Member – Equine High-Performance Sports Group, Zoom. May 2021.

Stover S. Traumatic injuries of bone, Davis Thompson Foundation Lecture (webinar) for Diseases of the Skeletal System meeting. June 2021.

Uzal F.A. The necropsy program of the California Horse Racing Board. Continuing education module for racehorse trainers licensed in California (California Horse Racing Board). April 2021.

Uzal F.A. Annual Report of the CHRB Postmortem Program. California Horse Racing Board. October 2020. Webinar.

SCIENTIFIC PUBLICATIONS

Harrison S.M., Whitton R.C., Stover S.M., Symons J., Cleary P.W. 2021. A coupled biomechanical-smoothed particle hydrodynamics model for horse racing tracks. *Frontiers Bioeng Biotech* doi: 10.3389/fbioe.2022.766748

Samol M.A., Uzal F.A., Hill A.E., Arthur R.M., Stover S.M.. 2021. *Equine Vet J.* 53:911-922.

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

Shaffer S.K., Sachs N., Garcia T.C., Fyhrie D.P., Stover S.M. 2021. In-vitro motion of equine proximal sesamoid bones under physiological mid-stance loads. *Am J Vet Res* 82:198-206.

Shaffer S.K., To C.M., Garcia-Nolen T.C., Fyhrie D., Uzal F.A., Stover S.M. 2021. Subchondral focal osteopenia associated with proximal sesamoid bone fracture in Thoroughbred racehorses. *Eq Vet J* 53:294-305.

Los Alamitos Race Course

Santa Anita Park

Oak Tree Racing Association

Golden Gate Fields

California Authority of Racing Fairs

Del Mar Thoroughbred Club

California Horse Racing Board

UC Davis Veterinary Medicine

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