UMASS DONAHUE INSTITUTE

Veterinary Medicine in New England: State-by-State Industry Characteristics and Economic Impacts

Part I: Industry Characteristics

Part II: Workforce Characteristics and Projected Needs

Part III: Economic Impact

Prepared for :
Cummings School of Veterinary Medicine at Tufts University

In partnership with:

Hill's Pet Nutrition

Massachusetts Veterinary Medical Association

Connecticut Veterinary Medical Association

Maine Veterinary Medical Association

New Hampshire Veterinary Medical Association

Rhode Island Veterinary Medical Association

Vermont Veterinary Medical Association

New England Veterinary Medical Association

InTown Veterinary Group



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April 2008

Special thanks are offered by Cummings School of Veterinary Medicine at Tufts University to all study partners for their financial and other support.

The study would not have been possible without lead sponsorship from **Hill's Pet Nutrition** and the **Massachusetts Veterinary Medical Association**. Their generous support of veterinary medicine in New England is greatly appreciated.

Information on study partners may be found at the following websites.

Cummings School of Veterinary Medicine at Tufts University
http://www.tufts.edu/vet

Hill's Pet Nutrition
www.hillspet.com

Massachusetts Veterinary Medical Association
http://www.massvet.org

Connecticut Veterinary Medical Association
http://www.ctvet.org

Maine Veterinary Medical Association
http://www.mainevetmed.org

New Hampshire Veterinary Medical Association
http://www.nhvma.unh.edu

Rhode Island Veterinary Medical Association
http://www.rivma.org

Vermont Veterinary Medical Association
http://www.vtvets.org

New England Veterinary Medical Association

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Acknowledgements

We thank Dean Deborah Kochevar of the Cummings School of Veterinary Medicine at Tufts University for providing guidance, and Executive Associate Dean Joe McManus and his staff for providing essential information about the Cummings School.

We wish to thank the representatives of the state Veterinary Medical Associations (VMAs) in New England, whose valuable insight into the character and key issues of the veterinary medical industry in the six New England states was instrumental in guiding our inquiry:

Dr. Elizabeth Alton, President, Vermont VMA
William Bell, Certified Association Executive, New England VMA and
Executive Director, Maine VMA
Dr. Eva Ceranowicz, President, Connecticut VMA
Dr. Christopher Hannafin, President, Rhode Island VMA
JoAnn Poole, Executive Director, New Hampshire VMA
Susan Weinstein, J.D., Executive Director, Massachusetts VMA

We also thank Jim Flanagan, Director of Marketing and Communications Division, and Susan Majchrzak of the Communications Division at the American Veterinary Medical Association (AVMA); Mike Chaddock, Deputy Director, and Brian Smith, Director of Governmental Affairs, at the Association of American Veterinary Medical Colleges; and Howard Rubin, Chief Executive Officer at BrightHeart Veterinary Centers, for providing knowledge and data that made this study possible.

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Executive Summary

Purpose of the Study

The Cummings School of Veterinary Medicine at Tufts University commissioned a study to analyze the characteristics and economic impact of the veterinary medical industry in the six-state New England region. The UMass Donahue Institute studied key veterinary medicine sectors, the nature of veterinary medicine industry activities, the scale and scope of activities in industry sectors, veterinary workforce demographics and projected workforce needs, and economic impact. The economic impact analysis presents outputs and employment that result from the veterinary medicine expenditures in each of the six states and in the New England region. Unless otherwise noted, all findings are for 2006, the latest year for which data are available.

Findings

Veterinary medicine in New England is a diverse industry, consisting of four major sectors: clinical practice, commercial scientific research and development, academia and nontraditional. Together, the four sectors have an economic impact of $3.3 billion and nearly 32,000 jobs, of which $1.7 billion and 20,000 jobs are direct spending and employment by the veterinary medicine industry.

Veterinary clinical practice – the treatment of companion and food animals – is the core of the industry, responsible for $2.1 billion of the total impacts. Scientific research and development is the next most significant sector, accounting for over $838 million of total economic impacts. Veterinary academia supports $285 million of the total impact, and nontraditional veterinary medicine (including government, zoos and humane societies) supports $108 million of the total economic impact.

Occupational projections predict a shortage of as many as 4,000 veterinarians nationally by 2014, mostly in the clinical practice sector. The New England region may face a shortage of as many as 650 veterinarians by 2014.

Part I: Veterinary Medicine Industry Description

Introduction

Veterinary medicine is a diverse industry. While clinical practice for companion animals is the core of the industry, providing treatment and prevention services to over three million pet-owning households in New England, a significant minority of veterinarians provides indispensable services for the region's biomedical research, agriculture and other industries, with implications for both human and animal health.

In this section, we examine the veterinary medical industry in the six-state New England region (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont). We explore four major veterinary medical sectors in the region: clinical practice, commercial scientific research and development, academia and nontraditional. The discussion includes:

- Detailed characteristics and business activities for each sector
- Estimated employment and expenditures for each sector in New England and in each state[1]
- Focus on activities of the Cummings Veterinary School of Medicine at Tufts University

Unless otherwise noted, all findings are presented for 2006, the latest year for which data are available.

Veterinary Medicine in New England

Veterinarians and key support staff provide veterinary medical services in each of four veterinary sectors: clinical practice, scientific research and development, academia and nontraditional. Workers in three key occupations – veterinarians, veterinary technologists and veterinary assistants – perform the core work of the industry.

[1] The employment and expenditure figures we present in Part I correspond to the direct output and employment in Part III: Economic Impact. Approximately 17% of AVMA member veterinarians provided no information about their employment statuses. Due to this lack of information, these vets are not included in the economic description and impacts.

Key Occupations

Workers in three key occupations perform the core work of the veterinary medical industry. The Bureau of Labor Statistics defines these key occupations, *Veterinarians* (SOC 29-1131), *Veterinary Technologists and Technicians* (SOC 29-2056) and *Veterinary Assistants and Laboratory Animal Caretakers* (SOC 31-9096), as follows:

> **(29-1131) Veterinarians:** Diagnose and treat diseases and dysfunctions of animals. May engage in a particular function, such as research and development, consultation, administration, technical writing, sale or production of commercial products, or rendering of technical services to commercial firms or other organizations. Includes veterinarians who inspect livestock.
>
> **(29-2056) Veterinary Technologists and Technicians (Veterinary technologists)**: Perform medical tests in a laboratory environment for use in the treatment and diagnosis of diseases in animals. Prepare vaccines and serums for prevention of diseases. Prepare tissue samples, take blood samples, and execute laboratory tests, such as urinalysis and blood counts. Clean and sterilize instruments and materials and maintain equipment and machines.
>
> **(31-9096) Veterinary Assistants and Laboratory Animal Caretakers (Veterinary assistants):** Feed, water, and examine pets and other nonfarm animals for signs of illness, disease, or injury in laboratories and animal hospitals and clinics. Clean and disinfect cages and work areas, and sterilize laboratory and surgical equipment. May provide routine post-operative care, administer medication orally or topically, or prepare samples for laboratory examination under the supervision of veterinary or laboratory animal technologists or technicians, veterinarians, or scientists. Exclude "Nonfarm Animal Caretakers" (39-2021).[2]

[2] BLS. Retrieved January 2008. <http://www.bls.gov/oco/ocos076.htm>; <http://www.bls.gov/oco/ocos183.htm>; <http://www.bls.gov/oco/oco20055.htm#K547>.

Veterinary Sectors

The four sectors of the veterinary medical industry are comprised of workers in key occupations and necessary support staff, and are categorized by AVMA employment types and the North American Industry Classification System (NAICS). Employment data for each sector are from AVMA membership surveys and the Bureau of Labor Statistics. Employment estimates for veterinarians are conservative, because they exclude non-AVMA members and members whose employment status could not be verified. AVMA estimates that its membership rolls represent 86% of veterinarians.

Employment numbers in this section are presented according to the following sector definitions:

- **Clinical practice:** veterinarians, veterinary technologists, veterinary assistants and all other employees, and associated economic activity for companion and food/ farm animal medicine. The clinical practice sector corresponds to all activity within NAICS sector 54194, Veterinary Services.
- **Scientific Research and Development (R&D):** veterinarians, veterinary technologists, veterinary assistants and associated economic activity in commercial scientific research and development. The scientific R&D sector corresponds to veterinary activity within NAICS sector 5417, Scientific Research and Development. This sector excludes research and development in academic settings.
- **Academia:** veterinarians, veterinary technologists, veterinary assistants and associated economic activity in higher education, including teaching and research at colleges, universities and junior colleges. The academic sector corresponds to veterinary activity within NAICS sector 6113, Colleges and Universities. It includes teaching and research activities in academic settings.
- **Nontraditional:** veterinarians and associated economic activity in nontraditional settings, including government, military, zoos, and manufacturing. The nontraditional sector corresponds to NAICS codes 92 (Public Administration), 8133 (Social Advocacy Organizations, including humane societies), and 7121 (Museums, Historical Sites and Similar Institutions, including zoos and aquariums).

We estimate employment and direct economic impacts, defined as operating expenditures, payroll, and business and personal income taxes resulting from the employment and economic output of the identified employees, for each sector.

Veterinary Sectors in the Six New England States

New England Veterinary Medical Employment and Expenditures

The New England veterinary medical industry employs an estimated 20,047 people and is responsible for an estimated $1.7 billion in direct expenditures throughout the New England region[3]. Veterinarians make up between seven percent (in scientific R&D) and 67 percent (in nontraditional) of employees in the veterinary medicine sectors. Veterinary technicians and assistants make up the majority of employees in the veterinary clinical practice, scientific R&D and academia sectors.

Figure 1: New England Employment in Key Veterinary Occupations, 2006

Occupation	Clinical Practice	Scientific R&D	Academia	Nontraditional	Total
Veterinarians	2,985	195	254	99	3,533
Vet Techs	4,217	517	327	50	5,111
Vet Assistants	4,041	2,120	627	NA	6,788
All Other/ Unknown	4,302	0	313	NA	4,615
Total	15,545	2,832	1,521	149	20,047

Source: AVMA Membership 2007, BLS National OES Estimates May 2006, Tabulation by Donahue Institute

Veterinary clinical practice is the core of the industry in the region and in each of the six New England states, accounting for 65 percent of veterinary medical expenditures and 78 percent of veterinary medical employment in the New England region. Clinical practices provide medical services for pets, farm and food animals, and exotic animals, with 85 percent of practices focusing on household pets.

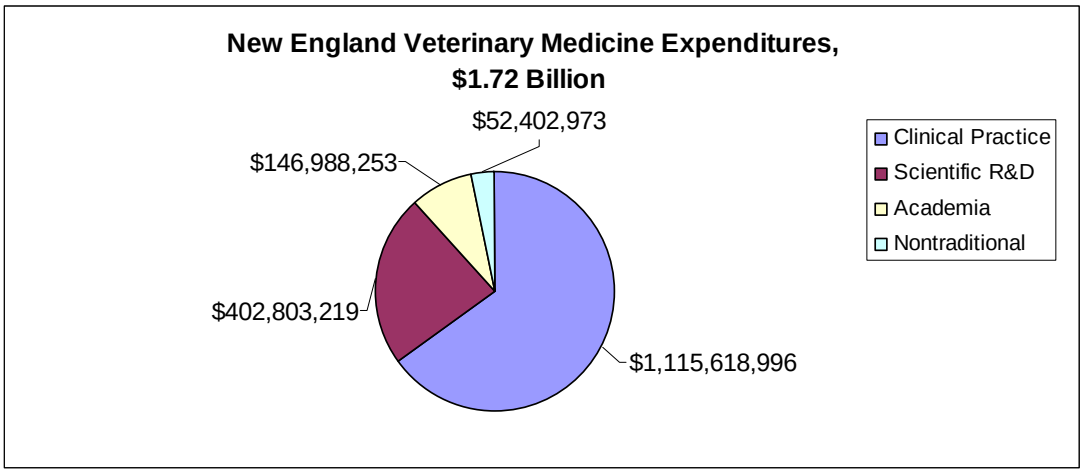
[3] All employment and expenditure estimates based on AVMA data are conservative, due to the fact that AVMA membership does not capture all veterinarians.

Figure 2: New England Veterinary Medical Expenditures, 2006

Sector	Expenditures	Percentage
Clinical Practice	$1,115,618,996	64.94%
Scientific R&D	$402,803,219	23.45%
Academia	$146,988,253	8.56%
Nontraditional	$52,402,973	3.05%
Total	$1,717,813,441	100.00%

Source: AVMA Membership 2007, BLS National OES Estimates May 2006, IMPLAN, Tabulation by Donahue Institute

Figure 3: New England Veterinary Medical Expenditures, 2006



Source: AVMA Membership 2007, BLS National OES Estimates, IMPLAN, Tabulation by Donahue Institute

Commercial scientific research and development, including pharmaceutical research and development, requires animal health and husbandry services provided by veterinarians and other workers in key occupations. Scientific research and development account for 23 percent of total veterinary medical spending and 14 percent of veterinary medical employment in New England. Veterinary scientific research and development is most highly concentrated in Massachusetts and Connecticut, but is also found in every state in the region.

Veterinary-related academia includes veterinary academic programs that produce veterinarians and veterinary technologists, agriculture-related animal science programs at state universities, and laboratory animal programs at many of the region's major universities. Academia generates nine percent of veterinary medical expenditures and eight percent of employment in New England. Veterinary medicine in higher education is especially strong in Massachusetts, as the home of the Cummings School and many major research universities, and in Connecticut, but is also found in every state in the region.

Finally, veterinarians work in smaller, niche settings that we categorize together as "nontraditional." Nontraditional veterinary medicine accounts for three percent of veterinary medical spending and less than one percent of employment in New England. These include veterinarians employed by governments for agriculture and public health programs, those who work exclusively or primarily at the region's zoos, and those who work primarily in pharmaceutical or animal food manufacturing. Nontraditional veterinary medicine, while small, is distributed throughout the region.

Veterinary Clinical Practice

Analysis of AVMA membership data shows that most of New England's 2,985 private practice veterinarians provide general medicine and surgery services (93 percent), but they also work in production medicine, referral and specialty medicine, and emergency and critical care. Of the 2,985 veterinarians in clinical practice, 383 of them identify a medical specialty in AVMA membership data.[4] These 383 veterinarians specialize in emergency and critical care (22 percent), internal medicine (17 percent), surgery (16 percent), alternative and complementary medicine (11 percent), preventive medicine (6 percent), and 27 other medical specialties.

The provision of veterinary medical care to food and companion animals employs 15,545 people and has direct expenditures of $1.12 billion in New England.[5] Veterinary clinical practice employment and expenditures are larger in the more populous states, reflecting the increased demand for medical services for pets. Massachusetts and Connecticut have the largest employment and expenditures, while Rhode Island and Vermont have the lowest. The highest per capita spending on veterinary clinical services is in Vermont, at $97 per capita, followed closely by New Hampshire at $94 per capita. The lowest is in Rhode Island, at $65 per capita. Higher per capita expenditures may reflect both higher cost of living, such as in Connecticut, and higher pet ownership rates, such as in Vermont and Maine.

[4] The AVMA allows veterinarians to specify "General Medicine" as a medical specialty; we exclude those veterinarians here.
[5] Clinical practice employment includes veterinarians, veterinary technologists, veterinary assistants and all other support staff.

Figure 4: Veterinary Clinical Practice, 2006

State	Employees	2006 Expenditures	Per Capita Spending
Connecticut	4,186	$313,678,016	$90
Maine	1,566	$106,811,000	$81
Massachusetts	6,058	$442,233,984	$69
New Hampshire	1,797	$123,150,000	$94
Rhode Island	967	$69,383,000	$65
Vermont	971	$60,362,996	$97
New England	15,545	$1,115,618,996	$78

Sources: AVMA Membership 2007, BLS National OES Estimates May 2006, IMPLAN, U.S. Census National and State Population Estimates (http://www.census.gov/popest/states/NST-ann-est.html), Tabulation by Donahue Institute

In each of the six New England states, the overwhelming majority (from 67 percent in Vermont to 92 percent in Rhode Island) of clinical practice veterinarians focus predominantly or exclusively on the treatment of companion animals. Vermont has the highest proportion of veterinarians who treat food animals predominantly or exclusively, at 16 percent, and with 44 veterinarians in this category it has the most food animal veterinarians of any state in the region. Rhode Island has the fewest food animal veterinarians by number and percentage, with only one AVMA-registered veterinarian who predominantly or exclusively treats food animals. Cummings School of Veterinary Medicine at Tufts University owns and operates a multi-veterinarian, food animal and equine practice that strives to serve the needs of producers in much of southern New England.

Figure 5: Number of Clinical Practice Veterinarians by Type of Animal Treated, 2006

Area	Food Animal	Companion Animal	Mixed Animal	Equine	No answer	Total
Connecticut	19 (2.7%)	630 (89.2%)	21 (3.0%)	34 (4.8%)	2 (0.3%)	706
Maine	18 (5.1%)	300 (84.3%)	29 (8.1%)	7 (2.0%)	2 (0.6%)	356
Massachusetts	22 (2.0%)	1,006 (90.7%)	31 (2.8%)	42 (3.8%)	8 (0.7%)	1,109
New Hampshire	12 (3.2%)	314 (83.7%)	32 (8.5%)	15 (4.0%)	2 (0.5%)	375
Rhode Island	1 (0.6%)	160 (92.5%)	3 (1.7%)	9 (5.2%)	0 (0%)	173
Vermont	44 (16.5%)	180 (67.7%)	26 (9.8%)	15 (5.6%)	1 (0.4%)	266
New England (Total)	116 (3.8%)	2590 (85.5%)	142 (4.7%)	122 (4.0%)	15 (0.5%)	3,031

Source: AVMA Membership 2007, Tabulation by Donahue Institute

Companion Animal Medicine

Companion animal private practice is the core of the veterinary medical industry in New England, with 73 percent of all AVMA veterinarians in New England providing medical care to pets. Most companion animal veterinarians who identified a professional discipline practice general medicine. A minority of veterinarians are specialists in internal medicine, surgery, alternative and complementary medicine, and preventive medicine, among others. Across New England, 80 percent of AVMA veterinary specialists in companion animal medicine are employed by general medicine practices, while the remaining 20 percent work in specialty or emergency practices or other settings.

Figure 6: All Companion Animal Veterinarians by Professional Discipline, 2006

Area	General Medicine	Specialty	Emergency/ Critical Care	Other	No Information	Total
Connecticut	198	52	9	2	369	630
Maine	90	19	6	3	182	300
Massachusetts	294	98	44	8	562	1,006
New Hampshire	101	25	9	0	179	314
Rhode Island	46	15	11	3	85	160
Vermont	54	18	1	0	107	180
New England	783	227	80	16	1,484	2,590

Source: AVMA Membership 2007, Tabulation by Donahue Institute

Figure 7: Companion Animal Specialists by State, 2006

Area	Internal Medicine	Surgery	Alternative/ Complementary	Preventive Medicine	Other	Total
Connecticut	15	11	7	6	13	52
Maine	3	6	8	0	2	19
Massachusetts	25	20	11	10	32	98
New Hampshire	10	6	2	0	7	25
Rhode Island	2	5	1	1	6	15
Vermont	2	3	5	1	7	18
New England	57	51	34	18	67	227

Source: AVMA Membership 2007, Tabulation by Donahue Institute

Specialties counted as “other” in Figure 7 include radiology, oncology, opthalmology, dermatology, and others.

Nationally, veterinarians are more likely to practice one or more specialties than they were in 2000. From 2000 to 2007, national AVMA specialty certifications increased 31 percent to 8,885, compared to a total AVMA membership increase of 20 percent (from 57,259 to 68,882). Because some veterinarians have certification in more than one specialty, the national increase in the number of certified specialists may be smaller than 31 percent. We cannot draw conclusions about trends in New England based on these data, but if New England is similar to the nation, then specialty certification may be growing more common.

Pet ownership is the major driver for the clinical practice sector. A 2007 American Veterinary Medical Association (AVMA) survey shows that 56 percent of New England households own one or more pets, making New England similar to the United States as a whole at 57 percent. Nationally, households with one or more pets visited a veterinarian about 2.8 times per year and spent a mean $366 annually on veterinary services.[6]

The AVMA reports that Vermont households have the highest rate of pet ownership of any state in the nation, with 75 percent of households, or 197,000 households, owning one or more pets. Maine has the nation's sixth-highest rate of pet ownership, with 70 percent of households (376,000 households) owning one or more pets.

With 54 percent of households owning pets (234,000 households), Rhode Island is estimated by the AVMA to have the eighth-lowest pet ownership per household of all states. With over 2.5 million households and a 51 percent pet ownership rate, Massachusetts has both the highest number of pet-owning households in New England, and the fourth-lowest rate of pet ownership per household in the United States, ranking higher than Maryland, New Jersey and New York.

[6] American Veterinary Medical Association. "U.S. pet ownership and demographics sourcebooks." 2007.

Figure 8: Pet Ownership among New England Households, 2006

Area	Households, total (thousands)	Pet Ownership Rate	Pet Owning Households (thousands)
U.S. Total	115,509	57.4%	66,270
New England	5,684	56.3%	3,202
Connecticut	1,407	55.6%	783
Maine	541	69.6%	376
Massachusetts	2,511	50.7%	1,274
New Hampshire	527	64.6%	341
Rhode Island	433	53.9%	234
Vermont	265	74.5%	197

Source: AVMA U.S. Pet Ownership & Demographics Sourcebook, 2007.

Companion animal veterinary practice provides strong opportunities for entrepreneurship and self-employment. In the six-state New England region, 38 percent of companion animal veterinarians own their own practices. Vermont has the highest rate of ownership, with 53 percent of companion animal veterinarians owning their practices. Maine also has a higher than average rate of ownership, with 44 percent of veterinarians owning their practices. Rhode Island has the lowest ownership rate among companion animal veterinarians at 31 percent.

Figure 9: Companion Animal Veterinarians by Practice Ownership, 2006

Area	Veterinarians	Owner	Associate	Other Clinician	Other/ No Info
Connecticut	630	40.2%	51.6%	4.3%	4.0%
Maine	300	44.3%	48.0%	1.7%	6.0%
Massachusetts	1006	34.8%	57.8%	4.0%	3.5%
New Hampshire	314	36.3%	58.3%	3.2%	2.2%
Rhode Island	160	31.3%	62.5%	4.4%	1.9%
Vermont	180	52.8%	45.0%	1.7%	0.6%
New England	2590	38.4%	54.6%	3.6%	3.4%

Source: AVMA 2007 Membership, Tabulation by Donahue Institute.

Food Animal Medicine

Livestock and poultry farms require services by food animal veterinarians, who usually must travel to farms to provide medical services. Food animal veterinarians serve important functions in ensuring food safety and preventing the spread of zoonotic disease. New England has an estimated 116 food animal veterinarians. In 2002, New England had over 12,000 livestock and poultry farms worth nearly $1 billion.

Figure 10: Number of Farms and Food Animal Market Value, 2002

Area	Livestock, Poultry and other Animal Farms	Market Value: Livestock, Poultry and Products
Connecticut	1,750	$143,110,000
Maine	2,883	$241,247,000
Massachusetts	2,461	$107,244,000
New Hampshire	1,559	$61,686,000
Rhode Island	344	$8,408,000
Vermont	3,264	$401,482,000
New England	**12,261**	**$963,177,000**

Note: Farm count includes aquaculture and other animal production.
Source: U.S. Department of Agriculture, National Agricultural Statistics Service,
Table 59, Summary by North American Industry Classification System, <http://www.nass.usda.gov/census/census02/volume1/>.

In most of New England, food animal veterinarians are more likely than companion animal veterinarians to own their own practices. In every state but Connecticut, more than half of food animal veterinarians own their own practices; in Connecticut, only 30 percent of food animal veterinarians own their own practices. This may be due in part to the fact that the largest food animal practice in southern New England, located in Woodstock, CT, is owned by Cummings School of Veterinary Medicine at Tufts University.

Figure 11: Food Animal Veterinarians by Practice Ownership, 2006

Area	Veterinarians	Owner	Associate	Other Clinician	Other/ No Info
Connecticut	**19**	31.6%	57.9%	5.3%	5.3%
Maine	**18**	61.1%	38.9%	0.0%	0.0%
Massachusetts	**22**	54.5%	31.8%	0.0%	13.6%
New Hampshire	**12**	58.3%	41.7%	0.0%	0.0%
Rhode Island	**1**	100.0%	0.0%	0.0%	0.0%
Vermont	**44**	52.3%	38.6%	4.5%	4.5%
New England	**116**	51.7%	40.5%	2.6%	5.2%

Source: AVMA Membership, 2007.

Industry Scientific Research and Development

In each of the six New England states, commercial scientific R&D veterinarians are most likely to specialize in laboratory animal medicine and anatomic pathology, but also practice 21 other identifiable specialties, including general medicine, pharmacology, surgery, and toxicology. Laboratory animal veterinarians oversee research protocols, and the veterinary staff provides health care, husbandry and enrichment services for research animals.

Veterinarians act as principal investigators, co-investigators, research scientists and technical advisors in animal research.[7] The federal Animal Welfare Act (AWA) regulates the use of laboratory animals (not including birds, mice or rats) and requires consultation by a veterinarian for any procedures that could cause an animal pain, as well as the appointment of a doctor of veterinary medicine to a committee to oversee animal treatment.[8] Laboratory animal veterinarians are responsible for the welfare of over 72,000 AWA-registered laboratory animals in New England.[9]

In 2007, the Foundation for Biomedical Research estimated that approximately 97 percent of all animals used in research are mice and rats (and therefore would not be registered with the AWA).[10] If this estimate is correct, then the total number of laboratory animals, including mice and rats, could be as high as 2.4 million in New England, with 1.9 million in Massachusetts alone.

As a national leader in biomedical research, Massachusetts boasts New England's biggest commercial veterinary scientific research and development sector. Over one in fifteen of the state's veterinarians (93 out of 1,414) work in commercial scientific research and development, and the state is home to nearly 100 commercial laboratory animal research facilities.[11] Nationally, 43 percent of NIH research funds are for vertebrate animal-based research, and Massachusetts is second only to California in NIH research funding dollars, with over $2.2

[7]The National Academy of Sciences. "National need and priorities for veterinarians in biomedical research." 2004. Retrieved January 2008. <ttp://www.nap.edu/catalog.php?record_id=10878>
[8] United States Department of Agriculture. " Animal and Plant Health Inspection Service." <http://www.aphis.usda.gov/lpa/pubs/awlicreg.html#IUOBS>; "Animal Welfare Act, 7 USC 2131-2156." <http://www.nal.usda.gov/awic/legislat/awa.htm>.
[9] United States Department of Agriculture. "Animal and Plant Health Inspection Service." FY05 AWA Inspections. 2006. <http://www.aphis.usda.gov/animal_welfare/downloads/awreports/awreport2006.pdf>.
[10] The Foundation for Biomedical Research. "Rats and Mice: The Essential Need for Animals in Medical Research." <http://www.fbresearch.org/>.
[11] Not including 28 academic animal laboratories. UMass Donahue Institute. Animal Research Laboratories, forthcoming.

billion in NIH grants compared to California's $3.1 billion[12]. Massachusetts laboratories subject to AWA regulation house 59,330 research animals, making the state fifth in the nation for number of AWA-registered animals, behind California, New York, Pennsylvania and Iowa.

Figure 12: Animal Welfare Act Registered Research Animals, FY 2006

State	Cats	Dogs	Guinea Pigs	Hamsters	Nonhuman Primates	Pigs	Rabbits	Sheep	Other Farm Animals	All Other Covered Species	Total
CT	33	764	631	2,779	325	531	820	23	21	657	6,584
ME	0	0	69	22	0	37	235	0	231	1,127	1,721
MA	127	3,310	18,973	7,474	4,861	3,994	14,525	821	423	4,822	59,330
NH	0	8	7	697	16	250	17	56	0	31	1,082
RI	6	4	99	149	24	317	274	50	81	554	1,558
VT	13	19	484	0	0	93	122	1,198	9	531	2,469
New England	179	4,105	20,263	11,121	5,226	5,222	15,993	2,148	765	7,722	72,744

Source: USDA Animal and Plant Health Inspection Service, FY05 AWA Inspections, http://www.aphis.usda.gov/animal_welfare/downloads/awreports/awreport2006.pdf.

In total, veterinary industrial scientific research and development activities employ 2,832 veterinary workers – veterinarians, veterinary technologists and veterinary assistants – and have expenditures of over $400 million in New England.

Figure 13: Employees and Expenditures for Scientific Research and Development, 2006

State	Employees	2006 Expenditures
Connecticut	1,118	$174,314,768
Maine	116	$10,705,494
Massachusetts	1,351	$189,988,256
New Hampshire	87	$11,641,828
Rhode Island	44	$4,999,209
Vermont	116	$11,153,664
New England	2,832	$402,803,219

Sources: AVMA Membership 2007, Occupational Employment Statistics 2006, IMPLAN.

[12] National Institutes of Health. Retrieved February 19, 2008. <http://grants.nih.gov/grants/award/trends/State_Congressional/StateOverview.cfm>.

Academia

Academic veterinary medicine in New England employs 1,521 people and has expenditures of nearly $147 million. Massachusetts has the highest employment and expenditures in veterinary academia of any state in New England, with 582 employees and $81 million in expenditures, of which 90 percent is generated by the Cummings School of Veterinary Medicine at Tufts University.

Figure 14: 2006 Employment and Expenditures for Veterinary Medicine in Academia

State	Employees	2006 Expenditures
Connecticut	411	$31,382,112
Maine	148	$8,735,254
Massachusetts	582	$81,723,819
New Hampshire	190	$13,135,596
Rhode Island	95	$6,431,475
Vermont	95	$5,579,997
New England	1,521	$146,988,253

Source: AVMA and State Occupational Industry Matrices, IMPLAN, 2007.

The Cummings School of Veterinary Medicine at Tufts University in Grafton

Founded in 1978, the Cummings School of Veterinary Medicine at Tufts University, located in Grafton, is the only university in New England educating veterinarians for work in the animal health, biotechnology, pharmaceutical and medical device industries.[13] Since its founding, the school has trained over 1,500 veterinarians who work in clinical practice, biomedical research, international medicine, conservation medicine and public health across New England. The school is also the largest provider of continuing education for veterinarians, veterinary technicians, and animal owners in the state. In addition, the Cummings School provides some training for veterinary technician students attending Mt. Ida College and Becker College. With 466 employees and total related expenditures of over $70 million, the Cummings School supports over 90 percent of direct veterinary academic expenditures in Massachusetts.[14]

[13] Cummings School of Veterinary Medicine at Tufts University. "The Economic Impact of Tufts Veterinary School."
[14] The figures presented are for full-time-equivalent employees and were supplied by the Cummings School.

The Cummings School:

A Leader in Biomedical Research

- **Infectious Diseases:** As the largest research program at the Cummings School, the Division of Infectious Diseases is one of six laboratories nationally to receive NIH support to form the Food and Waterborne Diseases Integrated Research Network (F&WD-IRN). As part of this network, the school's Microbiology and Botulism Research Unit focuses on diagnosis and treatment of botulism infection, considered a serious bioterrorism threat.
- **Heat-resistant vaccines:** Funded by the Gates Foundation Global Health Initiative, Cummings School researchers are working with Tufts Medical School collaborators to develop heat-resistant vaccines for childhood diseases. The research aims to develop affordable vaccines that could be delivered to parts of the world that lack electricity.

The school's employees include 154 veterinarians: 87 faculty and 66 interns, post-docs, residents, and resident associates. Faculty and veterinarians at the school's affiliated teaching hospitals and clinics provide referral services, consultations and pathology services to private veterinary hospitals, the equine industry and family farms across Massachusetts and New England. There are over 20 clinical specialties represented on the faculty, including cardiology, oncology, internal medicine, orthopedics, diagnostic imaging, surgery, and large animal health and husbandry.

The student body totals 335 students: 315 full time DVM students, 13 Masters of Science-only students, and 7 PhD students. Innovative dual DVM/Masters degree programs are offered in three areas (biomedical science, laboratory animal medicine and public health). According to a 2006 Senior Survey at the Cummings School, 61 percent of graduating seniors wanted to remain in New England to work after graduation: 46 percent hoped to work in Massachusetts, 2.7 percent in Connecticut, 4 percent in Maine, 1.4 percent in New Hampshire, 1.4 percent in Rhode Island, and 5.4 percent in Vermont.[15]

The School contributes to the growing life sciences industry by providing valuable research services and testing to over 30 research institutions and companies each year, including providing expertise in specialty contract research utilizing various animal models including swine, sheep, goats, cattle, and horses. Board certified veterinarians at the School are available to assist with pre-clinical studies including the development and testing

[15] American Veterinary Medical Association "Senior Survey." 2006.

of devices, biologics and pharmaceuticals, and faculty members at the school have started five companies so far based on their research. In line with this support for research and development, the Cummings School also provides space for biotech companies at the Tufts Biotechnology Transfer Center and Grafton Science Park.

The Cummings School: A Research Leader (continued):

- **New England Regional Biosafety Laboratory:** With $19.35 million in NIH funding, this planned Grafton Science Park facility will be owned, operated and maintained by Tufts University. The facility will allow regional scientists and Tufts faculty to work with specialized biological agents, including those that pose potential bioterrorism threats.
- **Tufts Biotechnology Transfer Center:** Developed and operated by Tufts University, the center is an incubator for biotechnology, pharmaceutical and medical device companies. Collaborative relationships with Tufts faculty provide research assistance and expertise in moving research products through the FDA approval process. The center has incubated 19 companies to date.

The Cummings School has several programs that are designed to help the local community. Efforts include science, technology, engineering and math (STEM) outreach to middle and high school students in Central Massachusetts, STEM enrichment for science teachers, scholarships for under-represented minority students to attend a summer veterinary enrichment camp held on campus, support of Norfolk Agricultural High School veterinary career enrichment, and operation of the Pet Loss Support Hotline, staffed by volunteer veterinary students and designed to give comfort to pet owners grieving the loss of a pet. The School also has a Wildlife Clinic, which is a federally designated center for the treatment of endangered and threatened species with the goal of returning animals to their native habitats. Wildlife Center faculty have unique insight into changes in sentinel animal populations and the environment and so serve as front-line monitors for incursion of zoonotic infectious diseases and for environmental concerns.

Veterinary Technician Programs

Veterinary technicians are vital both to clinical practice and to biomedical research. In clinical practice, veterinary technicians maintain patient case histories; collect specimens; perform laboratory procedures; provide specialized nursing care; prepare animals, equipment, and instruments for surgery; assist in various veterinary procedures; take radiographs; educate pet owners; supervise and train other practice personnel; and perform preventative dental procedures. In biomedical research, veterinary technicians perform many of the above tasks. In addition, they also supervise the care of research animals and assist in research projects. Veterinary technicians cannot prescribe medicines or diagnose problems, nor can they perform surgery or other complicated procedures without supervision. As such, veterinary technicians work under the supervision of a licensed veterinarian.[16]

A degree from an accredited veterinary technologist program prepares a student for the Veterinary Technician National Examination (VTNE), as well as preparing one for entry-level positions with the potential for advancement.[17] Though a degree from an AVMA accredited veterinary technician program is preferred, it is not required, and, depending on their education and work experience, candidates without a degree may still take the National Boards.[18]

Veterinary technologists programs typically take two years to complete, leading to an Associate of Science or equivalent degree.[19] New England is home to nine of the 138 veterinary technician programs in the United States that are accredited through the AVMA. There are nine programs in five states throughout New England (Rhode Island has no veterinary technologist program).

[16] American Veterinary Medical Association. "Becoming a Veterinarian." Retrieved January 7th, 2008. <http://www.avma.org/careforanimals/animatedjourneys/aboutvets/becomingtech.asp>.
[17] National Association of Veterinary Technicians in American. <www.navta.net>.
[18] Massachusetts Veterinary Technician Association. <www.massvta.org>.
[19] National Association of Veterinary Technician in America. "Education." Retrieved January 7th, 2008. <http://www.navta.net/education/index.php.>

Academic Research

Analysis of the AVMA membership data shows that, of the 195[20] academic veterinarians in New England, an estimated 134 are primarily engaged in research. Academic research veterinarians cite specialties including laboratory animal medicine (36 percent), pathology (22 percent), surgery (9 percent), and fifteen additional medical disciplines. Of the 134 AVMA-registered academic research veterinarians in New England, 93 are in Massachusetts, with concentrations around Boston, with its many universities, and Grafton, where the Cummings School is located. Connecticut has concentrations of academic research veterinarians in Storrs, where the University of Connecticut is located, in New Haven where Yale University is located, and in Hamden where Quinnipiac University is located.

Figure 15: Academic Veterinarians Primarily Engaged in Research, 2006

State	Veterinarians
Connecticut	19
Maine	5
Massachusetts	93
New Hampshire	7
Rhode Island	6
Vermont	4
New England	134

Source: AVMA Membership data, Tabulated by Donahue Institute

Nontraditional

Nontraditional veterinary medicine in New England includes services provided by veterinarians and veterinary technologists who work in diverse fields including humane societies, government, zoos, manufacturing and the military. Together, these fields employ an estimated 149 people, 99 of whom are veterinarians, and have expenditures of $52 million in New England.

[20] This is conservative, since numbers are based on AVMA membership, and academic veterinarian membership rates in the AVMA are unknown. We know that the Cummings School at Tufts employs 154 veterinarians.

Figure 16: Employment and Expenditures in Nontraditional Veterinary Fields, 2006

State	Employees	2006 Expenditures
Connecticut	18	$1,805,043
Maine	63	$43,178,111
Massachusetts	47	$5,061,532
New Hampshire	7	$838,346
Rhode Island	4	$400,692
Vermont	10	$1,119,249
New England	149	$52,402,973

Source: AVMA Membership data, Maine Occupation-Industry Matrix, IMPLAN

Government veterinarians include department of agriculture veterinarians and public health veterinarians. While few in number (there are an estimated 49 such veterinarians in New England according to AVMA membership data), these veterinarians make significant contributions to public safety by promoting food safety and the prevention of zoonotic diseases. An additional six veterinarians in New England work with the United States military.

New England is home to at least five major zoos, including the Roger Williams Park Zoo in Providence, Rhode Island and the Franklin Park Zoo in Boston, Massachusetts, and two aquariums, the New England Aquarium in Boston and the Mystic Aquarium and Institute for Exploration in Mystic, Connecticut.[21] Major institutions are likely to have one or two staff veterinarians, while smaller zoos and petting zoos spread throughout the area often rely on veterinary consultants.[22]

Veterinarians and veterinary technologists also perform veterinary and consulting services for pharmaceutical and animal food (including pet and non-pet food) manufacturing. New England is home to approximately 297 pharmaceutical manufacturing businesses and 47 animal food manufacturing businesses[23].

[21] Association of Zoos and Aquariums. <http://www.aza.org/FindZooAquarium/>.
[22] Interview with Dr. Christopher Hannafin, Rhode Island Veterinary Medical Association.
[23] Dun & Bradstreet. Marketplace October-December 2007.

Part II: Veterinary Medicine Workforce

Key Veterinary Medical Occupations

Key veterinary medical occupations include veterinarians, veterinary technologists and technicians, and veterinary assistants, each with different educational requirements and job responsibilities. Occupational definitions based on U.S. Bureau of Labor Statistics definitions are as follows:

Veterinarians are defined as those who diagnose and treat diseases and dysfunctions of animals. They may engage in a particular function, such as research and development, consultation, administration, technical writing, sale or production of commercial products, or rendering of technical services to commercial firms or other organizations. This includes veterinarians who inspect livestock. Veterinarians must have a Doctor of Veterinary Medicine (DVM) degree[24] from a four-year, accredited veterinary college. Most veterinarians also have a bachelor's degree. Competition for admission to veterinary school is intense; in 2005, only one in three applicants nationally were admitted[25].

Veterinary Technologists and Technicians are defined as those who perform medical tests in a laboratory environment for use in the treatment and diagnosis of diseases in animals. They prepare vaccines and serums for prevention of diseases. They also prepare tissue samples, take blood samples, and execute laboratory tests, such as urinalysis and blood counts. They clean and sterilize instruments and materials and maintain equipment and machines. This occupation typically requires a degree from a two-year, AVMA-accredited veterinary technologist program, although four-year programs also exist[26]. Veterinary technicians work under the supervisions of a licensed veterinarian.

Veterinary Assistants and Laboratory Animal Caretakers are defined as those who feed, water, and examine pets and other non-farm animals for signs of illness, disease, or injury in laboratories and animal hospitals and clinics. They clean and disinfect cages and work areas, and sterilize laboratory and surgical equipment. They may provide routine post-operative care, administer medication orally or topically, or prepare

[24] Veterinarians may also have a degree denoted VMD.
[25] BLS, <http://www.bls.gov/oco/ocos076.htm.>

samples for laboratory examination under the supervision of veterinary or laboratory animal technologists or technicians, veterinarians, or scientists. Veterinary assistants typically work under the supervision of a licensed veterinarian and receive on-the-job training[27].

Key Occupation Incomes Across New England

Figure 17: Median Earnings in Key Veterinary Occupations, by SOC code

State	Occupation (SOC code)	Annual Median Wage (2)
Connecticut	Veterinarians (291131)	$93,730
	Veterinary Technologists and Technicians (292056)	$33,750
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$22,800
	All Occupations	**$45,970**
Massachusetts	Veterinarians (291131)	$73,320
	Veterinary Technologists and Technicians (292056)	$31,050
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$26,520
	All Occupations	**$37,350**
Maine	Veterinarians (291131)	$67,730
	Veterinary Technologists and Technicians (292056)	$27,950
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$22,520
	All Occupations	**$28,630**
New Hampshire	Veterinarians (291131)	$78,180
	Veterinary Technologists and Technicians (292056)	$28,020
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$19,380
	All Occupations	**$31,440**
Rhode Island	Veterinarians (291131)	$74,310
	Veterinary Technologists and Technicians (292056)	$29,660
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$21,180
	All Occupations	**$32,430**
Vermont	Veterinarians (291131)	$65,740
	Veterinary Technologists and Technicians (292056)	$26,700
	Veterinary Assistants and Laboratory Animal Caretakers (319096)	$17,760
	All Occupations	**$29,510**

Source: BLS Occupational Employment Statistics, Extracted September 2007. Wages are calculated to reflect full-time work.

[26] BLS, <http://www.bls.gov/oco/ocos183.htm.>
[27] BLS, <http://www.bls.gov/oco/oco20055.htm#K547>

Among the key occupations, veterinarians have the highest median earning and veterinary assistants and laboratory animal caretakers have the lowest. Connecticut veterinarians have the highest wage of any state; with median earnings of $93,730, they earn fully $15,000 more than veterinarians in second-place New Hampshire, with median wages of $78,180. Median incomes for veterinarians range from Vermont's low of $65,740 to Connecticut's high of $93,730[28]. The national median wage for veterinarians is $71,990, squarely in the middle of the salary range for New England veterinarians. In every state, veterinarians' salaries compare favorably with the state median wage for all workers.

A 2006 AVMA survey of veterinarians found that industry, companion animal and large-animal predominant veterinarians in New England had higher median salaries in 2005 than veterinarians in those sectors in other parts of the country. Nationally, board-certified specialists had higher salaries than general practitioners. Certification in scientific R&D provided particularly strong salary boosts, with the highest median salary earned by certified specialists in laboratory animal medicine (median $139,000). Surgery ($133,000), clinical pathology ($133,000) and pathology ($133,000) also exhibited high national median salaries.

It should be noted that wages in Figure 17 do not include benefits. The 2006 AVMA national survey of veterinarians showed that the most common benefits were medical insurance, liability insurance, continuing education fees, association dues, medical insurance and paid leave[29]. Publicly employed veterinarians were more likely than others to receive medical insurance as a benefit, but less likely to receive association fees and continuing education expenses. The study did not present findings on the provision of benefits by region.

Veterinary technicians and assistants earn considerably less than veterinarians, as their lower educational requirements might suggest. Veterinarians earn as much as $60,000 more than veterinary technologists and $70,000 more than veterinary assistants, though in most states the differences between veterinarians' salaries and veterinary technologist and assistant salaries are between $40,000 and $50,000.

Median salaries for veterinary technicians are slightly beneath median wages for all occupations in each state, although the difference is more pronounced in Connecticut, where veterinary technician salaries are $12,000

[28] Available data do not allow us to determine causes of wage differences between states, but potential causes may include wage differences between higher and lower cost-of-living areas, male and female veterinarians, industry and clinical practice veterinarians, or other factors that disproportionately affect some states.
[29] American Veterinary Medical Association. "AVMA Report on Veterinary Compensation." 2007.

below median for all occupations. Veterinary assistants earn well below the median for all occupations in each state, earning the least in Vermont, at $17,760, and the most in Massachusetts, at $26,520.

Veterinarians and Gender

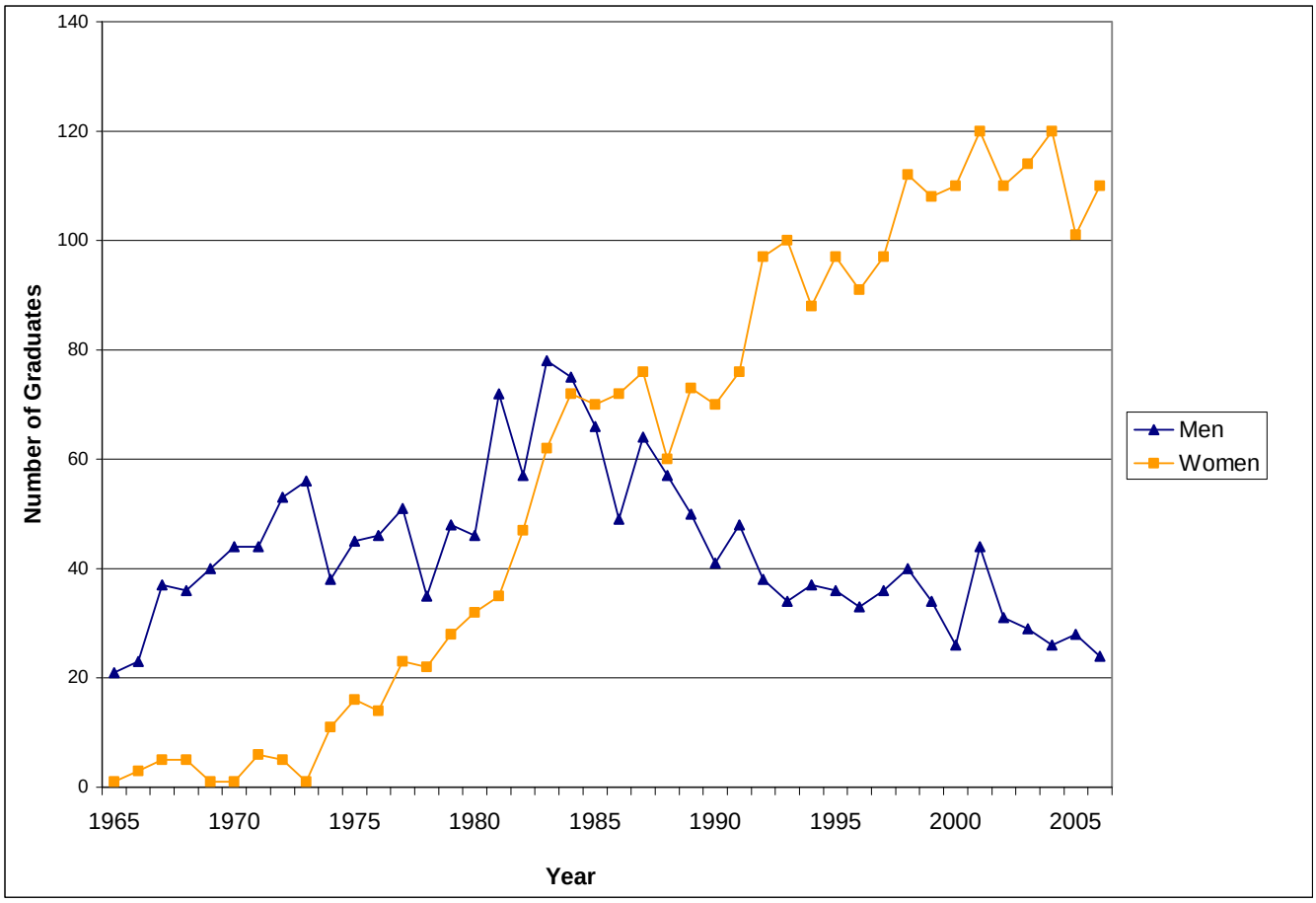
The veterinary profession is currently divided roughly equally between women (53 percent) and men (47 percent), but this fact masks the ascendancy of women within the profession. Since the mid-1980s, veterinary schools have been graduating more women and fewer men, so that the profession is becoming more female over time[30].

In the 1960's, women were less than five percent of graduating classes, and the percentage of graduating female veterinarians remained low into the 1980's. Currently, the American Veterinary Medical Association (AVMA) states that women make up approximately 75 percent of entering veterinary students[31].

AVMA membership data show that among veterinarians currently practicing, women overtook men as graduates of veterinary degree programs in the mid-1980s. Since then, the number of women graduates in the profession has steadily risen, while the number of male graduates has fallen.

[30] Larsen, Phyllis, Women as Veterinarians: a Century of Development, AVMA Convention Notes, July, 2000.
[31] AVMA, <http://www.avma.org>.

Figure 18: Gender of AVMA Veterinarians in New England by Graduation Year, 2006



Source: AVMA Membership 2007, Tabulated by Donahue Institute

Studies have consistently shown that among veterinarians, as in other occupations, men's earnings consistently outpace women's. The 2006 AVMA survey found that women in private practice earned a median $0.75 to each dollar earned by a man. The finding holds true across most practice types (small or large animal). The AVMA study did not control for such factors as hours worked, but did show that the average female associate in private practice worked 0.92 hours for every hour worked by a male counterpart, suggesting that hours worked may not explain the difference[32]. Thus, the increasing dominance of female veterinarians in the profession suggests that real wages may be decreasing accordingly.

[32] American Veterinary Medical Association. "AVMA Report on Veterinary Compensation." 2007.

Projected Workforce Needs

United States Projected Needs

In 1999, a report conducted by KPMG LLP and commissioned by the AVMA, American Animal Hospital Association (AAHA), and Association of American Veterinary Medical Colleges (AAVMC) projected an oversupply of veterinarians that would last until nearly 2015, followed by a period of balanced supply and demand for veterinarians[33]. The authors projected an average annual growth rate for demand of 1.13 percent for the period 2000 to 2005 and 1.25 percent for 2005 to 2015.

In fact, BLS figures show that the average annual growth rate for veterinarians during the period 2000 to 2006 was 3.9 percent[34] and project a similar average annual growth rate of 3.5 percent for the period 2006 to 2016[35], not including the need for new veterinarians to replace those who retire or otherwise exit the workforce. Total BLS national projected need for new veterinarians (which can also be understood as the projected training need) predicts a need for 24,000 new veterinarians by 2014, over 20,000 of them in clinical veterinary services. If these trends materialize[36], they suggest that current rates of training will be inadequate to meet the national demand for new veterinarians.

Figure 19: Projected Workforce Needs, 2006-2014[37]

	2006	Average Annual Openings	New Vets Needed by 2014	Annual New Vet Graduates	New Vet Graduates by 2014
United States	62,196	3,000	24,000	2,700	21,600

Sources: http://www.bls.gov/oco/ocos076.htm, http://data.bls.gov/oep/servlet/oep.noeted.servlet.ActionServlet?Action=empoccp, Retrieved January 25, 2008, Adjusted by UMass Donahue Institute
Note: Annual Openings are Job Growth and Net Replacement.

[33] Brown, JP, Silverman, JD. The current and future market for veterinarians and veterinary medical services in the United States. *J Am Vet Med Assoc* 1999;215:161-183; Belluck, P. A new problem for farmers: few veterinarians. *The New York Times;* February 6, 2007, <http://www.nytimes.com/2007/02/06/us/06vets.html.>
[34] OES Estimates,< http://www.bls.gov/oes/current/oes_nat.htm> and< http://www.bls.gov/oes/2000/oes_nat.htm>, Retrieved January 28, 2008
[35] A strict comparison of supply and demand projections from BLS and KPMG is not possible. BLS projections account for retirements and other exits from the occupation on the demand side, while KPGG projections account for exits on the supply side. However, the differences between supply and demand projections for each study are comparable.
[36] BLS occupational projections are based on factors such as historical economic trends, projections of GDP, historical hours worked per worker, and other factors. Each of these is a potential source of error for the occupational projections.
[37] Some vet graduate figures are closer to 2,500 per year <http://www.avma.org/onlnews/javma/apr07/070401a.asp>, so the projected shortage may be an underestimate.

US Food Animal Veterinarians

There is widespread concern in the veterinary community about the possibility of a shortage of food animal veterinarians[38]. Conflicting evidence and expert opinions make it difficult to assess whether such a shortage will materialize.

The KPMG LLP study projected a 3 percent increase in the need for food animal veterinarians nationally in the period from 2000 to 2015. BLS projections for 2006-2016 do not distinguish between companion and food animal veterinarians in private practice, but project declines in the number of veterinarians in fields closely related to agriculture and food safety, including animal production and federal and state government. To determine definitively whether a shortage of food supply veterinarians exists or will materialize in the future, more data are needed.

US Laboratory Animal Veterinarians

In the laboratory animal veterinary field, there are similar concerns about perceived current shortages of qualified veterinarians. One 2001 survey found evidence that laboratory animal veterinarian positions were going unfilled due to a lack of qualified applicants[39]. A 2004 study by the National Academy of Sciences suggested that the increase in lab animal veterinarian salaries at a rate faster than inflation and the increase in NIH animal research grants faster than the rise in the number of certified laboratory animal veterinarians might indicate a shortage of qualified laboratory animal veterinarians[40].

BLS occupational projections predict a 6.7 percent growth rate (16 veterinarians) for veterinarians in research and development in the physical, engineering and life sciences, and a 26 percent growth rate (42 veterinarians) among veterinarians in pharmaceutical and medicine manufacturing from 2006 to 2016, compared to a 45 percent growth rate in clinical services and 35 percent overall.

[38] Interviews; Prince, JP, Andrus, DM, Gwinner, KP. Future demand, probable shortages, and strategies for creating a better future in food supply veterinary medicine. *J Am Vet Med Assoc*2006; 229:57-69.
[39] Schub, T. Is there a shortage of laboratory animal veterinarians? *Lab Animal* 2001; 30: 39-42.
[40] National Academy of Sciences. National need and priorities for veterinarians in biomedical research, 2004. Retrieved January 2008 from <http://www.nap.edu/catalog.php?record_id=10878>.

New England Projected Needs

BLS projections for 2006 to 2016 suggest that New England will need 383 more veterinarians by 2014 due to industry growth, not including replacements needed due to retirement and workforce exits. AVMA membership data suggests that an additional 653 veterinarians may retire by 2014[41]. This suggests a potential need for 1,036 new veterinarians by 2014. If BLS national projection patterns hold true for New England, the majority of these veterinarians will be needed in clinical veterinary services.

Figure 20: New England: Projected Need for New Veterinarians by 2014

Region	Veterinarians Needed due to Growth	Veterinarians Needed due to Retirement	Total New Veterinarians Needed
CT	69	172	241
ME	70	71	141
MA	139	252	391
NH	67	63	130
RI	22	36	58
VT	17	59	76
Total	**383**	**653**	**1,036**

Source: AVMA Membership 2007, http://www.projectionscentral.com, Adjusted by Donahue Institute.

Taking into account current graduation rates and students' intentions to stay in New England, the Cummings school can be expected to produce approximately 630 new veterinarians by 2014, and 378 of these newly trained veterinarians might be expected to stay in New England. If current and projected trends materialize, New England will need to produce or recruit an additional 658 new veterinarians by 2014.

New England Food Animal Veterinarians

Available data are inadequate to assess or forecast the current demand for food animal veterinarians in New England. However, anecdotal evidence points to a current shortage of food animal veterinarians[42].

[41] Assuming that veterinarians retire at 65 years of age. While vacancy rates are not necessarily an indicator of shortage, in the fourth quarter of 2006 the 5% job vacancy rate for veterinarian positions surpassed the state's 3% rate for all occupations (Source: Massachusetts Job Vacancy Survey <http://lmi2.detma.org/Lmi/LMIjobvacancy.asp>).

[42] Belluck, P. A new problem for farmers: few veterinarians. *The New York Times;* February 6, 2007, <http://www.nytimes.com/2007/02/06/us/06vets.html>; Interviews with state VMA representatives.

Analysis of the AVMA member data shows that food animal veterinarians in New England are older than veterinarians in other fields, and thus more likely to retire. While 43 percent of all veterinarians are over 50 years old, 56 percent of food animal veterinarians are over 50 years old in 2008. From 2008 until 2014, food animal veterinarians can be expected to retire at nearly twice the rates of companion animal veterinarians (11 percent for food animal veterinarians compared to six percent for companion animal veterinarians, and seven percent for all veterinarians). New England may lose 29 food animal veterinarians – 25 percent of the current workforce – to retirement by 2014.

Maine Food Animal Veterinarian Survey

A 2007 survey of food animal veterinary practices in Maine, commissioned by the Maine Veterinary Medical Association and the Maine Department of Agriculture, showed that 28 of 38 responding veterinarians saw increasing demand for services, while 26 had difficulty hiring associate veterinarians for their practices. Only 40% of veterinarians surveyed saw farm animals (excluding equine) greater than 25% of their time.

A 2006 AVMA survey of veterinary school seniors at Tufts found that three out of 80 students planned to find employment in large animal medicine. If this rate of entrance to the food animal field continues until 2014, and if all of these students choose to work in New England, this would produce 12 new food animal veterinarians by 2014. This would suggest that New England may need an additional 13 food animal veterinarians to maintain the current workforce size. Not enough data are available to determine whether the potential unmet need could be met by graduates of other veterinary programs.

Additional data would be necessary to determine whether the current New England workforce of 116 food animal veterinarians is inadequate to meet demand. Nonetheless, Maine survey results and our key informant interviews suggest that there are strains on the current food animal workforce.

New England Laboratory Animal Medicine

While available data do not permit a full assessment of current or future shortages, the national concern over possible shortages of laboratory animal veterinarians could have a significant effect on New England centers of scientific research and development activities, particularly Massachusetts.

If BLS national projections of growth hold true for New England, the regional demand for laboratory animal veterinarians could increase by between 10 and 40 veterinarians by 2014 (using growth rates for the research and development and pharmaceutical manufacturing sectors), not including replacements for retirement or other workforce exits. AVMA membership data show that while 67 percent (132 veterinarians) of scientific research and development veterinarians in New England are over 50 years old in 2008, only eight percent (fifteen veterinarians) will be 65 by 2014, putting the retirement rate in line with that for all veterinarians in New England at seven percent. Based on projected retirements and BLS growth rates for research and development and pharmaceutical manufacturing, New England could need between 25 and 55 newly trained laboratory animal veterinarians by 2014.

The 2006 AVMA survey of Cummings School seniors shows that two out of 80 students planned to pursue post-graduate training in laboratory animal medicine. At that rate, the school could produce 16 laboratory animal veterinarians by 2014, which alone would not be enough to meet the potential need in New England. Not enough data are available to determine whether the potential unmet need could be met by graduates of other veterinary programs.

Part III: Industry Economic Impact Analysis

Introduction

In this section we examine the economic impact of the veterinary medical industry in each of the four sectors – clinical practice, scientific R&D, academia and nontraditional – across New England and in each of the six states. We express economic impacts in 2006 dollars and full-time equivalent jobs.

Using employment in each sector for each state and the IMPLAN input-output system, we estimated direct, indirect and induced expenditures and indirect and induced employment for each sector in each state and in New England[43]. Direct, indirect and induced are defined as follows:

- *Direct* output refers to the gross expenditures of the industry or sector on operations, payroll and taxes. *Direct* employment refers to workers in the sector or industry.
- *Indirect* output refers to spending by suppliers and contractors to produce inputs for the industry (such as medical devices). *Indirect* employment refers to employees of the industry's contractors and suppliers.
- *Induced* output refers to household spending on goods and services by industry employees and the employees of contractors and suppliers (both direct and indirect employees). *Induced* employment refers to the employees of industries that produce the household goods and services purchased by the direct and indirect employees.

New England

Across New England, the four sectors together contribute over $1.7 billion in direct operating, payroll and capital expenditures, and employ an estimated 20,047 veterinarians, veterinary assistants, veterinary technicians, and support staff. Clinical practice alone spends over $1 billion, while veterinary scientific R&D spends $402.8 million.

[43] Minnesota IMPLAN Group, Inc., IMPLAN System (data and software), 1725 Tower Drive West, Suite 140, Stillwater, MN 55082 <www.implan.com>.

Veterinary medical spending in New England supports an additional 11,918 jobs throughout the region and an additional $1.6 billion of economic activity, for a total of over $3.3 billion in economic impact throughout New England[44].

For every 100 veterinary medical jobs in the region, an additional 59 jobs are created in the economy, a multiplier of 1.59. For every dollar generated by the veterinary medical industry, another dollar is generated in the regional economy, a multiplier of 1.97.

Figure 21: New England Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$1,115,618,996	$456,855,497	$576,230,296	$2,148,704,787	1.93
Scientific R&D	$402,803,219	$145,662,805	$290,345,384	$838,811,404	2.08
Academia	$146,988,253	$78,071,886	$60,522,309	$285,582,449	1.94
Nontraditional	$52,402,973	$36,117,936	$19,686,442	$108,207,351	2.06
Total Output	$1,717,813,441	$716,708,125	$946,784,431	$3,381,305,990	1.97

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 22: New England Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	15,545	2,685	4,608	22,839	1.47
Scientific R&D	2,832	1,121	2,320	6,273	2.21
Academia	1,521	322	541	2,384	1.57
Nontraditional	149	162	158	469	3.15
Total Employment	**20,047**	**4,290**	**7,628**	**31,965**	**1.59**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

States

With one exception, in each of the states clinical veterinary practice comprises the majority of veterinary medical economic activity, with veterinary scientific R&D ranking second, academia third, and nontraditional fourth. The exception is Maine, where significant pharmaceutical manufacturing activity makes nontraditional veterinary medicine the second-highest spending sector in the state.

[44] Total economic impact in New England is greater than the sum of impacts in each of the six states, because New England impacts include interstate commerce among the six states.

Connecticut

Connecticut has the second largest veterinary medical industry in New England, after Massachusetts. Over 5,700 veterinarians and related support staff work in the state, mostly in clinical practice, scientific R&D and academia. Connecticut has a considerable scientific R&D sector, employing 1,118 veterinary medicine staff.

Veterinary medical spending helps to support an additional 3,130 jobs in the state. Direct expenditures of $521.1 million generate an additional estimated $431.5 million in indirect and induced economic impacts, for a total statewide impact of over $952 million.

Every $100 spent by the veterinary medical industry in Connecticut supports an additional $83 in other economic activity, a multiplier of 1.83. Additionally, every 100 jobs in the veterinary medical industry in Connecticut support another 55 jobs throughout the state economy, a multiplier of 1.55.

Figure 23: Connecticut Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$313,678,016	$108,732,116	$137,161,510	$559,571,642	1.78
Scientific R&D	$174,314,768	$52,096,422	$106,799,058	$333,210,253	1.91
Academia	$31,382,112	$8,771,695	$16,663,659	$56,817,466	1.81
Nontraditional	$1,805,043	$235,084	$1,070,520	$3,110,647	1.72
Total Output	**$521,179,939**	**$169,835,317**	**$261,694,747**	**$952,710,008**	**1.83**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 24: Connecticut Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	4,186	614	1,070	5,871	1.40
Scientific R&D	1,118	404	833	2,356	2.11
Academia	411	68	130	609	1.48
Nontraditional	18	1	8	28	1.54
Total Employment	**5,733**	**1,088**	**2,042**	**8,863**	**1.55**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Maine

Veterinary medicine in Maine is responsible for an estimated 1,893 jobs and over $169 million in direct spending. Maine's nontraditional veterinary sector is the largest one in New England, with 50 veterinary workers in pharmaceutical manufacturing and 13 veterinarians in government and animal food manufacturing.

Veterinary medical spending supports an additional 1,037 jobs throughout the Maine economy. Direct expenditures of $169 million support an additional $121.4 million in economic activity in the state, for a total economic impact of over $290 million.

For every 100 jobs in the veterinary medical industry, an additional 55 jobs are supported in the state, a multiplier of 1.55. Similarly, for every $100 of industry related spending, another $72 of economic impact ripples throughout the Maine economy, a multiplier of 1.72.

Figure 25: Maine Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$106,811,000	$33,145,761	$41,115,531	$181,072,293	1.70
Scientific R&D	$10,705,494	$3,642,564	$4,667,022	$19,015,080	1.78
Academia	$8,735,254	$2,517,555	$4,117,742	$15,370,550	1.76
Nontraditional	$43,178,111	$23,710,799	$8,574,159	$75,463,071	1.75
Total Output	**$169,429,859**	**$63,016,679**	**$58,474,454**	**$290,920,994**	**1.72**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 26: Maine Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	1,566	245	426	2,237	1.43
Scientific R&D	116	38	48	202	1.74
Academia	148	27	43	218	1.47
Nontraditional	63	121	89	273	4.33
Total Employment	**1,893**	**431**	**606**	**2,930**	**1.55**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Massachusetts

Massachusetts leads New England in each of the veterinary medical sectors, except nontraditional. Veterinary clinical practice in Massachusetts employs 6,058 people and spends over $442 million, while scientific R&D employs 1,351 and spends nearly $190 million. With 8,000 employees statewide and over $719 million in direct expenditures, veterinary medicine is a strong part of the state economy.

Altogether, veterinary medical direct spending supports an additional $634.5 million in economic impact throughout the state and supports an additional 4,331 jobs in other industries. The veterinary sectors contribute to the total industry impact of $1.3 billion in economic activity and over 12,000 jobs as follows: veterinary clinical practice supports $812 million in economic activity and over 8,000 jobs, veterinary scientific R&D supports over $375 million and nearly 3,000 jobs, and veterinary academia supports nearly $157 million and 944 jobs. The Cummings School alone contributes over 90 percent of total veterinary academic impacts, directly or indirectly supporting $142 million and 776 jobs as a result of routine operating expenditures, capital projects, and estimated student and staff spending.

Every 100 jobs in veterinary medicine support another 54 jobs elsewhere in the economy, a multiplier of 1.54. Massachusetts has the highest multiplier for economic output of any state in New England: for every $100 in industry spending, an additional $88 of economic activity is supported, a multiplier of 1.88.

Figure 27: Massachusetts Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$442,233,984	$165,119,415	$204,694,727	$812,048,125	1.84
Scientific R&D	$189,988,256	$64,447,105	$121,224,304	$375,659,660	1.98
Academia (not including Tufts)	$7,984,754	$2,553,151	$4,436,217	$14,974,121	1.88
Tufts	$73,739,065	$53,590,570	$14,693,201	$142,022,836	1.93
Nontraditional	$5,061,532	$1,162,693	$2,586,542	$8,810,768	1.74
Total Output	**$719,007,591**	**$286,872,934**	**$347,634,991**	**$1,353,515,510**	**1.88**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 28: Massachusetts Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	6,058	937	1,589	8,584	1.42
Scientific R&D	1,351	475	941	2,768	2.05
Academia (not including Tufts)	116	18	34	168	1.45
Tufts	466	135	175	776	1.67
Nontraditional	47	6	20	73	1.56
Total Employment	**8,038**	**1,571**	**2,760**	**12,369**	**1.54**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

New Hampshire

New Hampshire has the third largest veterinary medical employment in New England, with an estimated 2,081 employees. New Hampshire's veterinary medical industry contributed over $148.7 million to the state economy and employed over 2,000 people.

Direct veterinary medical spending supports an additional $109.8 million in indirect and induced economic impacts and almost 900 jobs in other industries, for a statewide total impact of over $258 million and nearly 3,000 jobs.

Every $100 of veterinary medical industry spending in New Hampshire supports another $74 of economic activity in the state, a multiplier of 1.74. Additionally, every 100 veterinary medical jobs in New Hampshire support another 43 jobs throughout the state, a multiplier of 1.43.

Figure 29: New Hampshire Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$123,150,000	$40,052,721	$48,469,686	$211,672,407	1.72
Scientific R&D	$11,641,828	$3,525,460	$6,645,572	$21,812,860	1.87
Academia	$13,135,596	$3,813,189	$6,733,882	$23,682,667	1.80
Nontraditional	$838,346	$0	$576,116	$1,414,462	1.69
Total Output	**$148,765,770**	**$47,391,370**	**$62,425,256**	**$258,582,396**	**1.74**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 30: New Hampshire Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	1,797	270	438	2,505	1.39
Scientific R&D	87	30	60	177	2.03
Academia	190	33	61	284	1.49
Nontraditional	7	0	5	12	1.74
Total Employment	**2,081**	**333**	**564**	**2,977**	**1.43**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Rhode Island

Rhode Island's veterinary medical industry contributes $81.2 million in direct spending to the state economy and employs over 1,000 people, of which $69.3 million and over 900 people are in clinical practice.

Direct veterinary medical expenditures in Rhode Island support an additional $52 million in economic activity and 400 jobs throughout the state, for a total impact of over $133 million and 1,500 jobs.

Every 100 veterinary medical workers in Rhode Island support another 37 jobs elsewhere in the economy, a multiplier of 1.37. Additionally, for every $100 of veterinary related spending in Rhode Island, another $65 in economic activity is supported, a multiplier of 1.65.

Figure 31: Rhode Island Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$69,383,000	$19,549,665	$24,786,709	$113,719,374	1.64
Scientific R&D	$4,999,209	$1,349,255	$2,251,678	$8,600,141	1.72
Academia	$6,431,475	$1,604,671	$2,860,207	$10,896,353	1.69
Nontraditional	$400,692	$40,434	$210,027	$651,153	1.63
Total Output	**$81,214,376**	**$22,544,025**	**$30,108,621**	**$133,867,021**	**1.65**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN

Figure 32: Rhode Island Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	967	116	222	1,304	1.35
Scientific R&D	44	11	20	75	1.71
Academia	95	15	26	135	1.42
Nontraditional	4	0	2	6	1.53
Total Employment	**1,110**	**141**	**270**	**1,521**	**1.37**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Vermont

Vermont's veterinary medical industry has $78.2 million in direct expenditures and an estimated 1,192 employees. The majority of economic activity and employment is in the clinical practice sector, with over $60 million in spending and an estimated 971 veterinary medicine jobs.

Direct expenditures support an additional $46.8 million in indirect and induced economic impact and an estimated 468 jobs, for a total statewide impact of $125 million and over 1,600 jobs.

For every $100 of veterinary medical spending in Vermont, another $60 in economic impact ripples through the state economy, a multiplier of 1.60. For every 100 veterinary medical jobs in the state, another 39 jobs are supported throughout the economy, a multiplier of 1.39.

Figure 33: Vermont Economic Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	$60,362,996	$14,361,279	$18,803,245	$93,527,520	1.55
Scientific R&D	$11,153,664	$4,098,671	$4,728,831	$19,981,165	1.79
Academia	$5,579,997	$1,697,237	$2,449,247	$9,726,481	1.74
Nontraditional	$1,119,249	$14,790	$704,994	$1,839,033	1.64
Total Output	**$78,215,906**	**$20,171,977**	**$26,686,317**	**$125,074,199**	**1.60**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Figure 34: Vermont Employment Impact, 2006

Sector	Direct	Indirect	Induced	Total	Multiplier
Clinical Practice	971	138	191	1,300	1.34
Scientific R&D	116	41	48	205	1.77
Academia	95	18	25	138	1.45
Nontraditional	10	0	7	17	1.73
Total Employment	**1,192**	**197**	**272**	**1,660**	**1.39**

Sources: AVMA Membership 2007, QCEW 2006, Occupational Employment Statistics 2006, IMPLAN.

Appendix I: Methodology

Employment Estimates

Each of the four veterinary medical sectors corresponds to veterinary activity in an industry sector recognized by the North American Industry Classification System (NAICS). We identified veterinary activities in each sector by estimating the number of employees in that sector who perform veterinary-related work.

Estimating 2006 employment in the four veterinary medical sectors in each state required multiple data sources. We used employment counts and/ or estimates from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW) for 2006 and Occupational Employment Statistics (OES) estimates for May 2006, American Veterinary Medical Association (AVMA) membership data for 2007, the U.S. Census Non-employer Statistics from 2002 through 2005, and state occupational-industry matrices from 2006, ranking the data sources in order of preference as follows:

- Most preferred:
    - Because they count actual employees rather than relying on statistical methods, QCEW employment numbers are preferred to OES or other survey-based estimates. QCEW data provide employment figures by state and NAICS sector, but do not provide detail about occupations or activities within NAICS sector. QCEW data are publicly available at http://data.bls.gov/PDQ/outside.jsp?survey=en.
    - AVMA membership data provides a count of AVMA-member veterinarians along with their employment types and professional disciplines. We analyzed AVMA employment types and professional disciplines to identify the best correspondence to NAICS sectors. The AVMA provided their 2007 membership data for the six states. While AVMA membership does not capture all veterinarians, this count provided more comprehensive coverage, and higher numbers, than available statistical estimates. According to the AVMA, their membership represents about 86 percent of veterinarians.

- Next most preferred:
    - We used National Occupational Employment Statistics (OES) survey-based estimates for occupations within industries where QCEW and AVMA data did not fully define the industry. OES data are publicly available at http://www.bls.gov/oes/current/oes_nat.htm.
    - Non-employer statistics are survey-based estimates of non-employer firms by area and NAICS code (i.e. proprietors with no employees). Non-employer statistics are publicly available at http://www.census.gov/epcd/nonemployer/2005/us/US000.HTM.
- Least preferred:
    - State occupational-industry matrices are survey-based statistical estimates with smaller sample sizes and bigger errors than the national estimates, due to the smaller geographical area that they model. The six states' departments of labor provided the matrices.

We estimated employment in each sector as follows:

Veterinary Clinical Practice: We used employment for NAICS sector 54194 from the Quarterly Census of Employment and Wages. Because the QCEW provides an actual count of employees, we preferred it to other data sources that used statistical methods to derive total employment from a sample. We estimated non-employers (self-employed) for 2006 using the available 2002-2005 estimates for NAICS 54194.

Scientific Research & Development AND Academia: Employment estimates for these sectors include the AVMA veterinarian counts for related employment types, plus a ratio of veterinary technologists and veterinary assistants per veterinarian, which we derived from the national OES occupation-industry matrix. We assume that veterinarians in each state require similar levels of support from veterinary technologists and assistants, on average, for a given industry.

Nontraditional: This sector includes government, zoos and human societies. Because the veterinary staffs for these institutions tend to be quite small compared to other sectors, we used AVMA counts of veterinarians in related employment types as total employment. This is conservative, because it does not represent the small numbers of support staff for this sector. For Maine employment estimates, we used additional detail provided by the state occupational-industry matrix.

Farm estimates

For farm estimates in Figure 10, we used data from the USDA's 2002 Census of Agriculture. Farms are identified by NAICS code. We include all those that might reasonably require veterinary services: livestock, poultry, and aquaculture. The following list shows NAICS farm categories that are included in our farm counts:

Beef Cattle Ranching and Farming (112111)

Cattle feedlots (112112)

Dairy cattle and milk production (11212)

Hog and pig farming (1122)

Poultry and egg production (1123)

Sheep and goat farming (1124)

Animal aquaculture and other animal production (1125, 1129).

Appendix II: Impact Analysis Definitions & Methodology

Impact Analysis and the IMPLAN Model

The UMass Donahue Institute built input-output models using the IMPLAN Professional 2.0 model building software and data packages. The data used in the model are for 2006, which is the latest available. Model outputs are reported in 2006 dollars.

Input-output models, such as the IMPLAN model, examine the flow of money between industries and households in the economy. Any given expenditure in an economy leads to further expenditures as the money is re-spent. Impact analysis models this spending and re-spending of money, tracing the path of a dollar through the economy. The path of a given dollar ends when that dollar leaves the region through foreign or domestic trade, or is collected as a tax.

The IMPLAN modeling system combines the U.S. Bureau of Economic Analysis' Input-Output Benchmarks with other data to construct quantitative models of trade flow relationships between businesses and between businesses and final consumers. From this data, one can examine the effects of a change in one or several economic activities to predict its effect on a specific state, regional, or local economy (impact analysis). The IMPLAN input-output accounts capture all monetary market transactions for consumption in a given time period. The IMPLAN input-output accounts are based on industry survey data collected periodically by the U.S. Bureau of Economic Analysis and follow a balanced account format recommended by the United Nations.

The IMPLAN model estimates two major types of impacts:

- *Outputs* are expenditures of the industry and supplier industries to produce the final good.
- *Employment* is all employees required to produce the outputs, including wage and salary employees, full-time and part-time employees, and the self-employed.

IMPLAN estimates direct, indirect and induced impacts for both outputs and employment. Direct, indirect, induced and total are defined as follows:

- *Direct output* refers to the gross expenditures of the industry or sector on operations, payroll and taxes.
- Direct employment refers to workers in the sector or industry.
- *Indirect output* refers to spending by suppliers and contractors to produce inputs for the industry (such as medical devices).
- *Indirect employment* refers to employees of the industry's contractors and suppliers.
- *Induced output* refers to household spending on goods and services by industry employees and the employees of contractors and suppliers (both direct and indirect employees).
- *Induced employment* refers to the employees of industries that produce the household goods and services purchased by the direct and indirect employees.
- *Total outputs* or *total impacts* are the sum of direct, indirect and induced outputs.
- *Total employment* is the sum of direct, indirect and induced outputs.

Multipliers

A *multiplier* is an index of how many times each dollar is re-spent in the economy of a geographical area. An *employment multiplier* is an index of how each job in an economy supports related jobs in other industries.

The multiplier is the ratio of total outputs or employment to direct outputs or employment. An output multiplier of 1.5 could be understood to mean that out of every one dollar of direct expenditure, 50 cents is re-spent in the local economy.

IMPLAN Methods

Given a number of employees and a specific industry definition, the model estimates the total production output and household expenditures of those workers using internal output-per-worker and pay-per-worker estimates for a given industry in a given geographical area.

For this study, three distinct models were constructed: one that modeled intrastate economic impacts for each of the six states, one that modeled intrastate *and* interstate economic impacts throughout New England, and one

that modeled economic impacts for the Cummings School in the state of Massachusetts. We customized employment and output in each model to match our original estimates of veterinary industry sector employment.

Appendix III: Top Industries Impacted by Veterinary Medicine, by State

State	Top Ten Impacted Industries	Indirect Impact
Connecticut	Pharmaceutical and medical manufacturing	$24,127,550
	Real estate	$15,628,880
	Wholesale trade	$11,608,520
	Insurance carriers	$6,712,275
	Employment services	$6,051,767
	Legal services	$5,086,224
	Telecommunications	$5,073,303
	All other miscellaneous professional and technical	$4,975,132
	Management consulting services	$4,550,400
	Office administrative services	$4,072,279
Maine	Pharmaceutical and medical manufacturing	$19,342,120
	Wholesale trade	$4,282,811
	Real estate	$3,551,546
	Insurance carriers	$2,202,265
	Management of companies and enterprises	$2,016,752
	Telecommunications	$1,818,626
	Lessors of nonfinancial intangible assets	$1,254,490
	Legal services	$1,202,283
	Hotels and motels-including casino hotels	$1,172,697
	All other miscellaneous professional and technical	$1,083,951
Massachusetts	Pharmaceutical and medical manufacturing	$34,137,740
	Wholesale trade	$17,259,640
	Real estate	$17,111,220
	Insurance carriers	$9,374,871
	Telecommunications	$8,448,091
	Employment services	$7,865,058
	Legal services	$7,478,653
	Management consulting services	$5,970,521
	Architectural and engineering services	$5,813,498
	All other miscellaneous professional and technical	$5,385,128

State	Top Ten Impacted Industries	Indirect Impact
New Hampshire	Pharmaceutical and medical manufacturing	$8,013,843
	Real estate	$4,388,810
	Wholesale trade	$2,920,689
	Insurance carriers	$2,742,587
	Telecommunications	$1,854,571
	Employment services	$1,136,109
	Hotels and motels - including casino hotels	$1,121,104
	Food services and drinking places	$951,226
	Management consulting services	$900,617
	Surgical appliance and supplies manufacturing	$895,547
Rhode Island	Pharmaceutical and medical manufacturing	$5,646,960
	Real estate	$2,024,818
	Insurance carriers	$1,467,658
	Wholesale trade	$1,155,816
	Telecommunications	$1,022,467
	Food services and drinking places	$470,331
	Monetary authorities and depository credit	$434,706
	Surgical and medical instrument manufacturing	$433,153
	Maintenance and repair of nonresidential buildings	$420,975
	Legal services	$417,794
Vermont	Real estate	$2,086,862
	Insurance carriers	$1,185,006
	Telecommunications	$1,160,839
	Wholesale trade	$1,082,911
	Hotels and motels - including casino hotels	$692,915
	Management consulting services	$557,477
	Legal services	$550,693
	Food services and drinking places	$526,254
	Architectural and engineering services	$503,018
	Maintenance and repair of nonresidential buildings	$497,827

Appendix IV: AVMA to NAICS Sector Bridge

Sector	NAICS Industry	AVMA Employment Type	AVMA Professional Discipline
Clinical Practice	Veterinary Services (54194)	General Medicine/ Surgery	All
		Production Medicine	All
		Referral/ Specialty Medicine	All
		Emergency/ Critical Care	All
		Other Private Clinical Practice	All
Scientific R&D	Scientific R&D (5417)	Pharmaceutical/Biological	All
		Laboratory	All
		Business/ Consulting	Cardiology
			Laboratory Animal Medicine
			Oncology
			Pathology-- Anatomic
			Surgery
		Other Industry/ Commercial	Anesthesiology
			Cardiology
			Epidemiology
			Laboratory Animal Medicine
			Microbiology
			Pathology-- Anatomic
			Pharmacology
			Physiology
			Surgery
			Toxicology
		Other/ not listed	Epidemiology
			Laboratory Animal Medicine
			Microbiology
			Oncology
			Pathology-- Anatomic
			Surgery
Academic	Colleges, Universities and Professional Schools (6113) and Junior Colleges (6112)	Veterinary Medical College/ School	All
		Veterinary Science Department	All
		Animal Science Department	All
		Veterinary Technician Program	All
		Other Academia	All

Sector	NAICS Industry	AVMA Employment Type	AVMA Professional Discipline
Nontraditional	Animal Food Manufacturing (3111)	Feeds/ Nutrition	All
	Museums, Historical Sites and Similar Institutions (7121)	Zoo/ Aquarium	All
	Social Advocacy Organizations (8133)	Humane Organization	All
	Social Advocacy Organizations (8133)	Membership Association/ Professional Society	All
	Social Advocacy Organizations (8133)	Wildlife	All
	Public Administration (92)	U.S. Federal Government	All
		State Government	All
		Local Government	All
	N/A	Army	All
		Air Force	All

Appendix V: Tax Revenue Generated by Veterinary Medicine, 2006

Tax revenue includes sales tax, personal income tax, property tax, corporate profits tax, dividends, motor vehicle license fees, and other taxes and fees.

State	State Revenues	Federal Revenues	Total
Connecticut	$46,059,729	$109,108,057	$155,167,786
Maine	$12,206,143	$19,286,215	$31,492,358
Massachusetts	$65,268,422	$128,597,092	$193,865,514
New Hampshire	$11,175,033	$28,326,706	$39,501,739
Rhode Island	$8,240,687	$15,095,420	$23,336,107
Vermont	$5,087,516	$9,440,867	$14,528,383

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