

POSTMORTEM EXAMINATION PROGRAM

Conducted for the California Horse Racing Board
July 1, 2019–June 30, 2020



UC DAVIS
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 7,323 horses as of June 30, 2020. 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 an effort 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 of racehorses (colic, pneumonia, etc.) are also studied.



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SUBMISSIONS

General Submission Information

During the 2019–20 fiscal year, 120 horses were submitted to CAHFS as part of the CHRB Postmortem Program (two additional horses died at a racetrack, but were not submitted to a CAHFS laboratory for necropsy). This number, which is 22 cases fewer than the 142 horses received during fiscal year 2018–19, continues the trend of significant reduction in fatalities initiated several years ago (Figure 1). 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

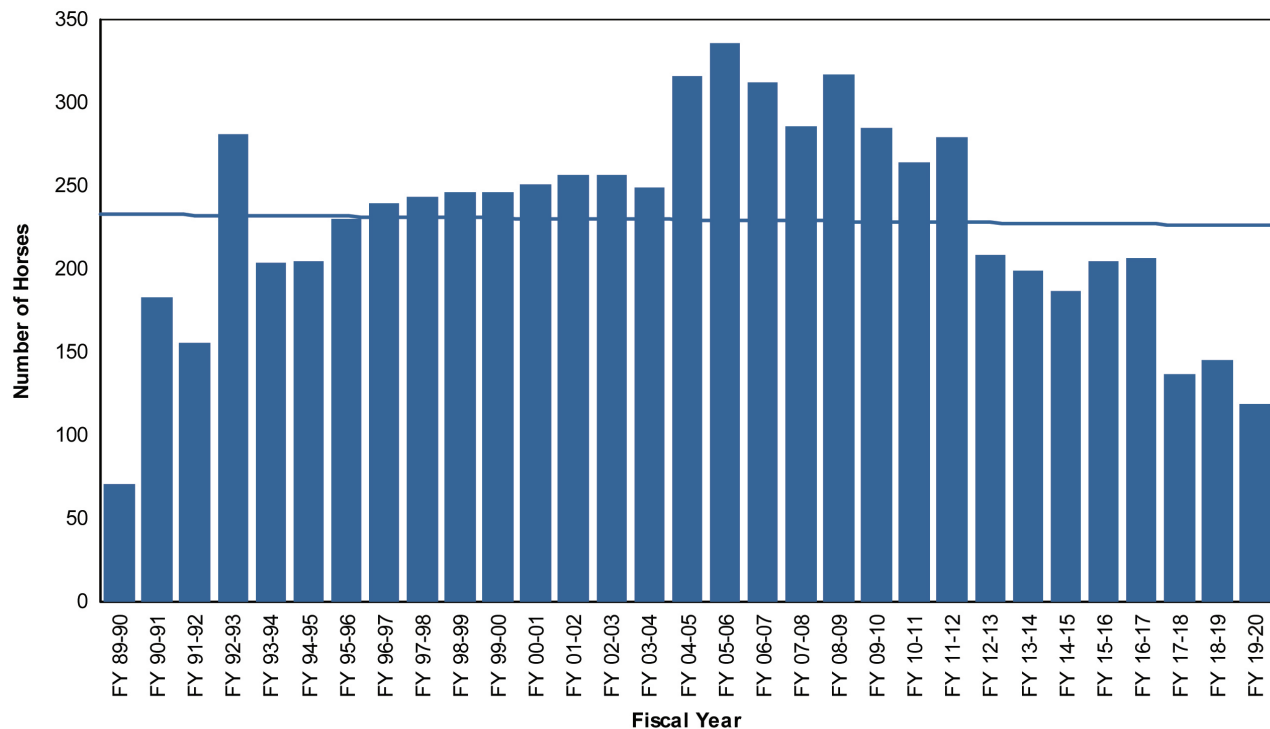
Table 1. Activity at Time of Injury/Fatality

Non-Exercise	34 (28%)
Racing	44 (37%)
Training	42 (35%)
Total	120 (100%)

officially 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.

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



SUBMISSIONS • continued

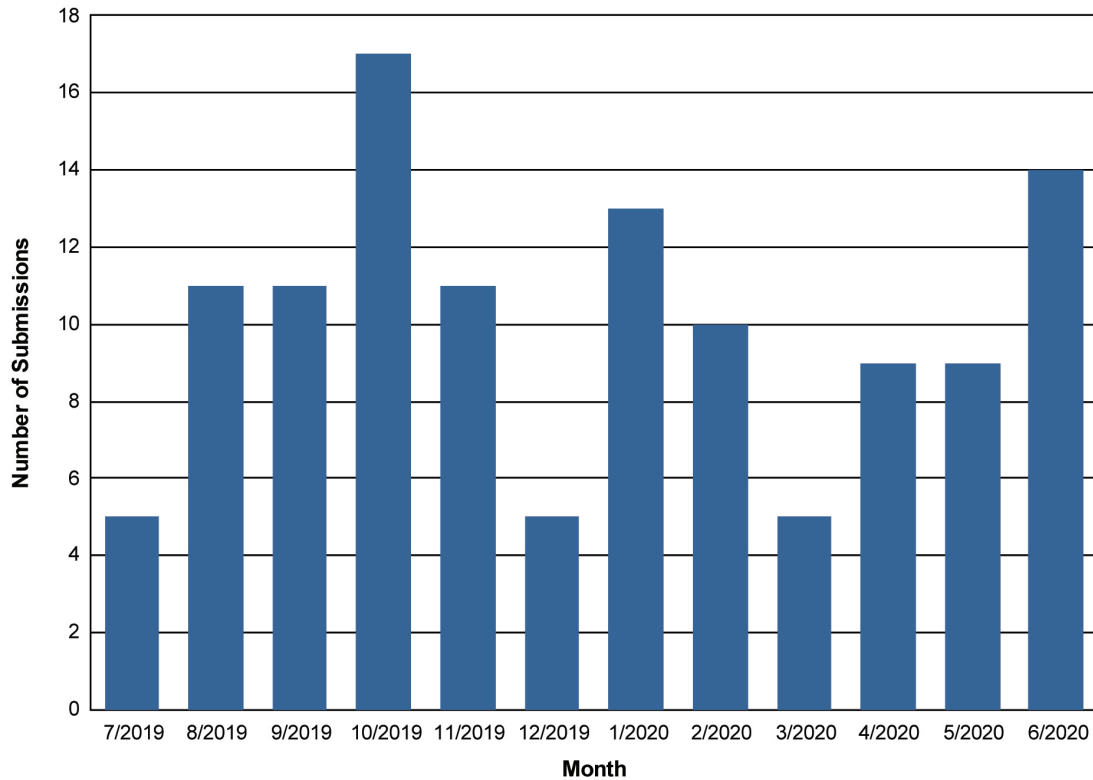
As in the past, for FY 2019–20 the vast majority of submissions (88; ~73%) were Thoroughbreds (Table 2). Thirty-two of the horses submitted (~27%) were Quarter Horses. No other breed of horse was submitted. This represents a moderate increase in Quarter Horses from the previous year.

The number of horses submitted per month was variable, although no obvious clusters of submissions appeared 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 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Total
Quarter Horse	1	4	5	7	0	0	4	0	3	3	1	4	32
Thoroughbred	4	7	6	10	11	5	9	10	2	6	8	10	88
Grand Total	5	11	11	17	11	5	13	10	5	9	9	14	120

Figure 2. Number of Horses Examined by Month



SUBMISSIONS • continued

The largest proportion of submissions (~79 %) were horses between 2 and 4 years of age (Table 3). Approximately 25% 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 CHR B are not known to us.

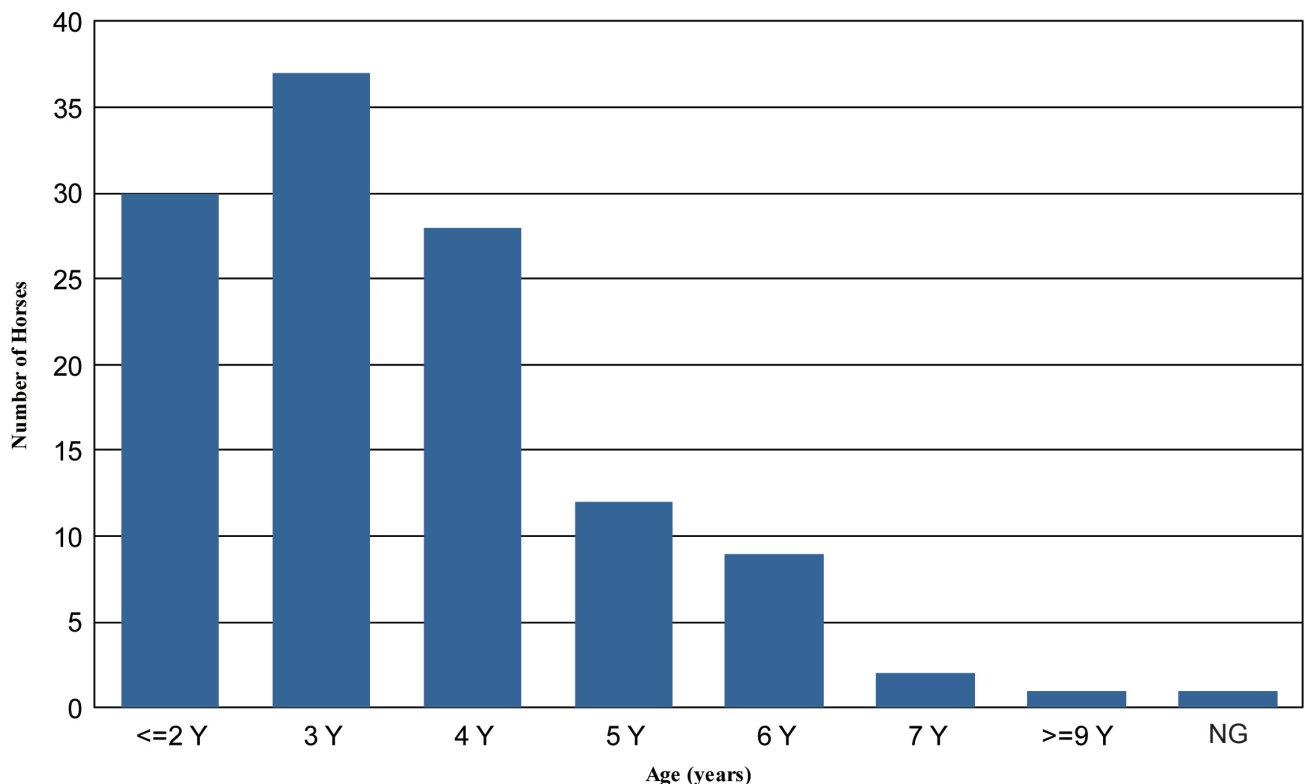
Submissions By Breed and Age

Table 3. Submissions by Breed and Age

Breed/Age	<=2	3	4	5	6	7	>=9	NR*	Total
Quarter Horse	18	8	3	0	2	1	0	0	32
Thoroughbred	12	29	25	12	7	1	1	1	88
Total	30	37	28	12	9	2	1	1	120

*NR: age not reported

Figure 3. Number of Horses Examined by Age



SUBMISSIONS • continued

Submissions By Gender

The gender distribution of the horses submitted during 2019–20 is shown in Table 4. Males represented ~68% of the total group, with 21% of males being intact (stallions), and 79% geldings. Females comprised ~32% of the group, all of them being intact.

Table 4. Distribution of Horses by Gender and Category

Gender	Non-Exercise	Racing	Training	Total
Female	15	8	15	38
Male	3	6	8	17
Gelding	16	30	19	65
Total	34	44	42	120

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, ~79%, 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	NR*	Total
Non-Exercise	13	10	7	4	0	0	0	0	34
Racing	6	15	10	5	6	2	0	0	44
Training	11	12	11	3	3	0	1	1	42
Total	30	37	28	12	9	2	1	1	120

*NR: age not reported

During this fiscal year, Thoroughbred horses suffered more training (38) than racing (32) 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 a small number of catastrophic injuries during training (4) in this period. This continues the trend down during the previous three years, and is similar to the years before when catastrophic injuries in Quarter Horses during a training session were infrequent.

Continued

INJURIES • continued

Quarter Horse submissions during 2019–20 (n=32) were higher than the previous years (18 in 2018–2019), interrupting the decline which had started several years ago. Figure 4 shows the historical number of Quarter Horses submitted to the program since its inception.

In 2019–20, ~69% of the total primary injuries or conditions in all breeds were due to musculoskeletal

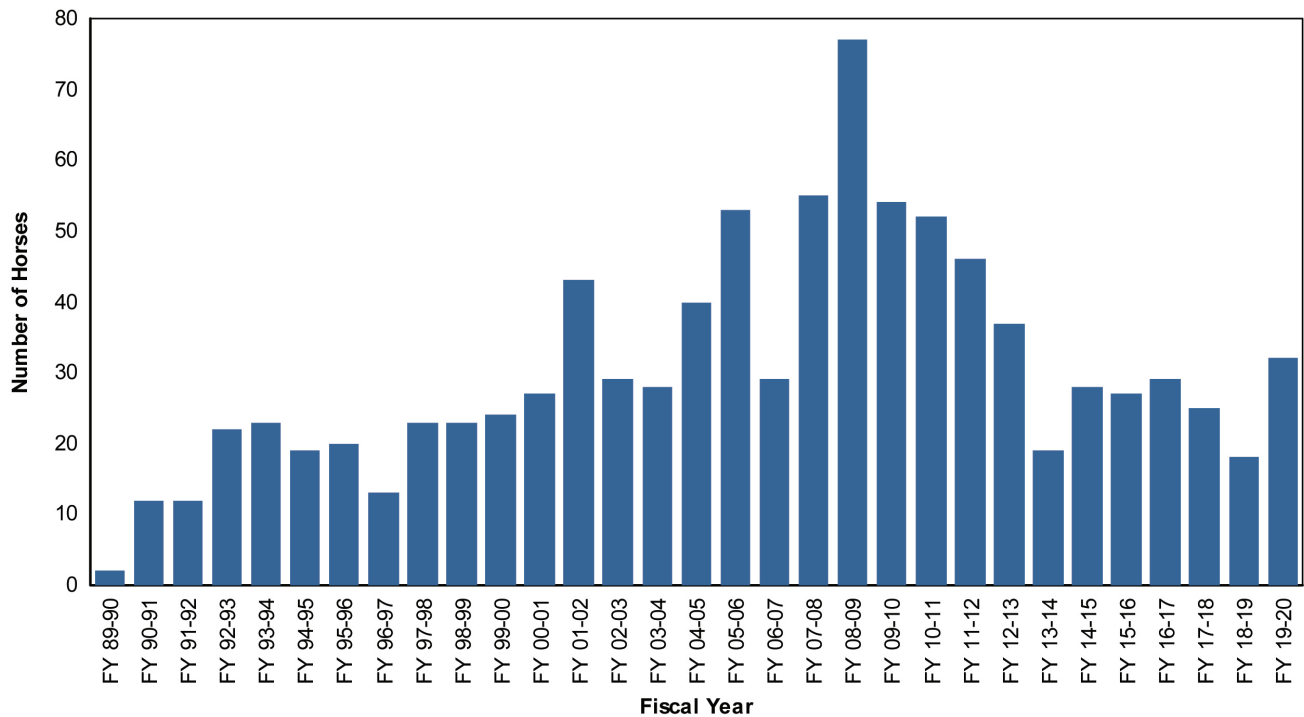
problems (Table 7), which is lower than what has been observed in previous years. Of this group, ~83% of injuries affected the front or rear legs (Table 8). The injuries listed in these tables represent the primary injury to the horse. In many cases, several primary findings for each horse submitted were recorded. Thus,

Continued on page 8

Table 6. Category of Injury/Fatality by Breed

Injury Class by Breed	Non-Exercise	Racing	Training	Total
Quarter Horse	16	12	4	32
Thoroughbred	18	32	38	88
Total	34	44	42	120

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



INJURIES • continued

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 (36) was higher than those injuries sustained during training (24). Variable numbers of right and left rear limb injuries occurred, but very similar numbers of right (35) and left front (27) limb injuries happened during racing.

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

Table 7. Organ Systems Affected

Breed	CV	GI	MS	Nerv	Resp	Inte	WB	Total
Quarter Horse	0	8	18	0	1	1	4	32
Thoroughbred	1	5	65	1	2	0	14	88
Total	1	13	83	1	3	1	18	120

(CV=Cardiovascular; 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	14	11	27
Left Rear	0	2	2	4
Right Front	0	22	13	35
Right Rear	0	1	2	3
Pelvis	0	1	3	4
Skull	5	0	0	5
Vertebra	1	5	2	8
Various Structures*	3	0	1	4
Total	11	45	34	90

* Includes tenosynovitis and laminitis of more than one limb, and diaphragmatic rupture.

INJURIES • continued

Table 9. Musculoskeletal Injury Type by Breed

Diagnosis	Quarter Horse	Thorough- bred	Total
Carpal Fracture – Left	1	1	2
Carpal Fracture – Right	3	3	6
Fetlock Failure – Left Front	2	14	16
Fetlock Failure – Left Rear	0	18	18
Fetlock Failure – Right Front	0	18	18
Fetlock Failure – Right Rear	0	2	2
Humerus Fracture – Left	0	4	4
Humerus Fracture – Right	0	3	3
Laminitis	3	0	3
Metacarpus III Fracture – Left	0	2	2
Metacarpus III Fracture – Right	0	2	2
Pastern Joint Luxation – Right Front	1	0	1
P1 Fracture – Left Rear	0	1	1
Pelvis Fracture	0	4	4
Radius Fracture – Left	1	1	2
Radius Fracture – Right	0	1	1
Scapula Fracture – Left	0	1	1
Scapula Fracture – Right	3	1	4
Skull Fracture	0	5	5
Tibia Fracture – Left	0	1	1
Tibia Fracture – Right	1	0	1
Ulna Fracture – Left	0	1	1
Vertebra Fracture	3	5	8
Total	18	72	90

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 on 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	19	3	3	2	27
Left Rear	3	0	1	0	4
Pelvis	4	0	0	0	4
Right Front	22	8	5	0	35
Right Rear	2	0	1	0	3
Skull	0	0	0	5	5
Vertebra	7	0	0	1	8
Various Structures**	1	0	9	3	13
Total	58	11	19	11	99

*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 five colitis cases were non-steroidal anti-inflammatory drugs, which is considered among the most common causes of colitis of horses in California and elsewhere.

Displacements included small intestinal torsion, strangulation, volvulus and entrapment, which are listed as some of the most common intestinal displacements in horses.

Diagnosis	Total
Colitis	5
Typhilitis	1
Enteritis	1
Gastric Rupture	2
Intestinal Displacement	4
Total	13

INJURIES • continued

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:

Wobbler syndrome (compressive myelopathy) was the only case of neurological disease diagnosed during this period.

Diagnosis	Total
Wobbler Syndrome	1

Respiratory:

Three cases of respiratory disease occurred during this fiscal year, all of which consisted of pleuropneumonia. The etiology of these three cases was bacterial, with two being of mixed bacterial etiology and the third caused by *Escherichia coli*.

Diagnosis	Total
Pleuropneumonia	3

Whole Body:

The number of unexplained sudden deaths in horses continues to be significant (7 cases reported in 2017–2018; 11 cases reported in 2018–2019). The septicemia cases were produced by *Actinobacillus equuli* (1 case), *Streptococcus zooepidemicus* (1 case) and mixed bacteria (2 cases). The cause of hemoabdomen was associated with trauma.

Diagnosis	Total
Hemoabdomen	1
Septicemia	4
Unexplained sudden death	11
Undetermined	2
Total	18

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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	Tanya Garcia	Matt Sheley
	Lucy Gomez	Susan Stover
	Viviana Gonzalez	Jennifer Symons
	Dave Hawkins	Shrini Upadhyaya
	Ashley Hill	Francisco Uzal
Linda Huong	Leslie Woods	

During this period, Dr. Monika 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 systems of racehorses, and to improve consistency and case documentation for the CHRB necropsy program. The program continues to be a success, and it has brought significant improvement in the consistency of case description, case documentation, and turnaround time of the reports.

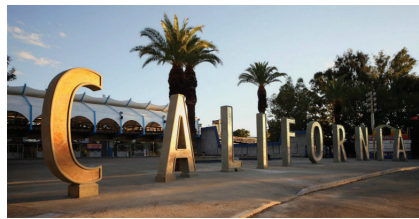
OUTREACH AND PRESENTATIONS TO SCIENTIFIC MEETINGS

- Wet lab on musculoskeletal injuries of racehorses for regulatory veterinarians. Santa Anita Race Park. March 2020
- Pre-existing conditions and lessons learned from the UC Davis Necropsy Program. Lecture and wet lab. S. Stover, M. Samol, F. Uzal. Regulatory Veterinary Continuing Education, Santa Anita Park, March 2, 2020
- Characteristics of complete tibial fractures in California racehorses. M. Samol, S. Stover, A. Hill, R. Arthur, F. Uzal. ACVP Annual Meeting, San Antonio, November 2019
- Characteristics of complete tibial fractures in California racehorses. M. Samol, S. Stover, A. Hill, R. Arthur, F. Uzal. AAVLD Annual Meeting, Providence, RI, September 2019
- Sudden death caused by fetlock breakdown in Thoroughbred racehorses. M. Samol, S. Stover, P. Blanchard, R. Arthur, F. Uzal. AAVLD Annual Meeting, Providence, RI, September 2019
- CHRB Fellowship. S. Stover. F. Uzal, M. Samol. Meeting with California racetrack regulatory veterinarians and stewards, CAHFS Davis, University of California, Davis, July 2019
- Injuries – not the cost of doing business. S. Stover. Comparative Orthopedic Research Laboratory, University of Montreal. June 2020
- Lessons learned from the California Postmortem Program, Welfare Safety Summit 2020, Grayson-Jockey Club Research Foundation. S. Stover. June 2020
- Skeletal Injuries in racehorses. Davis-Thompson Foundation Day Seminar. S. Stover. May 2020
- Proximal sesamoid bone fracture: pre-existing lesions and association with exercise. S. Stover. Consensus Conference: Fracture Risk Assessment of the Thoroughbred Fetlock, The Jockey Club, Newmarket, England. March 2020
- Morphological changes in proximal sesamoid bones from racehorses as a model for joint overuse injuries. S. Stover. Poster Presentation. Orthopedics Research Society 2020 Conference, Phoenix, AZ. February 2020
- In vitro motion of the proximal sesamoid bones under physiologic mid-stance loads. S. Stover. Veterinary Orthopedics Research Society 2020 Conference, Sun Valley, ID. February 2020
- Update on racehorse deaths. S. Stover. 42nd Lake Tahoe Equine Conference, Incline Village, NV. January 2020
- Using big data and artificial intelligence to detect pre-clinical lameness: Can it reduce the number of catastrophic injuries? S. Stover. American Association of Equine Practitioners, Denver, CO. December 2019
- Repetitive overuse injuries in racehorses. S. Stover. Equine Surgery Residents, University of California, Davis. November 2019
- Training for injury prevention. S. Stover. Continuing Education for Racehorse Trainers, Santa Anita Racetrack, Arcadia, CA. October 2019
- Consultant on racehorse deaths. S. Stover. Animal Welfare Committee, California Veterinary Medical Association, Sacramento, CA. September 2019
- Skeletal repetitive overuse injuries: etiology, pathogenesis, prevention. S. Stover. British Equine Veterinary Association Congress, Birmingham, England. September 2019
- Training for injury prevention – what we have learned from racehorses. S. Stover. First European High Performance Sports Medicine Symposium Tierklinik Lusche GmbH, Germany. August 2019
- Catastrophic injuries. Videoconference Breeder's Cup Committee, Lexington, KY. July 2019

SCIENTIFIC PUBLICATIONS

- 1–Samol MA, Uzal FA, Hill AE, Arthur RM, Stover SM. Characteristics of complete tibial fractures in California racehorses. *Equine Veterinary Journal*, 2020 doi: 10.1111/evj.13375. Online ahead of print.
- 2–Shaffer, SK., To, C., Garcia, TG., Fyhrie, DP., Uzal, FA., Stover, SM. Subchondral focal osteopenia associated with proximal sesamoid bone fracture in Thoroughbred racehorses. *Equine Veterinary Journal*, 2020; 00:1-12.
- 3–Shaffer, SK., Sachs, S., Garcia, TG., Fyhrie, DP., Stover, SM. In vitro assessment of the motion of equine proximal sesamoid bone relative to the third metacarpal bone under physiologic midstance loads. Accepted for Publication in the *American Journal of Veterinary Research*, October 2020.
- 4–Spriet M, Espinosa P, Cissell DD, Phillips KL, Arino-Estrada G, Katzman SA, Galupo LD, Garcia-Nolen TC, Murphy B, Stover SM. 18F-sodium fluoride positron emission tomography of the racing Thoroughbred fetlock: Validation and comparison with other imaging modalities in nine horses. *Equine Veterinary Journal*, 51(3): 375-383. 2019
- 5–Colgate VA; FRAT Group, Marr CM. Science-in-brief: Risk assessment for reducing injuries of the fetlock bones in Thoroughbred racehorses. *Equine Veterinary Journal*. 2020 Jul;52(4):482-488. doi: 10.1111/evj.13273. PMID: 32525619





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