

POSTMORTEM EXAMINATION PROGRAM

**Conducted for the California Horse Racing Board
January 1, 2004–December 31, 2004**

California Animal Health and Food Safety Laboratory System

J.D. Wheat Veterinary Orthopedic Research Laboratory

School of Veterinary Medicine
University of California, Davis
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Postmortem

Examination

Program

California Animal Health and Food Safety Laboratory System

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POSTMORTEM EXAMINATION PROGRAM

Introduction

Since its inception in February 1990, the Postmortem Examination Program has performed examinations on more than 3,665 horses. Initiated by the California Horse Racing Board (CHRB), the program is a partnership with the California Animal Health and Food Safety Laboratory System (CAHFS). The program was formed 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 or was euthanized on racetracks or at training facilities under the jurisdiction of the CHRB. This visionary partnership has become a national model for the racing industry in an effort to improve the safety and welfare of racehorses.

Pathologists at the Davis, Tulare and San Bernardino laboratories of the CAHFS 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 researchers in the School of Veterinary Medicine (SVM) at the University of California, Davis (UCD). In-depth analyses of these specimens

helps to more precisely determine the causes and risk factors that lead to catastrophic injuries in racehorses, resulting in their death or euthanasia. During the past year, funding for postmortem examinations was provided by the CHRB. Racing associations provided transportation of the horses to the nearest laboratory facility, and additional studies were funded by the UCD Center for Equine Health, and private sources.

Information from these tests and data gathered from the postmortem examinations are analyzed in efforts to elucidate the specific cause of catastrophic injuries. An advisory board, composed of horse owners, trainers, veterinarians, track maintenance workers and CHRB officials, provides insight into injury investigations, as well as sharing program findings and prevention strategies with the horseracing industry. In-depth studies of catastrophic musculoskeletal injuries in Thoroughbred racehorses have prompted studies by the Equine Orthopedics Laboratory Group within the SVM to focus on a variety of fractures and failures of the suspensory apparatus of the front limb.

With a detailed database representing more than 7,750 diagnostic findings, a valuable resource is available to help develop preventive strategies on racehorse injuries. Other states have initiated programs using the CAHFS Postmortem Examination Program as a model.



SUBMISSIONS

During the 2004 calendar year, 269 horses were submitted to CAHFS as part of the CHRB Postmortem Examination Program. The Davis, Tulare and San Bernardino branches of the CAHFS performed the necropsies, with horses being brought directly to the closest CAHFS facility. At the time of submission, the CHRB official at the race track categorized the activity of the horse at the time of injury into one of four types (Table 1). The majority of catastrophic injuries, 51.3 percent, occurred during a race or immediately following a race. A total of 29.4 percent of the fatal injuries occurred during or immediately following a training session. The third most frequent category of fatalities, accounting for 19.3 percent of submissions, included horses in the

non-exercise group. These were horses suffering primarily from colic or infectious diseases. Unlike previous years, no recorded deaths were due to accidents, which are typically fatal injuries due to mishaps that are considered one-of-a-kind events.

The vast majority of submissions (83.6 percent) during 2004 were Thoroughbreds (Table 2). With fewer numbers of the other breeds racing, not enough data exists to allow comparison of injury rates among breeds for any predisposition to any particular type of injury.

The number of horses submitted per month was highly variable, with statistically higher than average submissions in August and December, and significantly lower than average submissions in February and October (see Figure 1 on page 5).

The largest proportion of submissions (52.4 percent) were 3- or 4-year-old racehorses (see Table 3 on page 5). Only 16.0 percent of all racehorses submitted were horses 2-years-old or younger. The number of horses submitted with catastrophic injuries dramatically drops after the fourth year of age (Figure 2 on page 5). We cannot conclude if horses 5 years of age and greater are much less susceptible to the athletic injuries of racing because the numbers of each age group racing and training on facilities controlled by CHRB are not known.



**Table 1.
Activity at Injury**

STATUS AT TIME OF INCIDENT

Accident	0
Non-exercise	52
Racing	138
Training	79
Total	269

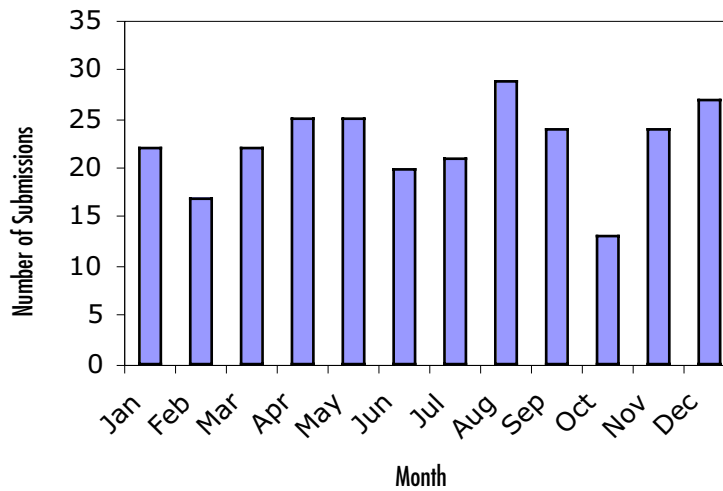
Table 2. Submissions by Breed and Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Arabian	0	0	0	1	0	0	0	0	0	0	0	1	2
Not Reported	0	0	1	0	1	0	1	0	0	0	0	0	3
Paint	0	0	0	0	0	0	0	1	1	0	0	1	3
Quarter Horse	0	1	3	2	2	4	5	3	2	1	3	4	30
Standardbred	0	1	1	0	1	0	1	0	0	0	1	1	6
Thoroughbred	22	15	17	22	21	16	14	25	21	12	20	20	225
Total	22	17	22	25	25	20	21	29	24	13	24	27	269



SUBMISSIONS BY MONTH

Figure 1. Number of Horses Examined by Month



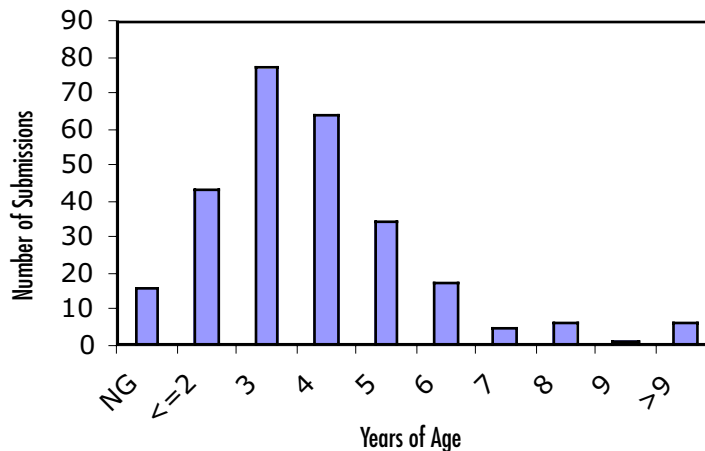
SUBMISSIONS BY BREED AND AGE

Table 3. Submissions by Breed and Age

Age (years)	NG*	≤2	3	4	5	6	7	8	9	>9	Total
Arabian	0	0	0	1	0	1	0	0	0	0	2
Not Reported	1	1	0	0	0	0	0	1	0	0	3
Paint	0	2	0	0	1	0	0	0	0	0	3
Quarter Horse	0	7	11	5	3	2	0	0	0	2	30
Standardbred	0	1	2	1	0	0	0	1	0	1	6
Thoroughbred	15	32	64	57	30	14	5	4	1	3	225
Total	16	43	77	64	34	17	5	6	1	6	269
Percent of Total	5.9%	16.0%	28.6%	23.8%	12.6%	6.3%	1.9%	2.2%	0.4%	2.2%	100%

*(NG=not given)

Figure 2. Number of Horses Examined by Age



INJURIES

As mentioned earlier, 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, 45.0 percent, occurred during racing and training in 3- and 4-year-old racehorses (Table 4). The 2-year-old horses had more fatalities related to training than in either racing or non-exercise, as would be expected for young horses. The 2- and 3-year-old group ac-

counted for 46.1 percent of all fatalities of the non-exercise type.

As was seen in 2003, Thoroughbred horses suffered a substantially larger number of catastrophic injuries while racing when compared to either training or non-exercise (Table 5). Typical of previous years, the Quarter Horses infrequently suffer a catastrophic injury during a training session, and in 2004 no fatalities occurred during training by this breed.



Table 4. Category of Injury by Age

Age (Years)	NG*	<=2	3	4	5	6	7	8	9	>9	Total
Non-exercise	6	9	15	5	6	3	2	3	0	3	52
Racing	2	14	36	43	24	10	3	2	1	3	138
Training	8	20	26	16	4	4	0	1	0	0	79
Total	16	43	77	64	34	17	5	6	1	6	269

*(NG=not given)

Table 5. Category of Injury by Breed

Breed/Injury Class	Accident	Non-exercise	Racing	Training	Total
Arabian	0	1	1	0	2
Not Reported	0	2	1	0	3
Paint	0	2	1	0	0
Quarter Horse	0	7	23	0	30
Standardbred	0	3	2	1	6
Thoroughbred	0	37	110	78	225
Total	0	52	138	79	269



Figure 3
Category of Injury:
All Breeds

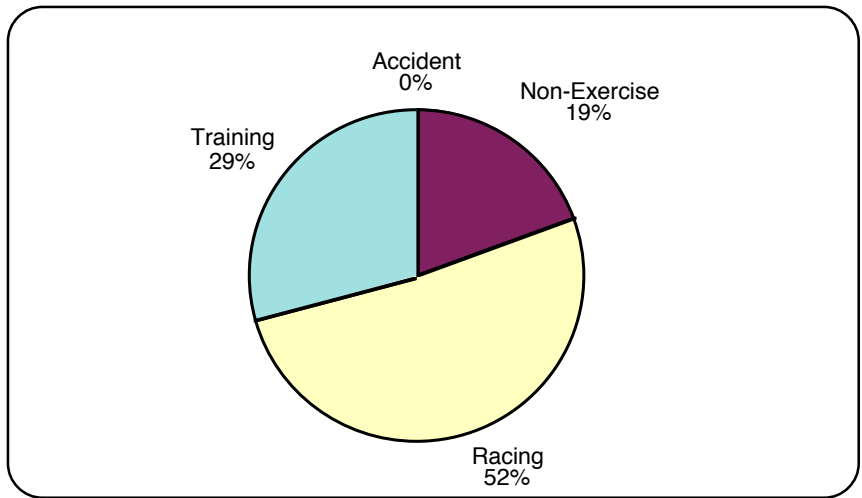


Figure 4
Category of Injury:
Quarter Horses

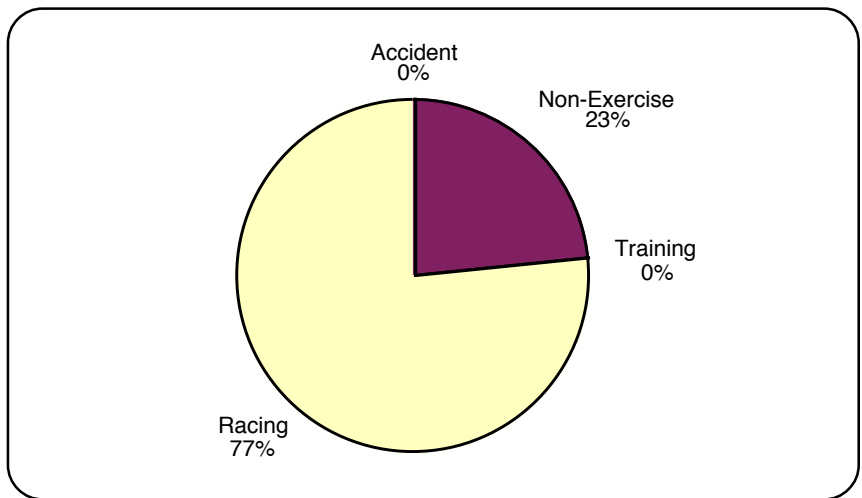
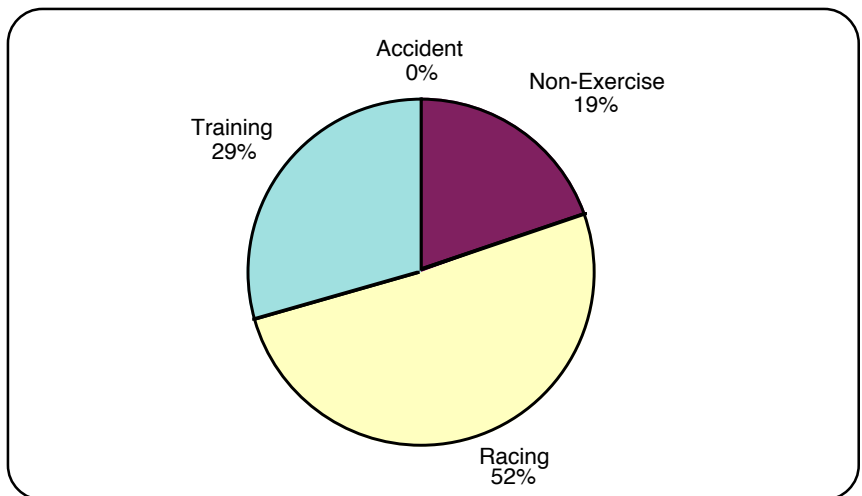


Figure 5
Category of Injury:
Thoroughbreds



ORGAN SYSTEMS AFFECTED IN INJURIES

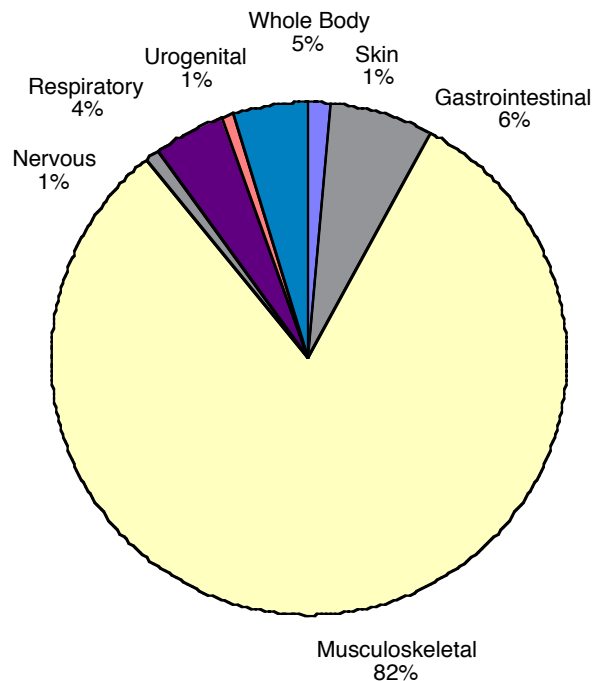
In 2004, approximately 81.4 percent of the fatal injuries were due to musculoskeletal problems, which are most likely to occur during racing or training (Table 6). Of this group, 96.3 percent of injuries involved problems affecting the front or rear legs (Table 7). The injuries listed in this table represent the primary injury to the horse. In many cases, multiple related injuries, such as tendon and ligament ruptures are identified concomitantly. 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 6. Organ Systems Affected

Organ System Affected	GI	Skin	MS	Nerv	Resp	UG	WB	Total
Appaloosa	0	1	0	0	0	0	0	1
Arabian	1	0	1	0	0	0	0	2
Not Reported	2	0	2	0	0	0	0	4
Paint	0	0	1	0	0	0	0	1
Quarter Horse	0	0	27	1	1	0	0	30
Standardbred	1	0	1	0	3	0	1	6
Thoroughbred	13	3	187	1	8	2	11	225
Total	17	4	219	2	12	2	13	269

(GI=gastrointestinal system; Skin=Integumentary system; MS=musculoskeletal; Nerv=nervous system; Resp=respiratory system; UG=Urogenital System; WB=whole body)

**Figure 6
Organ Systems Affected**



MUSCULOSKELETAL INJURIES

Musculoskeletal injuries include those occurring to all muscles, tendons, ligaments and bones. The laminitis or founder cases are listed with the musculoskeletal system rather than the integumentary (skin) system. Several of the horses in Table 7, below, had more than one injury to a part of the musculoskeletal system. In these instances, the injury was categorized according to the damage that most likely occurred first. This premise has been used consistently for every year of the program so the previous year's studies can be compared.

Table 7. Musculoskeletal Injuries by Breed

Injury by Breed	Arabian	Not Reported	Paint	Quarter Horse	Standardbred	Thoroughbred	Total
Fracture, Carpal	0	0	1	10	0	17	28
Fracture, Humerus	0	0	0	0	0	13	13
Fracture, Metacarpal	0	0	0	1	0	39	40
Fracture, Metatarsal	0	0	0	0	0	3	3
Fracture, P1	0	1	0	0	0	5	6
Fracture, Pelvis	0	0	0	0	0	1	1
Fracture, Scapula	0	0	0	1	0	11	12
Fracture, Sesamoid	0	0	0	0	0	25	25
Fracture, Sesamoid-Biaxial	0	0	0	6	0	49	55
Fracture, Skull	0	1	0	0	1	1	3
Fracture, Tarsal	0	0	0	1	0	0	1
Fracture, Tibia	0	0	0	1	0	4	5
Fracture, Ulna	0	0	0	0	0	1	1
Fracture, Vertebrae	1	0	0	2	0	0	3
Joint Luxation	0	0	0	0	0	2	2
Laminitis	0	0	0	1	0	3	4
Ligament Rupture	0	0	0	1	0	3	4
Muscle Laceration	0	0	0	0	0	1	1
Muscle Rupture	0	0	0	1	0	0	1
Suspensory Aparatus Failure	0	0	0	2	0	6	8
Tendon Rupture	0	0	0	0	0	2	2
Tenosynovitis	0	0	0	0	0	1	1
Total	1	2	1	27	1	187	219

The following three tables show musculoskeletal injuries broken down by activities at the time of injury.



INJURIES • continued

Table 7A, 7B, 7C Musculoskeletal Injuries by Breed and Activity

Non-Exercise	Arabian	Not Reported	Paint	Quarter Horse	Standardbred	Thoroughbred	Total
Fracture, Humerus						2	2
Fracture, Sesamoid						1	1
Fracture, Skull		1					1
Fracture, Ulna						1	1
Fracture, Vertebrae				2			2
Laminitis				1		2	3
Muscle Rupture				1			1
Tenosynovitis						1	1
Total		1		4		7	12

Race-Related	Arabian	Not Reported	Paint	Quarter Horse	Standardbred	Thoroughbred	Total
Fracture, Carpal			1	10		16	27
Fracture, Metacarpal				1		22	23
Fracture, Metatarsal						2	2
Fracture, P1		1				2	3
Fracture, Pelvis						1	1
Fracture, Scapula				1		3	4
Fracture, Sesamoid						17	17
Fracture, Sesamoid—Biaxial				6		31	37
Fracture, Tarsal				1			1
Fracture, Tibia				1		1	2
Fracture, Vertebrae	1						1
Joint Luxation						1	1
Laminitis						1	1
Ligament Rupture				1		3	4
Suspensory Apparatus Failure				2		5	7
Tendon Rupture						1	1
Total	1	1	1	23		106	132

Training-Related	Arabian	Not Reported	Paint	Quarter Horse	Standardbred	Thoroughbred	Total
Fracture, Carpal						1	1
Fracture, Humerus						11	11
Fracture, Metacarpal						17	17
Fracture, Metatarsal						1	1
Fracture, P1						3	3
Fracture, Scapula						8	8
Fracture, Sesamoid						7	7
Fracture, Sesamoid—Biaxial						18	18
Fracture, Skull					1	1	2
Fracture, Tibia						3	3
Joint Luxation						1	1
Muscle Laceration						1	1
Suspensory Apparatus Failure						1	1
Tendon Rupture						1	1
Total					1	74	75



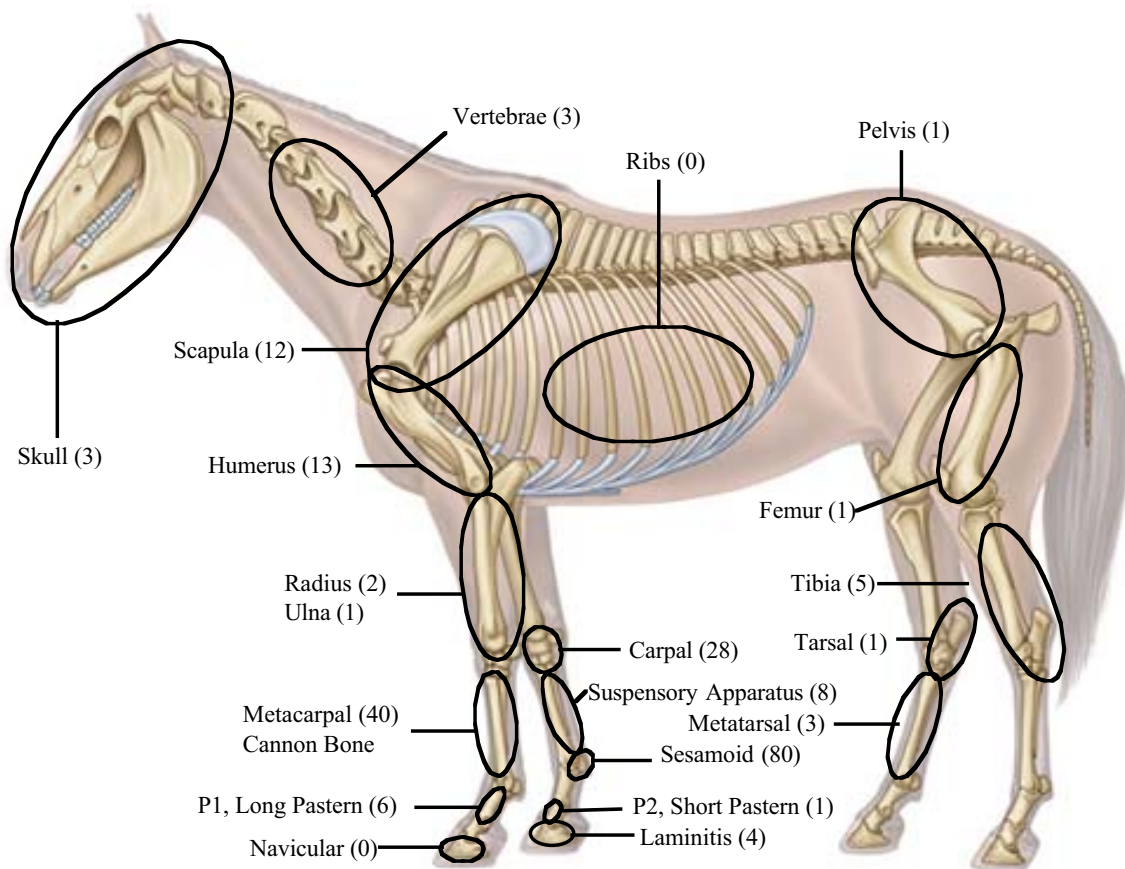
INJURIES • continued

Table 8 compares limb-specific catastrophic injuries. Interestingly, considerably more left front injuries were sustained during racing while the converse was true for injuries sustained during training. Although the numbers were small, no differences occurred between right rear leg injuries and left rear injuries.

Table 8. Injury by Primary Limb Affected

Limb Affected	Non-exercise	Racing	Training	Total
Bilateral	2	3	1	6
Left Front	4	65	25	94
Left Rear	1	5	4	10
Right Front	2	51	39	92
Right Rear	0	6	3	9
Total	9	130	72	211

**Figure 7
Musculoskeletal Injuries**



ORGAN SYSTEMS AFFECTED BY INJURIES

Integumentary (Skin):

It is unusual for diseases of the skin to result in the death or euthanasia of an animal; however, in the cases listed above, three were due to bacterial cellulitis, a wound infection that spreads along tissue planes and causes tremendous inflammation of the skin and subcutaneous tissues. Release of bacterial toxins may result in sloughing of the skin or a serious systemic illness leading to shock and death. Pemphigus foliaceus is a chronic autoimmune disease of the skin with no known cure.

Bacterial Cellulitis	3
Pemphigus Foliaceus	1

Gastrointestinal

Of the digestive system diagnoses, severe enteritis and colitis (inflammation of the intestinal tract) were most frequent. There were similar numbers of intestinal strangulation (due to a variety of non-infectious causes) and gastrointestinal rupture to those seen in 2003. The single case of esophagitis had an undetermined cause.

Enteritis/Colitis	8
Esophagitis	1
Gastrointestinal Rupture ...	4
Intestinal Strangulation/ Obstruction	4

Respiratory:

Several cases of pneumonia, often with a severe pleuritis occurred in 2004. The pattern returned to that seen prior to 2003, where *Streptococcus zooepidemicus* was the primary cause (4/8 cases). A mixture of bacterial species was responsible for the remaining cases. The horses dying from pulmonary hemorrhage were severe “bleeders” and one case of pulmonary edema was apparently due to anaphylaxis, while the other case was undetermined.

Pneumonia	8
Pulmonary hemorrhage	2
Other	2

Urogenital System:

One case of renal disease seen this year was of a chronic nature, with the underlying cause undetermined. The second case was due to a number of related causes, both from disease and treatment. A systemic bacterial infection resulted in shock and anti-inflammatory drug treatment resulted in additional damage to the kidney leading to kidney failure.

Nephropathy	2
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Central Nervous System:

Only two horses with neurological disorders were identified in 2004. These included one case of cerebral hemorrhage due to trauma to the skull and one case of encephalitis in which Herpesvirus was identified.

Cerebral hemorrhage	1
Herpesvirus encephalitis....	1

Whole body:

In only one case of the sudden deaths seen in 2004 could the cause of death be determined. In that case, extensive bleeding into the abdominal cavity was seen, although the source of the bleeding was not found. Two horses died from disseminated hemorrhage in the head region, although the cause could not be determined. A single horse died from an anaphylactic reaction to an injected product. Of the remaining two horses, one died from blood loss as a consequence of parasitic infection of a blood vessel resulting in its rupture, while the other horse had a systemic infection of unknown cause.

Sudden/unexplained death ...	8
Disseminated hemorrhage	2
Other	2
Anaphylaxis	1



MILESTONES

Publications

- 2004 Eddy, A.L., Galuppo, L.D., Stover, S.M., Taylor, K.T., Jensen, D.G. A biomechanical comparison of headless tapered variable pitch compression and AO cortical bone screws for fixation of a simulated midbody transverse fracture of the proximal sesamoid bone in horses. *Veterinary Surgery*, 33:253-262.
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- 2004 Gross, D.K., Stover, S.M., Hill, A.E., Gardner, I.A. Evaluation of forelimb horseshoe characteristics of Thoroughbreds racing on dirt surfaces. *American Journal of Veterinary Research*, 65:1021-1030.
- 2004 Hill, A.E., Gardner, I.A., Carpenter, T.E., Stover, S.M. Effects of injury to the suspensory apparatus, exercise, and horseshoe characteristics on the risk of lateral condylar fracture and suspensory apparatus failure in forelimbs of Thoroughbred racehorses. *American Journal of Veterinary Research*, 65:1508-1517.
- 2004 Gross, D.K., Stover, S.M., Hill, A.E., Gardner, I.A. Observer variation in visual assessment of forelimb horseshoe characteristics on Thoroughbred racehorses. *American Journal of Veterinary Research*, 65:1674-1679.

(Publications Continue on page 13)



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