United States Department of Agriculture

Animal and Plant Health Inspection Service

Veterinary Services

National Animal Health Monitoring System

October 2017

Report 3

Table of Contents

Equine 2015

Equine Management and Select Equine Health Conditions in the United States, 2015

USDA–APHIS–VS–CEAH–NAHMS
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526–8117
970.494.7000
http://www.aphis.usda.gov/nahms

#722.1017

Cover photograph courtesy of Josie Traub-Dargatz and David Dargatz.

Items of Note

Vaccinations

Just over three-fourths of operations (75.8 percent) vaccinated one or more equids in the 12 months before administration of the study's phase II questionnaire. This percentage is higher than reported in phase I of the study (66.7 percent), likely due to the fact that the operations that participated in phase II were a subset of operations that participated in phase I that were more likely to vaccinate their equids.

On operations that vaccinated resident equids, 48.3 percent had a veterinarian administer vaccines. Operation personnel, including the owner, administered vaccines on 38.1 percent of operations, and both veterinarian and/or operation personnel administered vaccinations on 13.6 percent.

The majority of operations vaccinated equids with the core vaccines, e.g., tetanus (70.7 percent of operations), Eastern/Western encephalitis (67.6 percent), and West Nile virus (56.3 percent). Only 40.4 percent of operations vaccinated one or more resident equids against rabies in the previous 12 months, even though this vaccine is considered a core vaccine, and rabid equids pose a public health risk.

Influenza and equine herpesvirus vaccines are considered risk-based vaccines by the American Association of Equine Practitioners (AAEP). Over half of operations provided these vaccines to at least one resident equid. Just over 13 percent of operations (13.5 percent) vaccinated one or more resident equids against strangles.

Parasites

Deworming was a common management practice. Over 93 percent of all operations dewormed any resident equids in the previous 12 months. The percentage of operations that dewormed resident equids ranged from 85.9 percent in the West region to 100.0 percent in the Northeast region.

Overall, 58.8 percent of operations dewormed foals (equids less than 6 months old). The AAEP recommends deworming foals twice in the first 6 months of age.

For operations that dewormed equids, over 70 percent used a deworming program that called for rotating the deworming product used. Daily administration of a dewormer was used on less than 4 percent of operations. The percentage of operations that tested manure for parasite eggs and then based their deworming practices on the test results ranged from 8.2 percent of operations with foals and 7.9 percent of operations with broodmares to less than 2 percent of operations with equids 6 months to 3 years old. The use of fecal testing to determine which equids require more frequent deworming and the effectiveness of the dewormer used is the current recommendation by the AAEP, yet the majority of equine operations are not using this parasite control practice.

For operations that dewormed, the most commonly used deworming products were ivermectin (78.7 percent of operations) and ivermectin combined with praziquantel (45.6 percent). Operations might have used more than one product.

On 12.0 percent of operations, a veterinarian recommended fecal egg testing before deworming, and on 12.9 percent of operations a veterinarian recommended both pre- and postdeworming fecal egg testing. The majority of operations (72.9 percent) reported that their veterinarian had never recommended fecal egg testing. Overall, one-fourth of operations (25.3 percent) had a fecal egg count performed on resident equids in the previous 5 years. Over one-half of boarding/training/riding stables (58.5 percent) had fecal egg counts performed.

Overall, 4.2 percent of operations had ever had their equids examined for antiparasitic drug resistance using a fecal egg count reduction test or egg reappearance period testing. Only a very low percentage of operations (0.3 percent) had a documented case of drug resistant equine internal parasites. For operations that had a documented case of drug resistant equine internal parasites, the resistance was detected to ivermectin, 5-day fenbendazole regimen, or pyrantel pamoate. Overall, 41.4 percent of operations changed their equine deworming plan due to concern about drug-resistant parasites.

Ticks

Overall, 59.1 percent of operations found ticks on resident equids in the previous 5 years. A higher percentage of operations found ticks on resident equids from March through May (40.5 percent) and from June through August (40.4 percent) than from December through February (10.2 percent) and from September through November (27.6 percent).

Over three-fourths of operations (76.8 percent) checked resident equids for ticks in the previous 12 months. Of these operations, 57.7 percent found ticks on resident equids. For operations that found ticks on resident equids, 57.2 percent found them in the crest/mane area, 51.2 percent in the elbow/girth area, 50.8 percent in the tail head or under the tail, and 41.1 percent found them between the hindquarters/thighs.

For operations that checked for and found ticks on resident equids, 22.3 percent identified the type of ticks found. A higher percentage of operations in the Northeast region (57.6 percent) identified the type of tick found on resident equids than operations in the South Central and Southeast regions (7.6 and 7.6 percent, respectively). The highest percentage of operations that identified ticks found on resident equids found deer ticks.

The percentage of operations that treated resident equids with a product to control ticks ranged from 35.6 percent in the Northeast region to 64.3 percent in the South Central region. Overall, 49.3 percent of operations treated resident equids with a product to

control ticks, and 87.3 percent of these operations used a product that had pyrethrin/pyrethroid as one of its active ingredients and 6.5 percent used a natural product such as garlic, vinegar, diatomaceous earth, or a combination of these ingredients to control ticks.

Overall, 2.4 percent of operations had one or more resident equids diagnosed with Lyme disease in the previous 12 months. A higher percentage of operations in the Northeast region had resident equids diagnosed with Lyme disease than operations in the other regions. All respondents that had resident equids with Lyme disease indicated that the disease had been diagnosed through laboratory testing or by examination by a veterinarian.

Lameness

Overall, 67.1 percent of operations had one or more lame equids in the previous 12 months, while 38.7 percent had one or more lame equids on the day the study questionnaire was administered.

Equids less than 2 years old were underrepresented among lame equids, accounting for 7.5 percent of all resident equids but only 0.7 percent of lame equids. Conversely, equids aged 21 years or more were overrepresented among lame equids, accounting for 12.9 percent of all resident equids but 20.0 percent of lame equids. It is no surprise that older equids were more likely to have lameness problems than younger equids, since joint, tendon, and hoof problems are often the result of age. The percentage of lame equids by breed mirrored the breed distribution in the population.

Just under half of resident equids with lameness in the previous 12 months (46.8 percent) fully recovered and remained sound; 21.7 percent improved but still had some lameness; 15.0 percent got worse or showed no improvement; and 12.1 percent improved but lameness recurred. It should be noted that equids that developed lameness just before the study interview were included among the lame equids but may not have had adequate time to resolve their lameness.

Of the 67.1 percent of operations that had any resident equids with a lameness problem, 64.7 percent consulted a veterinarian for either a lameness diagnosis or a consultation about treating lame equids.

Health care expenses

The majority of operations (89.9 percent) provided routine hoof trimming to one or more resident equids in the previous 12 months. Hoof trimming is generally the minimum requirement for hoof care in equids. Some equids that forage on rough ground might wear their hooves down adequately and not require trimming. About half of operations (48.1 percent) provided basic shoes on four hooves for one or more resident equids.

For operations that provided routine hoof trimming to resident equids, 14.2 percent reported no costs associated with hoof trimming in the previous 12 months. On 70.3 percent of operations, the typical per-equid cost of hoof trimming ranged from $1 to less than $300. The frequency with which hoof trimming is needed varies by equid; however, in general, hooves typically require trimming every 6 to 8 weeks.

Over one-fourth of operations that primarily used equids for farm or ranch work (26.9 percent) had no costs associated with hoof care in the previous 12 months. This finding is likely due to the fact that owners/operators of this type of operation performed hoof care themselves and, therefore, did not attribute a cost for hoof care. The majority of operations that primarily used equids for pleasure (58.2 percent) or breeding (66.3 percent) spent $1 to less than $300 per equid for hoof care in the previous 12 months, while the majority of operations that primarily used equids for lessons/school/showing/competition (66.9 percent) spent $300 or more per equid.

For the 75.8 percent of operations that vaccinated any resident equids in the previous 12 months, the overall operation average cost for vaccination per equid was $77.10. The average annual vaccination cost per equid by primary use of equid ranged from $48.30 for operations that used equids primarily for farm or ranch work to $106.50 for operations that used equids primarily for lessons/school/showing/competition.

Overall, 12.2 percent of operations spent no money for veterinary services for resident equids in the previous 12 months. Over half of operations (52.4 percent) spent from $50 to $350 on veterinary services. For operations that had a veterinarian make a farm call to provide services for one or more resident equids, the average typical cost for the call was $62.40. The average typical cost of a veterinary emergency call was $140.30—over twice the cost of a routine farm call.

Controlling insects and ticks is often accomplished through the use of one or more products applied to equids or placed into their environment. Sprays were used by 86.5 percent of operations. Other common products used were fly masks (40.7 percent of operations), hanging insect/fly attractant such as a fly bag or sticky tape (39.7 percent), and spot-on treatments (21.2 percent).

The overall per-equid cost for insect- and/or tick-control products in the previous 12 months was $35.00. The average total per-equid cost decreased as operation size increased.

Nearly all operations (93.2 percent) used dewormers for resident equids in the previous 12 months. Over half of operations (55.5 percent) used vitamins/mineral nutrition supplements for resident equids. One-third or more used vaccines not obtained from a veterinarian (43.4 percent), other drugs (45.6 percent), joint supplements (33.0 percent), or medical supplies (48.7 percent).

The total operation average cost of veterinary supplies per equid in the previous 12 months was $109.40. About one-third of operations (36.6 percent) spent less than $50 per equid, while one-fourth (25.9 percent) spent $150 or more per equid. On an individual operation, some equids might not have generated any associated costs for veterinary supplies, while others might have generated large costs.

Table of Contents

Introduction 1

Terms Used in This Report 4

Section I: Population Estimates 7

A. Vaccination Practices 7

1. General vaccination practices 7
2. Specific vaccinations given 11
3. Herpesvirus vaccination 15
4. Reasons for not giving specific vaccines 18

B. Internal Parasite Control and Management 20

1. General deworming practices 22
2. Fecal testing 31
3. Antiparasitic drug resistance 37

C. Tick Control and Management 46

1. Tick observation 47
2. Tick identification 62
3. Tick habitat 64
4. Treatment for equids with ticks 70
5. Tick and tick-control information sources 74
6. Tick-borne diseases 78

D. Lameness Occurrence and Management 81

1. Lameness occurrence 82
2. Lameness outcome 87
3. Diagnosis and treatment 91
4. Lameness prevention 106

E. Health Care and Health Care Expenses 112

1. Hoof care 112
2. Vaccination costs 120
3. Veterinary services 123
4. Insect and tick control 133
5. Veterinary products 141

Section II: Methodology 147

A. Needs Assessment 147

B. Sampling 147

1. State selection 147
2. Farm selection 147
3. Sampling selection 147
4. Population inferences 148

C. Data Collection 148

1. Phase I 148
2. Data collectors and data collection period for phase II 148

D. Data Analysis and Estimation 149

1. Validation and estimation 149

E. Sample Evaluation 150

1. Phase I response rates 150
2. Phase II response rates 151

References 152

Appendix I: Sample Profile 153

Appendix II: 2012 Census—U.S. Equine Populations 155

Appendix III: 2012 Census—Number of Farms Reporting Equids 156

Appendix IV: Habitat Types 157

Appendix V: Study Objectives and Related Outputs 159

Acknowledgments

The Equine 2015 study was a cooperative effort between two U.S. Department of Agriculture (USDA) Agencies: the National Agricultural Statistics Service (NASS) and the Animal and Plant Health Inspection Service (APHIS).

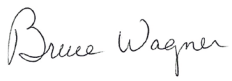
We'd like to thank the NASS enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the equine operations and collected data for the Equine 2015 study. Their hard work and dedication to USDA's National Animal Health Monitoring System (NAHMS) were invaluable.

We'd also like to thank the personnel at the Center for Epidemiology and Animal Heath (CEAH) for their efforts in generating and distributing findings from the Equine 2015 study and the subject-matter experts outside of NAHMS who reviewed various Equine 2015 reports and other products. The roles of the equine owners/operators, NAHMS study coordinators, VMOs, AHTs, and NASS enumerators were critical in providing quality data for Equine 2015 study.

Additional biological sampling and testing for the Equine 2015 study were afforded by the generous contributions of collaborators including,

- USDA–APHIS, National Veterinary Services Laboratories,
- USDA–ARS, Russell Research Center,
- Food and Drug Administration Center for Veterinary Medicine,
- University of Kentucky Gluck Equine Center Parasitology Group, and
- Cornell University Animal Health Diagnostic Laboratory and Research Center.

All participants are to be commended, particularly the equine owners/operators whose voluntary efforts made the Equine 2015 study possible.



Bruce Wagner
Director
Center for Epidemiology and Animal Health

Suggested bibliographic citation for this report:
USDA. 2017. Equine 2015 Report 3: “Equine Management and Select Equine Health Conditions, 2015.” USDA–APHIS–VS–CEAH–NAHMS. Fort Collins, CO
#722.1017

Contacts for further information:
Questions or comments on data analysis: Dr. Lindsey Garber (970) 494–7000
Information on reprints or other reports: Ms. Abby Zehr (970) 494–7000

For questions about this report or additional copies, please contact:
USDA–APHIS–VS–CEAH–NAHMS
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-0817
970–494–7000

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service's Veterinary Services (VS) and was designed to help meet the Nation's animal health information needs. In 1983, promoters of the concept that would become NAHMS envisioned a program that would monitor changes and trends in national animal health and management, thereby providing periodic snapshots of U.S. livestock industries. Three snapshots of the U.S. equine industry were provided via the Equine '98, Equine 2005, and Equine 2015 studies.

Equine '98 was NAHMS first national study on equine baseline health and management. Equine '98 provided participants, industry, and animal health officials with information on the Nation's equine population for education and research. Operations included in phase I of the study were selected from a combined National Agricultural Statistics Service (NASS) area and list data set (multiple-frame estimation) and included operations with one or more equids. For operations to qualify for phase II of the study, they had to have had three or more equids on January 1, 1998.

Equine 2005 was the second NAHMS study of the U.S. equine industry. Like Equine '98, it was designed to provide participants, industry, and animal health officials with information on the Nation's equine population to serve as a basis for education, service, and research related to equine infectious disease control. NASS collaborated with VS to select a representative sample of operations with five or more equids from the 2002 Census of Agriculture.

Equine 2015 was the third NAHMS study of the U.S. equine industry. The study updated baseline health and management information for the equine industry and provides detailed information on vaccine use, parasite control, tick control and tick-borne diseases, prevalence of owner-reported lameness and management of lameness, and the cost of animal health care. In addition, the prevalence of *Salmonella* shedding, tick infestation and identification, and the outcome of biosecurity assessments were reported.

Equine 2015 "Baseline Reference of Equine Health and Management in the United States, 2015" was the first in a series of reports containing information from the Equine 2015 study. This report focuses on health and management practices and contains information collected on equine operations with five or more equids based on the 2012 Census of Agriculture in 28 States.

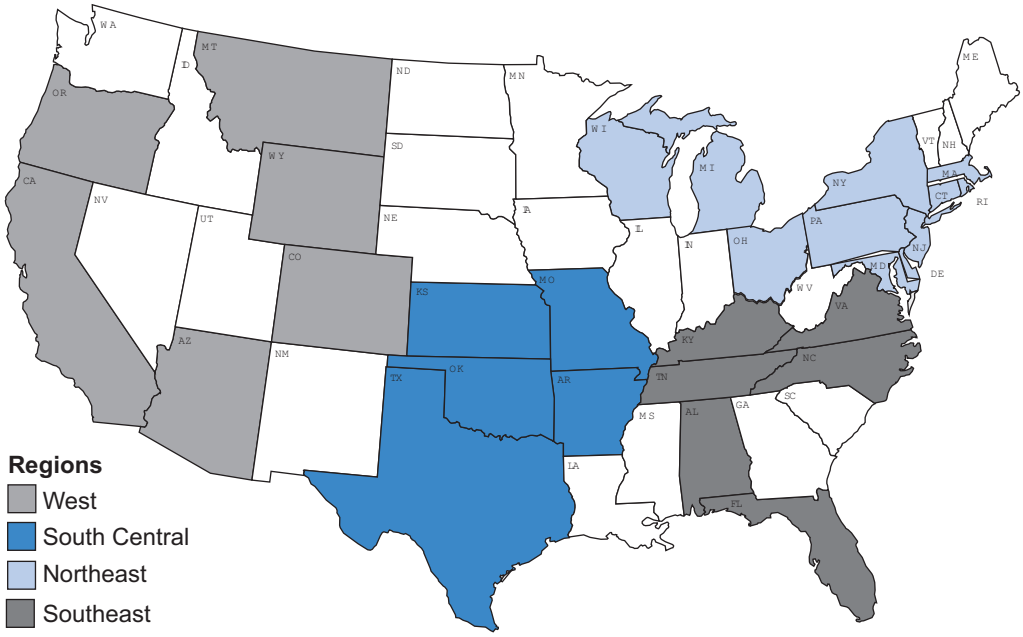
Equine 2015 study objectives

- Describe trends in equine care and health management for study years 1998, 2005, and 2015.
- Estimate the occurrence of owner-reported lameness and describe practices associated with the management of lameness.
- Describe health and management practices associated with important equine infectious diseases.
- Describe animal health related costs of equine ownership.
- Evaluate control practices for gastrointestinal parasites.
- Evaluate equids for the presence of ticks and describe tick-control practices used on equine operations.
- Collect equine sera along with equine demographic information to create a serum bank for future studies.

The Equine 2015 study's "Baseline Reference of Equine Health and Management in the United States, 2015" report (December 2016) and its "Changes in the U.S. Equine Industry, 1998—2015" report (May 2017), met the first objective of the Equine 2015 study.

This report, "Equine Management and Select Equine Health Conditions, 2015," focuses on topics prioritized through the study's needs assessment conducted with industry leaders and the general equine owner/operator population. These topics include information on specific vaccination practices, practices for controlling internal parasites, tick-control and management practices, the occurrence of owner-reported lameness and its management, and the cost of selected equine health-care practices.

Equine 2015 participating States



Terms Used in This Report

Acaracide: Product that kills ticks.

Advanced imaging:

CT scan: A computerized tomography that combines a series of X-ray images taken from different angles and uses computer processing to create cross-sectional images, or slices, of the bones, blood vessels, and soft tissues.

MRI: Magnetic resonance imaging uses a magnetic field and pulses of radio-wave energy to make an image of the structure being examined.

American Association of Equine Practitioners (AAEP): An organization covering a broad range of equine disciplines, breeds, and associations.

Egg reappearance period (ERP): Period from application of deworming product and the first occurrence of parasite eggs in feces.

Equid: Animal of the family *Equidae.* Only domestic horses, miniature horses, ponies, mules, donkeys/burros, and zedonks (zebra-donkey cross) were included in the Equine 2015 study.

Fecal egg count reduction test (FECRT): Testing to determine the efficacy of dewormer by counting the number of parasite eggs in feces before and after deworming.

Habitats: See appendix IV.

Lameness: For this study, lameness was defined as an abnormality in gait such that the equid could be used for its intended purpose or could only be used with intervention (e.g., medication, corrective shoeing, and/or rest).

Operation: Premises with five or more equids.

Phase I: The first phase of each NAHMS equine study. During phase I, NASS enumerators administered the study's baseline questionnaire via an in-person interview.

Phase II: The second phase of the equine study. During phase II, operators who participated in phase I and agreed to participate in phase II completed a second questionnaire administered in-person by veterinary medical officers and/or animal health technicians. Phase II participants were eligible to participate in biologic sampling and other aspects of phase II.

Population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean

95 out of 100 times. An estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). An estimate of 3.4 with a standard error of 0.3 results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported as (0.0). If there were no reports of the event, no standard error was reported (—).

Primary function of operation: The main purpose of the operation, i.e., boarding/training, breeding farm, farm/ranch, residence with equids for personal use, and other.

Primary use of equids: What the majority of equids on the operation were used for, i.e., pleasure, lessons/school/show/competition, breeding, farm or ranch work, and other.

Regions:

Northeast: Connecticut, Delaware, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Wisconsin
Southeast: Alabama, Florida, Kentucky, North Carolina, Tennessee, Virginia
South Central: Arkansas, Kansas, Missouri, Oklahoma, Texas
West: Arizona, California, Colorado, Montana, Oregon, Wyoming

Resident equid: An equid that spent or was expected to spend more time at the operation than at any other operation, whether or not it was present at the time of the study interview.

Size of operation: Size groupings were based on the number of equids present on May 1, 2015. Size of operation was categorized as small (5 to 9 equids), medium (10 to 19), and large (20 or more). Operations that had at least five equids on the NASS list frame but had fewer than five equids at the time the study questionnaire was administered were included in the study and were added to the small size category (5 to 9 equids).

Tick: An obligate ectoparasite of animals and humans. Ticks have eight legs and are more closely related to spiders than to insects.

Vaccinations: The administration of antigenic material (a vaccine) that stimulates the immune system to develop adaptive immunity to a pathogen.

Section I: Population Estimates

Note: Where applicable, column or row totals are shown as 100.0 to aid in interpretation; however, estimates may not sum to 100.0 due to rounding.

A. Vaccination Practices

1. General vaccination practices

Vaccination is one of the best ways to protect equids from vaccine-preventable diseases. Vaccines can prevent or alleviate morbidity from infection. Herd immunity to a pathogen is achieved when a sufficiently large percentage of a population has been vaccinated. The American Association of Equine Practitioners (AAEP) has vaccination guidelines for equids. There is no standardized vaccination protocol, however, that applies to all equids, and the decision to vaccinate equids usually depends on multiple factors, including the following:

- Risk of disease (anticipated exposure, environmental factors, geographic factors, age, breed, use, and sex)
- Consequences of the disease, e.g., disease severity, morbidity, mortality, or zoonotic potential
- Anticipated effectiveness of the selected product(s)
- Potential for adverse reactions to a vaccine(s)
- Balance between the cost of immunization and the potential cost or impact of disease.

Equine owners/operators can purchase most licensed equine vaccine products. However, when vaccines are purchased from or administered by a veterinarian, the veterinarian is able to oversee the handling of the vaccine, ensure that it is appropriately stored, and that specific aspects of vaccine administration are followed, e.g., site of administration, the use of sterile technique, and the selection of vaccine type.

Just over three-fourths of operations (75.8 percent) vaccinated one or more resident equids in the 12 months before the administration of the study's phase II questionnaire. This percentage was higher than the 66.7 percent reported in the first Equine 2015 report, "Baseline Reference of Equine Health and Management in the United States, 2015." This difference is likely due to the fact that the operations that participated in phase II were a subset of operations that participated in phase I and were more likely to vaccinate resident equids. In phase I, the percentage of operations that provided any vaccines to resident equids increased as operation size increased, while in phase II the percentage of operations that vaccinated one or more resident equids did not differ by size. Operations that participated in phase II might have been more similar, irrespective of the number of equids, or the small sample size in phase II made detecting a difference more difficult.

A.1.a. Percentage of operations that vaccinated any resident equids in the previous 12 months, by size of operation:

Percent Operations							
Size of Operation (number of equids)							
Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
76.0	(4.1)	72.9	(5.1)	81.2	(5.3)	75.8	(2.9)

There was no regional difference in the percentage of operations that vaccinated any resident equids in the previous 12 months.

A.1.b. Percentage of operations that vaccinated any resident equids in the previous 12 months, by region:

Percent Operations							
Region							
West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
80.1	(5.6)	77.6	(5.5)	83.7	(4.5)	62.2	(6.6)

A lower percentage of operations with a primary function of farm or ranch (70.3 percent) or residence with equids for personal use (72.7 percent) vaccinated any resident equids in the previous 12 months compared with operations with a primary function of boarding stable/training/riding stable (95.8 percent).

A.1.c. Percentage of operations that vaccinated any resident equids in the previous 12 months, by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
95.8	(2.2)	84.6	(6.9)	70.3	(5.0)	72.7	(5.3)	89.6	(8.2)

Photograph courtesy of Rose Digianantonio.

For operations that vaccinated any resident equids, a veterinarian was responsible for administering vaccines on 48.3 percent of operations, while operation personnel, including the owner, administered vaccines on 38.1 percent. On 13.6 percent of operations, both a veterinarian and operation personnel administered vaccines.

A.1.d. For the 75.8 percent of operations that vaccinated any resident equids in the previous 12 months (table A.1.a), percentage of operations by personnel that administered the vaccines, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Personnel	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Veterinarian	49.9	(5.6)	53.6	(7.4)	30.4	(6.4)	48.3	(4.0)
Operation personnel, including owner	40.0	(5.6)	31.4	(6.9)	41.1	(6.5)	38.1	(4.0)
Both	10.0	(3.1)	15.0	(4.7)	28.5	(6.9)	13.6	(2.4)
Total	100.0		100.0		100.0		100.0	

For operations that vaccinated any resident equids, a higher percentage of operations in the Southeast region (21.8 percent) used both a veterinarian and operation personnel to vaccinate resident equids compared with operations in the West region (5.7 percent).

A.1.e. For the 75.8 percent of operations that vaccinated any resident equids in the previous 12 months (table A.1.a), percentage of operations by personnel that administered vaccines, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Personnel	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Veterinarian	48.5	(8.8)	41.5	(7.6)	53.2	(7.4)	54.0	(7.9)
Operation personnel, including owner	45.8	(8.8)	42.1	(7.8)	36.3	(7.1)	24.2	(6.9)
Both	5.7	(3.1)	16.4	(4.7)	10.5	(4.1)	21.8	(7.0)
Total	100.0		100.0		100.0		100.0	

2. Specific vaccinations given

A wide array of vaccines for inoculating equids against preventable diseases are available in the United States. The need for specific vaccines is based on many factors, including the risk of disease exposure, the consequences of disease, and the efficacy and cost of vaccinations. The AAEP considers core equine vaccines those that protect against tetanus, rabies, Eastern and Western encephalitis, and West Nile virus, all of which can have a fatal outcome in equids. Rabies virus infection is always fatal to equids, and infected equids pose a public health risk. Core vaccines are recommended for all U.S. equids, and these vaccines are considered highly effective and safe.

Risk-based vaccines include those that protect against diseases but pose a risk to some, but not necessarily all, U.S. equids. These include contagious diseases such as influenza, equine herpesvirus, and strangles. These diseases pose a high risk to equids that are exposed to equids outside the home operation. Such exposures can occur when equids travel for breeding purposes or competitions, when new resident equids are introduced to the operation, and when outside equids visit the home operation. Other risk-based vaccines include those used for anthrax and Lyme disease, which can affect horses in certain geographic locations.

How often vaccines are administered varies based on an equid's previous vaccination history, age, and use (e.g., broodmare). The AAEP provides guidelines on the frequency of vaccination specific to foals, broodmares, and previously unvaccinated adult equids.

The majority of operations provided equids with core vaccines, including tetanus (70.7 percent of operations), Eastern/Western encephalitis (67.6 percent), and West Nile virus (56.3 percent). Only 40.4 percent of operations, however, vaccinated one or more resident equids against rabies.

In general, a lower percentage of operations administered core vaccines to foals than to adult equids (broodmares and other equids aged more than 1 year). The age at which to begin vaccinating young equids varies by vaccine type and by the vaccination history of the dam. For foals born to unvaccinated dams, the recommendation is to administer core vaccines at 3 to 4 months of age. Foals born to vaccinated dams should receive core vaccines at 4 to 6 months of age.

Vaccines for influenza and equine herpesvirus are considered risk-based vaccines by the AAEP. Equine influenza is one of the most common diseases affecting the respiratory tract of equids. Clinical signs of influenza include fever, hacking cough, and anorexia. Equine herpesvirus-1 can cause several syndromes, including respiratory disease in juvenile equids, abortion, neonatal death, and severe neurologic disease. Over half of operations administered vaccines for these diseases to at least one resident equid.

Just over 13 percent of operations (13.5 percent) vaccinated one or more resident equids against strangles. Strangles is a contagious bacterial disease of equids caused by *Streptococcus equi* spp. *equi*. Clinical signs include fever, purulent nasal discharge, and abscess formation, primarily in lymph nodes around the head and neck; however, internal abscess can also occur. Vaccinating at-risk equids against *Streptococcus equi* spp. *equi* is one part of a control program for strangles. Biosecurity practices also play a key role in controlling strangles.

A.2. For operations with the following age/type of resident equids, percentage of operations that vaccinated some or all of these equids in the previous 12 months, by disease vaccinated against:

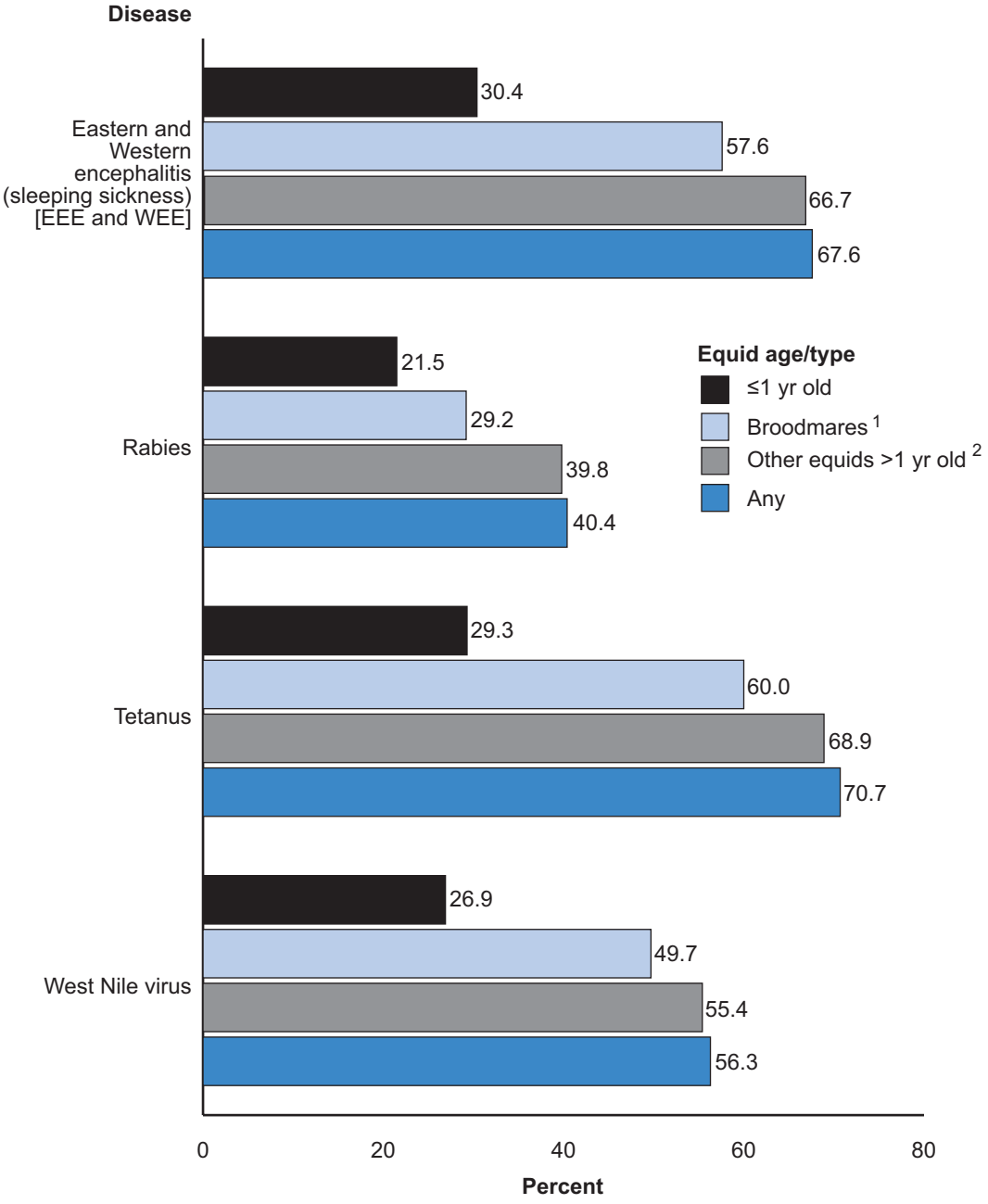
	Percent Operations							
	Equid Age/Type							
	Equids ≤1 yr old		Broodmares[1]		Equids other than broodmares >1 year old		Any equids	
Disease	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Anthrax	0.0	(—)	0.0	(—)	0.2	(0.2)	0.2	(0.2)
Botulism	1.4	(0.7)	1.4	(0.6)	2.0	(0.6)	2.2	(0.6)
Clostridium perfringens (C&D)[2]	0.4	(0.4)	0.3	(0.3)	0.0	(—)	0.1	(0.1)
Eastern and Western encephalitis (sleeping sickness) [EEE and WEE]	30.4	(5.4)	57.6	(5.1)	66.7	(3.2)	67.6	(3.2)
Equine viral arteritis (EVA)	2.5	(1.6)	3.4	(1.5)	3.6	(1.2)	3.9	(1.2)
Flu (influenza)	27.1	(5.3)	48.7	(5.2)	59.3	(3.3)	60.4	(3.3)
Herpesvirus (also called EHV or rhino)	24.5	(5.1)	44.3	(5.2)	51.2	(3.5)	52.9	(3.5)
Leptospirosis	0.0	(—)	1.2	(0.8)	1.2	(0.7)	1.8	(0.8)
Lyme disease[2]	0.0	(—)	0.0	(—)	0.8	(0.4)	0.8	(0.4)
Pigeon fever[3] (infection caused by *Corynebacterium pseudotuberculosis*)	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)
Potomac horse fever (PHF)	2.6	(1.5)	5.5	(2.2)	7.5	(1.6)	8.8	(1.8)
Rabies	21.5	(4.9)	29.2	(4.9)	39.8	(3.3)	40.4	(3.3)
Rhinitis A	1.5	(1.5)	2.2	(1.3)	5.6	(1.7)	6.1	(1.7)
Rotavirus	2.4	(1.5)	1.8	(1.0)	0.8	(0.5)	1.3	(0.6)
Snake venom	0.0	(—)	0.0	(—)	1.0	(0.6)	1.0	(0.6)
Strangles (*Strep. equi*)	9.2	(3.3)	11.3	(3.4)	10.9	(1.9)	13.5	(2.2)
Tetanus	29.3	(5.0)	60.0	(5.0)	68.9	(3.1)	70.7	(3.1)
Venezuelan equine encephalitis (VEE)	12.8	(4.2)	15.6	(3.8)	17.1	(2.6)	17.2	(2.6)
West Nile virus	26.9	(5.2)	49.7	(5.2)	55.4	(3.4)	56.3	(3.4)
Other	0.0	(—)	0.0	(—)	0.4	(0.4)	0.4	(0.4)
Any	34.4	(5.6)	65.0	(4.9)	74.5	(3.0)	75.8	(2.9)

[1]Broodmares by definition are aged more than 1 year.

[2]Vaccine for *Clostridium perfringens* not labeled for use in equids.

[3]Vaccine for pigeon fever no longer available.

For operations with the following age/type of resident equids, percentage of operations that vaccinated all or some these equids in the previous 12 months, by disease vaccinated against



[1]Broodmares by definition are aged 1 or more years.

[2]Equids other than broodmares.

3. Herpesvirus vaccination

A list of 26 equine herpesvirus (EHV) vaccines—including product names, manufacturers, and photos of the vaccines' containers or packages—was used to help respondents identify the EHV vaccine given to resident equids. If equine owners/operators were unable to provide specific EHV product information, they were asked to contact their veterinarian and ask for the information. If an EHV vaccine was not on the list, respondents were asked to specify what vaccine was used. EHV vaccine products were divided into four categories, based on the label claim and product type (table A.3.b).

For the 24.5 percent of operations that vaccinated any equids aged 1 year or less against EHV (table A.2), 58.2 percent vaccinated equids two times or more in the previous 12 months. The AAEP recommends vaccinating foals against EHV three times in the first year of age and at 6-month intervals thereafter.

The AAEP guidelines for nonpregnant mares at breeding facilities calls for vaccinating them before the breeding season and, based on exposure risks, thereafter. The AAEP guidelines for pregnant mares call for vaccinating them multiple times during pregnancy using an inactivated EHV-1 vaccine licensed for controlling abortions. The majority of operations that vaccinated broodmares against EHV (79.2 percent) administered only one dose. Some broodmares might not have been pregnant in the previous 12 months, but an operation might have considered these equids broodmares, since they planned to breed them in the future. In addition, some mares considered broodmares might have been bred but failed to conceive.

Overall, 84.4 percent of operations provided one dose of EHV vaccine to any resident equids over 1 year old—excluding broodmares. In general, AAEP guidelines do not recommend more than two EHV vaccinations a year for nonpregnant mature horses, as clinical respiratory disease occurs infrequently in mature equids. In younger/juvenile equids, immunity to EHV following vaccination appears to be short lived. It is currently recommended that the following equids be revaccinated at 6-month intervals:

- Equids less than 5 years of age
- Equids on breeding farms or in contact with pregnant mares
- Equids housed at facilities with frequent equine movement on and off the premises, increasing the risk of disease exposure.

Vaccinating equids against EHV more frequently than at 6-month intervals might be required in certain situations as a prerequisite for entering a facility. It is appropriate, however, that the majority of operations vaccinated resident equids other than broodmares over 1 year old against EHV via a single dose of vaccine.

A.3.a. For operations that vaccinated the following age/type of resident equids against EHV, percentage of operations by number of times vaccine was given in the previous 12 months:

	Percent Operations					
	Equid Age/Type					
	Equids ≤1 yr old		Broodmares*		Equids other than broodmares >1 year old	
Number times per year	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
1	41.8	(11.9)	79.2	(5.2)	84.4	(2.8)
2	52.8	(12.3)	6.6	(2.8)	13.8	(2.7)
More than 2	5.4	(3.5)	14.2	(4.3)	1.9	(0.7)
Total	100.0		100.0		100.0	

*Broodmares by definition are aged more than 1 year.

The majority of operations that vaccinated resident equids against EHV used a killed product to control respiratory disease in resident foals (69.2 percent of operations), broodmares (69.8 percent), and resident equids other than broodmares over 1 year of age (71.0 percent). The next highest percentage of operations used a killed product labeled for controlling respiratory disease and viral shedding. Only 9.0 percent of operations that vaccinated broodmares against EHV used an EHV vaccine labeled for controlling abortion. Six percent or less of operations that vaccinated resident equids against EHV used a modified live vaccine.

A.3.b. For operations that vaccinated the following age/type of resident equids against EHV, percentage of operations by vaccine type used in the previous 12 months:

	Percent Operations					
	Equid Age/Type					
	Equids ≤1 yr old		Broodmares*		Equids other than broodmares >1 year old	
Vaccine type used	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Killed product for control of respiratory disease	69.2	(12.9)	69.8	(7.4)	71.0	(4.8)
Killed product for control of abortion and respiratory disease	0.0	(—)	9.0	(4.2)	2.0	(1.2)
Killed product for control of respiratory disease and decreased virus shedding	26.5	(13.0)	10.7	(5.3)	17.7	(4.1)
Modified live product	4.2	(3.1)	6.0	(3.7)	3.5	(1.8)
Other	0.0	(—)	0.0	(—)	2.0	(1.7)
Multiple products	0.0	(—)	4.6	(2.3)	3.8	(1.7)
Total	100.0		100.0		100.0	

*Broodmares by definition are aged more than 1 year.

4. Reasons for not giving specific vaccines

AAEP guidelines suggest that all equids receive core vaccines at least once annually. Risk-based vaccines are recommended based on the likelihood of disease exposure and the outcome of a risk-benefit decisionmaking process. Risk-based vaccines listed in the following table include those for influenza, strangles, herpesvirus, and equine viral arteritis.

The majority of operations did not vaccinate against the diseases listed in the following table because they believed their equids had little risk of being exposed to the diseases, despite the fact that AAEP guidelines suggest that all U.S. equids are at risk of exposure to Eastern/Western equine encephalitis, West Nile virus, rabies, and tetanus. In regard to equine viral arteritis, 15.0 percent of operations did not know that a vaccine was available for the disease. Across disease types, equine viral arteritis accounted for the highest percentage of operations unaware of an available vaccine.

Photograph courtesy of Kirsten Tillotson.

A.4. For operations that did not vaccinate resident equids against the following diseases in the previous 12 months, percentage of operations by primary reason for not vaccinating:

	Percent Operations							
	Disease							
	Influenza	Strangles	Herpes-virus	Rabies	West Nile virus	Eastern and Western encepha-litis	Tetanus	Equine viral arteritis
Primary reason	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error
Concern of adverse reaction to vaccine	0.3 (0.3)	4.0 (1.3)	0.3 (0.2)	1.1 (0.9)	3.5 (2.0)	0.4 (0.4)	0.0 (—)	0.1 (0.1)
Vaccine considered ineffective	1.9 (1.1)	2.4 (0.9)	0.6 (0.4)	0.3 (0.3)	2.7 (1.4)	0.6 (0.6)	0.7 (0.6)	0.2 (0.2)
Little risk of disease exposure	58.8 (5.4)	61.9 (3.6)	59.2 (5.0)	61.4 (4.4)	51.5 (5.3)	55.9 (6.0)	55.6 (6.4)	51.4 (3.5)
Not recom-mended by veterinarian	7.1 (3.0)	12.8 (2.6)	7.4 (2.6)	7.4 (2.6)	3.3 (1.9)	3.9 (2.4)	4.1 (1.7)	20.2 (2.8)
Financial constraints on equine expenditure	8.7 (2.4)	4.6 (1.2)	7.2 (1.9)	6.2 (1.6)	9.7 (2.3)	9.9 (2.8)	7.5 (2.3)	3.6 (1.0)
Did not get around to it	14.0 (4.5)	5.8 (2.1)	11.2 (3.8)	12.3 (3.3)	20.9 (5.0)	15.1 (5.1)	19.5 (5.9)	4.7 (1.8)
Unaware vaccine was available	1.1 (0.8)	2.8 (1.3)	6.3 (3.1)	2.9 (1.5)	0.0 (—)	4.4 (2.7)	0.0 (—)	15.0 (2.5)
Other	8.1 (2.8)	5.8 (1.5)	7.9 (2.5)	8.3 (2.5)	8.4 (3.0)	10.0 (3.5)	12.6 (3.9)	4.7 (1.3)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

B. Internal Parasite Control and Management

Note: Estimates in this section include operations that completed only the parasite portion of the study and operations that completed phase II of the study.

All equids are exposed to internal parasites. Even with frequent dewormer treatments, complete prevention of parasitism in equids is likely not feasible. Controlling internal parasites, however, is necessary, as parasites can cause disease in some infected equids, especially when equids have heavy parasite burdens. The AAEP formed a task force to develop comprehensive recommendations for improved strategies and programs to control parasites in equids of all ages and types. There are references to AAEP parasite control guidelines throughout this section of the report.

About 100 parasite species can infect equids. The parasites most commonly included in parasite control programs for equids include roundworms (ascarids), small strongyles, and tapeworms. Roundworms are the main parasitic threat for foals. In foals, roundworms can cause airway inflammation, colic, diarrhea, and failure to thrive. Roundworm infestations gradually become less prevalent at about the time of weaning (4 to 6 months of age), because foals develop immunity to the parasite.

Cyathostomins (small strongyles) can infect any equid with pasture access and can become a problem in equids 6 months of age and older. Clinical signs include colic, weight loss, and diarrhea. Resistance among cyathostomins has been reported in several drug types on the market. Tapeworm infections in equids are more common than roundworm infections in adult equids. Most equids tolerate tapeworms very well, although infection with this parasite can result in colic. Currently, there is no evidence of resistance to the drugs used to treat tapeworms in equids. Equine pinworms cause irritation under the tail and result in tail rubbing; otherwise, they do not cause disease in equids. The larval stage of flies (bots) also affects equids internally. The migrating larvae can irritate gums as well as the stomach, if large numbers of these larvae adhere to the stomach mucosa.

There are several methods for controlling internal parasites in equids, most of which are most effective when used in combination. Parasite control methods include the selective use of deworming drugs; regular, diligent removal of feces from areas where equids graze; avoiding overgrazing and overstocking pastures; rotating pastures used for equine grazing; feeding equids away from fecal-contaminated areas in paddocks or pens or using feeders to avoid feeding on the ground; and isolating new equine additions to the operation while performing fecal testing and deworming, if indicated.

Young equids are at more risk than adult equids of developing clinical signs due to parasites. Deworming schedules should be tailored to each equine operation. Performing fecal testing is indicated to develop a targeted deworming program. Monitoring equids for parasites via fecal testing helps identify equids that require more frequent treatment with

dewormer drugs and helps determine the effectiveness of the drugs used. Overuse of these drugs in equids, such as deworming all equids on an operation frequently or year-round, can accelerate the development of drug resistance in equine parasites.

The AAEP parasite control guidelines indicate that there are three primary goals of any parasite control program:

1. Minimize risk of parasitic disease
2. Control parasitic egg shedding
3. Maintain efficacy of dewormer drugs.

Photograph courtesy of Rose Digianantonio.

1. General deworming practices

Over 93 percent of all operations dewormed any resident equids in the previous 12 months. The percentage of operations that dewormed did not differ by size of operation.

B.1.a. Percentage of operations that dewormed any resident equids at least once during the previous 12 months, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
91.8	(2.5)	97.4	(1.9)	96.1	(2.2)	93.7	(1.7)

The percentage of operations that dewormed resident equids ranged from 85.9 percent in the West region to 100.0 percent in the Northeast region.

B.1.b. Percentage of operations that dewormed resident equids at least once during the previous 12 months, by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
85.9	(5.3)	98.0	(1.5)	100.0	(—)	88.4	(4.9)

The percentage of operations that dewormed resident equids at least once in the previous 12 months ranged from 88.8 percent of operations with a primary function of farm or ranch to 100.00 percent of operations with a primary function of boarding stable/ training/riding stable or equine breeding farm.

B.1.c. Percentage of operations that dewormed resident equids at least once during the previous 12 months, by primary function of operation:

Percent Operations

Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
100.0	(—)	100.0	(—)	88.8	(3.7)	95.5	(2.1)	92.6	(7.4)

For operations that dewormed any equids, the majority dewormed resident equids in the previous 12 months as a **general** preventive measure. This measure was also the **primary** reason for deworming resident equids on 94.0 percent of operations. Rubbing tail represented the next highest percentage of operations (31.8 percent) that dewormed equids as a general preventive measure, followed by equids that were thin or doing poorly (22.1 percent).

B.1.d. For the 93.7 percent of operations that dewormed resident equids at least once in the previous 12 months (table B.1.a), percentage of operations by general and primary reasons for deworming:

	General reason		Primary reason	
Reason	**Percent operations**	**Std. error**	**Percent operations**	**Std. error**
General prevention measure	96.9	(1.4)	94.0	(1.7)
Equids had previous colic problem	4.9	(1.2)	0.4	(0.4)
Worms were seen	11.1	(1.8)	0.2	(0.2)
Equids were thin or doing poorly	22.1	(2.5)	2.2	(1.0)
Rubbing tail	31.8	(3.0)	0.1	(0.1)
Fecal test results indicated a need	10.8	(2.1)	2.9	(1.4)
Other	1.3	(0.5)	0.2	(0.1)
Total	NA		100.0	

Parasitism is often more of a problem for juvenile equids than for mature equids. The current AAEP recommendation for deworming foals is to treat foals with a benzimidazole drug at 2 to 3 months of age and administer a second deworming just before weaning at 4 to 6 months of age. A third and fourth treatment with an anthelmintic drug is recommended by the AAEP for equids at 9 and 12 months of age, respectively. Over 40 percent of operations with foals less than 6 months of age did not deworm them per the AAEP parasite control guidelines.

B.1.e. For operations with the specified age/type of equids, percentage of operations that dewormed these equids in the previous 12 months:

Percent Operations

Age/Type of Equid

<6 mo old		6 mo–1 yr old		Broodmares		Stallions		2–3 yr*		4+ yr*	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
58.8	(7.9)	87.0	(4.5)	91.0	(2.8)	90.4	(4.5)	93.0	(3.0)	92.6	(1.8)

*Equids other than broodmares or stallions.

For the 93.7 percent of operations that dewormed resident equids, over 70 percent used a deworming program that included rotating the deworming product used for all age categories and all types of equids. Historically, rotating deworming products was recommended as a strategy to prevent or counteract dewormer resistance. Current evidence, however, clearly illustrates that this strategy does not prevent resistance. Furthermore, because several drug classes already show resistance, equid owners might not have enough drug choices to make rotation possible. If no fecal testing is done to evaluate treatment efficacy, there is no way to determine if a rotational strategy is successful. Deworming year-round at regular intervals has been recommended for several decades. This protocol was developed in the 1960s to control large strongyle bloodworms, with the goal of killing these worms before they could mature and lay eggs. Since it took about 2 months for strongyle eggs to reappear after treatment, the protocol called for treating equids every 2 months to prevent egg shedding. This approach was successful in controlling large strongyle bloodworms, which are now very rare in equine populations that receive deworming drugs. Decades of frequent deworming, however, has led to resistance in important and common parasites (e.g., cyanthostomins (small strongyles) roundworms, and pinworms). The current AAEP parasite control guidelines do not recommend rotational and frequent deworming of all equids. However, it is clear that many respondents are still using these practices.

The second highest percentage of operations used the same dewormer drug regularly. Using only one highly effective dewormer can result in optimal parasite control; however, without fecal testing to determine its efficacy, there is the risk that the single dewormer used might not be effective or might lose its effectiveness. Less than 4 percent of operations administered a daily dose of dewormer to resident equids. The percentage of operations that performed fecal egg testing and then based their deworming practices on the test results ranged from 8.2 percent of operations with foals and 7.9 percent with broodmares to less than 2 percent with equids 6 months to 3 years old. Using fecal egg testing to determine which equids need frequent deworming and the effectiveness of the dewormer used are the current recommendations by the AAEP; however, the majority of equine operations are not using this recommended parasite control practice.

B.1.f. For operations that dewormed the following age/type of resident equids in the previous 12 months, percentage of operations by deworming program used:

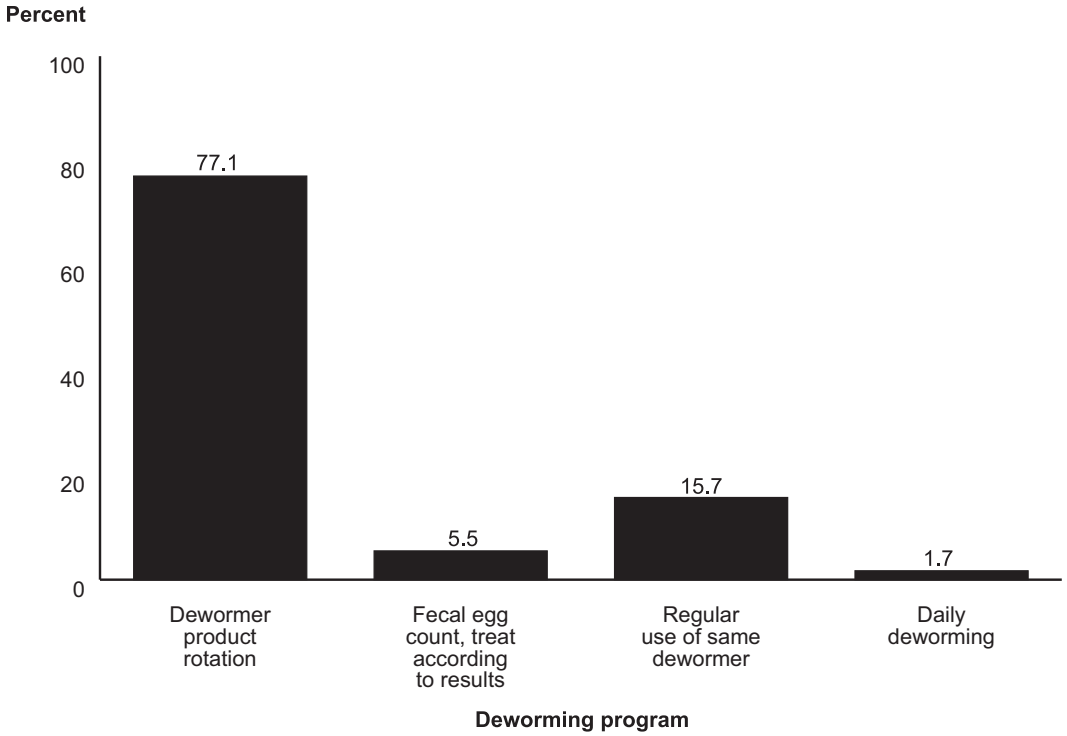
Percent Operations

Age/Type of Equid

	<6 mo old		6 mo–<1 yr		Broodmare		Stallion		2–3 yr old*		4+ yr old*	
Deworming program	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Dewormer product rotation	73.6	(7.9)	78.5	(5.8)	70.0	(5.1)	78.7	(4.9)	76.2	(4.4)	77.1	(2.7)
Fecal egg count, treat according to results	8.2	(6.4)	1.6	(1.1)	7.9	(3.6)	4.1	(3.0)	1.4	(0.7)	5.5	(1.3)
Regular use of same dewormer	14.5	(6.0)	16.7	(5.5)	20.5	(4.4)	15.6	(4.0)	21.0	(4.4)	15.7	(2.4)
Daily deworming	3.7	(1.9)	3.5	(2.2)	1.6	(1.2)	1.6	(1.6)	1.3	(1.1)	1.7	(0.8)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Equids other than broodmares or stallions.

For the operations that dewormed resident equids aged 4 years or more* in the previous 12 months, percentage of operations by deworming program used



*Equids other than broodmares or stallions.

For operations that dewormed resident equids aged 4 years or more (but not on a daily basis), the majority of operations—other than those with broodmares or stallions—dewormed equids two to three times per year, and about one-third of operations dewormed equids from four to six times per year (32.2 percent). The AAEP parasite control guidelines recommend that equids 4 years of age and older be dewormed at least two times per year, with additional deworming treatments provided to equids that are high shedders of strongyle eggs. Fecal testing is required to determine which equids are the high shedders of strongyle eggs.

The majority of operations with equids 6 months to 1 year of age, broodmares, stallions, and equids 2 to 3 years old dewormed these animals two to six times per year. Per the AAEP parasite control guidelines, equids less than 3 years of age require special attention, as they are more susceptible to parasite infection and are at higher risk of disease.

B.1.g. For operations that dewormed the following age/type of resident equids in the previous 12 months (but not on a daily basis), percentage of operations by number of times per year equids were dewormed:

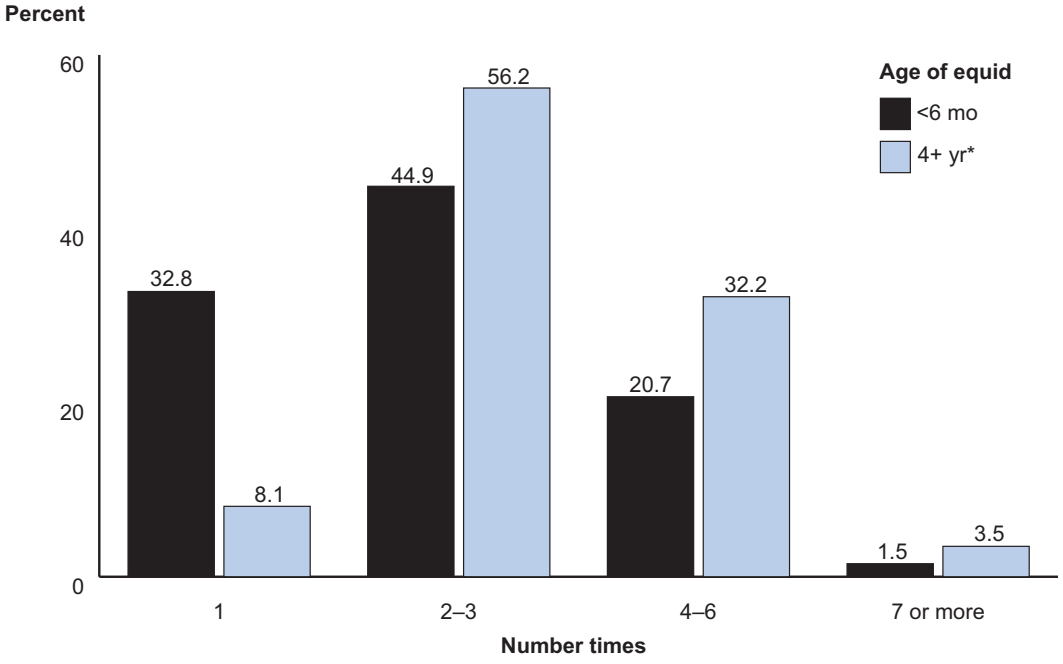
Percent Operations

Age/Type of Equid

	<6 mo old		6 mo–1 yr old		Broodmares		Stallions		2–3 yr old*		4+ yr old*	
Number times per year	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
1	32.8	(8.7)	15.8	(5.4)	16.2	(4.7)	17.4	(5.6)	16.6	(4.4)	8.1	(1.9)
2–3	44.9	(8.6)	39.8	(6.7)	46.9	(5.3)	47.6	(6.6)	45.7	(5.3)	56.2	(3.4)
4–6	20.7	(5.8)	41.6	(7.1)	34.8	(5.0)	33.3	(6.1)	35.3	(5.0)	32.2	(3.1)
7 or more	1.5	(1.5)	2.8	(1.4)	2.1	(1.1)	1.8	(1.1)	2.5	(1.7)	3.5	(1.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Equids other than broodmares or stallions.

For operations that dewormed the following age/type of resident equids in the previous 12 months (but not on a daily basis), percentage of operations by number of times per year equids were dewormed



*Equids other than broodmares or stallions.

Operations might have used more than one dewormer in the previous 12 months. The highest percentage of operations (78.7 percent) used ivermectin, followed by a combination of ivermectin and praziquantel (45.6 percent). Ivermectin targets all major gastrointestinal parasites, with the exception of tapeworms. Praziquantel targets tapeworms. Over one-third of operations (38.7 percent) used fenbendazole, which targets large and small strongyles, pinworms, and roundworms. About one-third of operations (31.0 percent) used pyrantel pamoate, which targets roundworms and large and small strongyles.

B.1.h. For the 93.7 percent of operations that dewormed any resident equids in the previous 12 months (table B.1.a) percentage of operations by product used and, if used, maximum number of times product was administered to any one equid:

	Percent Operations									
			Maximum Number Times Administered							
	Used		1		2—3		4–5		6 or more	
Deworming product	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Ivermectin	78.7	(2.7)	33.4	(3.5)	49.1	(3.8)	13.1	(2.7)	4.4	(1.8)
Ivermectin/ praziquantel	45.6	(3.2)	57.7	(4.5)	38.1	(4.4)	4.3	(2.1)	0.0	(—)
Moxidectin	19.9	(2.8)	66.3	(7.5)	31.9	(7.5)	1.7	(1.3)	0.0	(—)
Moxidectin/ praziquantel	17.9	(2.4)	72.2	(6.8)	21.6	(5.9)	6.1	(4.4)	0.0	(—)
Fenbendazole	38.7	(3.3)	58.7	(5.4)	34.6	(5.1)	6.8	(2.8)	0.0	(—)
5-day fenbendazole regimen	7.9	(1.7)	90.5	(6.0)	9.5	(6.0)	0.0	(—)	0.0	(—)
Oxibendazole	7.6	(1.7)	75.7	(9.4)	18.1	(7.9)	6.2	(6.0)	0.0	(—)
Piperazine	0.1	(0.1)	*		*		*		*	
Pyrantel pamoate	31.0	(3.0)	54.7	(5.6)	43.9	(5.6)	1.2	(1.0)	0.2	(0.2)
Pyrantel tartrate	3.1	(1.0)	*		*		*		*	
Other	1.9	(0.7)	*		*		*		*	

*Too few observations to report.

2. Fecal testing

On 12.0 percent of operations, a veterinarian recommended a fecal test for parasite eggs before deworming resident equids; a similar percentage (12.9 percent) recommended both a pre- and postdeworming fecal test. Interestingly, on the majority of operations (72.9 percent), a veterinarian had never recommended a fecal test. The percentages of operations by fecal test recommended were similar across operation sizes.

B.2.a. Percentage of operations by fecal testing ever recommended by a veterinarian, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Test	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Predeworming only	10.9	(2.6)	15.3	(4.2)	11.5	(3.0)	12.0	(2.0)
Postdeworming only	2.1	(1.3)	3.2	(1.5)	0.0	(—)	2.1	(0.9)
Both	13.9	(3.1)	8.3	(2.3)	16.9	(3.8)	12.9	(2.1)
Neither	73.1	(3.9)	73.2	(4.8)	71.5	(4.8)	72.9	(2.8)
Total	100.0		100.0		100.0		100.0	

The percentages of operations by type of fecal test recommended by a veterinarian were not substantially different by region.

B.2.b. Percentage of operations by fecal test ever recommended by a veterinarian, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Testing	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Predeworming only	7.4	(3.1)	12.7	(4.0)	14.9	(4.5)	12.5	(3.4)
Postdeworming only	4.9	(3.5)	1.2	(0.8)	1.8	(1.4)	1.3	(0.9)
Both	12.3	(3.8)	9.0	(4.1)	17.8	(5.1)	14.6	(3.7)
Neither	75.4	(5.4)	77.2	(5.3)	65.5	(6.0)	71.6	(4.9)
Total	100.0		100.0		100.0		100.0	

About half of boarding/stable/training/riding operations never had a veterinarian recommend fecal testing for parasite eggs compared with about three-fourths of the other operation types. The AAEP parasite guidelines recommend fecal testing for all equine operations.

B.2.c. Percentage of operations by type of fecal testing ever recommended by a veterinarian, and by size of operation:

	Percent Operations									
	Primary Function									
	Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Testing	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Predeworming only	16.5	(4.1)	10.2	(4.2)	10.9	(3.4)	10.3	(2.9)		
Postdeworming only	2.3	(1.7)	0.0	(0.0)	2.4	(1.8)	2.4	(1.3)		
Both	28.6	(5.3)	16.2	(5.8)	11.3	(4.3)	9.5	(2.7)		
Neither	52.7	(6.1)	73.6	(7.1)	75.4	(5.1)	77.8	(3.9)		
Total	100.0		100.0		100.0		100.0			

*Too few observations to report.

Overall, 25.3 percent of operations performed a fecal egg count on feces from resident equids in the previous 5 years. Percentages did not differ by herd size.

B.2.d. Percentage of operations that performed a fecal egg count on feces from resident equids in the previous 5 years, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
23.4	(3.6)	26.8	(5.0)	33.3	(5.4)	25.3	(2.7)

The percentage of operations that had a fecal egg count performed on resident equids did not differ by region.

B.2.e. Percentage of operations that performed a fecal egg count on feces from resident equids in the previous 5 years, by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
24.5	(6.0)	18.1	(5.0)	26.5	(4.6)	35.5	(5.8)

A lower percentage of farm or ranch operations (18.2 percent) and residence with equids for personal use operations (19.4 percent) performed a fecal egg count on resident equids compared with boarding stable/training/riding stable operations (58.5 percent).

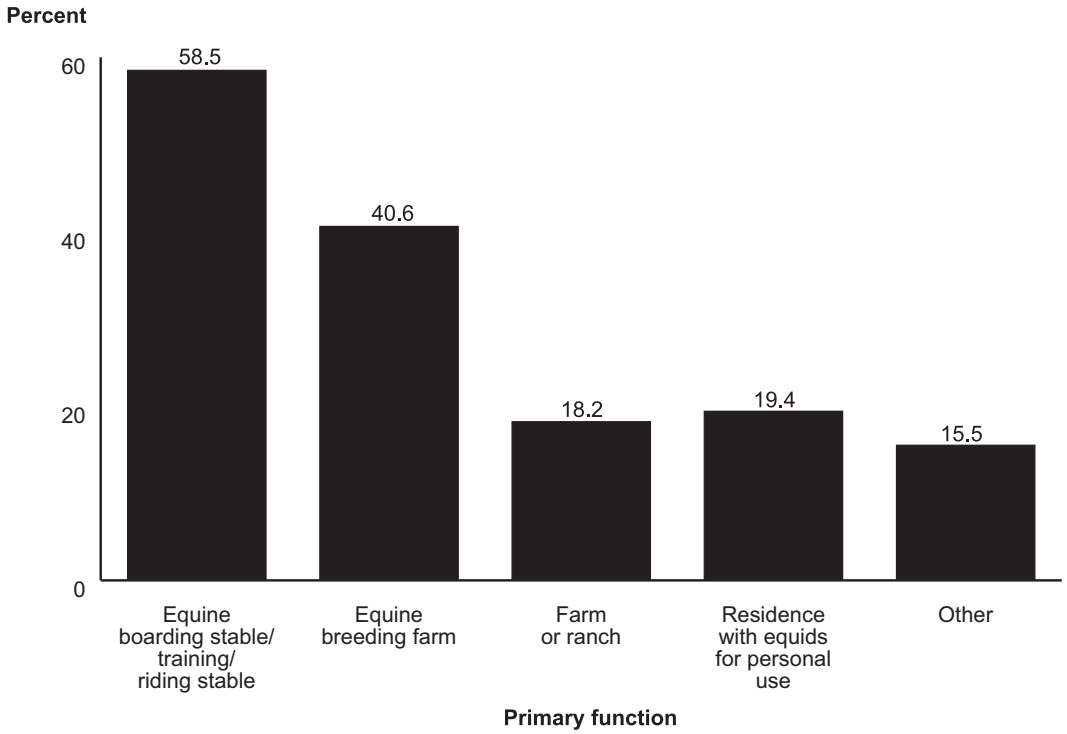
B.2.f. Percentage of operations that performed a fecal egg count on feces from resident equids in the previous 5 years, by primary function of operation:

Percent Operations

Primary Function

Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
58.5	(6.1)	40.6	(9.3)	18.2	(4.5)	19.4	(4.2)	15.5	(11.0)

Percentage of operations that performed a fecal egg count on feces from resident equids in the previous 5 years, by primary function of operation



Over three-fourths of operations with the following age/type of equids had no policy for fecal egg-count testing.

B.2.g. For operations with the following age/type of equids, percentage of operations by current policy for performing fecal egg counts:

	Percent Operations					
	Age/Type of Equid					
	<6 mo old	6 mo–1 yr old	Brood-mares	Stallions	2–3 yr old	4 yr + old
Policy	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error	Pct. Std. error
More often than annually	3.3 (2.9)	1.4 (0.8)	6.1 (3.0)	4.0 (2.7)	1.5 (0.6)	4.2 (1.5)
Annually	1.5 (0.8)	4.5 (2.8)	3.1 (1.6)	4.0 (2.9)	3.7 (2.3)	3.6 (1.0)
Less often than annually	0.0 (—)	2.1 (1.2)	1.5 (0.8)	0.9 (0.7)	2.4 (1.0)	2.2 (0.7)
No specific schedule; based on equid's health condition	5.4 (2.0)	4.7 (1.8)	6.5 (2.0)	7.8 (2.4)	10.7 (3.5)	10.7 (1.8)
Not done	89.8 (3.6)	87.3 (3.6)	82.8 (3.8)	83.3 (4.4)	81.7 (4.2)	79.4 (2.5)
Total	100.0	100.0	100.0	100.0	100.0	100.0

Over half of operations used two types of pasture management that can impact parasite transmission: flat rake and mowing (52.9 percent of operations) and/or rotation of pastures (54.5 percent). Leaving pastures unoccupied for several months might reduce the risk of infection, depending on the time of year. For example, infective strongyle larvae might only survive a few weeks in hot weather but can survive up to 6 to 9 months during colder weather (Nielson et al., 2007). Rotating grazing with ruminants on infected equine pastures might assist in control, as equine strongyle larvae are host specific and do not infect cattle, sheep, goats, or camelids (Eysker et al., 1986). For operations that flat raked and mowed and/or rotated pastures, a veterinarian recommended these practices on 7.0 and 13.7 percent of operations, respectively.

The risk of equids becoming infected with strongyle parasites can be reduced by promptly removing manure from pastures, since these parasites shed their eggs in manure piles. Equids produce 40 to 50 pounds (8 to 14 piles) of manure per day, making manure removal labor intensive. Options for removing manure include scoop shovels and brooms, and commercial vacuums. Vacuuming manure from pastures twice a week controls pasture infectivity more effectively than routine deworming (Herd, 1986).

Overall, 18.8 percent of operations used a combination of two or more dewormers given at the same time to control parasites, and 38.5 percent of these operations did so at the recommendation of a veterinarian.

B.2.h. Percentage of operations by parasite control practice(s) used in the previous 12 months and percentage of these operations for which a veterinarian recommended the practice:

Parasite control practice	Percent all operations	Std. error	Percent veterinarian recommended practice	Std. error
Flat rake and mow	52.9	(3.2)	7.0	(2.5)
Frequent removal of manure from pasture/ grazing area	28.8	(2.9)	15.1	(5.4)
Rotating pastures	54.5	(3.2)	13.7	(3.7)
Combination deworming (using two or more dewormers at once)	18.8	(2.7)	38.5	(8.8)
Other	4.5	(1.3)	14.8	(9.6)

3. Antiparasitic drug resistance

Resistance to antiparasitic drugs (dewormers) occurs when a population of parasites survive a dewormer treatment that was previously effective against the same parasite and stage of infection. Antiparasitic drug resistance has been documented in equine cyathostomins (small strongyles), pinworms, and roundworms (Kaplan and Nielsen, 2010). To reduce drug resistance, the AAEP recommends moving away from the traditional parasite control program—which relies on rotating deworming drugs given at frequent intervals to all equids—and now recommends using fecal testing to determine which equids require more frequent deworming and the effectiveness of the dewormer used.

The majority of owners/operators (93.4 percent) had heard of antiparasitic drug resistance. A higher percentage of owners/operators on medium and large operations than on small operations had heard of antiparasitic drug resistance.

Over half of owners/operators (56.0 percent) were slightly to moderately concerned about internal parasite drug resistance, and 10.5 percent were very concerned. Approximately one-fourth of owners/operators (27.0 percent) were not concerned about this issue. Equine owners/operators might not have been concerned about resistance for several reasons, including that they had not tested for resistance or that they already had and changed their parasite control practices as a result.

B.3.a. Percentage of operations by owner's/operator's level of concern about internal parasite drug resistance in resident equids, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Level of concern	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Never heard of it	9.6	(2.9)	1.3	(0.9)	1.0	(1.0)	6.6	(1.9)
Not concerned	23.8	(3.7)	34.0	(5.9)	29.9	(5.7)	27.0	(2.8)
Slightly concerned	27.0	(3.9)	14.7	(3.4)	30.1	(5.7)	24.5	(2.8)
Moderately concerned	30.3	(3.9)	39.5	(5.9)	22.0	(4.8)	31.5	(2.9)
Very concerned	9.2	(2.5)	10.5	(3.9)	17.0	(5.5)	10.5	(2.0)
Total	100.0		100.0		100.0		100.0	

The percentages of operations by owner's/operator's level of concern about antiparasitic drug resistance did not differ by region.

B.3.b. Percentage of operations by owner's/operator's level of concern about internal parasite drug resistance in resident equids, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Level of concern	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Never heard of it	14.5	(5.5)	5.7	(3.7)	2.3	(1.6)	4.9	(3.1)
Not concerned	24.4	(5.3)	33.0	(5.9)	25.3	(5.1)	22.1	(5.6)
Slightly concerned	24.8	(5.4)	25.4	(5.6)	25.8	(5.6)	21.4	(4.8)
Moderately concerned	32.7	(6.3)	25.6	(5.3)	34.8	(6.0)	35.9	(5.8)
Very concerned	3.6	(2.1)	10.2	(3.9)	11.7	(3.8)	15.8	(4.8)
Total	100.0		100.0		100.0		100.0	

Owners/operators had heard of antiparasitic drug resistance on a higher percentage of equine breeding farms than on farm or ranch or residence with equids for personal use operations.

B.3.c. Percentage of operations by owner's/operator's level of concern about internal parasite drug resistance in resident equids, and by primary function of operation:

Percent Operations

	Primary Function									
	Boarding stable/ training/ riding stable		**Equine breeding farm**		**Farm or ranch**		**Residence with equids for personal use**		**Other***	
Level of concern	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Never heard of it	3.6	(2.7)	0.0	(—)	11.6	(4.1)	4.1	(2.0)		
Not concerned	16.9	(4.3)	29.2	(8.9)	33.1	(5.2)	23.1	(4.6)		
Slightly concerned	30.4	(5.5)	47.1	(9.8)	21.7	(4.8)	20.9	(4.3)		
Moderately concerned	34.1	(5.7)	17.3	(7.3)	26.5	(4.7)	38.0	(5.2)		
Very concerned	15.0	(5.5)	6.5	(3.4)	7.1	(2.6)	14.0	(3.9)		
Total	100.0		100.0		100.0		100.0			

*Too few observations to report.

A fecal egg-count reduction test (FECRT) is used to determine the effectiveness of an antiparasitic drug. During testing, a fecal sample is taken prior to deworming and the number of strongyle eggs per gram (EPG) of feces is determined. Approximately 14 days after deworming, a second fecal sample is collected and the number of strongyle eggs per gram is again determined. The mean reduction for all equids tested is then calculated to determine the percentage reduction for the equine operation.

A formula for calculating the FECRT for an individual equid is:

$$\frac{\text{EPG (pre-treatment) - EPG (post-treatment)}}{\text{EPG (pre-treatment)}} \times 100 = \text{FECRT}$$

The AAEP recommends testing manure from at least six equids with the highest pretreatment fecal egg counts. Finding reduced drug efficacy might or might not indicate the presence of resistance. For example, an inadequate dose of dewormer, equids not consuming the entire dose, or the dewormer was stored in a way that reduced its potency can all lead to a false indication of lack of efficacy of the dewormer. That said, the FECRT is the only method currently available for detecting resistance in parasites in equids. An egg reappearance period (ERP) test is defined as the interval between the last effective antiparasitic treatment and the resumption of significant strongyle egg shedding. The ERP is measured by testing fecal samples weekly until egg reappearance. The ERP is irrelevant if there is evidence of resistance to a particular antiparasitic drug based on the initial FECRT. The shortening of the ERP (eggs appear in feces sooner than expected) is considered a precursor to resistance development, and monitoring the ERP is the most practical way of detecting the emergence of resistance to ivermectin or moxidectin.

Overall, 4.2 percent of operations had ever had resident equids examined for antiparasitic drug resistance using a FECRT or ERP. There was no difference by operation size in the percentage of operations that used a FCERT or ERP. Note: the study questionnaire did not ask which species/type of parasite was being checked for resistance.

B.3.d. Percentage of operations that ever had resident equids examined for drug resistant parasites using a FECRT, ERP, or other test, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
3.6	(1.5)	6.3	(2.3)	3.1	(1.4)	4.2	(1.1)

There was no difference by region in the percentage of operations that used a FCERT or ERP to check for antiprasitic drug resistance.

B.3.e. Percentage of operations that ever had resident equids examined for drug resistant parasites using a FECRT, ERP, or other test, by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
5.9	(3.6)	1.5	(1.0)	3.3	(1.2)	7.4	(3.1)

The percentage of operations that used FCERT or ERP to check for antiprasitic drug resistance did not differ by primary function of operation.

B.3.f. Percentage of operations that ever had resident equids examined for drug resistant parasites using a FECRT, ERP, or other test, by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
7.4	(2.3)	4.8	(2.7)	3.9	(2.2)	3.6	(1.7)		

*Too few observations to report.

Only a very small percentage of operations (0.3 percent) had a documented case of drug resistant internal parasites. For these operations, the resistance detected was to ivermectin, 5-day fenbendazole regimen, or pyrantel pamoate. Note: the study questionnaire did not ask which species/type of parasite was being checked for resistance.

B.3.g. Percentage of operations that ever had a documented case of drug resistant internal parasites in resident equids:

Percent operations	Std. error
0.3	(0.2)

Overall, 41.4 percent of operations changed their equine deworming plan due to concerns about drug resistant parasites.

B.3.h. Percentage of operations that ever changed their deworming plan due to concerns about drug resistant parasites, by size of operation:

Percent Operations							
Size of Operation (number of equids)							
Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
43.2	(4.3)	34.9	(5.7)	44.5	(6.1)	41.4	(3.1)

The percentage of operations that changed their equine deworming plan due to concern about drug resistant parasites did not differ by region.

B.3.i. Percentage of operations that ever changed their deworming plan due to concerns about drug resistant parasites, by region:

Percent Operations							
Region							
West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
36.8	(6.0)	38.0	(6.1)	42.0	(6.1)	49.8	(6.4)

The percentage of operations that changed their equine deworming plan due to concerns about drug resistant parasites did not differ by primary function of operation.

B.3.j. Percentage of operations that ever changed their deworming plan due to concern about drug resistant parasites, by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
57.2	(6.1)	50.5	(9.8)	38.1	(5.4)	37.7	(5.1)		

*Too few observations to report.

C. Tick Control and Management

Ticks are obligate ectoparasites of animals and humans. Ticks have eight legs and are more closely related to spiders than to insects. Ticks transmit a wide variety of infectious diseases, and worldwide ticks are second only to mosquitoes in their public health and veterinary importance.

Tick-transmitted diseases in equids include tularemia, equine piroplasmosis, equine granulocytic anaplasmosis, and Lyme disease. In addition to transmitting diseases, ticks can cause inflammation and secondary infections in equids at the bite site. If ticks infest the ear, they damage the ear canal. Equids with large tick infestations often develop poor body condition and anemia (low red blood cell count). Rarely, ticks can cause whole-body paralysis in equids due to a neurotoxin released by the ticks.

Identifying tick species can help determine disease risk subsequent to the ticks feeding on equids. Examining equids at risk for tick exposure, e.g., equids on pasture or ridden in high-tick habitat areas, allows for prompt and safe removal of ticks. Before riding and while grooming, equine owners should give special attention to areas on the equid to which ticks often attach: under the tail; along the mane; warm, dark, thin-skinned areas (e.g., between the upper thighs or on the udder or sheath); behind the elbows (girth area); and around the throatlatch and ears. Safe removal can be accomplished by hand or by using a tick tool designed specifically to remove attached ticks from equids. Additionally, applying tick-control pesticides to equids before they are exposed to a tick-friendly habitat can reduce tick infestation.

Managing the landscape of a property can also reduce tick densities. Landscape options include removing litter, brush, and weeds; creating a cleared area along each side of equine trails and around pasture perimeters; avoiding equid contact with tick-carrying animals by storing grain in tightly sealed containers; keeping equine pastures at a length that allows for adequate forage but short enough to reduce tick populations; and preventing access to wooded areas.

1. Tick observation

Overall, 59.1 percent of operations found ticks on resident equids in the previous 5 years. There was no difference across herd sizes in the percentage of operations that observed ticks on resident equids.

C.1.a. Percentage of operations on which ticks were ever found on resident equids in the **previous 5 years,** by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
56.9	(4.7)	59.0	(6.2)	71.1	(6.2)	59.1	(3.4)

The type and density of ticks vary based on weather conditions, wildlife presence, and favorable tick habitats. These factors vary geographically.

C.1.b. Percentage of operations on which ticks were ever found on resident equids in the **previous 5 years,** by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
45.5	(7.2)	59.4	(6.6)	60.3	(6.5)	69.2	(6.2)

C.1.c. Percentage of operations on which ticks were ever found on resident equids in the **previous 5 years,** by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
64.5	(6.6)	51.8	(10.5)	60.5	(6.0)	58.1	(5.9)		

*Too few observations to report.

Overall, 49.4 percent of operations found ticks on resident equids in the previous 12 months, and 59.1 percent found ticks in the previous 5 years. The percentage of operations that found ticks on resident equids in the previous 12 months was similar across regions.

C.1.d. Percentage of operations on which ticks were found on resident equids in the **previous 12 months,** by region:

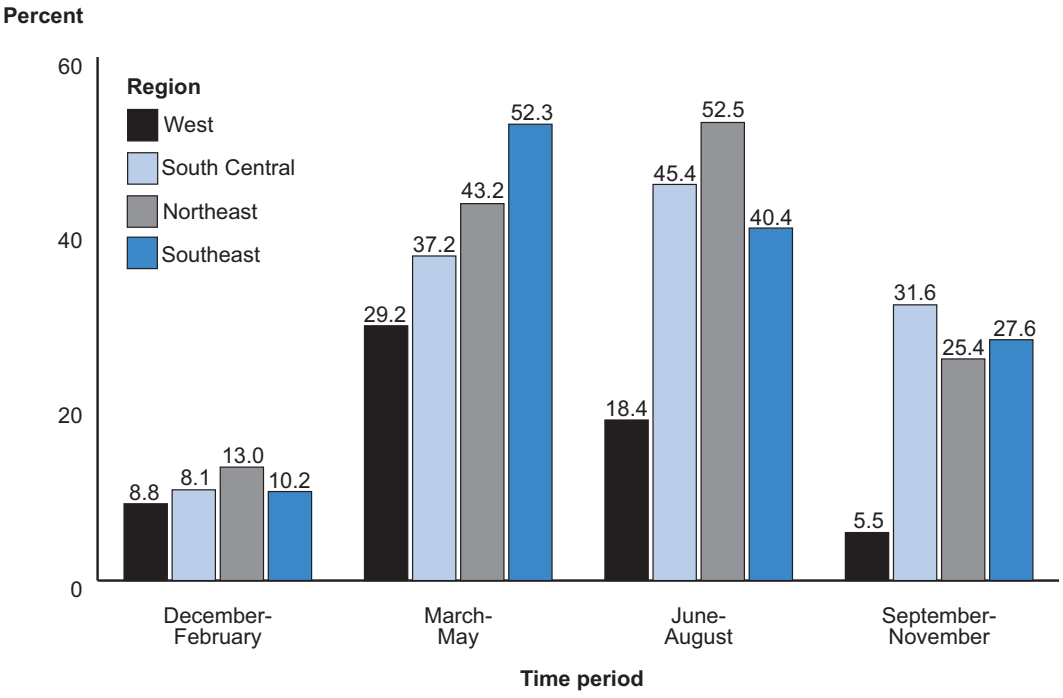
Percent Operations									
Region									
West		South Central		Northeast		Southeast		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
36.2	(6.8)	48.2	(6.3)	52.8	(6.7)	59.2	(6.6)	49.4	(3.4)

A higher percentage of operations found ticks on resident equids from March through May (40.5 percent) and from June through August (40.4 percent) than from December through February (10.2 percent) and from September through November (27.6 percent). A higher percentage of operations in the South Central region (45.4 percent) and Southeast region (52.5 percent) found ticks on resident equids from June through August than operations in the West region (18.4 percent).

C.1.e. Percentage of operations on which ticks were found on resident equids in the **previous 12 months,** by time period and by region:

	Percent Operations									
	Region									
	West		South Central		Northeast		Southeast		All operations	
Time period	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
December–February										
None	91.2	(4.6)	89.6	(3.1)	92.0	(3.5)	87.0	(4.4)	89.8	(1.9)
Less than monthly	3.6	(2.7)	4.3	(2.1)	4.5	(2.6)	7.4	(2.9)	5.0	(1.3)
Monthly	0.0	(—)	4.0	(1.9)	1.9	(1.9)	3.2	(2.6)	2.5	(1.0)
Weekly	4.7	(3.8)	2.1	(1.3)	0.0	(—)	2.3	(2.3)	2.2	(1.1)
Daily	0.5	(0.5)	0.0	(—)	1.6	(1.6)	0.0	(—)	0.4	(0.4)
Total	100.0		100.0		100.0		100.0		100.0	
March–May										
None	70.8	(6.2)	62.8	(5.6)	56.8	(6.8)	47.7	(6.7)	59.5	(3.2)
Less than monthly	8.8	(3.4)	10.3	(3.3)	21.6	(6.5)	21.5	(4.9)	15.1	(2.3)
Monthly	4.6	(3.2)	7.7	(2.8)	4.9	(2.6)	10.5	(4.7)	7.2	(1.7)
Weekly	5.8	(3.0)	11.2	(3.2)	13.7	(4.6)	13.0	(4.5)	11.1	(1.9)
Daily	9.9	(4.5)	8.1	(3.1)	3.0	(1.8)	7.3	(3.5)	7.2	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	
June–August										
None	81.6	(4.8)	54.6	(6.2)	59.9	(6.9)	47.5	(6.6)	59.6	(3.2)
Less than monthly	9.1	(3.9)	8.3	(2.9)	20.4	(6.5)	18.1	(4.7)	13.4	(2.2)
Monthly	0.8	(0.8)	14.2	(4.5)	5.9	(2.9)	15.7	(5.2)	10.1	(2.1)
Weekly	7.3	(2.8)	16.2	(4.2)	9.2	(3.9)	8.3	(3.9)	11.0	(2.0)
Daily	1.2	(0.9)	6.7	(2.5)	4.6	(2.6)	10.5	(4.0)	6.0	(1.4)
Total	100.0		100.0		100.0		100.0		100.0	
September–November										
None	94.5	(2.9)	68.4	(5.7)	74.6	(5.6)	57.3	(6.7)	72.4	(2.9)
Less than monthly	0.8	(0.6)	5.2	(2.4)	6.7	(3.6)	15.3	(4.6)	7.1	(1.6)
Monthly	0.0	(—)	12.2	(4.1)	0.5	(0.4)	13.8	(5.1)	7.6	(1.9)
Weekly	2.1	(1.3)	11.2	(3.5)	16.1	(5.2)	6.3	(3.4)	9.2	(1.8)
Daily	2.6	(2.6)	2.9	(1.7)	2.0	(1.7)	7.3	(3.7)	3.7	(1.2)
Total	100.0		100.0		100.0		100.0		100.0	

Percentage of operations that found ticks on resident equids in the previous 12 months, by time period and by region

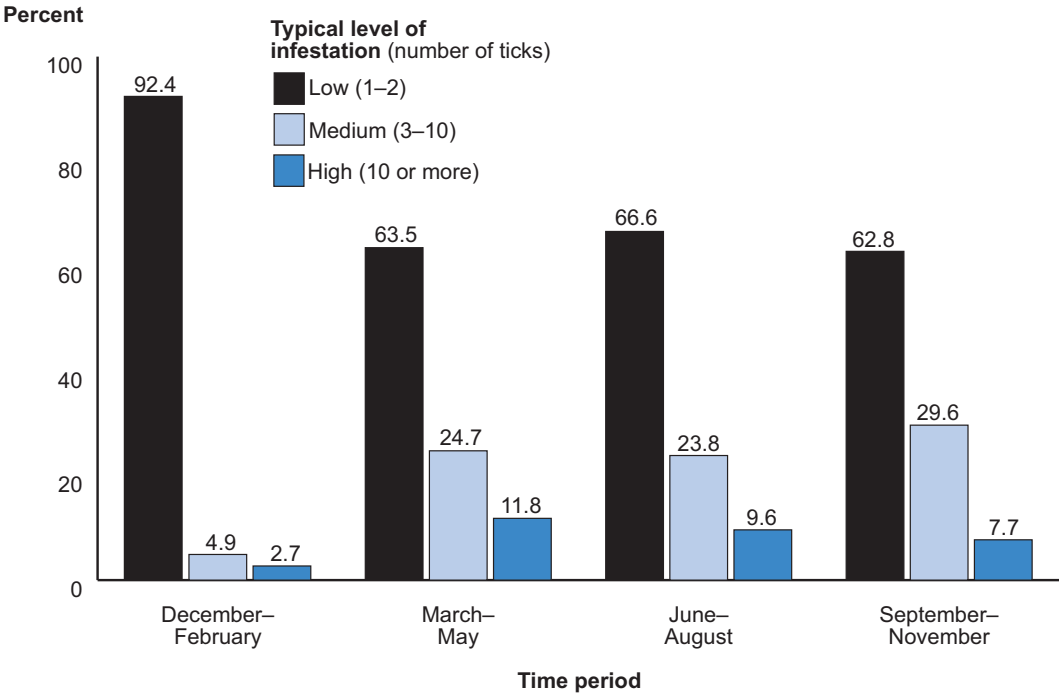


For this study, low-level tick infestation per equid is 1 to 2 ticks, medium level is 3 to 10 ticks, and high level is more than 10 ticks. The level of tick infestation was lowest in December through February.

C.1.f. For operations on which ticks were found on resident equids in the **previous 12 months,** percentage of operations by typical level of tick infestation per equid, and by time period:

	Percent Operations							
	Time Period							
	December–February		March–May		June–August		September–November	
Typical level of infestation (number of ticks)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Low (1–2)	92.4	(3.9)	63.5	(4.9)	66.6	(4.8)	62.8	(6.2)
Medium (3–10)	4.9	(3.5)	24.7	(4.4)	23.8	(4.4)	29.6	(6.0)
High (10 or more)	2.7	(1.6)	11.8	(3.2)	9.6	(2.9)	7.7	(3.3)
Total	100.0		100.0		100.0		100.0	

For operations on which ticks were found on resident equids in the previous 12 months, percentage of operations by typical level of tick infestation per equid, and by time period



About three-fourths of operations (76.8 percent) checked resident equids for ticks. The percentage of operations that checked resident equids for ticks was similar across operation sizes.

C.1.g. Percentage of operations that checked resident equids for ticks, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
77.5	(3.8)	74.0	(5.8)	78.9	(5.2)	76.8	(2.8)

The percentage of operations that checked resident equids for ticks ranged from 50.8 percent in the West region to 87.9 percent in the South Central region.

C.1.h. Percentage of operations that checked resident equids for ticks, by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
50.8	(6.7)	87.9	(4.6)	80.7	(4.9)	80.2	(5.6)

The percentage of operations that checked resident equids for ticks did not differ by primary function of operation.

C.1.i. Percentage of operations that checked resident equids for ticks, by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
83.5	(5.5)	69.3	(9.7)	79.3	(4.6)	72.8	(5.2)	92.2	(5.9)

The percentage of operations that found ticks on resident equids in the previous 5 years was considerably higher for operations that checked resident equids for ticks (71.1 percent) than for operations that did not (18.9 percent).

C.1.j. Percentage of operations that ever found ticks on resident equids in the **previous 5 years,** by whether or not they checked resident equids for ticks:

Percent Operations			
Checked for Ticks			
Yes		No	
Percent	Std. error	Percent	Std. error
71.1	(3.8)	18.9	(5.4)

Of the 76.8 percent of operations that checked resident equids for ticks, 40.7 percent had no specific routine for doing so. Nearly equal percentages of operations checked resident equids daily (17.9 percent) as checked resident equids after a specific activity (16.5 percent), and one-fourth of operations (24.8 percent) checked resident equids several times a week. A higher percentage of small operations (28.5 percent) checked resident equids for ticks several times a week than did large operations (10.3 percent).

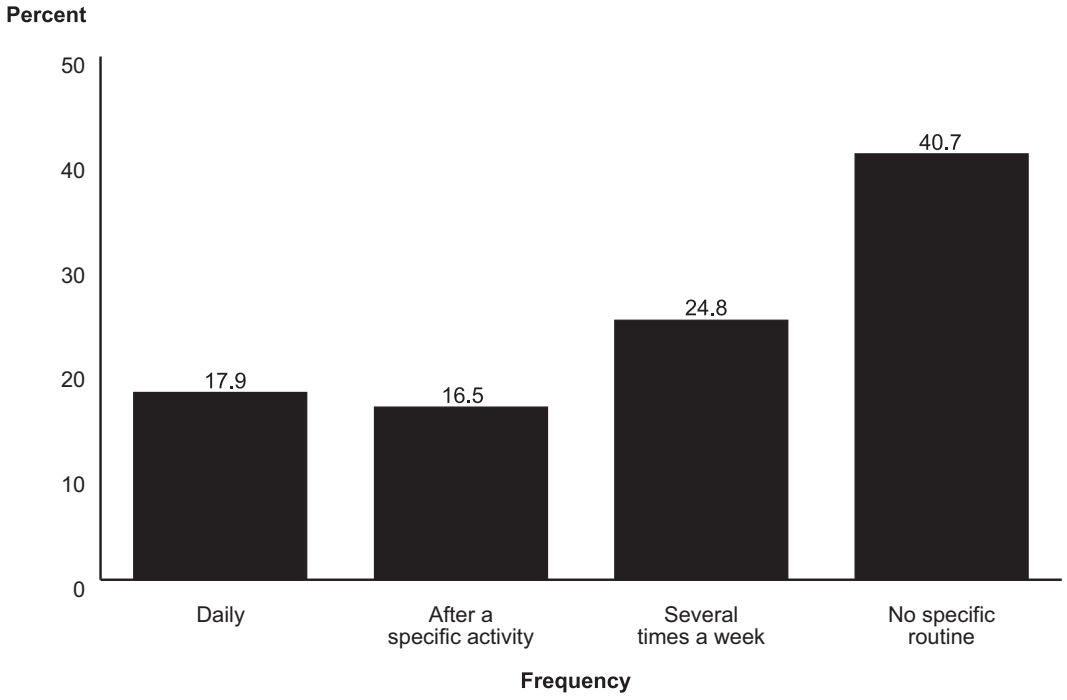
C.1.k. For the 76.8 percent of operations that checked resident equids for ticks (table C.1.g), percentage of operations by frequency equids were checked, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Frequency	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Daily	17.0	(4.2)	20.3	(5.9)	18.2	(5.4)	17.9	(3.1)
After a specific activity	14.4	(3.5)	21.7	(6.0)	17.7	(6.4)	16.5	(2.8)
Several times a week	28.5	(5.1)	22.3	(6.1)	10.3	(3.8)	24.8	(3.6)
No specific routine	40.1	(5.2)	35.7	(6.2)	53.8	(7.4)	40.7	(3.8)
Total	100.0		100.0		100.0		100.0	

For the 76.8 percent of operations that checked resident equids for ticks, percentage of operations by frequency equids were checked



The percentage of operations by frequency that resident equids were checked for ticks did not differ by region.

C.1.l. For the 76.8 percent of operations that checked resident equids for ticks (table C.1.g), percentage of operations by frequency equids were checked, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Frequency	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Daily	8.9	(3.9)	20.1	(6.2)	22.9	(6.1)	15.0	(4.8)
After a specific activity	23.7	(7.7)	10.3	(3.7)	14.9	(5.7)	24.0	(6.6)
Several times a week	16.9	(6.9)	32.4	(7.0)	21.5	(6.7)	20.2	(5.9)
No specific routine	50.5	(9.2)	37.3	(6.5)	40.7	(7.6)	40.7	(7.3)
Total	100.0		100.0		100.0		100.0	

The methods used to check resident equids for ticks were not mutually exclusive. When used in combination, however, these methods are more effective than any one method alone. Of the 76.8 percent of operations that checked resident equids for ticks, 81.1 percent checked them via visual inspection. The percentages of operations that checked resident equids for ticks through routine grooming or through palpation specifically to check for ticks were similar (66.4 and 62.5 percent, respectively).

C.1.m. For the 76.8 percent of operations that checked resident equids for ticks (table C.1.g), percentage of operations by method used to check:

Method	Percent operations	Std. error
Routine grooming	66.4	(3.8)
Visual inspection	81.1	(3.1)
Palpate specifically to detect ticks	62.5	(3.9)
Other	6.9	(1.9)

In total, 48.0 percent of all operations palpated resident equids specifically to detect ticks. Palpating equids for ticks entails running the fingertips over skin surfaces. For operations that palpated resident equids for ticks, 76.1 percent palpated ears, 74.9 percent the crest or mane area, 71.2 percent the elbow/girth/axillary area, and 79.3 percent palpated the tail head and/or under the tail. All listed locations in the following table represent areas where ticks often attach and feed. The nostril area is one of the most difficult locations to check for ticks, as equids are likely to be most resistant to palpation of their nostrils.

C.1.n. For 48.0 percent of operations* that palpated resident equids specifically for ticks, percentage of operations by location palpated:

Location palpated	Percent operations	Std. error
Ears	76.1	(3.9)
Crest/mane	74.9	(4.0)
Jaw line	63.9	(4.6)
Elbow/girth area/axilla	71.2	(4.2)
Sheath or udder	59.3	(4.7)
Between hindquarters/thighs	68.5	(4.2)
Tail head and/or under tail	79.3	(3.7)
Nose/nostril/faux nostril	42.1	(4.8)
Ventrum or belly	63.1	(4.5)
Face	59.0	(4.7)

*76.8 percent from table C.1.g x 62.5 percent from table C.1.m.

Of the 76.8 percent of operations that checked resident equids for ticks, 57.7 percent found ticks on any resident equids in the previous 12 months.

C.1.o. For the 76.8 percent of operations that checked resident equids for ticks in the previous 12 months (table C.1.h), percentage of operations that found ticks on any resident equids, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
55.6	(5.4)	63.8	(6.8)	56.8	(7.2)	57.7	(3.9)

There were no regional differences in the percentage of operations that found ticks on any resident equids.

C.1.p. For the 76.8 percent of operations that checked resident equids for ticks in the previous 12 months (table C.1.h), percentage of operations that found ticks on any resident equids, by region:

Percent Operations

Region

West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
54.4	(9.8)	53.6	(7.0)	60.1	(7.5)	63.6	(7.0)

In total, 44.3 percent of all operations checked for and found ticks on resident equids in the previous 12 months. A higher percentage of operations found ticks in the crest/mane (57.2 percent), elbow/girth area (51.2 percent), tail head or under the tail (50.8 percent), than found ticks in the ears (30.8 percent), belly/ventrum (25.5 percent), face (11.6 percent), or nose/nostril/faux nostril (8.5 percent). Over 10 percent of operations **most commonly** found ticks between the hind legs or on the thighs (17.9 percent), crest/mane (17.6 percent), tail head (12.7 percent), or elbow (12.3 percent). Tick locations might be dependent on how and how often equids are checked.

C.1.q. For the 44.3 percent of operations* that checked for and found ticks on resident equids in the previous 12 months, percentage of operations by location ticks were found and by **most common** location ticks were found:

	Percent Operations			
	Location		Most common location	
Location	**Percent**	**Std. error**	**Percent**	**Std. error**
Ears	30.8	(4.3)	11.7	(3.1)
Crest/mane	57.2	(4.7)	17.6	(3.9)
Jaw line	36.9	(4.7)	7.8	(2.6)
Elbow/girth area/axilla	51.2	(4.8)	12.3	(3.0)
Sheath or udder	34.9	(4.6)	6.0	(2.3)
Between hindquarters/thighs	41.1	(4.6)	17.9	(3.7)
Tail head and under tail	50.8	(4.8)	12.7	(3.1)
Nose/nostril/ faux nostril	8.5	(2.7)	0.1	(0.1)
Ventrum or belly	25.5	(4.2)	4.5	(2.2)
Face	11.6	(2.8)	1.3	(0.8)
Other	18.8	(3.9)	8.0	(2.6)
Total			100.0	

*76.8 percent from table C.1.g x 57.7 percent from table C.1.o.

For operations that checked for and found ticks on resident equids in the previous 12 months, 73.2 percent primarily found ticks after equids had been on pasture. Certain types of pasture contain vegetation that support tick populations.

C.1.r. For the 44.3 percent of operations* that checked for and found ticks on resident equids in the previous 12 months, percentage of operations by primary activity associated with finding ticks:

Primary activity	Percent operations	Std. error
On pasture	73.2	(4.2)
Trail riding	20.0	(3.7)
Cross-country competitions	0.1	(0.1)
Other	6.7	(2.6)
Total	100.0	

*76.8 percent from table C.1.g x 57.7 percent from table C.1.o.

2. Tick identification

Identifying ticks can help determine disease-causing agents that might have been transmitted to an animal or person. A diagnostic laboratory can identify tick species. In addition, submitting ticks to laboratories for identification also contributes to ongoing efforts to monitor changes in tick species in the United States.

For operations that checked for and found ticks on resident equids in the previous 12 months, 22.3 percent identified the tick species found. The percentage of operations that identified ticks did not differ by operation size.

C.2.a. For the 44.3 percent of operations* that checked for and found ticks on resident equids in the previous 12 months, percentage of operations that identified the type of ticks observed, by size of operation:

Percent Operations

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
19.2	(4.7)	28.7	(7.7)	24.4	(7.8)	22.3	(3.7)

*76.8 percent from table C.1.g x 57.7 percent from table C.1.o.

Of operations that checked for and found ticks on resident equids, a higher percentage in the Northeast region (57.6 percent) than in the South Central and Southeast regions (7.6 and 7.6 percent, respectively) identified the type of ticks found. Deer ticks were the most frequently reported tick identified. The percentage of operations that identified the type of ticks found might have been influenced by the operators' awareness of the importance of identifying ticks or by the operators' confidence in their own ability to identify tick types.

C.2.b. For the 44.3 percent of operations* that checked for and found ticks on resident equids in the previous 12 months, percentage of operations that identified the type of ticks found, by region:

Percent Operations							
Region							
West		South Central		Northeast		Southeast	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
27.9	(11.2)	7.6	(3.6)	57.6	(9.5)	7.6	(4.5)

*76.8 percent from table C.1.g x 57.7 percent from table C.1.o.

C.2.c. For the 44.3 percent of operations[1] that checked for and found ticks on resident equids in the previous 12 months, percentage of operations that identified the type of ticks found, by primary function of operation:

Percent Operations									
Primary Function									
Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other[2]	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
33.1	(8.5)	23.5	(10.8)	19.0	(6.2)	20.2	(6.6)		

[1]76.8 percent from table C.1.g x 57.7 percent from table C.1.o.
[2]Too few to observations to estimate.

On the 89.9 percent of operations that identified ticks, the owner identified the type of ticks found on resident equids. The stable manager identified ticks on just 3.9 percent of operations, and a veterinarian identified ticks on only 2.6 percent of operations. It should be noted that if ticks are not in the adult stage, identification can be difficult without special training.

C.2.d. For the 9.9 percent operations* that identified the type of ticks found on resident equids in the previous 12 months, percentage of operations by person who made the identification:

Person	Percent operations	Std. error
Owner	89.9	(4.6)
Stable manager	3.9	(2.3)
Extension agent	0.0	(—)
Veterinarian	2.6	(1.9)
Diagnostic laboratory	3.6	(3.6)
Other	0.0	(—)
Total	100.0	

*76.8 per cent from table C.1.g x 57.7 percent from table C.1.o x 22.3 percent from table C.2.a.

3. Tick habitat

Ideal habitats for ticks vary by type of tick. For example, deer ticks are very sensitive to hot and dry conditions; thus, their ideal habitat is cool, forested areas with thick shrubs present. In contrast, the American dog tick prefers open areas with woody edges or grasses and warmer temperatures. Lone star ticks can tolerate low humidity and hot temperatures and can be found in secondary growth forests with dense underbrush. Ticks have both habitat and host preferences (Sonenshine, 1994).

There are various integrated tick-control methods recommended, including habitat modifications. By clearing shrubs and making habitat more open to sunlight, equine owners can create zones that decrease the likelihood of tick survival. In addition, high grasses and weeds attract rodents and other hosts that can carry ticks, so owners should also remove leaf litter and keep lawns mowed. Habitat modifications and other tick-control methods, such as put-on tick repellants, can be used as part of an integrative approach to control ticks (Sonenshine, 1994).

C.3.a. Percentage of operations by habitat(s) in which resident equids spent any time in the previous 12 months, and by region:

	Percent Operations									
	Region									
	West		South Central		Northeast		Southeast		All operations	
Habitat	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Developed residential or commercial	44.1	(7.3)	24.3	(5.5)	41.2	(6.7)	46.7	(6.4)	37.4	(3.2)
Shrublands	34.3	(6.8)	24.0	(5.7)	33.7	(6.7)	31.1	(6.1)	30.0	(3.2)
Forested	39.2	(7.2)	19.8	(4.9)	50.6	(6.6)	56.1	(6.5)	39.2	(3.3)
Cultivated/ planted woody	18.8	(5.4)	20.4	(5.0)	33.2	(6.4)	40.1	(6.4)	27.5	(3.0)
Grasslands	67.3	(7.0)	67.2	(6.5)	76.7	(5.1)	46.8	(6.5)	64.5	(3.3)
Wetlands	26.6	(6.4)	8.6	(2.8)	23.5	(5.8)	11.7	(3.3)	16.3	(2.3)
Urban/ recreational grasses	14.8	(5.2)	10.2	(4.0)	26.4	(6.3)	19.0	(4.9)	16.8	(2.5)
Water bodies	39.2	(7.5)	35.7	(5.8)	35.6	(6.8)	47.3	(6.6)	39.1	(3.3)

The percentages of operations by predominant habitat in which equids spent time were similar across time periods. The highest percentage of operations used grasslands as the predominant habitat for equids in all four time periods. Less than 2 percent of operations reported wetlands, urban/recreational grasses, or water bodies as the predominant habitat during any time period.

C.3.b. Percentage of operations by **predominant** habitat resident equids spent time in the previous 12 months, and by time period:

	Percent Operations							
	Time Period							
	December–February		March–May		June–August		September–November	
Habitat	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Developed residential or commercial	23.4	(2.7)	18.5	(2.5)	14.8	(2.3)	17.3	(2.5)
Shrublands	11.2	(2.5)	9.7	(2.3)	8.9	(2.2)	8.7	(2.2)
Forested	6.5	(1.7)	8.8	(2.0)	10.4	(2.1)	9.1	(2.0)
Grasslands	42.4	(3.4)	46.3	(3.4)	46.6	(3.4)	46.9	(3.4)
Wetlands	0.2	(0.2)	0.2	(0.2)	0.2	(0.2)	0.2	(0.2)
Cultivated/ planted woody and nonwoody	13.7	(2.3)	13.9	(2.3)	15.7	(2.4)	14.6	(2.3)
Urban/ recreational grasses	1.8	(1.2)	1.8	(1.2)	1.8	(1.2)	1.8	(1.2)
Water bodies	1.0	(0.9)	1.0	(0.9)	1.6	(1.1)	1.6	(1.1)
Total	100.0		100.0		100.0		100.0	

Overall, 78.4 percent of operations modified their landscape by controlling weeds, mowing pasture, or creating vegetation-free zones, and 12.2 percent of these operations modified their landscape specifically to reduce tick populations. The percentage of operations that modified their landscape, and the percentage of these operations that did so specifically to control ticks, did not differ by operation size.

C.3.c. Percentage of operations that modified their landscape in the previous 12 months, and percentage of these operations that did so specifically to control ticks, by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Measure	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Modified landscape	77.6	(4.0)	78.2	(5.5)	83.1	(5.1)	78.4	(2.9)
Modified to reduce tick population	11.8	(3.4)	12.1	(3.9)	14.4	(4.2)	12.2	(2.4)

The percentage of operations that modified their landscape ranged from 65.1 percent in the West region to 88.5 percent in the Southeast region. The percentage of these operations that did so specifically to reduce tick populations ranged from 3.4 percent in the West region to 21.4 percent in the Southeast region.

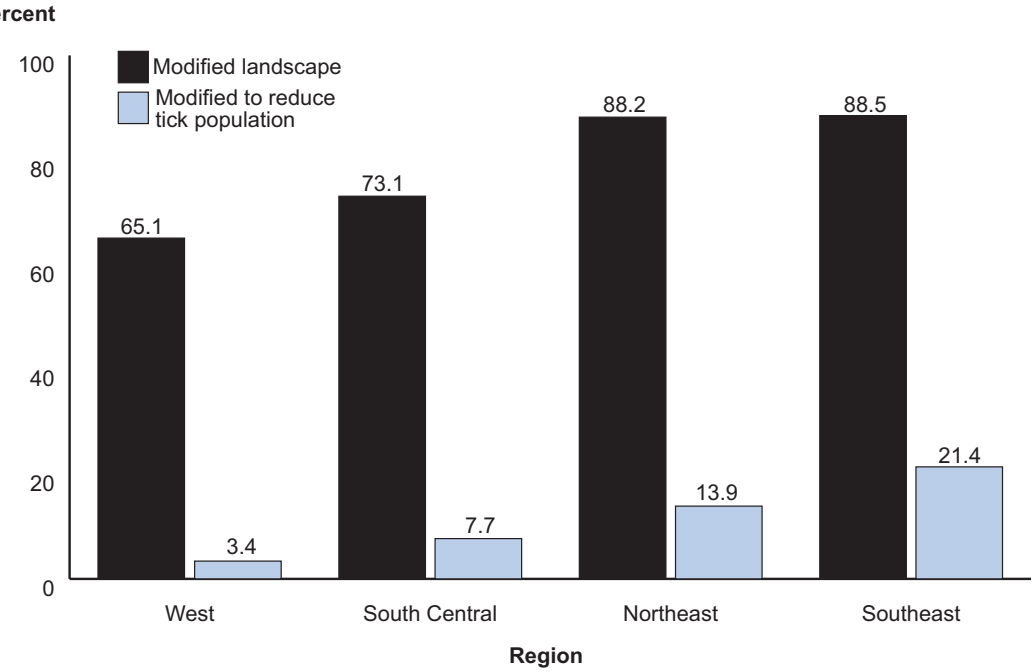
C.3.d. Percentage of operations that modified their landscape in the previous 12 months, and percentage of these operations that did so specifically to control ticks, by region:

Percent Operations

Region

	West		**South Central**		**Northeast**		**Southeast**	
	Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Modified landscape	65.1	(7.2)	73.1	(6.2)	88.2	(3.8)	88.5	(4.1)
Modified to reduce tick population	3.4	(3.0)	7.7	(3.2)	13.9	(5.3)	21.4	(5.8)

Percentage of operations that modified their landscape in the previous 12 months, and percentage of these operations that did so specifically to control ticks, by region



The percentage of operations that modified their landscape for any reason in the previous 12 months did not differ by primary function of operation, nor did the percentage of these operations that did so specifically to control of ticks.

C.3.e. Percentage of operations that modified their landscape in the previous 12 months, and percentage of the these operations that did so specifically to control ticks, by primary function of operation:

	Percent Operations									
	Primary Function									
	Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Modified landscape	83.5	(5.5)	90.9	(5.3)	75.4	(4.8)	77.4	(5.4)		
Modified to reduce tick population	20.8	(5.4)	15.4	(7.6)	5.1	(3.3)	16.6	(4.6)		

*Too few observations to report.

Overall, 71.2 percent of operations had forest or wooded areas on or around the operation. A higher percentage of operations in the Northeast and Southeast regions (81.6 and 83.8 percent, respectively) had forest or wooded areas than operations in the West region (50.3 percent).

C.3.f. Percentage of operations with forested/wooded areas, by region:

Percent Operations									
Region									
West		South Central		Northeast		Southeast		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
50.3	(6.9)	68.2	(6.3)	81.6	(5.8)	83.8	(5.0)	71.2	(3.2)

Keeping equids out of forest or wooded areas can reduce tick exposure. The percentage of operations that did not allow resident equids to graze in wooded or forested areas did not differ by region.

C.3.g. For the 71.2 percent of operations with forested or wooded areas (table C.3.f), percentage of operations that did not allow resident equids to graze these areas by fencing them off, by region:

Percent Operations							
Region							
West		South Central		Northeast		Southeast	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
29.7	(9.1)	29.4	(7.5)	55.7	(7.3)	29.4	(6.6)

4. Treatment for equids with ticks

Note: During the study interview, a list of products for treating equids for ticks was given to respondents to ensure that responses to questions about tick treatments were accurate.

Overall, 49.3 percent of equine operations treated resident equids with a product to control ticks.

C.4.a. Percentage of operations that treated resident equids with a product to control ticks, by size of operation:

Percent Operations							
Size of Operation (number of equids)							
Small (5–9)		Medium (10–19)		Large (20 or more)		All operations	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
50.4	(4.9)	53.1	(6.2)	35.6	(6.3)	49.3	(3.5)

The percentage of operations that treated resident equids with a product to control ticks ranged from 35.6 percent in the Northeast region to 64.3 percent in the South Central region.

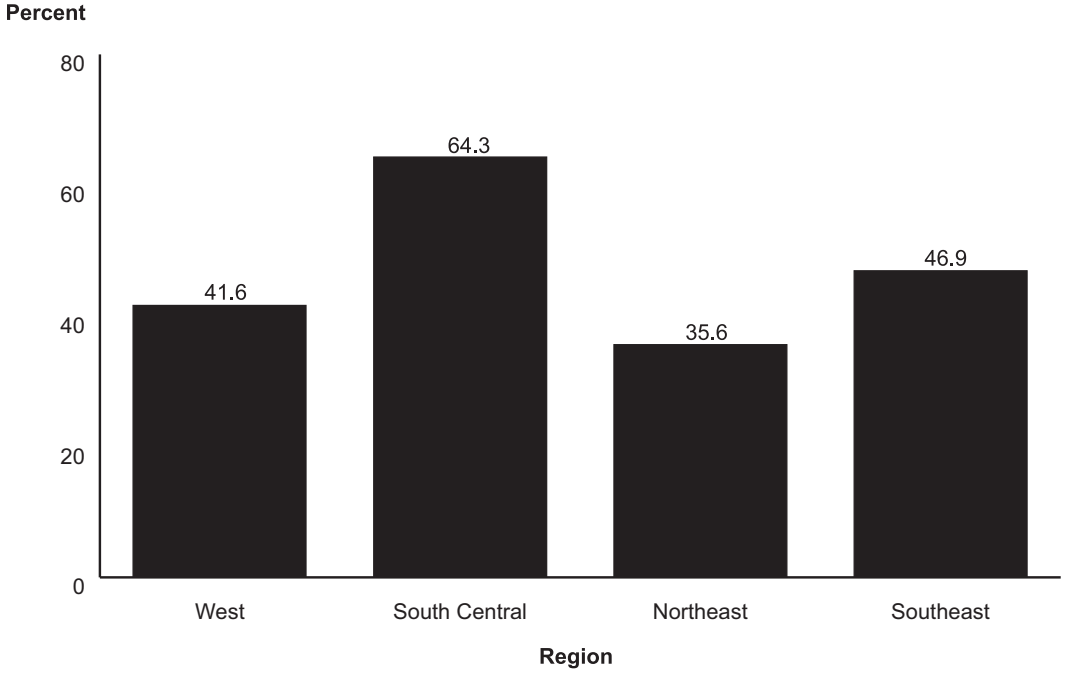
C.4.b. Percentage of operations that treated resident equids with a product to control ticks, by region:

Percent Operations

Region

West		South Central		Northeast		Southeast	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
41.6	(7.8)	64.3	(6.6)	35.6	(6.3)	46.9	(6.6)

Percentage of operations that treated resident equids with a product to control ticks, by region



The percentage of operations that treated resident equids with a product to control ticks was similar by primary function of operation.

C.4.c. Percentage of operations that treated resident equids with a product to control ticks, by primary function of operation:

Percent Operations

Primary Function

Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
53.3	(6.7)	49.2	(10.5)	48.5	(5.9)	50.3	(6.0)		

*Too few observations to report.

Of the 49.3 percent of operations that treated resident equids with a product to control ticks, 87.3 percent used a product with pyrethrins/pyrethroids. Pyrethrins/pyrethroids are the active ingredients in most acaricides used to treat equids and are available in several formulations: ready-to-use spray, aerosol spray, emulsifiable concentrate, pour on, wipe on, spot on, dip, impregnated blanket or leg wraps, and back rubbers. Only 6.5 percent of operations used a natural product such as garlic, vinegar, diatomaceous earth, or a combination of these ingredients. “Other” products included administering ivermectin and homemade products.

C.4.d. For the 49.3 percent of operations that used a product to control ticks (table C.4.a), percentage of operations by type of product(s) used:

Product	Percent operations	Std. error
Pyrethrin/pyrethroid	87.3	(2.9)
Organophosphate*	0.9	(0.7)
Natural product (e.g., garlic, vinegar, diatomaceous earth)	6.5	(2.0)
Other	7.7	(2.3)

*Use of the organophosphate-based product requires a special license.

For the 49.3 percent of operations that treated resident equids with a product to control ticks, 78.8 percent used a product for a reason other than controlling ticks, e.g., fly control.

C.4.e. For the 49.3 percent of operations that used a product to control ticks (table C.4.a), percentage of operations by the primary reason for using product:

Primary reason	Percent operations	Std. error
Tick control	21.2	(3.6)
Other (e.g., fly control)	78.8	(3.6)
Total	100.0	

For the 49.3 percent of operations that treated resident equids with a product to control ticks, 26.7 percent applied the product to resident equids daily. Just 3.9 percent of operations applied a tick-control product on resident equids while on pasture, and 14.7 percent applied product to resident equids being trail ridden. An acaricide's duration of effectiveness varies by the type and concentration of its active ingredient(s), so it is important to read the product label to determine when to reapply the product. The duration of effectiveness is also affected by profuse sweating due to exercise, hot and humid days, or when equids are wet from rain.

C.4.f. For the 49.3 percent of operations that used a product to control ticks (table C.4.a), percentage of operations by frequency of application:

Frequency	Percent operations	Std. error
Daily (regardless of location or activity)	26.7	(4.3)
When on pasture	3.9	(1.7)
When trail ridden	14.7	(3.8)
When ticks/flies observed or as needed	17.3	(3.5)
Other*	37.4	(4.8)
Total	100.0	

*Common "other" frequencies include 1–3 times/week, every 2 weeks/bimonthly, monthly, and seasonally.

5. Tick and tick-control information sources

Overall, 60.4 percent of operations obtained some type of information on ticks and tick control.

C.5.a. Percentage of operations that obtained any information on ticks and tick control, by size of operation:

Percent Operations							
Size of Operation (number of equids)							
Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
63.7	(4.4)	48.8	(6.2)	67.0	(5.9)	60.4	(3.3)

A lower percentage of operations in the West region (40.8 percent) obtained any information on ticks and tick control than operations in the Northeast region (70.5 percent).

C.5.b. Percentage of operations that obtained any information on ticks and tick control, by region:

Percent Operations							
Region							
West		**South Central**		**Northeast**		**Southeast**	
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
40.8	(6.8)	63.0	(6.3)	70.5	(5.9)	64.4	(6.4)

C.5.c. Percentage of operations that obtained any information on ticks and tick control, by primary use of equid:

Percent Operations

Primary Use of Equid

Pleasure		Lessons/ school/ showing/ competition (not betting)		Breeding		Farm or ranch work		Other	
Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
69.0	(4.7)	59.2	(8.6)	41.0	(10.1)	46.4	(7.4)	73.9	(9.9)

Of the 60.4 percent of operations that obtained any information on ticks and tick control, 66.6 percent listed a veterinarian in the top three sources. Other common sources of information ranked in the top three were the Internet (58.8 percent of operations), equine magazines (40.7 percent), feed store (27.4 percent), and other owners/trainers (26.3 percent).

C.5.d. For the 60.4 percent of operations that obtained information on ticks and tick control (table C.5.a), percentage of operations that ranked any of the following among their **top three** sources of information:

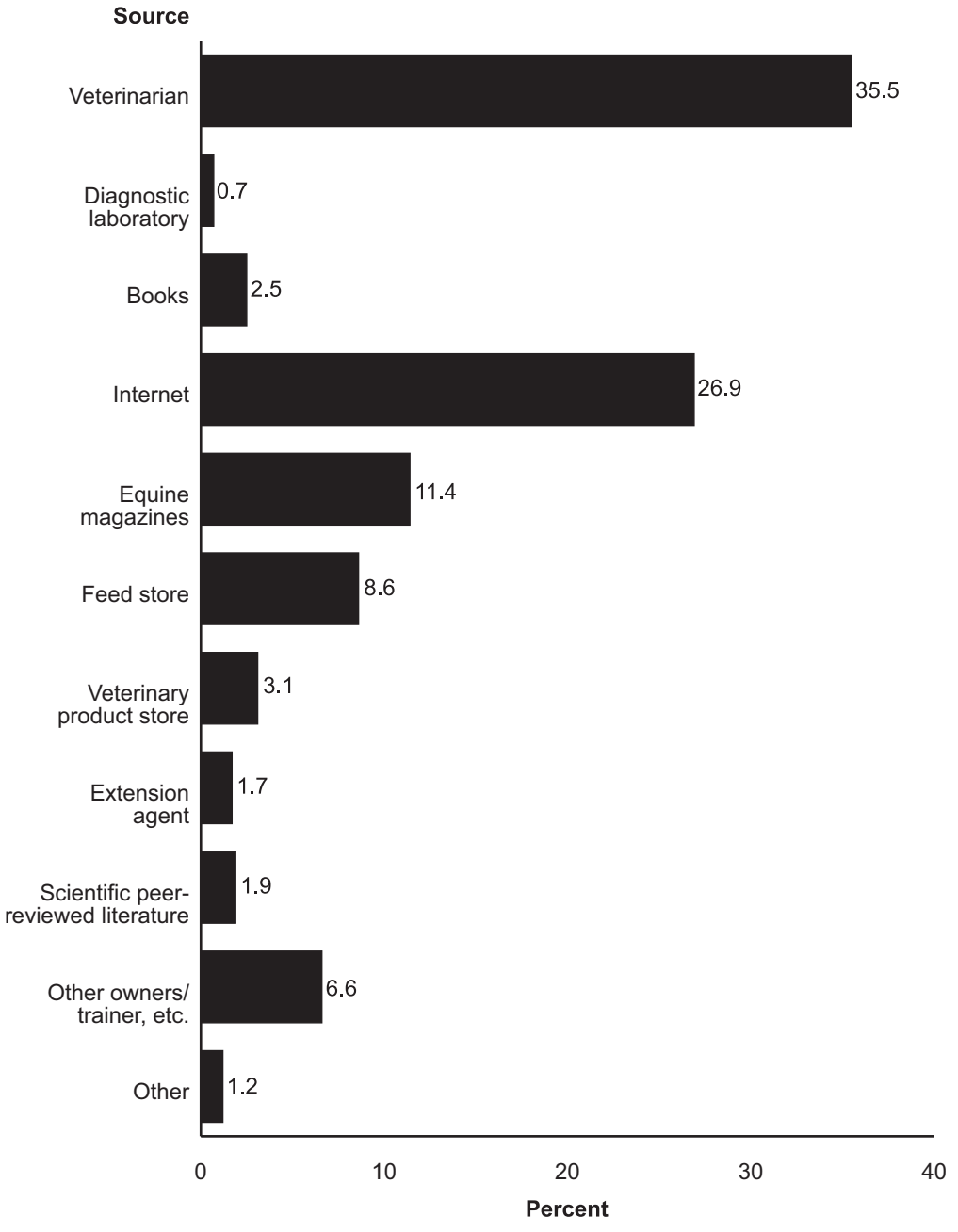
Source	Percent operations	Std. error
Veterinarian	66.6	(4.3)
Diagnostic laboratory	3.9	(1.7)
Books	15.4	(3.3)
Internet	58.8	(4.4)
Equine magazines	40.7	(4.3)
Feed store	27.4	(4.4)
Veterinary product store	13.9	(3.1)
Extension agent	12.2	(2.7)
Scientific peer-reviewed literature	6.9	(2.2)
Other owners/trainer, etc.	26.3	(4.0)
Other	5.1	(1.9)

Of the 60.4 percent of operations that obtained information on ticks and tick control, the top sources of information for the highest percentages of operations was obtained from a veterinarian (35.5 percent) and the Internet (26.9 percent).

C.5.e. For the 60.4 percent of operations that obtained any information on ticks and tick control (table C.5.a), percentage of operations by the **top source** of information:

Source	Percent operations	Std. error
Veterinarian	35.5	(4.3)
Diagnostic laboratory	0.7	(0.6)
Books	2.5	(1.1)
Internet	26.9	(4.1)
Equine magazines	11.4	(2.5)
Feed store	8.6	(3.1)
Veterinary product store	3.1	(1.4)
Extension agent	1.7	(1.1)
Scientific peer-reviewed literature	1.9	(1.4)
Other owners/trainer, etc.	6.6	(1.9)
Other	1.2	(0.8)
Total	100.0	

For the 60.4 percent of operations that obtained any information on ticks and tick control, percentage of operations by the top source of information



6. Tick-borne diseases

Ticks are known to transmit pathogens to equids, including the causative agents for Lyme disease and equine granulocytic anaplasmosis. Illnesses caused by ticks are termed tick-borne diseases.

In equids, clinical signs of Lyme disease include chronic weight loss, sporadic lameness, stiffness, arthritis, swollen joints, muscle tenderness or wasting, hepatitis, laminitis, fever, abortion, hyperesthesia, change in behavior, uveitis, and encephalitis (Johnson, 2015). Diagnosing Lyme disease can be challenging, as diagnosis is based on the presence of compatible clinical signs, possible or confirmed exposure to infected ticks, and detection of exposure through serologic testing.

Equine granulocytic anaplasmosis (formerly named equine granulocytic ehrlichiosis) is a tick-borne disease caused by a rickettsia. Clinical signs can include fever, anorexia, depression, limb edema, petechiation, icterus, ataxia, and reluctance to move (Madigan and Pusterla, 2015). Diagnosis is based on recognition of clinical signs, potential exposure to infected ticks, and blood-smear detection of the causative agent in white blood cells. The causative agent can also be detected in the patient's blood through polymerase chain reaction (PCR) testing.

Equine piroplasmosis (EP), also referred to as equine babesiosis, is caused by the protozoan organisms *Babesia caballi* and *Theileria equi.* EP is considered a foreign animal disease in the United States, and suspect cases must be reported to State and Federal regulatory officials. Equids are the natural hosts for EP, and certain ticks are biologic vectors. Clinical signs in acute cases may include fever, jaundice, anemia, hemoglobinuria, bilirubinuria, digestive or respiratory signs, and even death. In the subacute form, EP cases might have anorexia, lethargy, weight loss, poor performance, increased heart and respiratory rates, and an enlarged spleen. Chronic EP cases can be indistinguishable from other chronic conditions with nonspecific signs, such as poor body condition, poor performance, and anemia. Often, chronic cases show no abnormal signs.

Except for Puerto Rico and the U.S. Virgin Islands, the United States is considered to be free of EP; however, isolated incidents of the disease have occurred infrequently in the continental United States (Pelzel-McCluskey and Traub-Dargatz, 2015). Cases of *Theileria equi* infection have been detected in the United States, primarily in racing Quarter horses, and appeared to be due to iatrogenic transmission of the disease agent rather than tick transmission. In October 2009, Quarter horses on a cattle ranch in south Texas were confirmed to be infected with *Theileria equi.* Transmission on the premises was confirmed by at least two species of ticks—*Amblyomma mixtum* and *Dermacentor variabilis* (Pelzel-McCluskey and Traub-Dargatz, 2015). Trace-out of horses that left the index ranch was performed and no tick-borne transmission outside of south Texas was

detected. Through tick management and chemotherapeutic treatment of equids, the infection on the ranch was eradicated and, to date, there are no infected equids on this premises.

Overall, 2.4 percent of operations had one or more resident equids diagnosed with Lyme disease in the previous 12 months. A higher percentage of operations in the Northeast region had resident equids diagnosed with Lyme disease than operations in other regions. All respondents that had resident equids with Lyme disease indicated that the disease had been diagnosed by a veterinarian and laboratory testing.

Overall, 0.6 percent of operations had one or more resident equids diagnosed with equine granulocytic anaplasmosis in the previous 12 months. The Northeast region accounted for the highest percentage of operations with one or more resident equids diagnosed with equine granulocytic anaplasmosis. All respondents that had resident equids with equine granulocytic anaplasmosis indicated that the disease had been diagnosed through laboratory testing.

Overall, 0.1 percent of operations had one more resident equids diagnosed with EP, all of which were in the Northeast region. However, operations in the Northeast region that reported resident equids with EP might not have understood the disease, as horses involved in active racing (e.g., at race tracks) were not part of the NAHMS study and, as of September 2017, no tick transmission of EP had been detected outside of south Texas (Dr. Angela Pelzel-McClusky, pers. comm.).

C.6. Percentage of operations on which any resident equids had the following tick-borne disease(s) in the previous 12 months, by region:

	Percent Operations									
	Region									
	West		South Central		Northeast		Southeast		All operations	
Disease	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Lyme disease	0.0	(—)	0.0	(—)	9.9	(3.4)	1.0	(1.0)	2.4	(0.8)
Anaplasmosis	0.0	(—)	0.0	(—)	2.1	(0.9)	0.3	(0.3)	0.6	(0.2)
Equine piroplasmosis (EP)	0.0	(—)	0.0	(—)	0.5	(0.5)	0.0	(—)	0.1	(0.1)
Tick paralysis	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)
Other	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)	0.0	(—)

D. Lameness Occurrence and Management

Note: For this report, lameness was defined as an abnormality in gait such that the equid could be used for its intended purpose or could only be used with intervention (e.g., medication, corrective shoeing, and/or rest). In addition, lameness occurrence was reported by the owner/operator and did not require an equine health professional to confirm the diagnosis.

Most lameness can be attributed to pain, but in equids it can also be the result of mechanical dysfunctions or neurologic conditions. Few health problems affect equids the way lameness does, as lameness can affect equids of all ages, breed, and gender.

Lameness can be detected by owners, riders, trainers, or caregivers as a change in the way the animal moves or a reduced level of performance; however, diagnosing the source and cause of lameness is usually done by a veterinarian during a lameness examination. In many instances, further testing with radiographs or diagnostic nerve blocks is necessary to determine a specific cause of lameness. The severity of lameness in equids is often described using a standardized grading system from 0 (lameness is not perceptible under any circumstances) to 5 (lameness produces minimal weight bearing in motion and/or at rest [nonweight bearing]) or there is a complete inability to move.

Treatments for lameness may be empirical, e.g., providing rest and administering nonsteroidal anti-inflammatory drugs (NSAIDs), or they might be tailored to the specific cause of lameness. Some lame equids recover without a diagnosis or treatment intervention.

1. Lameness occurrence

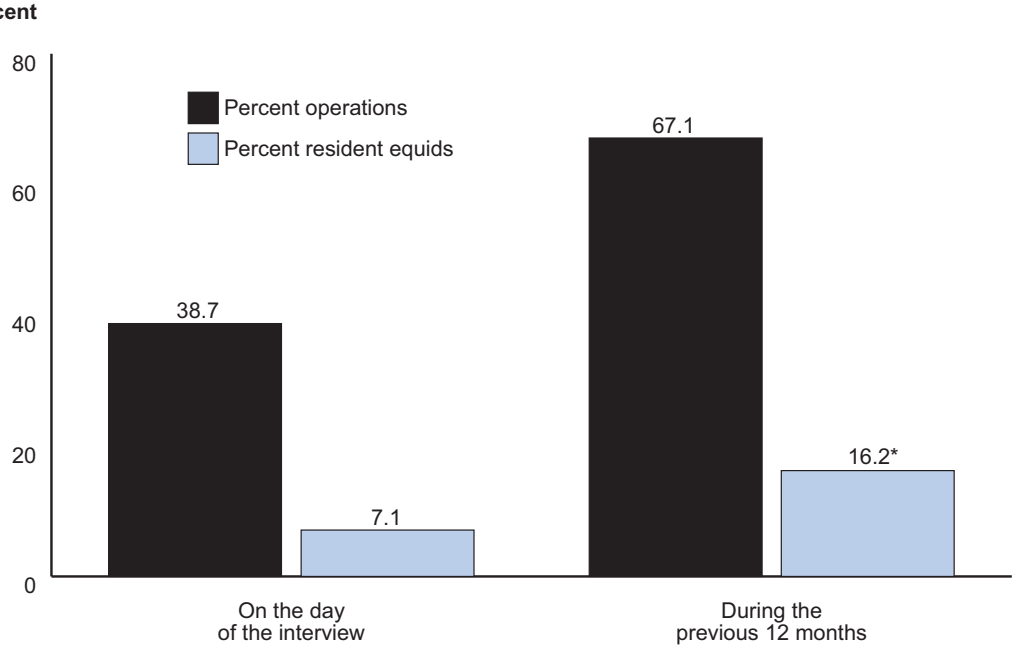
Overall, 38.7 percent of operations had one or more resident equids with a lameness problem on the **day of the study interview**, while 67.1 percent had one or more resident equids with a lameness problem in the **previous 12 months.** Overall, 7.1 percent of resident equids had a lameness problem on the day of the interview, and 16.2 percent had a lameness problem in the previous 12 months.

D.1.a. Percentage of **operations** that had any resident equids with a lameness problem and percentage of resident **equids** with a lameness problem, on the day of the interview and in the previous 12 months,

	Percent operations	Std. error	Percent equids	Std. error
On the day of the interview	38.7	(3.2)	7.1	(0.7)
During the previous 12 months	67.1	(3.4)	16.2*	(1.1)

*Includes resident equids that died or were no longer on the premises.

Percentage of operations that had any resident equids with a lameness problem and percentage equids that had a lameness problem on the day of the interview or in the previous 12 months



*Includes resident equids that died or were no longer on the premises.

Resident equids less than 2 years old were underrepresented among equids with a lameness problem. Equids in this age group accounted for 7.5 percent of all resident equids and 0.7 percent of equids with a lameness problem. Conversely, equids 21 years of age or older were overrepresented among resident equids with a lameness problem. Equids in this age group accounted for 12.9 percent of all resident equids and 20.0 percent of resident equids with a lameness problem. It is no surprise that the older equids were more likely to have lameness problems than the younger equids, since joint, tendon, and hoof problems are often more likely to occur with age.

D.1.b. Percentage of all resident equids and percentage of resident equids with a lameness problem in the previous 12 months, by age of equids:

Age (yr)	**Percent all resident equids***	**Std. error**	**Percent equids with lameness problem**	**Std. error**
Less than 2	7.5	(0.4)	0.7	(0.9)
2 to 5	13.6	(1.4)	7.8	(1.0)
6 to 10	23.4	(2.2)	22.5	(1.4)
11 to 15	23.2	(2.5)	27.8	(1.3)
16 to 20	19.4	(2.2)	21.2	(1.3)
21 or more	12.9	(2.3)	20.0	(1.1)
Total	100.0		100.0	

*As of May 1, 2015.

Castrated males (geldings) were overrepresented among resident equids with a lameness problem, accounting for 56.2 percent of resident equids with a lameness problem but only 39.9 percent of all resident equids. Conversely, intact males were underrepresented among equids with a lameness problem, accounting for just 2.8 percent of resident equids with a lameness problem and 7.7 percent of all resident equids.

D.1.c. Percentage of all resident equids and percentage of resident equids with a lameness problem in the previous 12 months, by gender:

Gender	Percent all resident equids*	Std. error	Percent equids with lameness problem	Std. error
Intact male (stallion or colt)	7.7	(0.4)	2.8	(0.9)
Castrated male (gelding)	39.9	(0.9)	56.2	(3.2)
Intact female (nonpregnant)	43.1	(0.8)	37.8	(3.0)
Pregnant female	4.6	(0.4)	2.8	(0.8)
Spayed female	0.9	(0.2)	0.3	(0.3)
Unknown status	3.9	(0.7)	0.1	(0.1)
Total	100.0		100.0	

*As of May 1, 2015.

By breed, the percentage of resident equids with a lameness problem mirrored the breed distribution of resident equids. For example, Quarter horses made up 40.3 percent of the resident equids with a lameness problem and accounted for 38.0 percent of all resident equids. This finding illustrates the importance of accounting for the distribution of breeds in the general population when interpreting the distribution of breeds among equids with a lameness problem.

D.1.d. Percentage of all resident equids and percentage of equids with a lameness problem in the previous 12 months, by type/breed:

Equid type/breed	Percent all resident equids*	Std. error	Percent equids with lameness problem	Std. error
Appaloosa	1.7	(0.2)	2.3	(0.8)
Arabian	3.5	(0.5)	3.0	(0.8)
Draft breed	4.3	(0.4)	2.5	(0.7)
Miniature horse	4.6	(0.5)	2.5	(1.1)
Morgan	1.3	(0.2)	1.5	(0.8)
Mustang	0.9	(0.2)	0.8	(0.5)
Paint	6.1	(0.4)	9.4	(1.7)
Quarter horse	38.0	(1.5)	40.3	(3.5)
Saddlebred	2.3	(0.3)	1.5	(0.8)
Standardbred	3.3	(0.4)	2.4	(1.0)
Tennessee Walker	4.1	(0.4)	3.9	(1.4)
Thoroughbred	6.4	(0.7)	7.9	(1.6)
Warmblood breed	2.8	(0.3)	4.9	(1.6)
Grade	3.7	(0.6)	2.5	(0.7)
Other (including mixed breed)	7.0	(0.7)	10.0	(1.9)
Ponies	3.4	(0.2)		
Mule	2.0	(0.2)	1.4	(0.8)
Donkey or burro	4.5	(0.4)	3.2	(1.2)
Total	100.0		100.0	

*As of May 1, 2015.

The intended use of equids in the general population of resident equids was not collected as part of the Equine 2015 study, so comparison of lame equids by intended use with that of the general population was not possible.

In total, 35.1 percent of lame equids had an intended use of pleasure, and 22.6 percent had an intended use of showing/competition (not betting). Because of the definition of lameness used in this study, there could have been equids with an intended use of breeding that could have been lame but not to the extent that it affected their intended use, e.g., as a breeding animal. For example, a broodmare might have a grade 2 lameness problem, but she could still function as a broodmare without intervention, such as medication or special shoeing. On the other hand, an equid with an intended use of showing or other competition with grade 2 lameness could not perform its intended purpose without intervention. It should be noted that equids housed at race tracks were not included in the study, so the equids intended for racing likely represented equids in training that may not yet have encountered the demands of active racing; thus, only a small percentage of lame equids intended for racing were among the lame equids.

D.1.e. Percentage of resident equids with a lameness problem in the previous 12 months, by intended use of equids:

Percent Resident Equids

Intended Use*

Pleasure		**Lessons/ school**		**Showing/ competi-tion** (not betting)		**Breeding**		**Racing**		**Farm or ranch work**		**Retired, not in use**		**Other**		
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Total**
35.1	(3.4)	6.5	(1.5)	22.6	(3.5)	7.2	(1.5)	0.4	(0.3)	11.0	(2.3)	14.6	(2.5)	2.6	(1.2)	100.0

*Before becoming lame.

2. Lameness outcome

About half of resident equids with a lameness problem in the previous 12 months (46.8 percent) had fully recovered and remained sound by the time of the study interview. During the same time period, 21.7 percent of resident equids with a lameness problem had improved but still had some lameness, and 15.0 percent were worse or had shown no improvement. In addition, 12.1 percent of resident equids with a lameness problem had improved, but the lameness recurred. It should be noted that equids that developed lameness problems just before the study interview were still counted among lame equids but might not have had adequate time to recover, while other resident equids might have developed lameness problems up to 12 months earlier and had ample time to recover.

D.2.a. Percentage of resident equids with a lameness problem in the previous 12 months, by outcome:

Outcome	Percent resident equids	Std. error
Recovered or sound and remained sound	46.8	(3.6)
Recovered but were affected by a different lameness problem	1.5	(0.6)
Recovered but same lameness problem later recurred	12.1	(2.3)
Improved but still had lameness	21.7	(2.5)
No improvement or worse	15.0	(2.4)
Sold or given away due to lameness	1.2	(0.5)
Died or euthanized due to lameness	1.2	(0.5)
Other	0.5	(0.3)
Total	100.0	

The majority of resident equids with a lameness problem (53.7 percent) had the problem from 1 week to 6 months, and 26.6 percent had the problem for 1 year or more. Some resident equids with a long duration of lameness (e.g., over 6 months) might have had permanent or chronic problems, but they might still have been useable with intervention, such as medication or special shoeing. For example, a show horse that had a permanent lameness problem, such as navicular disease, might have required special shoeing to perform, but it would still have met the study definition of a resident equid with lameness problems.

D.2.b. Percentage of resident equids with a lameness problem in the previous 12 months, by duration of problem:

Duration	Percent resident equids	Std. error
Less than 1 week	12.6	(2.1)
1 week up to 1 month	32.0	(3.4)
1 month up to 6 months	21.7	(2.9)
6 months up to 12 months	7.1	(1.5)
12 months or more	26.6	(2.9)
Total	100.0	

Equids with a lameness problem that required treatment so they could be used for their intended purpose were considered to have a lameness problem, even though they did not accumulate days of lost use. For the majority of resident equids with a lameness problem (61.2 percent), the duration of lost use was less than 1 month, while lost use for 17.1 percent of resident equids with a lameness problem lasted 12 months or more. For about one-fourth of resident equids with a lameness problem (24.3 percent) no loss of use occurred.

D.2.c. Percentage of resident equids with a lameness problem in the previous 12 months, by duration of lost use*:

Duration	Percent resident equids	Std. error
None	24.3	(3.1)
1 to 6 days	16.0	(3.2)
1 week up to 1 month	20.9	(2.8)
1 month up to 6 months	17.0	(2.4)
6 months up to 12 months	4.8	(1.5)
12 months or more	17.1	(2.4)
Total	100.0	

*Equid could not be used for intended purpose.

Over three-fourths of resident equids with a lameness problem in the previous 12 months (78.2 percent) remained in their intended use category; 3.0 percent became pleasure riding equids, and 12.3 percent were retired from all use and turned out or kept as a pet.

D.2.d. Percentage of resident equids with a lameness problem in the previous 12 months, by permanent change* in the equid's intended use:

Change	Percent resident equids	Std. error
No change of use	78.2	(2.7)
Pleasure riding	3.0	(0.8)
Lesson or school horse	1.0	(0.6)
Different type of showing/ competition (not betting)	0.6	(0.4)
Breeding	0.7	(0.3)
Racing	0.0	(—)
Farm or ranch work	0.5	(0.3)
Companion animal	0.2	(0.1)
Retired from all use and turned out or kept as a pet	12.3	(2.3)
Died or euthanized	1.4	(0.5)
Left operation, uncertain of current use	1.0	(0.5)
Other	1.4	(0.6)
Total	100.0	

*As a result of lameness problem.

3. Diagnosis and treatment

Of the 67.1 percent of operations that had any resident equids with a lameness problem (table D.1.a), 57.4 percent consulted a veterinarian for a lameness diagnosis, and 58.0 percent consulted a veterinarian about treating lame equids. In addition, a veterinarian was consulted to diagnose lameness problems for 51.8 percent of resident equids with a problem, and a veterinarian was consulted about treatment for 51.7 percent of lame equids.

D.3.a. For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months (table D.1.a), percentage of operations and percentage of lame resident equids, by reason(s) a veterinarian was consulted:

Veterinarian consulted for…	Percent operations	Std. error	Percent resident equids	Std. error
Diagnosing lameness	57.4	(4.0)	51.8	(3.7)
Treating lameness	58.0	(4.1)	51.7	(3.7)
Either	64.7	(3.9)	NA	

For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months, the most common diagnostic test performed (67.1 percent of operations and 60.1 percent of lame equids) was a lameness examination. A lameness exam might include palpating the equid's back and/or limbs, applying hoof testers, or examining various gaits (walk, trot, canter). It is apparent from the data in table D.3.a that not all lameness examinations were done by a veterinarian, since only 57.4 percent of operations with lame equids had a veterinarian consult on diagnosis, and 67.1 percent of operations had a lameness examination performed on resident equids with a problem. Some lameness examinations could have been done by the owner/operator, farrier, trainer, or other person experienced with equids.

Flexion tests, where joints are momentarily held in flexed positions, can temporarily exacerbate a lameness but make it easier to locate the source of the problem. Flexion tests were performed on 33.5 percent of resident equids with a lameness problem.

Some lameness can be more obvious when the horse is ridden. Examination under the saddle was used as a diagnostic modality by 12.0 percent of operations and on 9.3 percent of resident equids with a lameness problem.

Once a lameness examination and, in some cases, a flexion test has been completed, diagnostic nerve and joint blocks can be used to further isolate the lameness site. Overall, 11.0 percent of lame equids had diagnostic nerve blocks, and 4.4 percent had diagnostic joint blocks.

Radiographic images can reveal disease in the bones and joints. Just under one-third of operations with any lame resident equids (31.8 percent) and just under one-fourth of lame equids (23.9 percent) had radiographs taken to help diagnose the cause of lameness.

While the emphasis of radiographic examination is to image the bones and joints, diagnostic ultrasound can be performed to image an animal's soft tissues, such as tendons and ligaments; 10.8 percent of operations with any lame resident equids had any lame equids undergo an ultrasound examination, and 7.5 percent of lame equids had an ultrasound examination.

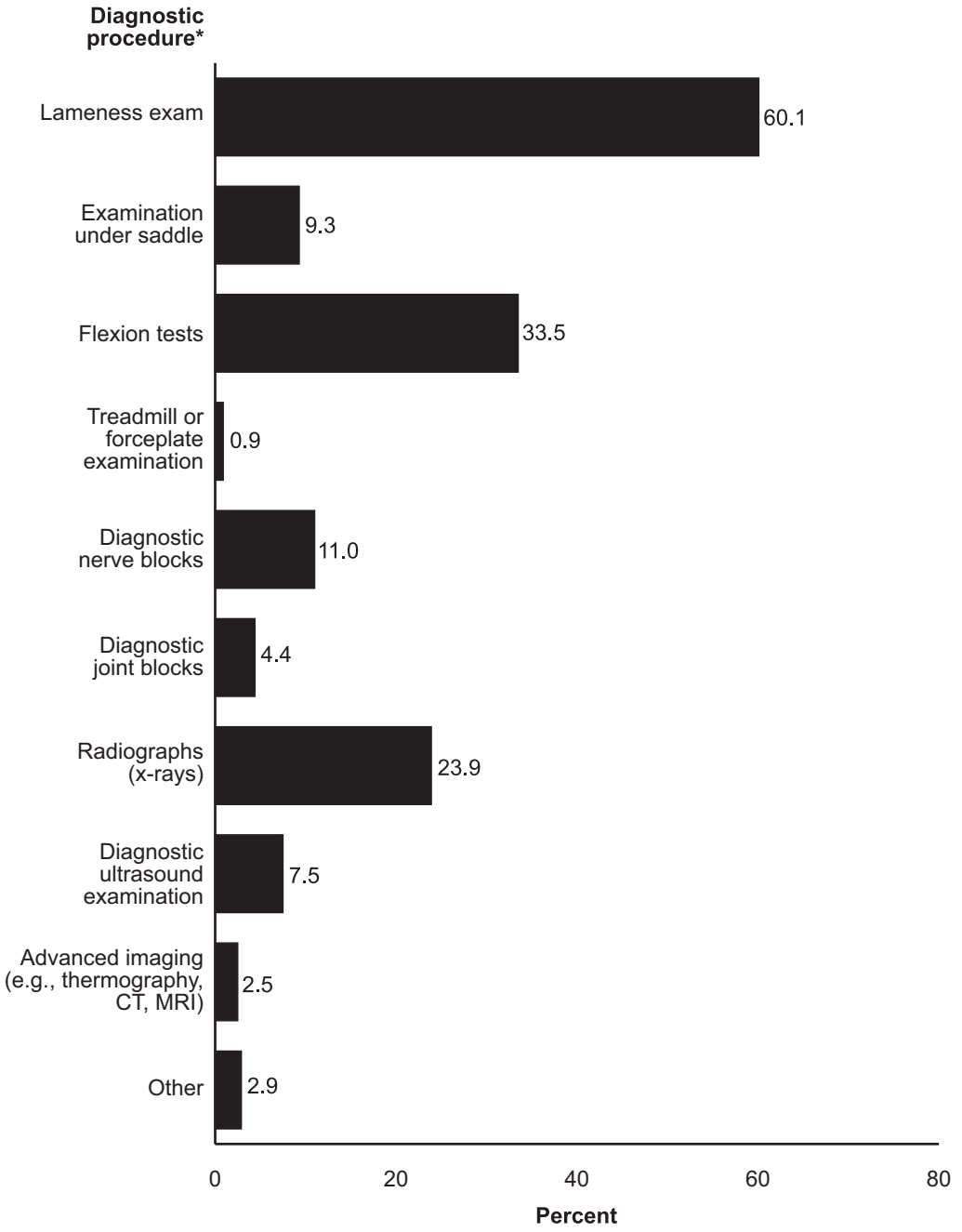
Advanced imaging such as thermography, computerized tomography (CT), or magnetic resonance imaging (MRI) can be used if more routine methods such as radiography or diagnostic ultrasonography are inadequate to make a diagnosis or fully localize the lameness site. Advanced procedures, however, are more expensive and less readily available than routine radiography or diagnostic ultrasonography. Just 4.4 percent of operations had one or more resident equids with a lameness problem undergo an advanced imaging test, and just 2.5 percent of lame equids underwent an advanced imaging test.

D.3.b. For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months (table D.1.a), percentage of operations and percentage of lame resident equids by diagnostic procedures performed on these equids:

Diagnostic procedure*	Percent operations	Std. error	Percent lame equids	Std. error
Lameness exam (may include limb or back palpation; hoof testers; or examination walk, trot, or canter)	67.1	(3.9)	60.1	(3.6)
Examination under saddle	12.0	(2.6)	9.3	(1.9)
Flexion tests	39.5	(3.9)	33.5	(3.6)
Treadmill or forceplate examination	0.3	(0.2)	0.9	(0.7)
Diagnostic nerve blocks	14.4	(2.9)	11.0	(2.2)
Diagnostic joint blocks	6.8	(1.8)	4.4	(1.1)
Radiographs (x-rays)	31.8	(3.6)	23.9	(3.3)
Diagnostic ultrasound examination	10.8	(2.5)	7.5	(1.6)
Advanced imaging (e.g., thermography, CT, MRI)	4.4	(1.9)	2.5	(1.0)
Other	5.8	(2.0)	2.9	(0.9)

*Diagnostic procedure may have been performed by someone other than a veterinarian.

For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months, percentage of lame equids by diagnostic procedures performed on these equids



*Diagnostic procedure may have been performed by someone other than a veterinarian.

Table D.3.c describes the percentage of operations that had any resident equids with lameness problems and the percentage of lame equids affected by specific lameness conditions. For these estimates, if a lame resident equid had the same condition more than once in the previous 12 months, it was only counted once as having that condition. A lame equid could have had multiple conditions within the previous 12 months and would have been counted once under each different condition.

Foot conditions

For operations with lame resident equids, common foot conditions included sole abscesses (25.6 percent of operations and 17.0 percent of lame equids), laminitis (23.9 percent of operations and 15.8 percent of lame equids), and sole/hoof bruise (19.7 percent of operations and 13.3 percent of lame equids). Sole abscesses are acute and often result in severe lameness. Affected equids might be unable to bear weight on the affected hoof. Abscesses can develop when an animal's sole is injured, e.g., stepping on a nail. Further, a simple bruise on an animal's sole can cause a blood clot, leaving the tissue under the sole prone to bacteria colonization, which can lead to an abscess.

Laminitis is inflammation and damage to the junction between the sensitive and insensitive laminae or layers of the hoof wall. Severe cases of laminitis are also called founder. Causes of laminitis include consumption of excessive carbohydrates in pasture grasses or grains; equine metabolic syndrome; Cushing's disease; toxins; and complications due to colic, diarrhea, or retained placenta.

Hoof problems include navicular disease (11.6 percent of operations and 7.6 percent of lame equids) and coffin joint problems (7.9 percent of operations and 3.6 percent of lame equids). Navicular disease is the inflammation or degeneration of the navicular bone (a sesamoid bone located within the hoof) and its surrounding tissues, usually on the front hooves. This disease can lead to significant and even disabling chronic lameness. The coffin joint is within the hoof, between the second and third phalanx.

Limb conditions

The most frequently reported limb problems included injuries, strains, or contracture of tendons, ligaments, or muscles (28.6 percent of operations with lame equids and 16.0 percent of lame equids) followed by wounds or lacerations causing lameness (16.6 percent of operations with lame equids and 8.9 percent of lame equids). It is important to note that not all wounds result in lameness.

Joint problems

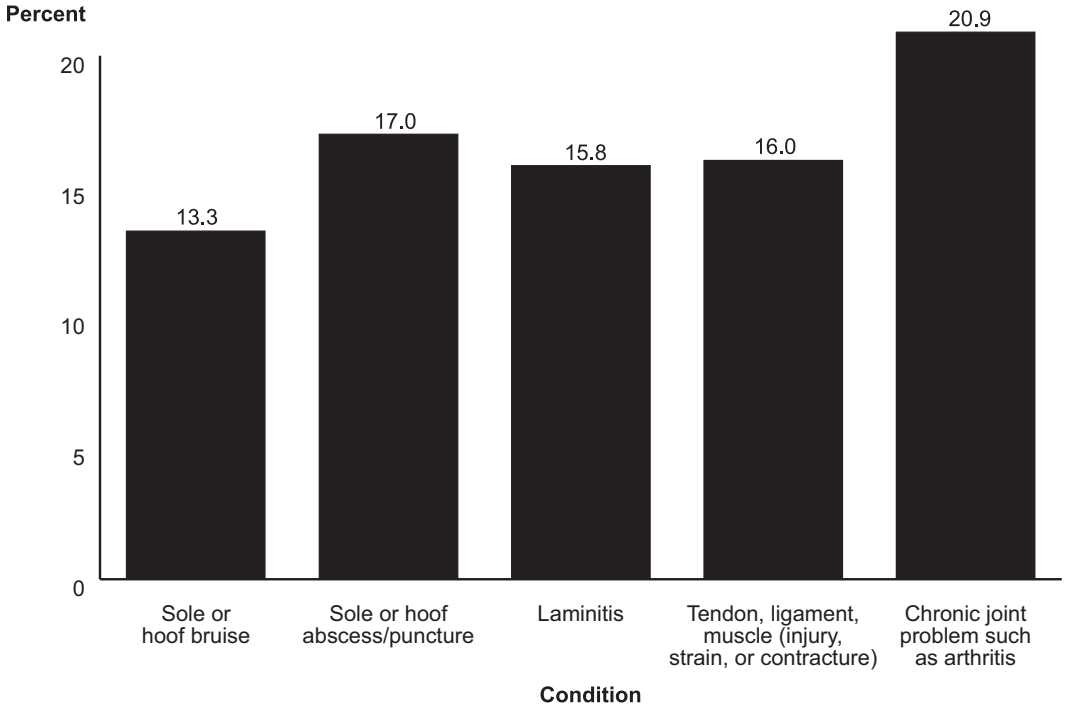
Joint problems include chronic conditions such as arthritis (30.5 percent of operations with lame equids and 20.9 percent of lame equids). Each of the other types of joint

conditions affected less than 5 percent of operations with lame equids and less than 3 percent of lame equids.

D.3.c. For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months (table D.1.a), percentage of operations and percentage of lame resident equids, by lameness condition(s):

Condition*	Percent operations	Std. error	Percent lame equids	Std. error
Foot conditions				
Sole or hoof bruise	19.7	(3.1)	13.3	(2.1)
Sole or hoof abscess/puncture	25.6	(3.4)	17.0	(2.2)
Laminitis	23.9	(3.4)	15.8	(2.4)
Coffin joint problem	7.9	(2.2)	3.6	(1.0)
Navicular problem or disease	11.6	(2.5)	7.6	(2.1)
Other	13.3	(2.7)	7.5	(1.6)
Limb conditions				
Wound or laceration causing lameness	16.6	(3.0)	8.9	(1.7)
Tendon, ligament, muscle (injury, strain, or contracture)	28.6	(3.5)	16.0	(2.0)
Bone fracture	4.3	(1.8)	2.0	(0.8)
Other bone injury (splint, bucked shins)	2.3	(1.0)	1.4	(0.7)
Angular limb deformity (crooked legs)	1.7	(0.9)	0.9	(0.4)
Other	1.1	(0.6)	0.5	(0.3)
Joint problems				
Developmental joint problem (OC, OCD)	4.1	(1.5)	2.1	(0.8)
Sudden joint injury (strain, sprain)	4.8	(1.4)	2.9	(0.8)
Joint infection	2.1	(0.8)	1.8	(0.7)
Chronic joint problem such as arthritis	30.5	(3.7)	20.9	(2.5)
Other	2.3	(1.0)	1.2	(0.5)
Other conditions				
Back pain or soreness	6.9	(1.8)	4.8	(1.1)
Unknown problem	8.0	(2.4)	4.2	(1.2)
Other known problem	4.8	(1.7)	2.6	(0.8)

For the 67.1 percent of operations that had any resident equids with a lameness problem in the previous 12 months, percentage of lame resident equids, by lameness condition(s)



The age of equids can impact the frequency of various types of lameness. The percentage of lame equids with a chronic joint condition/arthritis increased with age, ranging from 4.2 percent of lame equids 2 to 5 years of age to 43.9 percent of lame equids over 20 years of age. Causes of arthritis include everyday wear and tear. Physical injury can trigger inflammation and, less commonly, infection or fractures within the joint that can stimulate inflammation and result in arthritis.

D.3.d. Percentage of lame resident equids, by lameness condition(s) and by age of equids:

	Percent Lame Equids											
	Age (yr)											
	<2		2–5		6–10		11–15		16–20		21+	
Condition	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Foot conditions												
Sole or hoof bruise	*		16.6	(8.6)	14.7	(3.4)	14.9	(3.8)	16.9	(4.5)	5.6	(2.1)
Sole or hoof abscess/puncture	*		10.8	(5.3)	25.8	(4.9)	16.0	(3.3)	17.5	(4.5)	10.8	(3.7)
Laminitis	*		1.4	(1.0)	19.1	(4.4)	11.8	(3.1)	22.4	(5.3)	17.6	(5.6)
Coffin joint problem	*		7.9	(7.4)	4.5	(2.4)	2.4	(1.4)	5.5	(2.3)	1.1	(0.6)
Navicular problem or disease	*		0.0	(—)	5.1	(3.1)	13.3	(4.8)	7.2	(2.4)	6.9	(3.1)
Other	*		14.8	(6.6)	15.8	(4.3)	8.5	(3.0)	1.4	(0.7)	0.7	(0.5)
Limb conditions												
Wound or laceration causing lameness	*		18.1	(7.3)	14.0	(4.2)	7.7	(3.2)	4.2	(1.8)	6.4	(3.1)
Tendon, ligament, muscle (injury, strain, or contracture)	*		20.7	(7.5)	15.1	(3.8)	17.4	(4.1)	12.4	(3.4)	18.7	(4.2)
Bone fracture	*		3.8	(1.9)	1.5	(1.1)	4.2	(2.7)	0.3	(0.3)	1.0	(0.7)
Other bone injury (splint, bucked shins)	*		0.6	(0.6)	2.9	(1.7)	2.0	(1.3)	0.0	(—)	0.7	(0.7)
Angular limb deformity (crooked legs)	*		0.7	(0.7)	0.6	(0.6)	0.6	(0.4)	0.4	(0.4)	2.3	(1.8)
Other	*		0.0	(—)	0.0	(—)	0.6	(0.4)	1.6	(1.2)	0.0	(—)

continued→

D.3.d. (cont'd.) Percentage of lame resident equids, by lameness condition(s) and by age of equids:

	Percent Lame Equids											
	Age (yr)											
	<2		2–5		6–10		11–15		16–20		21+	
Condition	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Joint problems												
Developmental joint problem (OC, OCD)	*		0.0	(—)	0.0	(—)	0.9	(0.6)	2.5	(1.7)	5.1	(2.9)
Sudden joint injury (strain, sprain)	*		3.8	(2.1)	2.4	(1.1)	2.9	(1.4)	3.6	(2.2)	2.6	(1.6)
Joint infection	*		1.6	(1.6)	2.7	(1.6)	0.5	(0.4)	0.0	(—)	4.6	(2.5)
Chronic joint problem such as arthritis	*		4.2	(1.8)	8.8	(3.0)	16.2	(4.0)	26.1	(5.7)	43.9	(6.8)
Other	*		0.0	(—)	2.6	(1.2)	0.6	(0.3)	0.7	(0.7)	1.8	(1.8)
Other conditions												
Back pain or soreness	*		4.8	(3.7)	1.5	(0.9)	5.6	(2.6)	5.6	(2.6)	7.2	(2.6)
Unknown problem	*		4.1	(4.0)	2.9	(1.6)	1.9	(0.8)	7.7	(3.9)	5.2	(2.6)
Other known problem	*		2.4	(1.9)	0.0	(—)	0.7	(0.4)	5.4	(2.8)	5.1	(2.4)

*Too few observations to report.

Complete rest was the treatment for lame equids used by the highest percentage of operations and on the highest percentage of lame equids (67.2 and 59.2 percent, respectively).

Nonsteroidal anti-inflammatory drugs can reduce pain and inflammation associated with lameness. Examples of NSAIDs include phenylbutazone (commonly called bute), flunixin megulmine (Banamine®), diclofenac (Surpass®), and firocoxib (Equioxx®).

Hoof management includes routine trimming without shoes (41.5 percent of operations with lame equids and 33.6 percent of lame equids) or corrective hoof trimming (18.1 percent of operations with lame equids and 11.7 percent of lame equids). Routine hoof trimming with shoeing (21.9 percent of operations with lame equids and 18.6 percent of lame equids) or corrective shoeing (25.7 percent of operations with lame equids and 19.1 percent of lame equids) were common treatment modalities.

Overall, 31.2 percent of operations with lame equids used nutritional supplements, nutriceuticals, or joint supplements for 29.2 percent of lame equids. Although their efficacy is often uncertain, joint supplements are among the most popular nutritional supplements for equids. These supplements contain a variety of ingredients including, but not limited to, glucosamine, chondroitin, methylsulfonylmethane, and hyaluronic acid.

Ice, cold hosing, or heat therapy were used by 29.4 percent of operations with lame equids and on 24.4 percent of lame equids. Cold or heat treatments are usually combined with other treatments and might be used to manage ongoing, sometimes nonspecific, lameness problems. Some of the "other" specified treatments included leg wraps, wound care, Epsom salt soaks, casting, antibiotics, sutures, and treatment of hypothyroidism or Cushing's disease.

D.3.e. For the 67.1 percent of operations that had any resident equids with lameness problems in the previous 12 months (table D.1.a), percentage of operations by treatment(s) used for lame equids, and percentage of lame resident equids by treatment received:

Treatment	Percent operations	Std. error	Percent lame equids	Std. error
Complete rest	67.2	(3.7)	59.2	(3.7)
Controlled or restricted exercise	54.3	(4.0)	47.6	(3.9)
Routine hoof trimming without shoes	41.5	(4.0)	33.6	(3.6)
Routine hoof trimming with routine shoeing	21.9	(3.1)	18.6	(3.0)
Corrective hoof trimming without shoes	18.1	(3.2)	11.7	(2.3)
Corrective shoeing	25.7	(3.6)	19.1	(3.3)
Ice, cold hosing, cold or heat therapy	29.4	(3.5)	24.4	(3.0)
Nonsteroidal, anti-inflammatory medications [NSAID] (phenylbutazone [bute], flunixin meglumine/Banamine®, diclofenac/Surpass®, firocoxib/Equioxx®, etc.)	60.7	(4.0)	54.2	(3.7)

continued→

D.3.e. (cont'd) For the 67.1 percent of operations that had any resident equids with lameness problems in the previous 12 months (table D.1.a), percentage of operations by treatment(s) used for lame equids, and percentage of lame resident equids by treatment received:

Treatment	Percent operations	Std. error	Percent lame equids	Std. error
Site-specific injections (joints, tendon sheaths, bursae, etc.) with corticosteroid anti-inflammatory medications	14.9	(3.0)	11.8	(3.0)
Site-specific injections (joints, tendon sheaths, bursae, etc.) with other medications (Legend®/hyaluronate sodium [HA], Adequan®/polysulfated glycosaminoglycan [PSGAG])	12.2	(2.6)	9.4	(2.2)
Systemic injectable medication other than NSAID	6.5	(1.7)	4.2	(1.2)
Stem cell therapy	1.6	(0.8)	1.5	(0.9)
Nutritional supplements, nutriceuticals or joint supplements	31.2	(3.7)	29.2	(3.7)
Surgery	3.6	(1.2)	1.8	(0.6)
Chiropractic	19.1	(3.1)	17.2	(3.2)
Acupuncture	5.9	(1.8)	4.9	(1.5)
Laser treatments	4.4	(2.0)	2.3	(1.1)
Therapeutic ultrasound for treatment	3.5	(2.0)	1.7	(0.9)
Shockwave therapy	3.7	(1.8)	2.4	(1.1)
Massage	12.1	(2.4)	10.4	(2.2)
Other alternative medicine	5.3	(1.8)	4.7	(1.6)
Other	15.7	(2.8)	10.7	(2.1)

There was no difference by size of operation in the percentages of operations by treatment(s) used for equids with a lameness problem.

D.3.f. For the 67.1 percent of operations that had any resident equids with lameness problems in the previous 12 months (table D.1.a), percentage of operations by treatment(s) used for lame equids, and by size of operation:

	Percent Operations							
	Size of Operation (number of equids)							
	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Treatment	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Rest[1]	74.4	(5.1)	88.7	(4.0)	87.0	(4.9)	80.6	(3.2)
Hoof care[2]	66.0	(5.6)	63.5	(6.6)	70.4	(6.6)	65.9	(3.8)
Ice, cold hosing, cold or heat therapy	24.9	(4.8)	30.8	(6.2)	42.7	(7.0)	29.4	(3.5)
Systemic treatment[3]	61.2	(6.0)	60.0	(6.6)	66.6	(6.9)	61.7	(4.0)
Site-specific injection[4]	18.4	(4.9)	16.3	(5.2)	26.4	(5.8)	19.0	(3.2)
Stem cell therapy	1.3	(1.3)	1.5	(0.9)	3.0	(2.2)	1.6	(0.8)
Nutritional supplements or nutriceuticals or joint supplements	28.7	(5.4)	36.4	(6.8)	29.8	(6.2)	31.2	(3.7)
Surgery	1.5	(1.3)	6.1	(3.0)	6.2	(2.6)	3.6	(1.2)
Laser treatment	4.0	(3.1)	6.0	(3.3)	2.4	(1.4)	4.4	(2.0)
Alternative[5]	22.5	(4.8)	31.9	(6.4)	22.6	(5.1)	25.3	(3.4)
Therapeutic ultrasound for treatment	3.4	(2.9)	4.0	(3.9)	2.9	(1.7)	3.5	(2.0)
Shockwave therapy	3.4	(2.9)	1.8	(1.1)	8.3	(4.4)	3.7	(1.8)
Other	12.9	(4.0)	20.7	(5.3)	15.9	(4.3)	15.7	(2.8)
Any	93.7	(3.2)	98.0	(2.0)	98.9	(1.1)	95.7	(1.9)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medication other than NSAID.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

There was no regional difference in the percentages of operations by treatment used for equids with a lameness problem.

D.3.g. For the 67.1 percent of operations that had any resident equids with lameness probles in the previous 12 months (table D.1.a), percentage of operations by treatment(s) used for lame equids, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Treatment	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Rest[1]	84.7	(6.3)	88.2	(5.2)	76.9	(6.4)	71.1	(7.3)
Hoof care[2]	60.7	(8.2)	69.9	(7.1)	68.7	(7.5)	63.8	(7.3)
Ice, cold hosing, cold or heat therapy	22.3	(6.9)	25.5	(6.6)	34.3	(7.0)	36.2	(7.1)
Systemic treatment[3]	58.1	(8.7)	68.5	(7.8)	61.5	(7.6)	57.5	(7.6)
Site-specific injection[4]	26.6	(7.3)	14.3	(6.6)	23.1	(6.8)	12.8	(4.2)
Stem cell therapy	1.1	(0.8)	1.2	(0.9)	3.1	(3.0)	1.2	(1.2)
Nutritional supplements or nutriceuticals or joint supplements	35.6	(8.0)	20.6	(7.3)	40.9	(7.9)	29.5	(6.4)
Surgery	2.2	(1.3)	4.5	(2.9)	4.3	(3.1)	3.3	(1.8)
Laser treatment	3.3	(3.3)	10.6	(6.0)	1.7	(1.3)	0.7	(0.7)
Alternative[5]	30.3	(8.0)	16.0	(5.4)	35.0	(7.7)	21.5	(5.5)
Therapeutic ultrasound for treatment	0.7	(0.7)	10.9	(6.6)	0.0	(—)	1.1	(1.1)
Shockwave therapy	0.3	(0.3)	6.6	(5.5)	5.1	(2.8)	2.3	(1.6)
Other	9.6	(5.2)	18.8	(5.6)	10.4	(3.9)	23.3	(6.7)
Any	100.0	(—)	93.6	(4.5)	95.6	(3.7)	94.0	(4.5)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

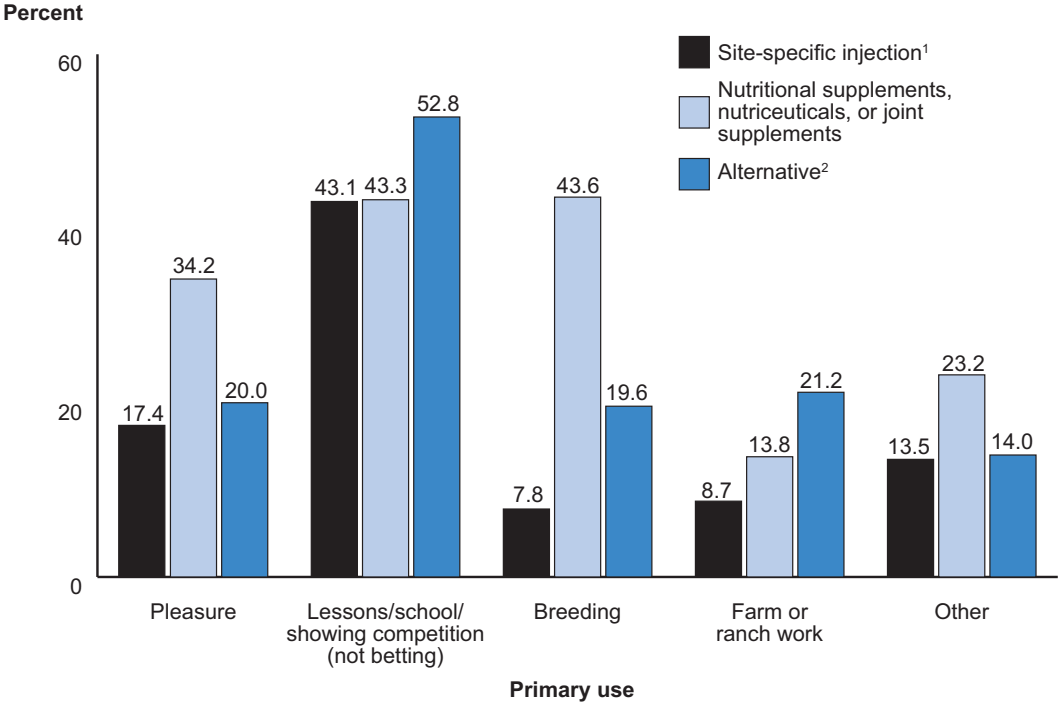
Photograph coutesty of Kirsten Tillotson.

D.3.h. For the 67.1 percent of operations that had any resident equids with lameness problems in the previous 12 months (table D.1.a), percentage of operations by treatment(s) used for lame equids, and by primary use of equid:

	Percent Operations									
	Primary Use									
	Pleasure		Lessons/ school/ showing competition (not betting)		Breeding		Farm or ranch work		Other	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Rest[1]	80.6	(4.7)	91.7	(5.3)	75.4	(9.2)	73.5	(8.2)	79.8	(11.4)
Hoof care[2]	65.7	(5.5)	72.0	(7.7)	78.9	(8.6)	55.1	(9.2)	75.9	(11.5)
Ice, cold hosing, cold or heat therapy	29.2	(5.1)	41.8	(8.8)	37.2	(10.7)	13.7	(6.2)	43.3	(14.1)
Systemic treatment[3]	63.8	(5.9)	74.1	(7.9)	51.7	(11.0)	48.0	(8.9)	68.4	(12.3)
Site-specific injection[4]	17.4	(4.6)	43.1	(9.4)	7.8	(4.8)	8.7	(4.3)	13.5	(8.9)
Stem cell therapy	0.0	(—)	8.7	(4.9)	0.0	(—)	0.0	(—)	2.8	(2.8)
Nutritional supplements or nutriceuticals or joint supplements	34.2	(5.7)	43.3	(9.3)	43.6	(11.0)	13.8	(5.8)	23.2	(11.0)
Surgery	1.9	(0.9)	8.7	(4.8)	4.9	(3.9)	3.5	(3.5)	2.8	(2.8)
Laser treatment	5.9	(3.5)	3.1	(1.9)	1.5	(1.5)	3.8	(3.7)	0.0	(—)
Alternative[5]	20.0	(4.1)	52.8	(9.1)	19.6	(8.0)	21.2	(7.7)	14.0	(10.6)
Therapeutic ultrasound for treatment	3.8	(3.2)	8.2	(6.8)	1.5	(1.5)	0.0	(—)	2.8	(2.8)
Shockwave therapy	4.4	(3.3)	4.2	(2.4)	0.0	(—)	0.0	(—)	12.4	(9.0)
Other	14.1	(4.0)	18.1	(6.5)	11.5	(6.1)	20.8	(7.2)	8.5	(6.1)
Any	94.9	(2.9)	100.0	(—)	93.7	(6.0)	93.6	(5.4)	100.0	(—)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

For the 67.1 percent of operations that had any resident equids with lameness problems in the previous 12 months, percentage of operations by treatment(s) used for lame equids, and by primary use of equids



[1]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[2]Includes chiropractic, acupuncture, massage, and other alternative medicine.

4. Lameness prevention

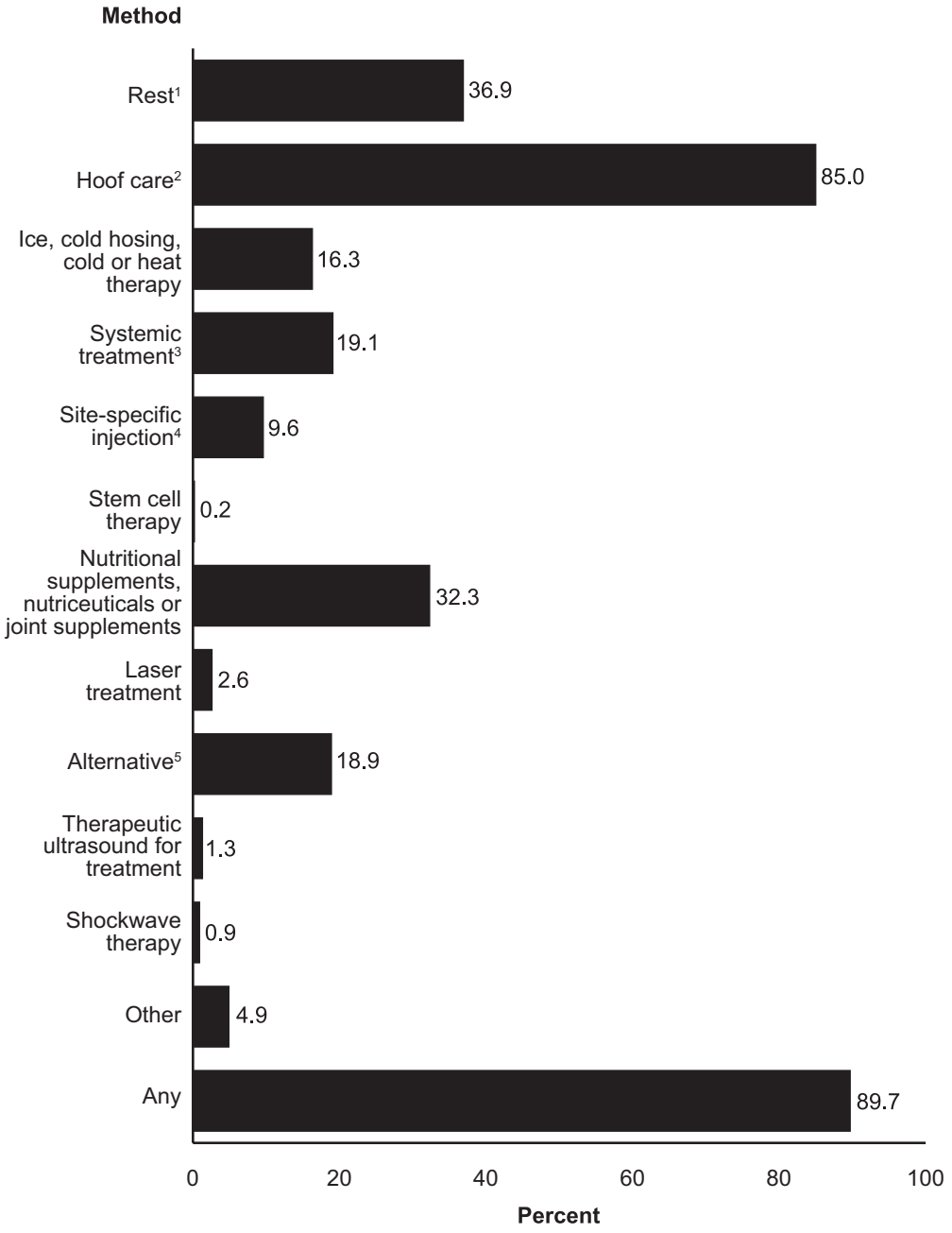
A higher percentage of large operations than small operations used rest, icing/heat treatments, site-specific medication injections, or alternative therapy for lameness prevention. Since large operations have more equids than small operations, large operations are more likely to have equids with lameness problems.

D.4.a. Percentage of operations by method(s) used in the previous 12 months to prevent lameness in resident equids, whether or not operations had any lame resident equids, and by size of operation:

	Percent Operations							
	Size of Operation (number of equids)							
	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Rest[1]	31.9	(4.5)	41.6	(6.0)	53.9	(6.4)	36.9	(3.3)
Hoof care[2]	83.9	(3.5)	84.8	(4.9)	90.7	(3.7)	85.0	(2.6)
Ice, cold hosing, cold or heat therapy	12.4	(2.7)	17.5	(4.1)	34.3	(6.2)	16.3	(2.2)
Systemic treatment[3]	16.5	(3.5)	17.6	(4.0)	35.8	(6.3)	19.1	(2.6)
Site-specific injection[4]	5.1	(2.1)	14.8	(4.4)	22.3	(5.4)	9.6	(1.8)
Stem cell therapy	0.0	(—)	0.0	(—)	1.5	(1.4)	0.2	(0.2)
Nutritional supplements or nutriceuticals or joint supplements	28.8	(4.1)	39.2	(6.1)	36.6	(6.0)	32.3	(3.1)
Laser treatment	2.1	(1.2)	3.5	(2.3)	3.6	(2.1)	2.6	(1.0)
Alternative therapy[5]	12.9	(3.1)	28.3	(5.2)	30.9	(5.7)	18.9	(2.5)
Therapeutic ultrasound for treatment	1.3	(0.9)	0.8	(0.8)	2.3	(1.4)	1.3	(0.6)
Shockwave therapy	0.2	(0.2)	0.6	(0.6)	5.0	(3.4)	0.9	(0.5)
Other	3.7	(1.5)	6.2	(3.1)	8.5	(3.8)	4.9	(1.3)
Any	86.5	(3.2)	94.0	(2.8)	97.2	(2.3)	89.7	(2.2)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

Percentage of operations by method(s) used in the previous 12 months to prevent lameness in resident equids, whether or not operations had lame resident equids



[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and sytemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

A higher percentage of operations in the West region (96.7 percent) used at least some method to prevent lameness than operations in the Southeast region (77.9 percent). A higher percentage of operations in the Northeast region (48.2 percent) used nutritional supplements for lameness prevention than operations in the South Central region (20.9 percent).

D.4.b. Percentage of operations by method(s) used in the previous 12 months to prevent lameness in resident equids, whether or not operations had a lame resident equid, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Rest[1]	40.9	(6.9)	38.4	(6.5)	35.5	(6.3)	32.6	(6.0)
Hoof care[2]	88.1	(4.6)	88.2	(4.2)	85.8	(5.0)	77.0	(6.2)
Ice, cold hosing, cold or heat therapy	19.4	(5.2)	9.1	(2.8)	21.6	(5.3)	19.0	(4.7)
Systemic treatment[3]	23.8	(6.7)	10.6	(3.2)	29.6	(6.4)	17.3	(4.6)
Site-specific injection[4]	8.5	(3.0)	11.0	(4.4)	11.9	(3.5)	6.3	(2.0)
Stem cell therapy	0.9	(0.9)	0.0	(—)	0.0	(—)	0.0	(—)
Nutritional supplements, nutriceuticals or joint supplements	37.9	(7.4)	20.9	(5.2)	48.2	(6.8)	29.2	(5.6)
Laser treatment	8.1	(4.1)	0.0	(—)	2.2	(1.3)	2.0	(1.6)
Alternative[5]	29.4	(6.6)	10.4	(4.0)	26.9	(6.0)	14.7	(3.2)
Therapeutic ultrasound for treatment	2.9	(2.4)	0.3	(0.3)	1.8	(1.6)	0.8	(0.8)
Shockwave therapy	0.9	(0.9)	0.0	(—)	3.3	(1.9)	0.0	(—)
Other	2.0	(1.2)	4.2	(2.4)	7.1	(3.3)	6.2	(2.8)
Any	96.7	(2.3)	93.5	(3.0)	89.8	(4.7)	77.9	(6.2)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

Higher percentages of operations that primarily used equids for breeding or for lessons/school/showing/competition (not betting) used hoof care as a lameness prevention treatment compared with operations that primarily used equids for farm or ranch work. A higher percentage of operations that primarily used equids for lessons/school/showing/competition (54.5 percent) used nutritional supplements, nutriceuticals, or joint supplements to prevent lameness than operations that primarily used equids for breeding (13.8 percent) or farm or ranch work (25.3 percent).

D.4.c. Percentage of operations by method(s) used in the previous 12 months to prevent lameness in resident equids, whether or not operations had a lame resident equid, and by primary use of equid:

	Percent Operations									
	Primary Use									
	Pleasure		Lessons/ school/ showing/ competition (not betting)		Breeding		Farm or ranch work		Other	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Rest[1]	37.7	(4.9)	34.8	(7.3)	27.3	(8.9)	36.9	(7.2)	49.3	(12.2)
Hoof care[2]	84.3	(3.8)	95.4	(3.5)	96.2	(2.4)	75.9	(6.3)	92.5	(5.2)
Ice, cold hosing, cold or heat therapy	12.9	(2.9)	26.2	(6.4)	19.1	(7.5)	12.6	(4.6)	40.1	(12.1)
Systemic treatment[3]	15.0	(3.5)	34.6	(8.4)	15.1	(6.1)	16.7	(4.8)	41.5	(12.5)
Site-specific injection[4]	7.0	(2.6)	25.7	(7.6)	5.5	(3.2)	5.1	(2.4)	26.1	(10.6)
Stem cell therapy	0.0	(—)	0.0	(—)	2.2	(2.2)	0.0	(—)	0.0	(—)
Nutritional supplements, nutriceuticals or joint supplements	32.9	(4.6)	54.5	(8.5)	13.8	(5.2)	25.3	(6.2)	37.0	(12.3)
Laser treatment	2.6	(1.5)	1.0	(1.0)	4.1	(2.9)	2.9	(2.3)	3.0	(3.0)
Alternative[5]	15.4	(3.4)	40.0	(8.5)	13.5	(5.2)	15.3	(4.7)	30.7	(11.6)
Therapeutic ultrasound for treatment	0.0	(—)	1.3	(1.0)	0.0	(—)	1.9	(1.9)	13.8	(8.2)
Shockwave therapy	0.3	(0.3)	0.4	(0.4)	2.2	(2.2)	0.0	(—)	10.7	(7.8)
Other	3.6	(1.7)	2.8	(2.7)	9.3	(4.0)	5.2	(3.0)	15.0	(9.6)
Any	88.4	(3.3)	98.7	(1.3)	99.3	(0.7)	84.1	(5.6)	92.5	(5.2)

[1]Includes complete rest and controlled or restricted exercise.
[2]Includes routine hoof trimming without shoes, routine hoof trimming with routine shoeing, corrective hoof trimming without shoes, and corrective shoeing.
[3]Includes nonsteroidal anti-inflammatory medications and systemic injectable medications other than NSAIDs.
[4]Includes site-specific injections with corticosteroid anti-inflammatory medications and site-specific injections with other medications.
[5]Includes chiropractic, acupuncture, massage, and other alternative medicine.

E. Health Care and Health Care Expenses

Note: This section describes hoof care, vaccination, veterinary services, insect and tick control, veterinary products, and associated costs of each.

1. Hoof care

The level of hoof care needed often depends on how equids are used. Hoof trimming without applying shoes is the most basic form of hoof care. The need for shoes also depends on the equid's conformation and hoof quality. Some equids can be ridden periodically on rough ground without shoes, if they have excellent hoof quality and conformation. Corrective shoeing is usually used to correct a conformation problem or as part of the treatment for lameness. Hoof protectors or boots are used to protect one or more hooves, generally during work tasks. These protectors are removed when the equids are not working, unless the protectors are providing coverage for a sole bruise or sole abscess.

Overall, 89.9 percent of operations provided routine hoof trimming to one or more resident equids in the previous 12 months. About half of operations (48.1 percent) provided basic shoes on all four hooves for one or more of their resident equids, and just over one-fourth of operations (27.0 percent) provided basic shoes on two hooves.

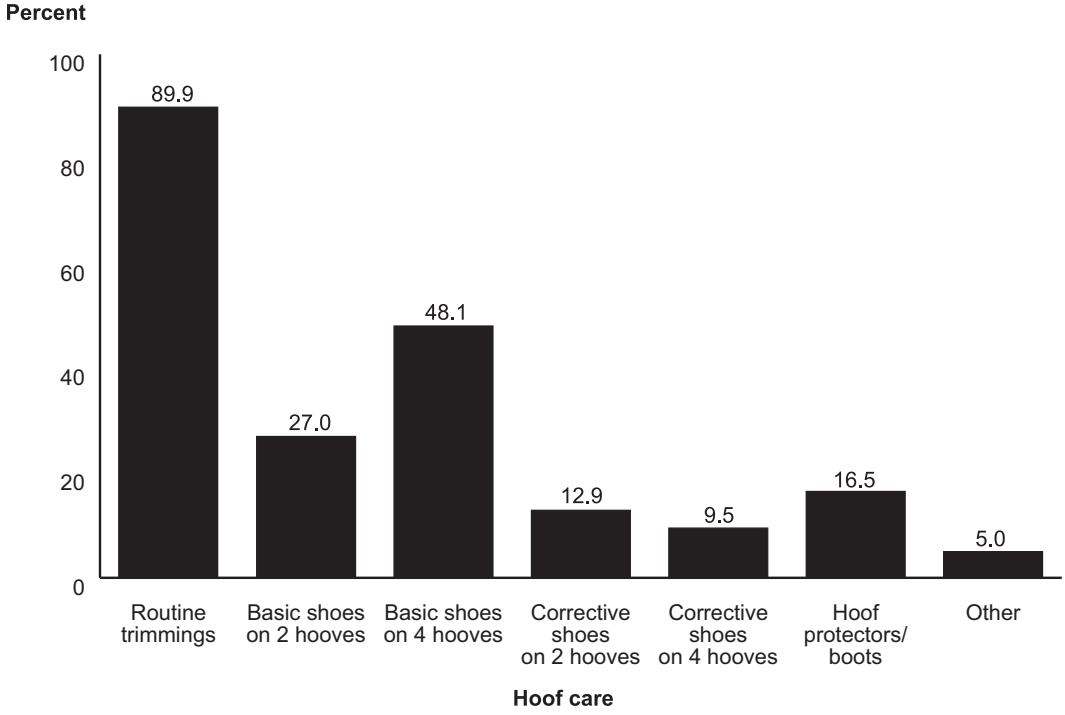
E.1.a. Percentage of operations by type(s) of hoof care provided to any resident equids in the previous 12 months, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Hoof care	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Routine trimmings	90.9	(2.9)	87.7	(3.6)	89.3	(4.5)	89.9	(2.1)
Basic shoes on 2 hooves	23.4	(3.9)	28.1	(5.4)	44.6	(6.4)	27.0	(2.9)
Basic shoes on 4 hooves	43.6	(4.7)	56.3	(6.1)	55.3	(6.5)	48.1	(3.5)
Corrective shoes on 2 hooves	12.1	(3.1)	12.4	(3.6)	18.6	(4.0)	12.9	(2.2)
Corrective shoes on 4 hooves	9.8	(2.8)	8.4	(3.5)	10.2	(3.7)	9.5	(2.1)
Hoof protectors/ boots	15.4	(3.3)	14.8	(4.4)	26.8	(6.0)	16.5	(2.5)
Other	1.5	(0.9)	12.1	(3.6)	9.6	(4.8)	5.0	(1.2)

Percentage of operations by type(s) of hoof care provided to any resident equids in the previous 12 months



A higher percentage of operations that primarily used equids for lessons/school/showing/competition (42.6 percent) used hoof protectors than operations that primarily used equids for pleasure (12.2 percent), breeding (12.2 percent), or farm or ranch work (11.0 percent).

E.1.b. Percentage of operations by type(s) of hoof care provided to any resident equids in the previous 12 months, and by primary use of equids:

Percent Operations

	Primary Use									
	Pleasure		**Lessons/ school/ showing/ competition** (not betting)		**Breeding**		**Farm or ranch work**		**Other**	
Hoof care	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Routine trimmings	89.6	(3.2)	100.0	(—)	100.0	(—)	82.5	(5.5)	88.7	(7.8)
Basic shoes on 2 hooves	28.9	(4.4)	40.3	(8.5)	27.6	(8.2)	17.0	(5.3)	22.3	(10.7)
Basic shoes on 4 hooves	43.7	(5.1)	47.3	(8.5)	39.0	(10.4)	58.5	(7.3)	58.5	(11.8)
Corrective shoes on 2 hooves	12.4	(3.2)	23.4	(7.6)	8.5	(4.6)	11.1	(4.4)	9.2	(6.9)
Corrective shoes on 4 hooves	8.4	(3.0)	22.9	(8.2)	6.2	(4.5)	6.2	(3.0)	9.2	(6.9)
Hoof protectors/ boots	12.2	(3.2)	42.6	(8.8)	12.2	(5.2)	11.0	(4.2)	30.7	(12.5)
Other	2.1	(1.2)	8.2	(3.7)	6.0	(3.6)	7.5	(3.4)	13.5	(8.1)

The costs of owning equids include purchase price, stabling/housing, feeding, health care, and the purchase of maintenance equipment that allows equids to be used for their intended purpose. Additional expenses might include transportation costs and entry fees to equine events.

The frequency with which hoof trimming is needed varies by equid; however, in general hooves typically require trimming every 6 to 8 weeks. Overall, 14.2 percent of operations reported no costs associated with hoof trimming in the previous 12 months. Operations might have performed this service themselves or received the service at no cost. On 70.3 percent of operations, the typical per-equid cost of hoof trimming ranged from $1 to less than $300.

Of operations that provided any resident equids with basic shoes on two hooves, 35.3 percent spent less than $150 per equid in the previous 12 months, and 34.1 percent spent $450 or more. Since the typical cost represented in the following table is factored on a 12-month basis, the wide range in costs might be explained by the fact that some operations only had shoes on their equids during peak use periods, while other operations might have kept shoes on their equids year-round.

Of operations that provided corrective shoes on two hooves, 29.2 percent typically spent $150 to less than $300 per equid per year. Operations that provided four corrective shoes typically spent $450 or more. Corrective shoes are typically reset every 6 to 8 weeks. Equids that need corrective shoeing often wear shoes year round and at times might also need the corrective shoes modified or replaced, which adds to the costs associated with corrective shoeing.

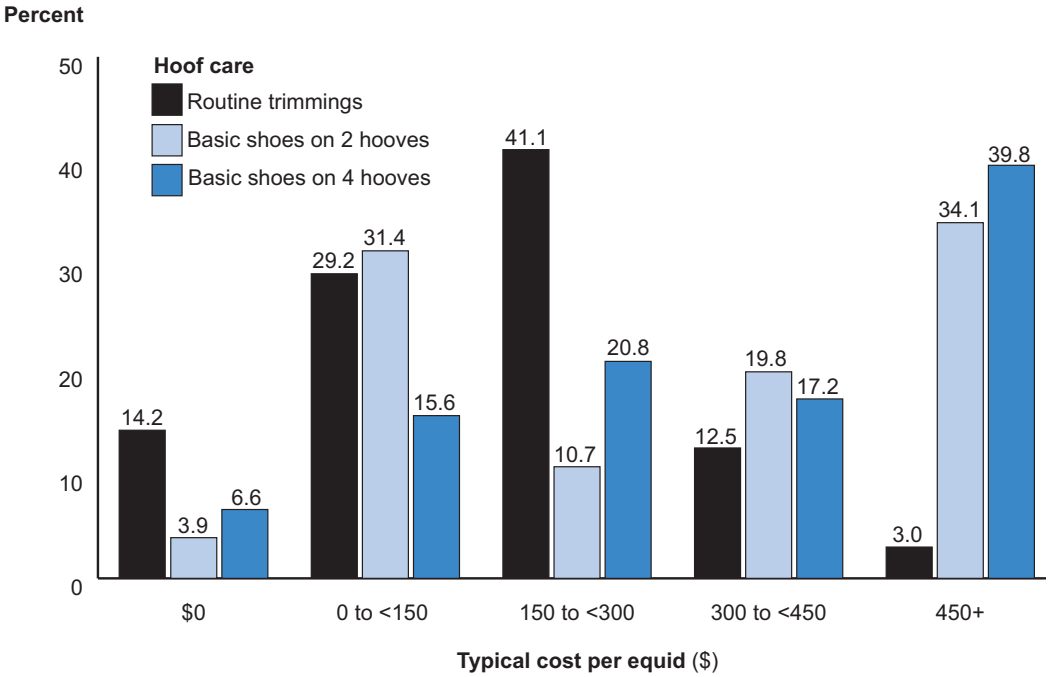
E.1.c. For operations that provided the following type(s) hoof care to resident equids in the previous 12 months, percentage of operations by typical per-equid cost of care:

Percent Operations

Typical Cost per Equid ($)

	0		>0–<150		150–<300		300–<450		450+		
Hoof care	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Total**
Routine trimmings	14.2	(2.8)	29.2	(3.5)	41.1	(4.0)	12.5	(2.7)	3.0	(1.1)	100.0
Basic shoes on 2 hooves	3.9	(2.3)	31.4	(7.2)	10.7	(4.2)	19.8	(6.3)	34.1	(6.3)	100.0
Basic shoes on 4 hooves	6.6	(2.5)	15.6	(4.1)	20.8	(4.4)	17.2	(4.7)	39.8	(5.5)	100.0
Corrective shoes on 2 hooves	4.1	(3.4)	13.0	(6.7)	29.2	(10.5)	16.9	(7.5)	36.7	(9.8)	100.0
Corrective shoes on 4 hooves	4.0	(3.2)	13.8	(8.5)	21.6	(12.7)	0.0	(—)	60.7	(13.3)	100.0
Hoof protectors/ boots	1.7	(1.4)	59.2	(9.4)	36.4	(9.4)	2.0	(1.5)	0.8	(0.8)	100.0
Other	0.0	(—)	79.3	(9.2)	14.6	(8.0)	0.0	(—)	6.1	(4.4)	100.0
Total	13.4	(2.9)	21.8	(3.2)	28.3	(3.7)	17.2	(3.2)	19.4	(3.1)	100.0

For operations that provided the following hoof care to any resident equids in the previous 12 months, percentage of operations by typical per-equid cost of care



Overall, 13.4 percent of operations had no costs associated with hoof care, while 49.0 percent of small operations spent from $150 to $450 per equid. Nearly half of large operations (46.7 percent) spent less than $150 per equid for hoof care.

E.1.d. Percentage of operations by typical per-equid cost of hoof care in the previous 12 months, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Hoof care cost ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	14.9	(4.1)	8.7	(3.9)	15.3	(5.2)	13.4	(2.9)
>0–<150	15.7	(3.8)	33.2	(7.0)	31.4	(7.4)	21.8	(3.2)
150–<300	33.6	(5.2)	21.1	(5.4)	13.1	(4.8)	28.3	(3.7)
300–<450	15.4	(4.0)	21.0	(6.7)	18.9	(7.0)	17.2	(3.2)
450+	20.4	(4.4)	16.0	(4.8)	21.3	(6.4)	19.4	(3.1)
Total	100.0		100.0		100.0		100.0	

There were no differences in hoof-care costs by region.

E.1.e. Percentage of operations by typical per-equid cost of hoof care in the previous 12 months, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Hoof care cost ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	19.4	(6.5)	13.9	(5.5)	7.7	(3.9)	11.0	(5.2)
>0–<150	12.0	(4.9)	19.0	(5.6)	19.8	(6.1)	36.7	(7.4)
150–<300	29.4	(7.4)	27.2	(7.2)	31.3	(7.9)	26.5	(6.8)
300–<450	23.5	(7.2)	21.9	(6.9)	9.4	(3.8)	10.0	(4.0)
450+	15.7	(5.4)	18.0	(5.8)	31.7	(8.4)	15.9	(5.1)
Total	100.0		100.0		100.0		100.0	

Over one-fourth of operations that primarily used equids for farm or ranch work (26.9 percent) had no costs associated with hoof care in the previous 12 months. Owners/operators of this type of operation might have performed hoof care themselves and, therefore, did not attribute a cost for hoof care. The majority of operations that primarily used equids for pleasure (58.2 percent) or breeding (66.3 percent) spent $1 to less than $300 per equid for hoof care in the previous 12 months, while the majority of operations that primarily used equids for lessons/school/showing/competition (66.9 percent) spent $300 or more per equid.

E.1.f. Percentage of operations by typical per-equid cost of hoof care in the previous 12 months, and by primary use of equid:

Percent Operations

	Primary Use									
	Pleasure		**Lessons/ school/ showing/ competition** (not betting)		**Breeding**		**Farm or ranch work**		**Other***	
Total hoof care cost per equid in previous 12 months ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	11.4	(4.2)	3.7	(2.8)	9.3	(4.7)	26.9	(7.6)		
>0–<150	22.9	(4.8)	10.7	(5.3)	35.9	(12.3)	16.9	(6.1)		
150–<300	35.3	(5.9)	18.6	(7.1)	30.4	(12.8)	19.3	(6.6)		
300–<450	11.3	(3.6)	31.8	(9.6)	21.3	(12.2)	22.4	(8.3)		
450+	19.0	(4.6)	35.1	(10.2)	3.1	(3.1)	14.5	(5.5)		
Total	100.0		100.0		100.0		100.0			

*Too few observations to report.

2. Vaccination costs

The cost of vaccinating equids depends on the type of vaccines used, the number of doses given, the cost of each dose, and/or the cost of having a veterinarian provide and administer the vaccines. The AAEP recommends that all equids receive core vaccines, which include tetanus toxoid, Eastern and Western encephalitis, West Nile, and rabies. Additional vaccines might be recommended based on how the equids are used and their geographic location. In particular, equids at risk of being exposed to equids outside their home base should be vaccinated against influenza and equine herpesvirus.

For the 75.8 percent of operations that vaccinated any resident equids, the overall operation average annual cost for vaccination per equid was $77.10.

E.2.a. For the 75.8 percent of operations that vaccinated any resident equids (table A.1.a), operation average per-equid cost of vaccinations in the previous 12 months, by size of operation:

Operation Average Cost per Equid ($)

Size of Operation (number of equids)

Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Avg.	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**
72.90	(5.90)	82.90	(8.90)	88.30	(10.1)	77.10	(4.50)

Costs were rounded to $0.10 (10¢).

For the 75.8 percent of operations that vaccinated any resident equids, the operation average per-equid cost of vaccination ranged from $62.50 in the South Central region to $98.20 in the Northeast region. This regional difference might be due to differences in the number of vaccines given per equid, or the cost of the vaccination service might have varied by region.

E.2.b. For the 75.8 percent of operations that vaccinated any resident equids (table A.1.a), operation average per-equid cost for vaccinations in the previous 12 months, by region:

Operation Average Cost per Equid per Year ($)

Region

West		South Central		Northeast		Southeast	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
65.40	(7.50)	62.50	(6.50)	98.20	(11.30)	89.70	(11.20)

Costs were rounded to $0.10 (10¢).

The average annual vaccination cost per equid by primary use of equid ranged from $48.30 for operations that used equids primarily for farm or ranch work to $106.50 for operations that used equids primarily for lessons/school/showing/competition.

E.2.c. For the 75.8 percent of operations that vaccinated any resident equids (table A.1.a), operation average per-equid cost of vaccinations in the previous 12 months, by primary use of equid:

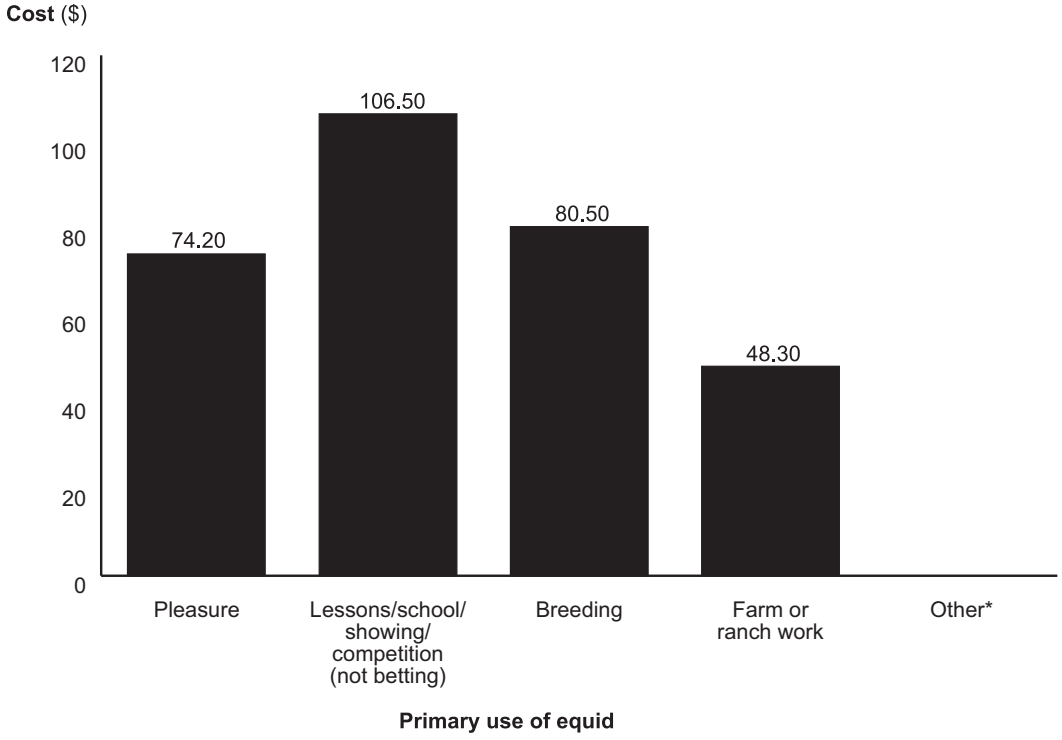
Operation Average Cost per Equid ($)

Primary Use of Equid

Pleasure		Lessons/ school/ showing/ competition (not betting)		Breeding		Farm or ranch work		Other	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
74.20	(6.40)	106.50	(10.50)	80.50	(13.30)	48.30	(7.90)	*	

*Too few observations to report.
Costs were rounded to $0.10 (10¢).

For the 75.8 percent of operations that vaccinated any resident equids, operation average per-equid cost of vaccinations in the previous 12 months, by primary use of equid



*Too few observations to report.
Costs were rounded to $0.10 (10¢).

3. Veterinary services

The cost of veterinary services can vary based on the number and type of services provided. In addition, the costs of similar services might vary by region, based on the market for the service and the distance a veterinarian traveled to provide the service (farm call).

Overall, 59.8 percent of operations had a farm call in the previous 12 months, and 28.6 percent had an emergency call. More than half of operations used a veternarian for routine dental treatment (55.5 percent), to provide or administer vaccines (52.8 percent), and/or to perform a physical exam (50.7 percent). Generally, the percentage of operations that contacted a veternarian for any of the services listed in the following table increased as operation size increased. Since large operations have more equids, it follows that they would have more equids in need of veterinary services.

E.3.a. Percentage of operations by type(s) of veterinary service used in the previous 12 months, and by size of operation:

Percent Operations

Size of Operation (number of equids)

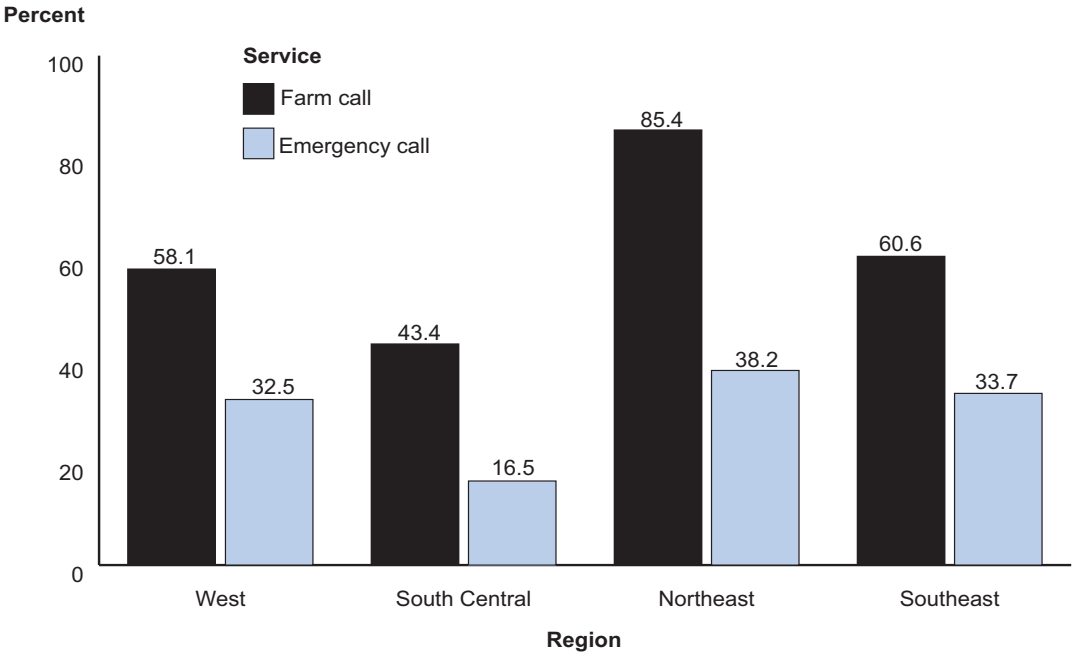
	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Service	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Farm call	59.4	(4.7)	53.8	(6.2)	74.9	(5.1)	59.8	(3.4)
Emergency call	25.1	(4.0)	26.8	(5.2)	51.5	(6.5)	28.6	(3.0)
Routine floating/dental	52.9	(4.8)	52.0	(6.0)	76.5	(5.4)	55.5	(3.4)
Advanced dental treatment	6.0	(2.0)	9.4	(3.7)	18.5	(5.6)	8.3	(1.7)
Physical exam	48.5	(4.7)	49.3	(6.0)	65.2	(6.1)	50.7	(3.4)
Vaccine purchased from or administered by veterinarian	51.0	(4.8)	53.3	(6.1)	61.2	(6.3)	52.8	(3.5)
Laboratory testing	45.6	(4.8)	45.4	(6.1)	61.2	(6.5)	47.4	(3.5)
Sick/injured animal treatment	40.0	(4.5)	49.5	(6.1)	66.8	(6.2)	45.5	(3.4)
Mare reproductive services	6.8	(2.4)	20.4	(5.0)	33.3	(6.2)	13.3	(2.2)
Other	12.5	(3.2)	15.0	(4.3)	16.2	(4.5)	13.6	(2.4)

A higher percentage of operations in the Northeast region (38.2 percent) had a veterinarian make an emergency call in the previous 12 months than operations in the South Central region (16.5 percent).

E.3.b. Percentage of operations by type(s) of veterinary service used in the previous 12 months, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Service	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Farm call	58.1	(7.0)	43.4	(6.6)	85.4	(4.3)	60.6	(6.6)
Emergency call	32.5	(7.1)	16.5	(4.1)	38.2	(6.6)	33.7	(6.0)
Routine floating/dental	55.2	(7.1)	52.3	(6.8)	68.6	(6.4)	47.7	(6.2)
Advanced dental treatment	13.4	(5.1)	5.9	(2.8)	7.8	(2.6)	7.8	(3.4)
Physical exam	56.0	(6.8)	50.8	(6.7)	51.9	(6.8)	44.4	(6.4)
Vaccine purchased from or administered by veterinarian	51.7	(7.7)	47.0	(6.7)	64.4	(6.2)	51.0	(6.6)
Laboratory testing	43.6	(7.6)	43.2	(6.7)	50.6	(6.8)	53.9	(6.7)
Sick/injured animal treatment	57.3	(6.9)	32.3	(6.0)	50.6	(6.6)	49.5	(6.6)
Mare reproductive services	14.0	(4.6)	14.6	(4.6)	9.3	(3.2)	14.6	(3.9)
Other	27.1	(6.9)	10.4	(4.3)	11.9	(4.2)	7.6	(2.8)

Percentage of operations by type(s) of veterinary service used in the previous 12 months, and by region



A higher percentage of operations that used resident equids primarily for lessons/school/showing/competition (not betting) [85.3 percent] used a veterinarian to provide and/or administer vaccines to one or more resident equids in the previous 12 months than operations that used equids primarily for pleasure (46.8 percent) or farm or ranch work (41.4 percent).

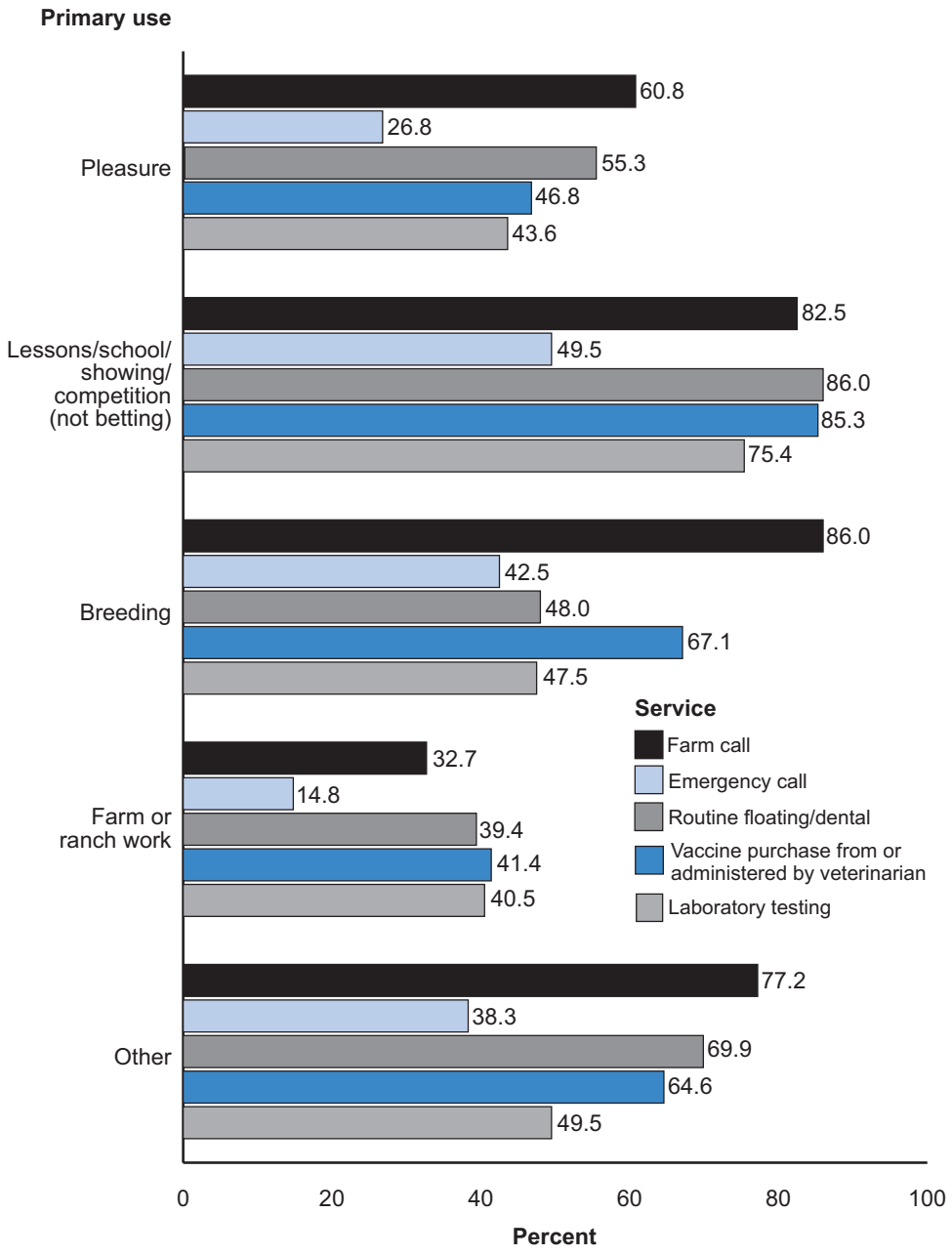
In total, 42.3 percent of operations that used resident equids primarily for breeding had a veterinarian perform a mare reproductive examination; however, some breeding operations might not have had resident mares on the operation, e.g., operations that serve as stallion stations. Mares are sent to stallion stations for breeding, but are not housed at the operation on a regular basis.

E.3.c. Percentage of operations by type(s) of veterinary service used in the previous 12 months, and by primary use of resident equids:

Percent Operations

	Primary Use									
	Pleasure		Lessons/ school/ showing/ competition (not betting)		Breeding		Farm or ranch work		Other	
Service	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Farm call	60.8	(5.1)	82.5	(5.8)	86.0	(4.8)	32.7	(6.7)	77.2	(9.1)
Emergency call	26.8	(4.4)	49.5	(8.6)	42.5	(9.7)	14.8	(5.1)	38.3	(12.1)
Routine floating/dental	55.3	(5.0)	86.0	(5.5)	48.0	(10.5)	39.4	(7.4)	69.9	(10.6)
Advanced dental treatment	5.9	(1.9)	14.3	(6.5)	14.5	(6.2)	4.3	(3.4)	26.1	(11.7)
Physical exam	49.6	(5.1)	66.8	(7.8)	76.3	(7.0)	30.6	(7.0)	73.4	(10.2)
Vaccine purchased from or administered by veterinarian	46.8	(5.1)	85.3	(5.4)	67.1	(8.7)	41.4	(7.3)	64.6	(11.2)
Laboratory testing	43.6	(5.0)	75.4	(7.5)	47.5	(10.4)	40.5	(7.5)	49.5	(12.4)
Sick/injured animal treatment	42.7	(5.0)	67.8	(7.6)	70.8	(10.5)	29.0	(6.6)	56.0	(11.9)
Mare reproductive services	9.5	(2.9)	27.4	(8.4)	42.3	(10.0)	5.0	(2.4)	10.9	(6.2)
Other	6.8	(2.3)	20.4	(7.0)	11.4	(4.5)	26.0	(7.0)	11.7	(6.9)

Percentage of operations by type(s) of veterinary service used in the previous 12 months, and by primary use of equids



Operations paid an average of $62.40 for a farm call and $140.30 for an emergency call. Emergency calls are generally more expensive, since they are made outside routine business hours, such as at night, on weekends, or on holidays. On average, the typical average cost of routine float/dental care was $126.50 per service.

E.3.d. For operations that used any of the following veterinary services in the previous 12 months, operation average cost per service, by size of operation:

Operation Average Cost ($)

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Service	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**	**Avg.**	**Std. error**
Farm call	65.00	(4.90)	60.30	(3.90)	53.10	(6.40)	62.40	(3.40)
Emergency call	135.40	(15.50)	159.20	(37.20)	131.10	(21.60)	140.30	(13.40)
Routine floating/ dental	135.80	(14.10)	113.90	(10.90)	103.00	(23.30)	126.50	(10.00)

For operations that used the following veterinary services, the majority paid less than $100 for a farm call (86.8 percent), from $50 to $200 for an emergency call (66.3 percent), and from $50 to $200 for a routine float/dental treatment (71.6 percent).

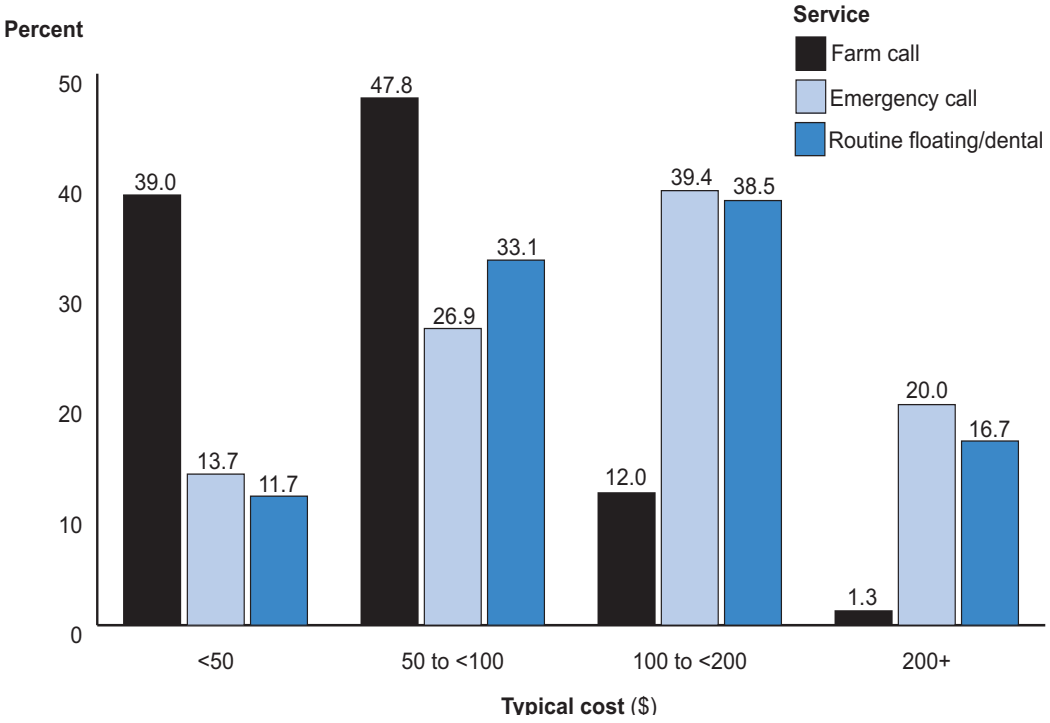
E.3.e. For operations that used the following veterinary services in the previous 12 months, percentage of operations by typical cost per service:

Percent Operations

Typical Cost per Service ($)

	<50		50–<100		100–<200		200+		
Service	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Total**
Farm call	39.0	(4.4)	47.8	(4.6)	12.0	(3.1)	1.3	(0.9)	100.0
Emergency call	13.7	(4.8)	26.9	(5.5)	39.4	(6.3)	20.0	(5.2)	100.0
Routine floating/dental	11.7	(2.8)	33.1	(4.7)	38.5	(4.9)	16.7	(3.9)	100.0

For operations that used the following veterinary services in the previous 12 months, percentage of operations by typical cost per service



Overall, 12.2 percent of operations spent no money for veterinary services for resident equids in the previous 12 months. A higher percentage of medium operations (21.7 percent) had no cost for veterinary services compared with large operations (4.1 percent). Over half of operations (52.4 percent) spent from $50 to $350 on veterinary services.

E.3.f. Percentage of operations by total cost paid per equid for all veterinary services used in the previous 12 months, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Total per-equid cost ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	9.8	(3.0)	21.7	(5.8)	4.1	(2.6)	12.2	(2.4)
>0–<50	16.5	(4.1)	11.0	(4.2)	11.4	(4.6)	14.6	(2.9)
50–<150	37.0	(5.1)	19.8	(5.4)	36.1	(7.3)	32.5	(3.7)
150–<350	17.3	(3.5)	24.0	(5.8)	25.9	(6.3)	19.9	(2.8)
350+	19.4	(3.9)	23.5	(5.9)	22.5	(5.2)	20.8	(3.0)
Total	100.0		100.0		100.0		100.0	

E.3.g. Percentage of operations by total cost paid per equid for all veterinary services used in the previous 12 months, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Total per-equid cost ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	11.5	(4.9)	16.0	(4.8)	3.3	(2.4)	15.5	(5.8)
>0–<50	12.2	(5.3)	18.3	(5.9)	13.8	(5.8)	12.0	(5.2)
50–<150	27.0	(7.3)	32.5	(6.9)	28.1	(7.0)	42.4	(7.7)
150–<350	21.6	(5.9)	16.9	(5.4)	25.4	(5.8)	17.6	(4.6)
350+	27.7	(7.1)	16.4	(4.8)	29.4	(7.6)	12.5	(3.6)
Total	100.0		100.0		100.0		100.0	

Of operations that used resident equids primarily for pleasure, 54.9 percent spent from $50 to $350 per equid for veterinary services in the previous 12 months. Of operations that used resident equids primarily for lessons/school/showing/competition, 67.4 percent spent $150 or more per equid on veterinary services. Of operations that used equids primarily for breeding, 58.3 percent spent $150 or more.

E.3.h. Percentage of operations by total cost paid per equid for all veterinary services used in the previous 12 months, and by primary use of equid:

Percent Operations

	Primary Use									
	Pleasure		**Lessons/ school/ showing/ competition** (not betting)		**Breeding**		**Farm or ranch work**		**Other**	
Total per-equid cost ($)	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
0	13.1	(3.7)	4.8	(3.8)	7.1	(3.8)	15.2	(5.9)	16.5	(9.2)
>0–<50	14.0	(4.3)	0.8	(0.8)	15.4	(9.9)	24.8	(7.0)	5.1	(5.0)
50–<150	33.1	(5.4)	27.0	(8.2)	19.2	(7.5)	39.3	(8.3)	28.7	(11.3)
150–<350	21.8	(4.4)	21.7	(6.1)	27.2	(9.3)	11.9	(4.7)	22.8	(11.9)
350+	17.9	(4.2)	45.7	(9.6)	31.1	(11.2)	8.8	(4.2)	26.9	(11.8)
Total	100.0		100.0		100.0		100.0		100.0	

4. Insect and tick control

Controlling insects and ticks is an important part of equine health management. Insects and ticks can transmit disease agents to equids and can injure skin while feeding on blood or secretions. Controlling these pests is often accomplished by using one or more products applied to the equid or to the environment.

Fly masks cover equids' eyes and part of their face. Some fly masks also cover the ears. Fly masks are made of a porous mesh, allowing equids to see and air to circulate while still protecting the equids' eyes. Some masks also prevent insects from entering equids' ears.

Fly sheets are also made of a meshlike material and protect the upper body. Some fly sheets also protect the neck area.

The highest percentage of operations (86.5 percent) used sprays to control insects. Overall, 40.7 percent of operations used fly masks; 39.7 percent used hanging insect/fly attractants, such as a fly bag or sticky tape; and 21.2 percent used spot-on treatments.

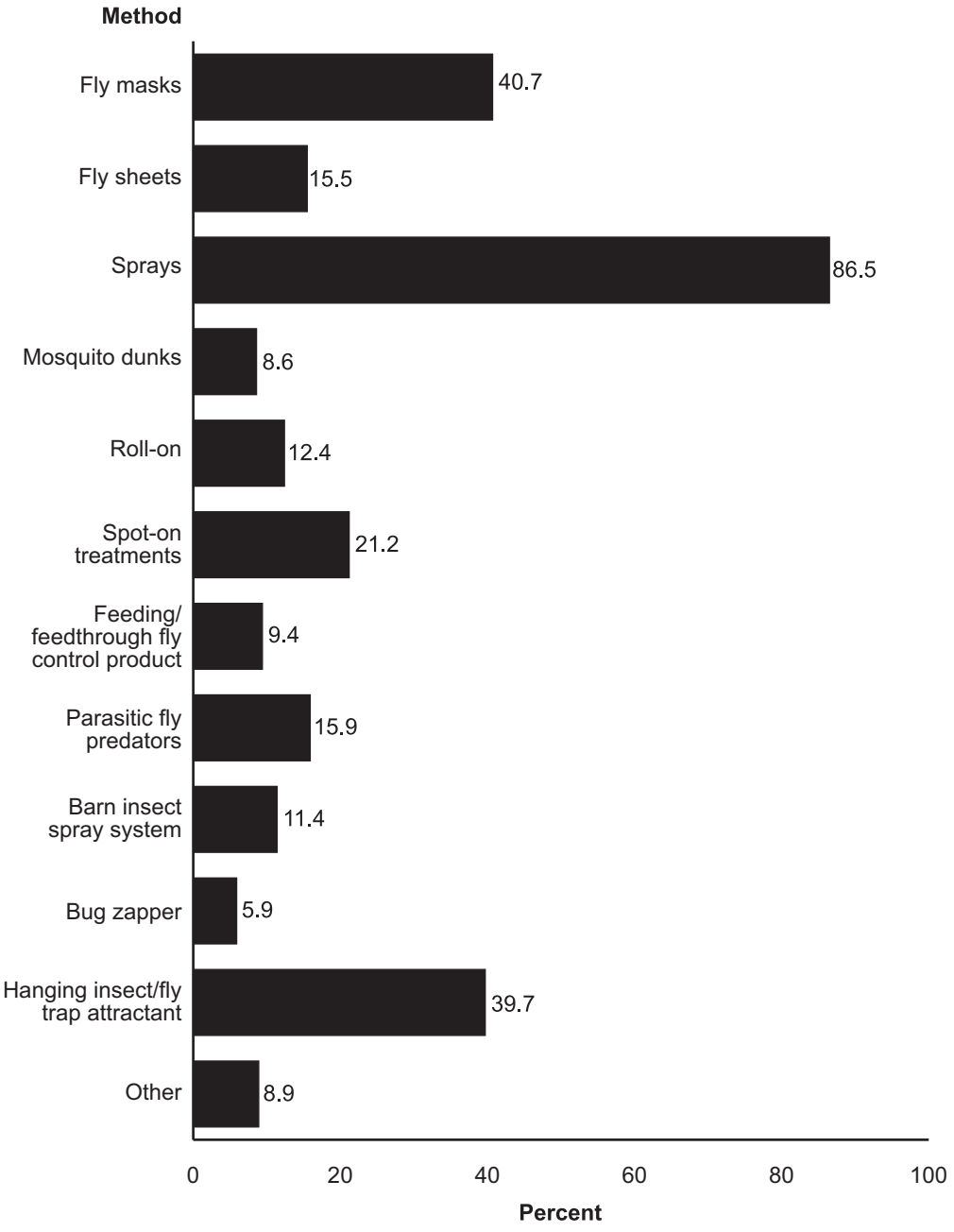
E.4.a. Percentage of operations by insect- and tick-control method(s) used for any resident equids in the previous 12 months, and by size of operation:

Percent Operations

Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Method	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Fly masks	41.4	(4.7)	34.5	(5.5)	50.7	(6.6)	40.7	(3.3)
Fly sheets	16.5	(3.4)	13.0	(3.6)	15.4	(3.8)	15.5	(2.4)
Sprays	86.5	(3.6)	88.4	(4.7)	82.6	(5.2)	86.5	(2.6)
Mosquito dunks	10.2	(3.3)	5.6	(2.5)	6.3	(4.6)	8.6	(2.2)
Roll-on	12.1	(2.8)	12.1	(3.7)	14.5	(5.4)	1 .4	(2.1)
Spot-on treatments (individual doses)	20.7	(3.8)	23.8	(5.1)	18.7	(5.5)	21.2	(2.8)
Feeding/feed-through fly control product	9.6	(2.9)	6.7	(2.8)	13.5	(4.7)	9.4	(2.0)
Parasitic fly predators	17.4	(3.8)	14.4	(4.3)	11.3	(3.8)	15.9	(2.7)
Barn insect spray system	11.2	(2.6)	12.0	(3.5)	11.4	(4.1)	11.4	(1.9)
Bug zapper	4.5	(1.7)	8.3	(3.8)	8.1	(4.7)	5.9	(1.6)
Hanging insect/ fly trap attractant (e.g., fly bag, sticky tape)	41.2	(4.6)	33.8	(5.7)	44.1	(6.5)	39.7	(3.3)
Other	7.7	(2.0)	8.1	(2.8)	17.4	(5.8)	8.9	(1.6)

Percentage of operations by insect- and tick-control method(s) used for any resident equids in the previous 12 months



A higher percentage of operations in the Northeast region than in the South Central region used hanging insect/fly trap attractants as a control method (54.2 and 27.7 percent, respectively). Sticky tape or a trap system can be used in equine housing areas to attract and trap insects, reducing the number of insects that might bite or feed on equids.

E.4.b. Percentage of operations by insect- and tick-control method(s) used for any resident equids in the previous 12 months, and by region:

	Percent Operations							
	Region							
	West		South Central		Northeast		Southeast	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Fly masks	49.2	(7.3)	29.1	(6.0)	47.4	(6.7)	43.8	(6.5)
Fly sheets	17.6	(5.8)	11.9	(4.2)	23.8	(5.3)	10.9	(3.2)
Sprays	85.9	(5.2)	86.2	(5.4)	87.0	(4.3)	87.1	(4.9)
Mosquito dunks	3.7	(2.7)	14.3	(5.5)	4.4	(2.5)	8.6	(3.6)
Roll-on	10.7	(4.5)	5.0	(2.1)	18.0	(5.2)	19.6	(5.4)
Spot-on treatments	14.4	(4.4)	18.4	(4.9)	18.0	(5.3)	35.0	(6.4)
Feeding/feed-through fly control product	8.4	(4.7)	12.4	(4.4)	7.6	(3.2)	7.4	(2.8)
Parasitic fly predators	24.7	(6.9)	13.7	(5.1)	16.9	(5.2)	10.3	(3.9)
Barn insect spray system	15.3	(4.9)	10.8	(3.3)	5.9	(2.6)	14.1	(4.2)
Bug zapper	8.6	(3.9)	4.2	(2.4)	7.7	(4.0)	4.0	(2.6)
Hanging insect/ fly trap attractant (e.g., fly bag, sticky tape)	49.1	(7.6)	27.7	(5.7)	54.2	(6.5)	34.8	(6.2)
Other	5.6	(2.9)	3.7	(1.8)	16.5	(4.5)	12.4	(3.9)

A higher percentage of boarding stable/training/riding stable operations (77.1 percent) used fly masks than equine breeding operations (44.9 percent), farm or ranch operations (22.5 percent), or operations that primarily used equids for personal use (45.7 percent). When using fly masks on equids, it is important to regularly observe the equids to be certain the mask is in place and fitting properly. Operations with a high density of equids are more likely to have high levels of flies in the environment and, therefore, might use fly masks on resident equids more often.

A higher percentage of boarding stable/training/riding operations used fly sheets (35.9 percent) than farm or ranch operations (7.4 percent). Like fly masks, the use of fly sheets requires regular observation of the equids to be certain sheets are in place. Fly sheets would likely be used on operations in which equids are housed separately, in small groups, or in locations in which it would be unlikely that the fly sheet would get caught on brush or fences.

E.4.c. Percentage of operations by method(s) used control insects and ticks in the previous 12 months, and by primary function of operation:

	Percent Operations									
	Primary Function									
	Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other	
Method	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error	Pct.	Std. error
Fly masks	77.1	(5.5)	44.9	(10.7)	22.5	(4.9)	45.7	(5.9)	*	
Fly sheets	35.9	(6.4)	15.3	(7.2)	7.4	(2.6)	17.6	(4.5)	*	
Sprays	95.4	(2.9)	85.1	(6.8)	80.3	(4.9)	89.5	(4.1)	*	
Mosquito dunks	7.6	(3.1)	17.9	(10.0)	7.1	(3.9)	9.1	(3.7)	*	
Roll-on	19.8	(5.2)	10.9	(7.3)	7.2	(2.6)	12.5	(3.7)	*	
Spot-on treatments	31.3	(6.0)	15.1	(7.1)	17.2	(4.3)	24.4	(5.1)	*	
Feeding/feed-through fly control product	15.6	(4.3)	6.1	(5.0)	7.6	(3.0)	9.9	(3.8)	*	
Parasitic fly predators	26.9	(6.2)	14.4	(7.9)	12.5	(4.4)	14.7	(4.3)	*	
Barn insect spray system	19.5	(5.9)	9.1	(5.3)	8.0	(2.7)	12.6	(3.3)	*	
Bug zapper	6.9	(3.5)	6.1	(3.3)	6.6	(3.0)	5.1	(2.4)	*	
Hanging insect/fly trap attractant (e.g., fly bag, sticky tape)	55.4	(6.5)	41.8	(10.6)	36.3	(5.7)	37.7	(5.4)	*	
Other	10.9	(4.0)	10.4	(4.4)	9.3	(3.0)	7.2	(2.5)	*	

*Too few observations to report.

On average, operations spent $35 per equid for insect- and tick-control products in the previous 12 months. The average per-equid cost for insect- and tick-control products decreased as operation size increased.

E.4.d. Average per-equid cost for insect- and tick-control products in the previous 12 months, by size of operation:

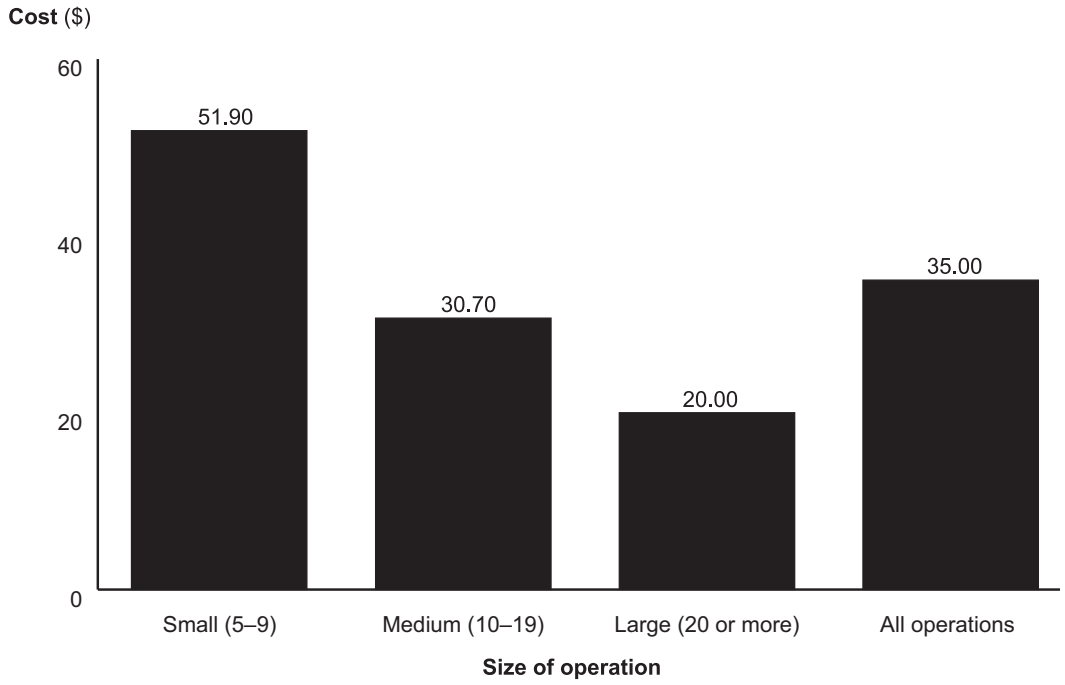
Average Cost per Equid ($)

Size of Operation (number of equids)

Small (5–9)		Medium (10–19)		Large (20 or more)		All operations	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
51.90	(5.70)	30.70	(5.40)	20.00	(4.10)	35.00	(3.10)

Costs were rounded to $0.10 (10¢).

Average per-equid cost for insect- and tick-control products in the previous 12 months, by size of operation



Costs were rounded to $0.10 (10¢).

E.4.e. Average cost paid per equid for insect- and tick-control products in the previous 12 months, by region:

Average Cost per Equid ($)

Region

West		South Central		Northeast		Southeast	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
40.70	(7.40)	27.80	(3.70)	37.70	(7.00)	36.90	(7.40)

Costs were rounded to $0.10 (10¢).

The average total cost per equid for insect- or tick-control products for a 12-month period varied by primary function of operation and ranged from $15.70 for breeding operations to $56.90 for boarding stable/training/riding stable operations.

E.4.f. Average total cost paid per equid for insect- and tick-control products in the previous 12 months, by primary function of operation:

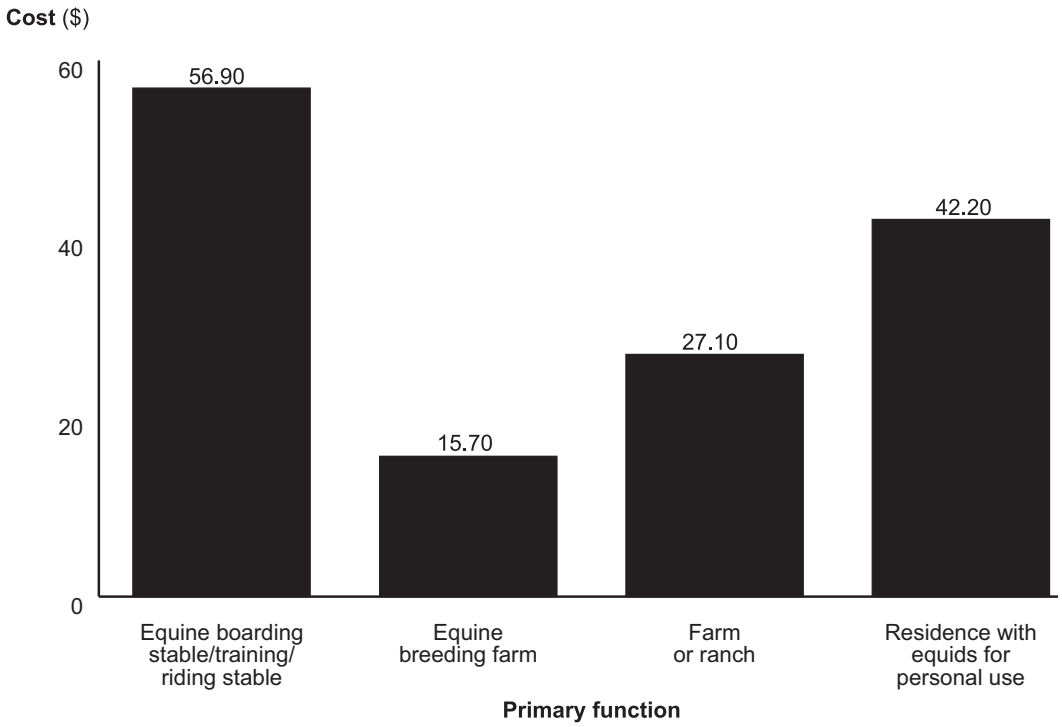
Average Cost per Equid ($)

Primary Function

Boarding stable/ training/ riding stable		Equine breeding farm		Farm or ranch		Residence with equids for personal use		Other*	
Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error	Avg.	Std. error
56.90	(10.20)	15.70	(3.00)	27.10	(4.70)	42.20	(5.70)		

*Too few observations to report.
Costs were rounded to $0.10 (10¢).

Average total cost paid per equid for insect- and tick-control products in the previous 12 months, by primary function of operation



Costs were rounded to $0.10 (10¢).

5. Veterinary products

Equine operations use various types of veterinary products to provide health care to equids. Certain drugs such as dewormers, wound ointments, over-the-counter antibiotics, and anti-inflammatories can be purchased at veterinary supply stores or through online sources. Wound-care kits containing bandage materials, wound cleansers, and ointments are commonly used by equine operations.

Nearly all equine operations (93.2 percent)[1] used dewormers for resident equids in the previous 12 months. Over half of operations (55.5 percent) used vitamins/mineral nutrition supplements for resident equids. One-third or more used vaccines not obtained from a veterinarian (43.4 percent), other drugs (45.6 percent), joint supplements (33.0 percent), or medical supplies (48.7 percent).

E.5.a. Percentage of operations by veterinary product(s) used for resident equids in the previous 12 months, and by size of operation:

Percent Operations

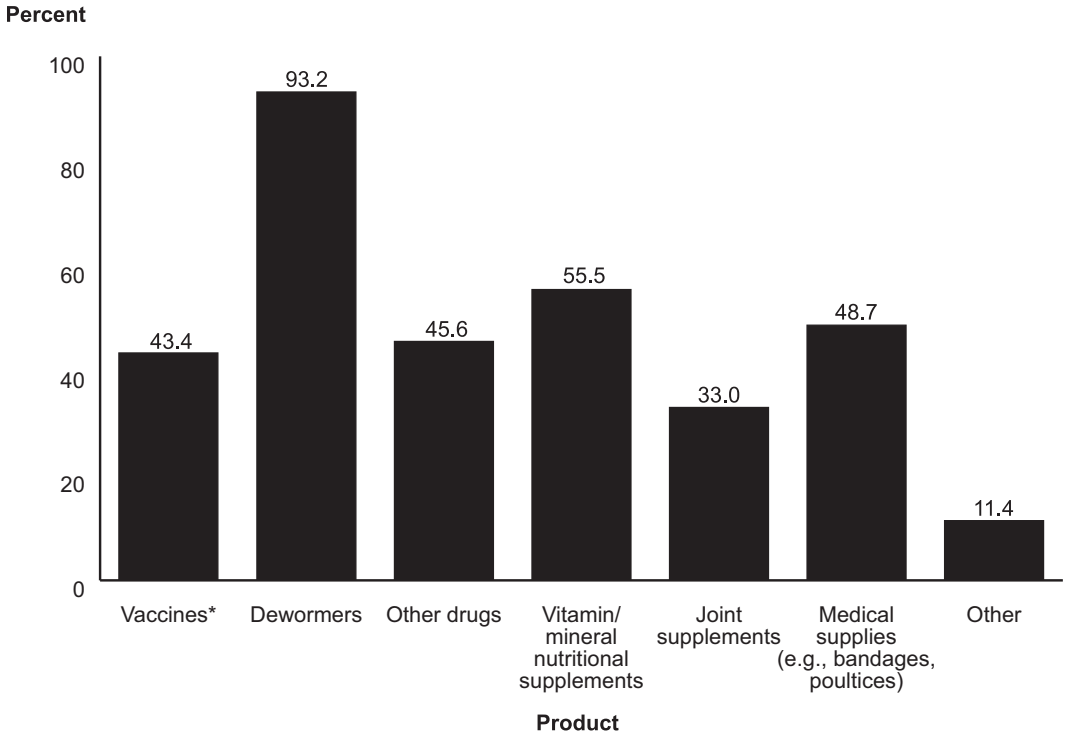
Size of Operation (number of equids)

	Small (5–9)		**Medium** (10–19)		**Large** (20 or more)		**All operations**	
Product	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Vaccines*	46.5	(4.8)	31.5	(5.4)	52.2	(6.5)	43.4	(3.5)
Dewormers	93.6	(2.3)	94.7	(2.6)	87.7	(4.1)	93.2	(1.7)
Other drugs	39.6	(4.6)	51.3	(6.1)	65.7	(6.0)	45.6	(3.4)
Vitamin/mineral nutritional supplements	49.2	(4.8)	66.3	(5.7)	66.5	(6.1)	55.5	(3.5)
Joint supplements	27.9	(4.2)	37.4	(5.6)	50.8	(6.5)	33.0	(3.1)
Medical supplies (e.g., bandages, poultices)	43.7	(4.7)	54.6	(6.1)	62.6	(6.2)	48.7	(3.4)
Other	10.8	(3.0)	15.3	(4.8)	6.0	(3.4)	11.4	(2.2)

*Purchased, but not from a veterinarian.

[1]This estimate is slightly different from that in table B.1.a, because part B of the report includes only operations that participated in the parasite section and those that completed the entire phase II questionnaire.

Percentage of operations by veterinary product(s) used for resident equids in the previous 12 months



*Purchased, but not from a veterinarian.

A higher percentage of operations in the Northeast region (72.1 percent) used vitamin/mineral nutritional supplements than operations in the South Central region (43.9 percent).

E.5.b. Percentage of operations by veterinary product(s) used for resident equids in the previous 12 months, and by region:

Percent Operations

Region

	West		South Central		Northeast		Southeast	
Product	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Vaccines*	43.4	(7.6)	48.1	(6.7)	48.1	(6.6)	32.5	(6.1)
Dewormers	90.6	(4.0)	96.7	(1.8)	92.0	(4.2)	91.5	(3.8)
Other drugs	52.5	(7.5)	36.9	(6.5)	58.3	(6.8)	40.4	(6.0)
Vitamin/mineral nutritional supplements	55.3	(7.6)	43.9	(6.6)	72.1	(6.4)	57.2	(6.6)
Joint supplements	34.5	(7.2)	23.5	(5.2)	46.9	(6.9)	32.6	(5.5)
Medical supplies (e.g., bandages, poultices)	62.6	(7.4)	40.5	(6.4)	46.8	(6.8)	49.9	(6.5)
Other	16.1	(5.1)	6.6	(3.8)	14.5	(4.7)	11.1	(4.1)

*Purchased, but not from a veterinarian.

Over half of operations that used equids primarily for lessons/school/showing/competition (not betting) used dewormers, other drugs, vitamin/mineral nutritional supplements, joint supplements, and medical supplies for resident equids. Equids with a high level of performance might require additional nutritional and joint supplements.

E.5.c. Percentage of operations by veterinarian products used for resident equids in the previous 12 months, and by primary use of equid:

Percent Operations

	Primary Use									
	Pleasure		**Lessons/ school/ showing/ competition** (not betting)		**Breeding**		**Farm or ranch work**		**Other**	
Product	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**
Vaccines*	45.5	(5.1)	36.9	(8.3)	52.6	(10.5)	36.6	(7.4)	55.3	(12.2)
Dewormers	92.6	(2.5)	98.7	(1.3)	98.0	(1.4)	89.2	(4.3)	96.6	(3.4)
Other drugs	38.5	(4.8)	69.4	(7.1)	43.0	(9.9)	44.6	(7.5)	67.8	(10.8)
Vitamin/ mineral nutritional supplements	53.7	(5.1)	79.7	(6.3)	72.9	(9.5)	36.8	(7.0)	77.7	(9.7)
Joint supplements	28.0	(4.3)	57.2	(8.6)	32.6	(9.7)	24.1	(6.1)	68.3	(10.7)
Medical supplies (e.g., bandages, poultices)	45.0	(5.0)	74.0	(7.0)	54.6	(10.7)	35.9	(6.8)	75.3	(9.2)
Other	13.7	(3.8)	7.8	(5.6)	14.4	(9.4)	8.0	(3.3)	7.2	(6.8)

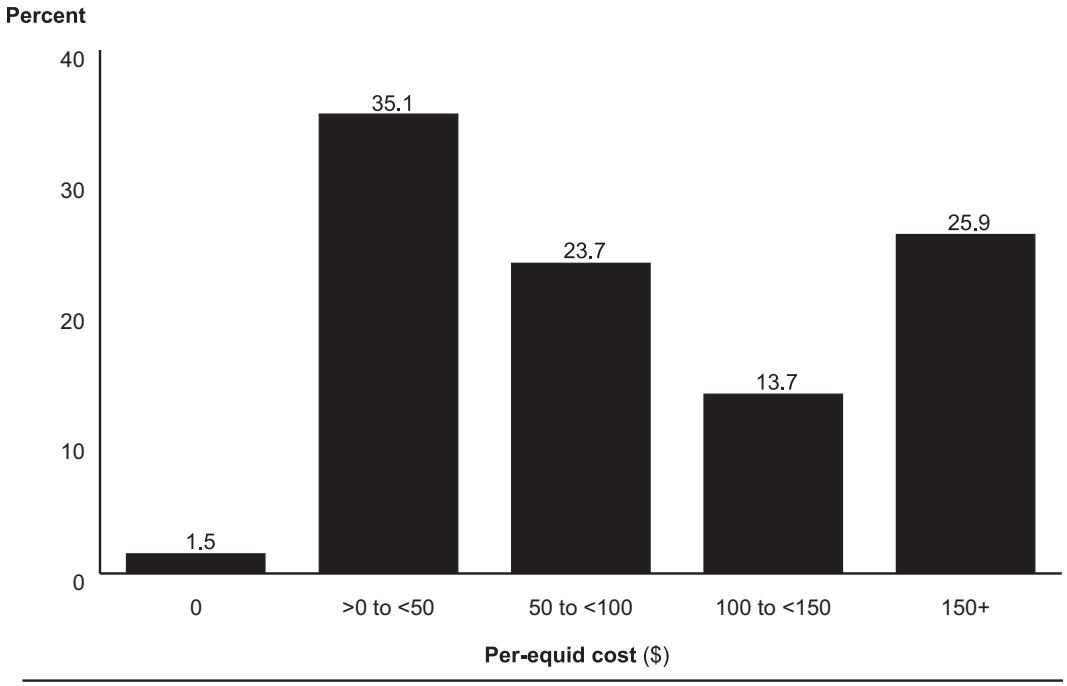
*Purchased, but not from a veterinarian.

The total operation average cost of veterinary products per equid in the previous 12 months was $109.40. About one-third of operations (36.6 percent) spent less than $50 per equid, while one-fourth (25.9 percent) spent $150 or more per equid. On an individual operation, some equids might not have generated any associated costs for veterinary supplies, while other equids on the operation might have generated large costs. The estimates in this table reflect an average cost that takes into account all equids on a given operation.

E.5.d. Percentage of operations by per-equid cost for veterinary products in the previous 12 months and operation average total cost paid per equid:

Percent Operations												
Total Cost per Equid ($)											**Operation average**	
0		**>0–<50**		**50–<100**		**100–<150**		**150+**				
Pct.	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Pct.**	**Std. error**	**Total**	**$**	**Std. error**
1.5	(0.9)	35.1	(3.4)	23.7	(3.1)	13.7	(2.7)	25.9	(3.4)	100.0	109.4	(21.50)

Percentage of operations by per-equid cost for veterinary products in the previous 12 months



Section II: Methodology

A. Needs Assessment

Prior to each national study, NAHMS conducts a needs assessment to determine an industry's critical information gaps. For the Equine 2015 study, the needs assessment gathered input through multiple means, including reviews of the literature and equine health-related discussions held at various equine industry meetings. In addition, NAHMS conducted a survey. Responses were provided by 89 equine industry leaders and 2,435 individuals via an online questionnaire from November 2013 through January 2014.

B. Sampling

1. State selection

The goal for NAHMS national studies is to include States that account for at least 70 percent of the animal and farm populations being studied. This method helps to ensure that the representation of the sample and the statistical inferences made using the sample data can be generalized to the target population, but balances this scientific aim with practical budget constraints. A total of 28 States were selected for inclusion in the study based upon each State's contribution to the total number of U.S. equine farms, number of equids, and equine density (number of horses per square mile). Twenty-one of the States were included due to high weighted averages of the number of equine operations and the number of equids in the State, while the remaining States were included based upon equine density and geographic coverage.

The 28 States represented 71.8 percent of all equids in the United States and 72.1 percent of all U.S. farms with equids (appendices II and III). The 28-State target population represented 71.6 percent of all equids on farms with 5 or more equids and 70.9 percent of farms with 5 or more equids in the United States (appendices II and III).

2. Farm selection

Equine farms were the primary sampling units in this study. The only time equine operations are directly captured by NASS is during the Census of Agriculture; thus, the NASS list frame of equine operations used for this study was based primarily on the 2012 Census of Agriculture. A farm is defined in the Census of Agriculture as being any place with $1,000 or more sales of agricultural products during the year or having at least five equids. Thus, all farms on the NASS list frame in the chosen 28 States with 5 or more equids were eligible to be included in the NAHMS sample.

A stratified random sampling design was used and 3,997 operations were selected to be part of the sample. Stratification was based on State and size of operation from the 2012 Census of Agriculture (where "size" was defined as the number of equids—5 to 9, 10 to 19, and 20 or more). The total sample size was computed to achieve prespecified precision criteria while accounting for the estimated population size, design effect, and expected response rate at the 95-percent confidence level. The sample size was allocated to strata proportional to size, based upon a weighted average number of equine operations and number of equids within the strata. This sampling design allowed for

logistical efficiencies in administering the survey, prespecified precision for estimates, and oversampling of larger operations. Of the 1,920 operations that provided questionnaire data for phase I and thus were eligible for phase II, 945 operations agreed to be contacted for phase II of the study.

3. Population inferences

The reference population was composed of all places/operations in the NASS list frame with 5 or more equids that met the NASS Agricultural Census definition of a farm for the 28 States. Sample data were weighted to reflect the reference population from which they were selected. Weights were created and supplied by NASS and were checked by NAHMS staff to ensure that the sum of the weights approximated the population size. Phase II data were re-weighted to allow for inference back to the original population. The inverse of the probability of selection (with probabilities being approximately proportional to stratum size) was used as the initial weight and then adjusted for nonresponse within State and operation size strata. Nonresponse was accounted for using an additional adjustment according to the proportion of nonrespondents within each stratum.

SUDAAN® software (RTI, version 11.0.1) was used to produce population estimates and their standard errors. SUDAAN software allows estimation of standard errors for complex sampling designs using Taylor series linearization.

C. Data Collection

1. Phase I

From April through July 2015, NASS-trained enumerators administered the phase I questionnaire and determined the operation's willingness to be contacted by Veterinary Services for participation in phase II of the study.

2. Data collectors and data collection period for phase II

Start of phase II of the NAHMS Equine 2015 study was delayed due to Veterinary Services' response to the highly pathogenic avian influenza outbreak that occurred in 2015. One portion of the planned phase II study was implemented in 2015 by modifying the study plan for parasite testing. Operations that had agreed to be contacted by Veterinary Services in phase I of the study were sent a letter explaining the delay in starting VMO/AHT visits to equine operations and were offered the option of fecal testing for their equids if they completed the parasite management portion of the phase II questionnaire. For those operations that completed the parasite section of the phase II questionnaire, kits were shipped that allowed them to collect pre- and postdeworming fecal samples from their resident equids. The VMO/AHT visits to equine operations were from May 1 through October 15, 2016; the VMOs and AHTs administered the phase II questionnaire. Operations that had not previously completed the parasite portion of the study completed it at this time. Operations that agreed to provide

information for the phase II questionnaire were eligible to have a biosecurity assessment of the operation performed by the VMO/AHT and have biologic samples collected.

D. Data Analysis and Estimation

1. Validation and estimation

After completing the VMO questionnaire, data collectors sent the completed questionnaires to their respective State NAHMS coordinators, who reviewed the questionnaire responses for accuracy. NAHMS staff independently reviewed the questionnaires prior to data entry and performed validation on the data set to identify any inconsistency and statistical issues. Consistency issues included logical inconsistencies within a survey and were identified using summaries of responses to check for invalid responses (e.g., a response of 3 for a 0/1 response variable); threshold checks (e.g., identifying invalid total sums of equine inventory); and if-then checks (e.g., if no equids were foals less than 6 months of age, should not report disease conditions for foals).

Statistical issues were identified via investigation of summary measures of responses for variables, and extreme outliers were investigated by data analysts and subject-matter experts. Inconsistencies were identified using SAS software, and hard copies of surveys were reviewed by data analysts and subject-matter experts. Identified inconsistencies were addressed using item-level imputation measures, if appropriate values could be logically deduced.

Summarization and estimation were performed using SUDAAN software, which accounted for the stratified sampling study design. Estimates were generated by one analyst and numbers and estimation code were reviewed by a second analyst to ensure accurate reporting of estimates.

E. Sample Evaluation

1. Phase I response rates

Of the 3,997 operations selected for participation, 569 were ineligible (no resident equids or out of scope). Of the 3,428 eligible operations, 66 were office holds (deliberately not contacted) and 748 were unable to be contacted. Of the 2,614 eligible operations that were contacted, 1,920 (945+975) provided questionnaire data. Of those, 945 operations agreed to be contacted for the second phase of the study.

Response category	Number of operations	Percent operations	Contacts	Usable[1]	Complete[2]
No resident equids on May 1, 2015, not eligible	552	13.8	X	X	
Refused	694	17.4	X		
Completed NASS interview for baseline report, signed consent for phase II	945	23.6	X	X	X
Completed NASS interview for baseline report, refused consent for phase II	975	24.4	X	X	X
Out of scope—ineligible	17	0.4			
Office hold	66	1.7			
Inaccessible	748	18.7			
Total	3,997	100.0			
Percent of total operations			79.2	61.9	48.0
Percent of total operations weighted			80.0	63.6	48.4

[1]Provided inventory data.

[2]Provided equine health data.

2. Phase II response rates

There were 945 operations that consented during the phase I visit to the operation to be contacted by a VMO/AHT for phase II. Of these, 329 completed (34.8 percent) and 51 partially completed (5.4 percent) (parasite section of questionnaire only) the phase II questionnaire; 267 (28.3 percent) refused to participate. Approximately 28 percent of the 945 operations were not contacted, and 1.2 percent of operations had no resident equids at the time of contact for phase II.

			Measurement Parameter			
Response category	**Number of operations**	**Percent operations**	**Contacts**	**Usable[1]**	**Complete[2]**	**Complete parasites[3]**
Survey complete	329	34.8	x	x	x	x
Survey partial complete	51	5.4	x	x		x
Out of business	19	2.0	x	x		
Refusal	267	28.3	x			
Inaccessible	268	28.4				
No resident equids	11	1.2	x	x		
Total	945	100.0	679	412	329	380
Percent of total operation			71.9	43.6	34.8	40.2
Percent of total operations weighted[4]			71.8	44.3	33.8	39.7

[1]Provided inventory and/or operation status data.
[2]Provided equine health data.
[3]Completed parasite portion of phase II questionnaire.
[4]Calculated using NASS weights.

References

Eysker et al. 1986. Control of strongylosis in horses by alternate grazing of horses and sheep and some other aspects of epidemiology of strongylidae infections. Vet Parasitol 19:103–115.

Herd RP. 1986. Epidemiology and control of equine strongylosis in Newmarket. Equine Vet J 18:447–452.

Johnson AL. 2015. Neurologic Consequences of Lyme Disease. Robinson's Current Therapy in Equine Medicine, 7th ed. Sprayberry KA, Robinson NE, eds. Elsevier, 391–393.

Kaplan RM, Nielsen MK. 2010. An evidence-based approach to equine parasite control: It ain't the 60's anymore. Eq Vet Educ 22:306–316.

Madigan JE, Pusterla N. 2015. Equine Granulocytic Anaplsmosis (formerly Ehrlichiosis). In Robinson's Current Therapy in Equine Medicine, 7th ed. Sprayberry KA, Robinson NE, eds. Elsevier, 193-195.

Nielsen MK, Kaplan RM, Thamsborg SM, Monrad J, Olsen JM. 2007. Climatic influences on development and survival of free-living stages of equine strongyles: Implications for worm control strategies and managing anthelmintic resistance. Vet J 174:23–32.

Pelzel-McCluskey PM, Traub-Dargatz JL. 2015. Equine Piroplasmosis. In In Robinson's Current Therapy in Equine Medicine, 7th ed. Sprayberry KA, Robinson NE, eds. Elsevier, 480–483.

Sonenshine DE. 1994. Ecological Dynamics of Tick-Borne Zoonoses. Oxford University Press.

Appendix I: Sample Profile

1. Size of operation

	Number of responding operations		
Number of resident equids[1]	Phase I	Phase II	Phase II parasites[3]
5 to 9[2]	1,038	148	180
10 to 19	469	95	106
20 or more	413	86	94
Total	1,920	329	380

[1]An equid that spent or was expected to spend more time at the operation than at any other operation, whether or not it was present at the time of the interview. The operation was its home base.
[2]Includes operations that had five or more equids per NASS list frame but could have had fewer than five equids on May 1, 2015.
[3]Completed parasite portion of phase II questionnaire.

2. Region

	Number of responding operations		
Region	Phase I	Phase II	Phase II parasites*
West (AZ, CA, CO, MT, OR, WY)	375	69	82
South Central (AR, KS, MO, OK, TX)	524	92	100
Northeast (CT, DE, MA, MD, MI, NJ, NY, OH, PA, RI, WI)	493	81	100
Southeast (AL, FL, KY, NC, TN, VA)	528	87	98
Total	1,920	329	380

*Completed parasite portion of phase II questionnaire.

3. Type of operation

	Number of responding operations		
Primary function of operation	**Phase I**	**Phase II**	**Phase II parasites***
Boarding stable/training	262	60	74
Riding stable	57	17	19
Rescue/rehabilitation facility	29	2	2
Equine breeding farm	174	40	45
Guest ranch	19	6	6
Farm/ranch	713	101	113
Residence with equids for personal use	650	100	118
Other	11	3	3
Not specified	5	0	0
Total	1,920	329	380

*Completed parasite portion of phase II questionnaire.

Appendix II: 2012 Census—U.S. Equine Populations

		2012 Census: Number of Equids on Farms[1] by size of operation (number of equids)				
Region	**State**	**All**	**5–9**	**10–19**	**20 or more**	**5 or more[2]**
Northeast	CT	18,227	2,607	4,917	9,179	16,703
	DE	6,261	1,552	1,646	2,362	5,560
	MA	21,004	3,814	4,552	11,215	19,581
	MD	29,842	7,710	7,853	10,894	26,457
	MI	92,221	25,652	22,885	28,468	77,005
	NJ	28,639	6,085	6,049	13,097	25,231
	NY	93,600	19,901	22,685	39,933	82,519
	OH	121,055	34,492	33,794	33,306	101,592
	PA	129,460	36,443	37,115	37,972	111,530
	RI	2,518	474	768	947	2,189
	WI	109,226	32,030	27,269	25,948	85,247
	Total	652,053	170,760	169,533	213,321	553,614
South Central	AR	69,255	23,267	17,064	14,093	54,424
	KS	78,787	18,937	15,553	29,394	63,884
	MO	127,588	39,117	30,199	30,875	100,191
	OK	172,438	46,301	37,469	54,914	138,684
	TX	458,333	126,701	97,375	137,585	361,661
	Total	906,401	254,323	197,660	266,861	718,844
Southeast	AL	75,108	24,421	18,727	19,212	62,360
	FL	129,667	30,040	29,430	54,877	114,347
	KY	154,483	40,407	32,326	56,803	129,536
	NC	75,953	22,065	19,696	20,206	61,967
	TN	112,009	34,697	29,590	25,097	89,384
	VA	93,771	25,772	22,788	30,087	78,647
	Total	640,991	177,402	152,557	206,282	536,241
West	AZ	95,440	23,042	18,629	40,091	81,762
	CA	149,253	30,785	29,441	72,804	133,030
	CO	116,262	29,933	25,189	43,709	98,831
	MT	102,547	26,599	19,967	42,065	88,631
	OR	74,157	18,095	15,346	27,452	60,893
	WY	75,035	14,841	15,196	39,447	69,484
	Total	612,694	143,295	123,768	265,568	532,631
Total 28 States		2,812,139	745,780	643,518	952,032	2,341,330
28 States as a % of 50 States		71.8	70.9	70.7	72.8	71.6
Total U.S.		3,913,938	1,051,540	910,150	1,306,906	3,268,596

[1]Source: NASS, 2012 Census of Agriculture.

[2]Reference population.

Appendix III: 2012 Census—Number of Farms Reporting Equids

		2012 Census: Number of Farms Reporting Equids[1]				
Region	**State**	**All**	**5–9**	**10–19**	**20 or more**	**5 or more[2]**
Northeast	CT	1,698	412	359	279	1,050
	DE	713	249	127	66	442
	MA	1,849	586	340	343	1,269
	MD	3,373	1,196	596	278	2,070
	MI	12,666	4,006	1,775	833	6,614
	NJ	3,142	928	452	348	1,728
	NY	10,389	3,097	1,754	1,058	5,909
	OH	16,825	5,289	2,626	999	8,914
	PA	16,854	5,513	2,908	1,138	9,559
	RI	302	69	60	29	158
	WI	17,729	5,020	2,106	796	7,922
	Total	85,540	26,365	13,103	6,167	45,635
South Central	AR	11,531	3,654	1,339	458	5,451
	KS	11,031	2,994	1,238	612	4,844
	MO	20,634	6,170	2,359	821	9,350
	OK	25,099	7,279	2,920	1,147	11,346
	TX	71,518	19,892	7,589	3,421	30,902
	Total	139,813	39,989	15,445	6,459	61,893
Southeast	AL	10,908	3,819	1,462	550	5,831
	FL	14,522	4,666	2,272	1,265	8,203
	KY	20,248	6,345	2,528	1,318	10,191
	NC	11,274	3,482	1,523	614	5,619
	TN	17,673	5,409	2,295	712	8,416
	VA	12,870	4,010	1,760	906	6,676
	Total	87,495	27,731	11,840	5,365	44,936
West	AZ	11,428	3,662	1,472	690	5,824
	CA	15,275	4,832	2,268	1,539	8,639
	CO	14,437	4,675	1,950	1,123	7,748
	MT	12,087	4,179	1,581	982	6,742
	OR	9,940	2,844	1,184	570	4,598
	WY	6,251	2,318	1,169	690	4,177
	Total	69,418	22,510	9,624	5,594	37,728
Total 28 States		382,266	116,595	50,012	23,585	190,192
28 States as a % of 50 States		72.1	71.0	70.6	71.4	70.9
Total U.S.		530,030	164,328	70,793	33,031	268,152

[1]Source: NASS, 2012 Census of Agriculture.
[2]Reference population.

Appendix IV: Habitat Types

Habitat type	Description	Examples
Developed, residential	Areas with 30 percent or higher constructed materials such as asphalt, concrete, wooden fences, or metal beams May or may not have vegetation interspersed among construction material	• Barns • Paddocks • Fenced-in areas • Lawns, small shrubs, mixed vegetation near housing areas for equids
Developed, commercial	Areas associated with infrastructure—railroads, highways, road structures, and training tracks	• Roadways along fenced area for equids with shrubs and/or small trees • Vegetation may be interspersed in the middle of roadway
Shrubland	Areas dominated by natural woody vegetation less than 6 m (20 ft) tall Grasses and young trees (both evergreen and deciduous) can be interspersed among shrubs	• Shrubs are woody, like trees, but much shorter • Horses that come in contact on a regular basis with shrubs along fence rows, interspersed among pasture or rangeland areas, or found along the sides of buildings such as barns and paddocks • Examples of shrub species: black hawthorn, bitter pea, saltbush, crepe myrtle, hagbrier, and Texas sage
Forested	Areas associated with tree cover taller than 6 m (20 ft) and covering more than 75 percent of the area • Deciduous trees (shed leaves seasonally) • Evergreen trees (maintain leaves year round) • Mixed areas (both deciduous and evergreen trees)	• Horses that come in contact with a large number of trees on a regular basis • Examples of tree species: hickory, beech, poplar, ash, hemlock, and red cedar
Cultivated/planted, nonwoody	Areas of planted herbaceous vegetation (do not have woody stems) that **are intensively managed** or irrigated	• Horses that come in contact with a pasture type habitat on a regular basis • Grass and/or hay planted for food for equids

continued→

Habitat type	Description	Examples
Cultivated/planted, woody	Areas with woody vegetation (such as orchards and vineyards) that are planted for production of berries, nuts, etc.	• Horses that forage near orchards on a regular basis
Grasslands	Majority of coverage related to upland grasses and forbs • Might be used for grazing • **Not intensively managed**	• Horses that come in contact on a regular basis with rangeland type grasses that may be planted for horses or be natural grasses • Grass can be annual or perennial (western wheatgrass, cane bluestem, bunch grass, mountain brome, meadow fescue, etc.
Wetlands	Areas that are periodically saturated or covered with water	• Horses that forage near these areas such as swamps, bogs, or marshes on a regular basis
Urban/recreational grasses	Grasses developed and maintained for recreation, erosion control, parks, lawns, trails, etc.	• Horses that participate in activities on a regular basis where the habitat is maintained by the city or county • Grasses such as bluegrass may be planted and maintained for equine activities
Water bodies	Open water present year-round	• Horses come in contact with ponds, lakes, reservoirs, streams, rivers, canals, or waterways on a regular basis

Appendix V: Study Objectives and Related Outputs

Study Objectives

1. Describe trends in equine care and health management for study years 1998, 2005, and 2015
    - "Changes in the U.S. Equine Industry, 1998–2015," descriptive report
    - "Baseline Reference of Equine Health and Management, 2015," descriptive report,
    - Information Sources and Providers of Equine Health Care, 2015, information sheet
    - Equine Biosecurity and Biocontainment Practices on U.S. Equine Operations, 2015, information sheet,
    - Equine Mortality, 2015, information sheet
    - End-of-life Planning for Equids in the United States, 2015, information sheet
    - Testing for Equine Infectious Anemia in the United States, 2015, information sheet
    - Equine Movement and Disposition of U.S. Equids, 2015, information sheet
    - Demographics of the U.S. Equine Population, information sheet
2. Estimate the occurrence of owner-reported lameness and describe practices associated with the management of lameness
    - Lameness Occurrence and Management, information sheet
3. Describe health and management practices associated with important equine infectious diseases
    - "Equine Management and Selected Equine Health Conditions, 2015," descriptive report
4. Describe animal health related costs of equine ownership
    - "Equine Management and Selected Equine Health Conditions, 2015," descriptive report
    - Cost of equine ownership in the United States, 2015
5. Evaluate control practices for gastrointestinal parasites
    - "Equine Management and Selected Equine Health Conditions, 2015," descriptive report
    - Parasite Test Findings, information sheet
6. Evaluate equids for presence of ticks and describe tick-control practices used on equine operations
    - "Equine Management and Selected Equine Health Conditions, 2015," descriptive report
    - Tick Occurrence and Identification on Equids, 2015, information sheet
7. Collect equine sera along with equine demographic information to create a serum bank for future studies.