Laboratory Animal Medicine: Guidelines for Education and Training (1978)

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Preface

In the past three decades, laboratory animal medicine has emerged as one of the most challenging and exciting specialty fields of veterinary medicine. It offers numerous opportunities for rewarding careers. This document provides information about laboratory animal medicine and offers guidelines for education and training in the field.

The Institute of Laboratory Animal Resources first published *A Guide to Postdoctoral Training in Laboratory Animal Medicine* in 1967. When the guide was revised in 1971, the word "Training" in the title was changed to "Education." The inclusion of both "Education" and "Training" in the title of this edition reflects the opinion of the Committee on Education that preparation for a career in laboratory animal medicine requires significant intellectual effort and the acquisition of specific practice skills.

We hope this document will aid those considering careers in laboratory animal medicine in gaining an understanding of the specialty and of training opportunities. We specifically wish to encourage flexibility and variety in training programs, but the guidelines also are intended to provide a unifying framework for program development. Finally, we hope to stimulate interest in laboratory animal medicine while pointing the way to the personal growth of specialists in the field.

Comments on the guidelines will be welcomed and should be addressed to the Institute of Laboratory Animal Resources, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

Contents

I Introduction

A. CONTEMPORARY CONCEPTS OF ANIMAL EXPERIMENTATION

Laboratory animal medicine is a dynamic, rapidly evolving specialty that is an integral part of animal experimentation contributing to biomedical research, teaching, and testing. Those considering a career in this specialty should understand the evolution, scope, and characteristics of contemporary animal experimentation, since these factors bear importantly on the future of laboratory animal medicine.

Current practices in laboratory animal medicine differ significantly from those considered to be commonplace as recently as a decade ago. The evolution of the specialty has paralleled the growing sophistication of biomedical research as a whole, and this process generates increased demands for better-defined animal subjects and more innovative methods of animal experimentation. The requirements for better definition and control of laboratory animal quality, as well as the critical need for well-characterized animal models of human disease, have placed heavy demands on laboratory animal veterinarians and continue to present unique challenges and opportunities.

National health goals greatly influence policies governing biomedical research, drug testing, and education of health professionals. Consequently, they also influence the scope and characteristics of animal experimentation. The major areas of emphasis in biomedical research, including animal experimentation, must take into account the major causes of human death (Figure 1) and disability (Figure 2). Fluctuations occur in the relative emphasis on specific areas of research, and methods of animal experimentation must be responsive to these changes.

Contemporary animal experimentation also has been influenced by fiscal, ethical, and legal factors. Recent restrictions on the use of human subjects (USDHEW, 1977b, 1978) have further increased the need for animal research. At the same time, government regulations that reflect public concern about humane animal experimentation have constrained the use of animals in research (USDA, 1977a,b,c, 1978).

Agencies that provide financial support for biomedical research, regulate drug testing, or develop guidelines for care and use of laboratory animals are specifying increasingly rigorous standards that must be met by scientists engaged in animal experimentation (Ninety-fourth Congress, 1976; USDHEW, 1976, 1977a; ILAR, 1978). The scientific community itself has supported and encouraged high standards of animal experimentation by adopting guidelines that scientists follow voluntarily through participation in the accreditation program of the American Association for Accreditation of Laboratory Animal Care (AAALAC).

All of these factors contribute to elevating the quality of science, assuring the humane use of animals for scientific purposes, and emphasizing the value of laboratory animal veterinarians in animal experimentation.

B. HISTORICAL PERSPECTIVES

From its beginnings about 30 years ago, laboratory animal medicine has been an important field of biomedical research. Hundreds of veterinarians have entered the specialty during the past generation and have contributed significantly to achieving today's high standards and quality of research involving vertebrate animals.

Organized efforts to improve the care and quality of laboratory animals began as World War II ended. This was a

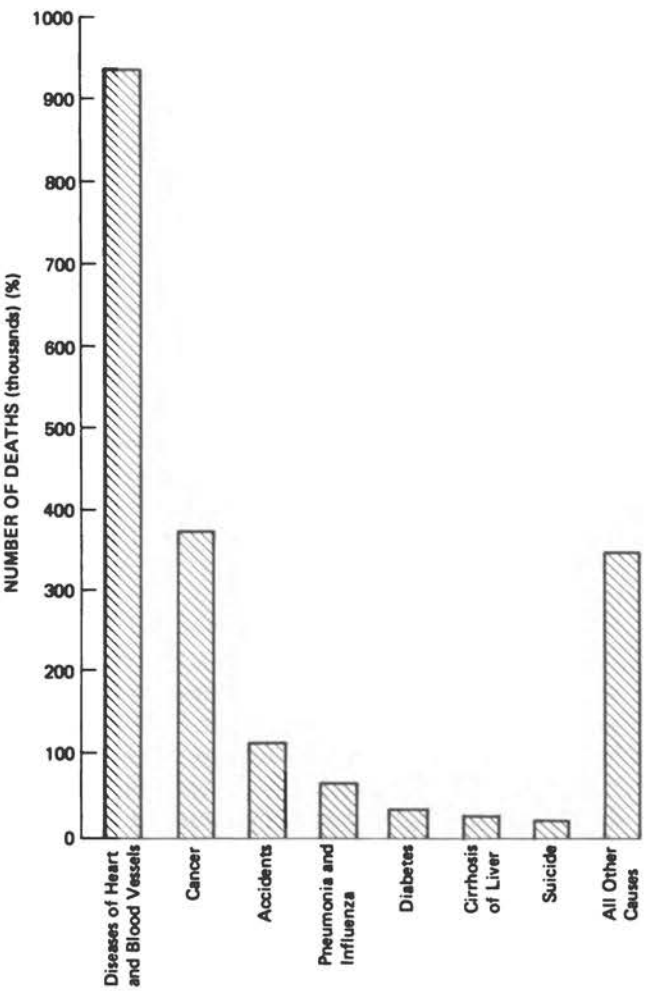

FIGURE 1 Leading causes of death in the United States in 1976. Data are from National Health Education Committee (1976, p. 289).

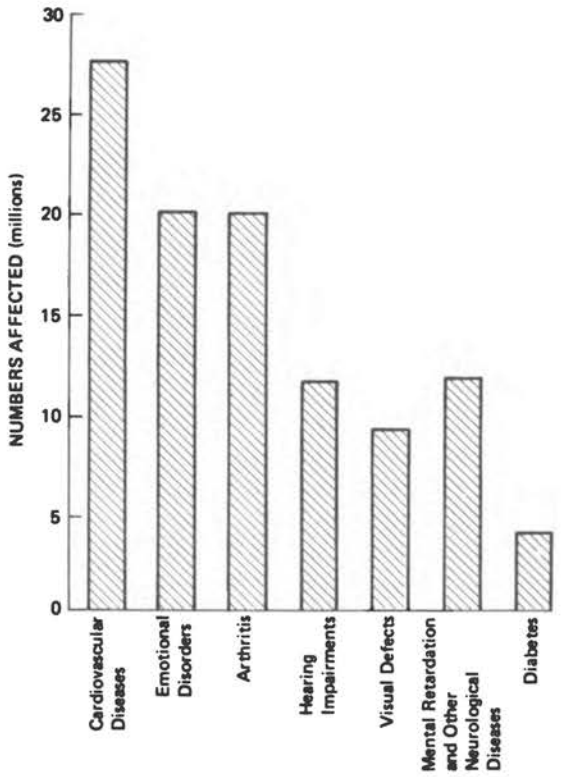

FIGURE 2 Leading causes of disability in the United States in 1974. Data are from the National Health Education Committee (1976, p. 291).

time when medical scientists and the veterinary profession lived in separate worlds. Virtually no positions existed for veterinarians in medical research institutions. Nevertheless, the use of animals had slowly been increasing, and concerned medical scientists recognized that problems of animal care and quality were developing for which no solutions were available. Some of these matters were discussed at a conference in New York City in 1944 that was organized by the New York Academy of Sciences (NYAS, 1945). Not a single veterinarian presented a paper at that pioneering meeting; yet this conference may well be said to mark the beginnings of laboratory animal medicine.

The initial employment of veterinarians in research institutions was an outgrowth of the explosive increase in federal support of biomedical research between 1945 and 1955. Medical school faculties and the staffs of other research institutions realized that veterinarians could be helpful in dealing with the unprecedented problems that accompanied the rapidly increasing use of animals, such as poor animal quality, rampant disease in animal colonies, inadequate facilities, opposition voiced by antivivisectionists, and many others. The evolution of laboratory animal medicine during this period has been described by Cohen (1959).

The problems that confronted laboratory animal veterinarians initially differed from those that confront specialists in the field today. They were a small, inexperienced group. They had to rely largely on personal contact, self-instruction, and intuition in developing solutions to the problems they faced. Information on laboratory animal care and diseases was not readily accessible to them. There were no scientific journals devoted to laboratory animal science. Jaffe's (1931) volume on laboratory animal pathology and diseases was not available in English. The first edition of the *UFAW Handbook on the Care and Management of Laboratory Animals* (Worden, 1947) and *The Biology of the Laboratory Mouse* (Snell, 1941) were among the few easily accessible volumes dealing with laboratory animal problems.

By today's standards the technology of animal care and animal husbandry was rudimentary in those early years. Knowledge of laboratory animal diseases also was fragmentary. The Animal Care Panel was organized in 1950. In 1967 it was renamed the American Association for Laboratory Animal Science (AALAS). This organization provided a needed forum for the exchange of information about laboratory animals. Early meetings were characterized by the presentation of numerous descriptive papers. Subjects such as animal colony management ("this is how we do it"), design of animal facilities and cage equipment, and common diseases of the laboratory species were discussed. The papers published in the annual *Proceedings of the Animal Care Panel* (1950-1956) mark the early emphasis of laboratory animal veterinarians on developing the technology of laboratory animal care.

The organizational structure of laboratory animal resources in medical schools and other institutional animal facilities evolved in the 1950's. At AALAS meetings, veterinarians discussed their respective institutional roles. They argued the advantages and disadvantages of centralizing animal facilities. They wondered how a single institutional veterinarian could meet all the developing needs for veterinary services. They considered the possibility of organizing laboratory animal facilities as academic departments. By 1960 a pattern of central administration of medical school animal facilities under veterinary direction had become established (Cohen, 1960), and the concept of academic contributions from animal medicine units had emerged (Clarkson, 1961). By the early 1970's this concept had become well established (Lang and Harrell, 1972).

Laboratory animal medicine was recognized by the American Veterinary Medical Association (AVMA) in 1952 by the appointment of a Committee on the Medical Care of Laboratory Animals. This was followed by the establishment of a professional specialty board, the American Board of Laboratory Animal Medicine, in 1955, the predecessor of the American College of Laboratory Animal Medicine (ACLAM). In 1957, ACLAM was established by the AVMA (1) to define standards of training and experience required for certification in the specialty, (2) to certify veterinarians found to be qualified as specialists in laboratory animal medicine, and (3) to encourage education, training, and experience in the specialty (ACLAM,

1977). The American Society of Laboratory Animal Practitioners (ASLAP) was established in 1967 and recognized by the AVMA as a professional society open to veterinarians having an interest in laboratory animal medicine.

The technology for rearing laboratory animals free of their common pathogens emerged in the late 1950's (Griffin, 1952; Henthorne and Veenstra, 1957; Reyniers, 1957; Foster, 1958, 1959). This laid the foundation for the striking improvement in laboratory animal quality that occurred with the advent of barrier rearing techniques. Publication of the *Guide for Laboratory Animal Facilities and Care* (Animal Care Panel, 1963), now known as the *Guide for the Care and Use of Laboratory Animals* (ILAR, 1978) and the establishment of AAALAC in 1965 were milestones because, for the first time, standards became available by which scientific institutions could evaluate the quality of their animal care programs. Laboratory animal veterinarians contributed significantly to the guide and the development of AAALAC. The original edition of the guide was adopted by the Institute of Laboratory Animal Resources (ILAR), National Research Council, National Academy of Sciences, which has developed subsequent revisions. ILAR was founded in 1952; by the early 1960's it had become a major organizational focus for development of standards and guidelines in laboratory animal science.

The first formal postdoctoral educational program in laboratory animal medicine was started at the Bowman Gray Medical School in 1959. During the next 10 years, additional programs were established in other institutions mainly with the aid of training grants from the Animal Resources Branch, Division of Research Resources, National Institutes of Health (NIH) (Pick, 1965; Cohen, 1976). The definition of laboratory animal medicine and identification of the body of knowledge comprising the field were troublesome questions during the early 1960's. These and related matters were reviewed at an ILAR workshop on graduate education in 1964 (ILAR, 1965). The outcome was a better basis for defining laboratory animal medicine as a veterinary clinical specialty.

Veterinarians in laboratory animal medicine units have made significant contributions to medical research since the early 1950's. For example, they have helped to provide the scientific basis for present standards of use and care of animals. They have contributed enormously to the diagnosis, control, and eradication of laboratory animal diseases. They have developed valuable animal models of human diseases. The discovery of naturally occurring atherosclerosis in pigeons and primates (Clarkson *et al.*, 1959, 1969), the isolation of oncogenic viruses from primates (Melendez *et al.*, 1968), and the identification and use of the cat as a model of heritable human lysosomal disorders (Baker *et al.*, 1976) are but a few examples of significant contributions by veterinarians to biomedical research. A development of equal significance has been the growth of strong research units in comparative medicine in several medical research institutions.

More than 400 veterinarians are currently employed full time in laboratory animal medicine. This compares favorably with a projection made in 1959 that 300 positions would become available in the next 10-15 years over and above the 125 positions then known to exist (Cohen, 1959).

A survey in 1967-1968 (ILAR, 1970) bore out the need for additional numbers of veterinarians in laboratory animal medicine. Furthermore, NIH recently has estimated that 0.3-0.6 full-time equivalent professional positions are needed for adequate staffing of institutional animal medicine programs per million dollars of animal research projects (Charles W. McPherson, personal communication, 1977). Approximately $900 million of animal research projects are being funded by NIH in 1977. This suggests a current need to train up to 150 additional veterinarians for positions in institutions that receive NIH funds. A new survey currently in progress (by the Commission on Human Resources, Panel on Clinical Sciences, NAS/NRC) may yield additional information on the need for veterinarians.

The developments highlighted in this brief review are but the "tip of an iceberg." It would take an entire volume to describe this history in adequate detail and to do justice to the organizations and individuals who have brought the field to its present state of advancement. It is apparent, however, that laboratory animal medicine has come a long way in a relatively short period of time.

In his well-known book, *Self Renewal*, John W. Gardner (1963) examined the qualities of human societies that promote creativity and the capacity for renewal. A society that is creative and able to renew itself is comfortable with the prospect of change. Its members expect to play a role in shaping its future. There is much in the concept of societal renewal that applies to laboratory animal medicine. It is an evolving field. It has demonstrated the capacity for renewal, and it has grown in the light of experience and new knowledge. Its future is as promising as its past has been productive.

C. DEFINITIONS

1. Laboratory Animal Science

Laboratory Animal Science (LAS) refers to the complex of knowledge and skills, derived from many disciplines and specialty fields, that relate to the use of animals in biomedical research, testing, and education. Thus areas of knowledge such as laboratory animal breeding, genetics, animal husbandry and technology, animal technician training, animal facilities design and construction, animal resources management, animal research methodology, and laboratory animal medicine all are part of laboratory animal science.

2. Laboratory Animal Medicine

Laboratory Animal Medicine (LAM) is that specialty of veterinary medicine which deals with the diagnosis, treatment, and prevention of disease in animals used as sub-

jects in biomedical activities (Friel, 1974). It is a pivotal component of laboratory animal science. Indeed, this veterinary specialty is so integrally related to laboratory animal science that it is difficult to clearly delineate and separate the two. Professional service, research, and teaching constitute the major components of the specialty. Specific activities include the following: laboratory animal disease control, and research leading to better understanding of these diseases and their diagnosis, prevention, and treatment; experimental surgery, experimental radiology/radiobiology, and other methods of animal experimentation; animal resources administration and management; development, characterization, and use of spontaneous or induced animal models of human disease; research aimed at advancing all facets of animal experimentation; and instruction of personnel, at all levels, on the selection, care, and use of animals in research. These activities are elaborated on in later sections.

3. Comparative Medicine

The term "comparative medicine" sometimes is used interchangeably with laboratory animal medicine and is defined as the study of phenomena basic to the diseases of all species (Friel, 1974).

D. INTERRELATIONSHIP OF LABORATORY ANIMAL MEDICINE AND OTHER SPECIALTIES

From the foregoing definitions it should be clear that laboratory animal medicine is very broad in scope and overlaps many other specialty fields. Most institutions that employ laboratory animal veterinarians require broadly trained professionals who are competent to guide programs involving many species and varied activities. Therefore it is essential that laboratory animal specialists achieve a basic level of competence in all facets of the specialty. It is not uncommon for large institutions to employ veterinary pathologists and surgeons as well as laboratory animal specialists to conduct experimental animal resources programs. In such instances, close liaison is necessary among these veterinary specialists to implement a sound program. In addition, subspecialization within laboratory animal medicine is evolving, and it is desirable for some specialists to focus their activities at some point in their careers. For example, primate research laboratories require laboratory animal specialists with interests and skills that may differ significantly from those of specialists working in laboratories that use rodents primarily.

E. CAREER OPPORTUNITIES

A remarkable number and variety of career opportunities presently are available to veterinarians trained in laboratory animal medicine. The important contributions made to animal experimentation by laboratory animal specialists during the past few decades have helped to stimulate an increasing demand for specialists. In addition, the demand has been intensified by federal laws and policies that require veterinary supervision of the care and use of experimental animals. Consequently, the number of unfilled positions in laboratory animal medicine exceeds the availability of veterinarians trained in this area. Indeed, NIH has designated laboratory animal medicine as one of the critical areas of need for health-manpower personnel (Charles W. McPherson, personal communication, 1977) and has authorized funding to increase training opportunities in the specialty. One conclusion of an AVMA-funded study on veterinary manpower needs for the period 1978-1990 is that the greatest growth area in veterinary medicine consists of positions whose specifications prefer or require training in research and laboratory animal medicine (Arthur D. Little, Inc., 1978). Because of current manpower deficits, anticipated increased demand, and an inadequate rate of training, it is likely that the number of open positions will exceed the availability of specialists for years to come.

Laboratory animal veterinarians presently have excellent opportunities to select the type of institution and professional activity that best matches their career goals (ACLAM, 1978). Institutions employing laboratory animal specialists include: universities; schools of medicine, dentistry, and veterinary medicine; pharmaceutical testing and research firms; private research organizations; military services; federal, state, and local governmental agencies; and Veterans Administration and other hospitals.

II Predoctoral Professional Education and Training

A. NEED AND PURPOSE

Education and training beyond the veterinary degree is necessary for specialty practice, but exposure to specialty fields should begin in veterinary school. Even though the veterinary school curriculum is very crowded, most schools are attempting to provide introductory courses in laboratory animal medicine. There is growing recognition within the veterinary schools that laboratory animal medicine is a vital component of biomedical research, and educational opportunities in laboratory animal medicine for veterinary students are expanding.

B. CURRICULUM

1. Introductory Subjects

Subject material related to laboratory animal medicine often can be presented with introductory material on veterinary and comparative medical research, zoonoses, or public health. Information about specific laboratory species also can be incorporated as part of basic science courses such as anatomy, physiology, microbiology, and pathology. Often, stimulating field trips and lectures on exotic, aquatic, or zoo animal medicine provide a medium to focus on laboratory animal medicine. By the third or fourth year of veterinary school, however, students should be introduced to subjects such as (1) the role of the laboratory animal veterinarian in biomedical research, (2) surveys of commonly used laboratory animals and their use as research models, and (3) husbandry, diseases, and pathology of laboratory animals.

2. Enrichment Subjects

Senior veterinary students should have the opportunity to broaden their knowledge of laboratory animal medicine through additional subjects such as effects of environmental factors on animal behavior, diseases of laboratory animals, complications of diseases in research animals, methods in animal experimentation, ethical aspects of animal experimentation, and opportunities for careers in laboratory animal medicine. This can be accomplished through elective courses, special short courses, or independent training and study as suggested in Sections C and D following.

C. EXPERIENCE

1. Externships and Preceptorships

Opportunities are increasing for veterinary students to obtain experience in laboratory animal medicine programs through 1- to 8-week externships or preceptorships. Training of 1-8 weeks' duration is offered through institutions that have postdoctoral training programs and in other medical and veterinary school settings (see Appendix C). This direct exposure enables students to gain insight into the practice of laboratory animal medicine and the challenging opportunities in the field.

2. Summer Fellowships

Fellowships or positions are available in limited numbers to students with good academic qualifications who have completed one or more years of veterinary school and are interested in laboratory animal medicine. The positions are available at institutions that offer postdoctoral training and in other institutions having organized laboratory animal medicine departments or units. A stipend generally is provided. Summer fellows participate in a broad spectrum of laboratory animal medicine activities as well as in research (see Appendix C).

D. AUTOTUTORIAL PROGRAMS

In recent years a few self-instructional programs (see Appendix E) have been developed to provide introductory information about laboratory animal science (Clark *et al.*, 1976). The autotutorial programs are not designed to be intensive, but they provide source material that can be incorporated in veterinary college courses and can be helpful to students seeking introductory information about laboratory animal medicine.

III Postdoctoral Education and Training

A. PURPOSE

Postdoctoral training is essential to prepare adequately for specialty practice. Although it is possible to become a laboratory animal medicine specialist through self-instruction and experience, the value of formal training is well established, and most veterinarians now enter laboratory animal medicine through formal training programs.

B. VARIATIONS IN POSTDOCTORAL TRAINING PROGRAMS

Flexibility and variety are desirable in training programs in laboratory animal medicine. The programs now in existence did not arise in a vacuum. Hence their content and format reflect the experience and orientation of the preceptors, the interests of their trainees, and the interrelationships perceived among laboratory animal medicine, laboratory animal science, and biomedical research. Similar considerations undoubtedly will guide development of new programs.

There is every reason to expect varying emphases in programs from institution to institution. Thus some institutions emphasize clinical training, while in others research training is foremost. In some programs, trainees are encouraged or required to earn a graduate degree, while in others there is no degree requirement but preparation for board certification is stressed. Program quality is the crucial factor. The particular structure is important only insofar as it enhances program quality. However, in all programs, trainees must be provided a core of basic knowledge and skills of laboratory animal medicine.

C. ENVIRONMENT FOR TRAINING

Institutions that sponsor training programs are obliged to provide an environment that will enable students to attain their educational objectives. A suitable training environment for laboratory animal medicine consists of the following essential elements:

1. Faculty and Supporting Staff

The program should be directed by a laboratory animal medicine specialist. Faculty input from fields such as pathology, microbiology, surgery, or genetics is highly desirable. Interaction of trainees with members of the professional and technical staff should be encouraged.

2. Physical Plant

The laboratory animal facilities should be in compliance with existing laws and standards. The programs should be conducted in facilities that meet federal standards and comply with NIH policy. AAALAC accreditation is desirable. Adequate laboratory space, conference rooms, and offices for trainees should be provided.

3. Library

A modern library is essential. It should contain carefully selected medical and scientific textbooks, monographs, and journals, with special emphasis on volumes dealing with the use and care of animals, laboratory animal diseases and pathology, methods of animal experimentation, animal models for biomedical research, and related subjects.

4. Experimental Animals

An adequate number and variety of animals, including breeding colonies, should be available to enable trainees to acquire broad experience with the species that are most commonly used in research.

5. Diagnostic Laboratory

Adequate diagnostic facilities should be available to support an adequate program of veterinary clinical care for the animals being used in research, testing, or education.

6. Research Programs

Adequate exposure of trainees to research, with suitable opportunities for their participation in research, is essential.

D. DURATION OF TRAINING

The duration of training will vary depending on factors such as the experience, interest, and goals of the individual student and the depth of research training. Generally, at least 2 years of training are required.

E. GOALS AND FORMAT

The goals of postdoctoral training are the acquisition of knowledge and skills to practice laboratory animal medicine

competently, the acquisition of research training and experience to advance knowledge in the specialty, and the acquisition of experience to permit competent teaching in laboratory animal science related subjects. Trainees must acquire a range of knowledge and skills about many animal species. Laboratory animal medicine invariably is practiced in a biomedical research environment. Therefore education and training necessarily must concentrate on the mammalian species most commonly used in biomedical research: mice, rats, guinea pigs, rabbits, hamsters, dogs, cats, and a variety of nonhuman primates. However, knowledge of and experience with certain less often used mammals, avian species, fishes, amphibians, reptiles, and certain invertebrates also should be acquired.

The format for training used to achieve these goals should consist of didactic education in core subjects, residency-type experiences, research training, and teaching opportunities. The balance among these activities will depend on the philosophy and available resources of the training institution as well as on the needs and interests of individual trainees.

F. CORE SUBJECTS

The method(s) of presentation and the coverage of core subjects in laboratory animal medicine may vary considerably, but an organized format must be followed to insure that all subjects are dealt with adequately. The following listing should not preclude the presentation of additional subjects, as deemed appropriate by program directors.

1. Diseases of Laboratory Animals

Detailed knowledge of bacterial, viral, parasitic, fungal, degenerative, metabolic, and iatrogenic diseases is essential. Study of these conditions should be systematic and intensive, including natural history, etiology, clinical signs, control, prevention, treatment, pathogenesis, and physiological, biochemical, and pathological expressions. The application of laboratory methods to the differential diagnosis of specific diseases within the above mentioned categories also should be reviewed in depth, including selection of the most appropriate analytic methods for interpreting, supporting, or confirming a diagnosis. Such study is essential to an understanding of disease mechanisms, of the disruptive effects of disease on experimental results, and of the impact of disease on animals intended for use as models of human disease.

2. Preventive Medicine

Disease prevention and control methods should be studied intensively, including techniques for early detection of disease in animals. Knowledge of preventive medicine aids the laboratory animal medicine specialist significantly in eliminating or minimizing the consequences of infectious diseases.

3. Anesthesiology

Anesthetic agents are administered commonly to animals for restraint, analgesia, surgical manipulations, and euthanasia. Knowledge of the pharmacological, physiological, and metabolic actions of anesthetic drugs is essential as is knowledge of the variation in response to anesthetics among different species and strains. Awareness of the numerous complication effects of anesthetics, particularly when used in conjunction with other drugs, is extremely important. The interpretation of experimental results as influenced by anesthetic agents is another area in which the laboratory animal veterinarian must be knowledgeable. The types and dosages of anesthetic agents and the methods of administration for each species also must be studied.

4. Experimental Surgery and Postoperative Care

Trainees in laboratory animal medicine must be knowledgeable about experimental surgery, instrumentation for surgery, and the operation of surgical research facilities. Didactic study should include careful review of basic operative techniques involving the various organ systems as applied to experimental procedures. This should be supplemented by appropriate participation in surgical procedures including postoperative care of research animals.

Physiological responses must be monitored carefully and controlled during the immediate postsurgical period if the animals involved are to serve their intended purpose. A postsurgical care program requires knowledge of physiological responses to surgery, intensive care procedures, and supportive equipment and facilities. The objective should be to develop good clinical judgment to foster proper care of surgically altered animals.

5. Experimental Animal Radiology and Radiation Biology

Training in radiation biology is essential, with emphasis on the hazards, monitoring, safe handling, decontamination, and disposal of radioisotopes. In addition, the effects of partial or whole body irradiation and the clinical management of irradiated animals should be studied. Training in diagnostic radiology techniques not used routinely in clinical veterinary medicine but used frequently in experimental animal medicine is highly desirable.

6. Laboratory Animal Management and Care

a. Management Laboratory animal medicine specialists require training in basic management of a laboratory animal resource in a biomedical research environment. Emphasis should be placed on organizational principles, financing and cost analysis, public and intrainstitutional relations, communications, and personnel management. The impact of management on the complex ethical, moral,

humane, and legal considerations involved in the use of animals for research also should be studied. Personnel health and safety should be emphasized.

b. Facility Design The design and construction of an animal facility is a critical factor in the proper care and use of laboratory animals. Accordingly, trainees should become knowledgeable in laboratory animal facility design and engineering with emphasis on function, spatial relationships, environmental control, biohazard control, energy conservation, and building materials.

c. Laboratory Animal Husbandry Detailed knowledge is required of the components of adequate daily care of animals, including the principles and techniques of housing and caging, feeding, watering, sanitation practices, waste disposal, and pest control. Equipment requirements for animals such as conventional and automated caging systems, sanitation equipment, and specialized air-handling equipment such as filtration mass air displacement units also should be studied. In addition, trainees should learn the specialized husbandry practices associated with gnotobiotic technology, barrier housing systems, and biohazard containment for infectious agents, chemical carcinogens, and radioisotopes.

Trainees must become aware of the impact of factors in the environment on laboratory animals. Emphasis should be placed on the influences of environmental variables on physiological responses and the effects of variations in response on research data. Among the environmental factors that should be considered are light, temperature, humidity, air quality, including volatile contaminants and particulate matter, sound, diet, and dietary contaminants, disinfectants, cage sanitation, bedding, pests, insecticides, and microbial contamination.

7. Conservation of Endangered Species, Protection of the Environment, and Protection of Public and Animal Health

The use of captive wild animals in research requires knowledge of laws and policies governing conservation of protected or endangered species, protection of the environment against potential pests imported from other countries, and protection of personnel and domestic animals against pathogens harbored by imported or native wild animals.

8. Biology of Laboratory Animals

a. Special and Applied Anatomy, Physiology, Pharmacology, Biochemistry, and Immunology The core curriculum should include specific instruction in the morphological, functional, and applied aspects of anatomy, physiology, pharmacology, biochemistry, and immunology of the commonly used laboratory animal species. Knowledge of species variation in response to drugs is important. Special attention should be given to reproductive physiology, since most research animals are produced specifically for research in specialized breeding colonies. In addition, institutional breeding colonies are maintained to meet experimental requirements or to produce animals that are not commercially available. Similarities and differences within and between species, including man, should be considered. Such information is essential in selecting appropriate animal models and in differentiating inherent species and strain differences from those induced by disease or those that occur as a consequence of experimental intervention.

b. Animal Behavior Ethology, the biological and evolutionary approach to studies of animal and human behavior, has had considerable influence on the biomedical sciences (Kramer, 1977). However, the psychological, social, and behavioral needs of research animals still are not well understood. It is important that trainees in laboratory animal medicine study established principles of animal behavior as they apply to animal colony management.

c. Genetics Most trainees will have had at least one course in genetics as undergraduates. However, it is essential to build on this basic knowledge by studying mechanisms of inheritance and the classification of diseases caused by single mutant genes, by polygenic defects, and by chromosomal anomalies. Trainees should understand genetic factors that influence specific traits and the expression of diseases and review mammalian genetics as applied to the development of inbred strains and outbred stocks and to the use of these animals in research.

d. Nutrition Trainees must be familiar with the nutritional requirements of each of the commonly used laboratory animal species for growth, reproduction, normal maintenance, and longevity. They should review basic nutritional principles, nutrients and their metabolism, methods of measuring body needs, the nutritive values of feeds, and diseases due to excesses as well as deficiencies of nutrients. Quality control of feeds with respect to nutritive values and protection from contaminants should also be studied.

9. Animal Models for Biomedical Research

An animal model has an inherited, naturally acquired, or experimentally induced pathological process or condition that closely resembles an abnormality in man (Wessler, 1976). Such models provide an important and often a key facet to meaningful investigations of the mechanisms of disease. The study of animal models is of particular significance to laboratory animal medicine specialists. They must understand the advantages and limitations of research with animal models.

Animal models can be classified as (a) spontaneous disease models, (b) experimentally induced models, and (c) needed models—as yet not available.

a. Spontaneous Disease Models Naturally occurring or spontaneous models can be inherited or acquired. Areas of study should include recognition of the model; identification of sources; characterization and development; appropriateness and reliability; preservation and accessibility; maintenance, utilization and productivity; benefits to man and other animals; and cost effectiveness. Criteria for selecting the best available model of specific human diseases should also be studied in depth.

b. Experimentally Induced Models Much useful information has been obtained by experimental induction in animals of diseases or specific conditions that mimic naturally occurring diseases of man or other animals. This methodology has been successfully used to characterize, treat, prevent, and control many diseases caused by infectious and toxic agents, and nutritional imbalance. Frequently, induced models provide specific information about some but not all aspects of a particular disease. Thus it is important for trainees to understand the limitations of certain animal models and the methods of designing experiments to yield reproducible and relevant results.

c. Need for New Models of Human Disease Understanding of certain diseases has been hampered significantly by the unavailability of appropriate spontaneous or induced disease models. Examples of such deficiencies include models of cystic fibrosis, spontaneous arterial thrombosis, cervical cancer, and certain age-associated diseases such as senile osteoporosis. The search for spontaneous models of these and other diseases and the improvement of existing models are important goals of laboratory animal medicine. This clearly implies that trainees must become familiar with the analytical and experimental techniques that can lead to the development of new or improved animal models of human disease.

10. Elective Subjects

Trainees should be encouraged to develop clinical and/or research expertise in elective areas such as the subjects listed below:

- biological ultrastructure
- physiological biochemistry
- histochemistry
- data storage and retrieval by manual and computer methods
- experimental design and statistics
- pathobiology of selected human diseases
- experimental microbiology
- animal psychobiology
- advanced mammalian genetics
- experimental nutrition
- advanced primatology

G. RESIDENCY TRAINING

1. General Considerations

Residency training should reinforce didactic study and provide an opportunity to acquire working experience. There is no substitute for direct participation in an institution's laboratory animal resource program, and this type of experience should be considered mandatory. A good residency is characterized by orderly exposure to and participation in animal colony operations, by the assignment of meaningful responsibilities, by the availability of experienced preceptors to provide good supervision, by exposure to a variety of animal facilities and laboratory animal species, and by organization of the residents' time so there is adequate opportunity for study and review. Some of the major activities of a good residency are described briefly in this section.

2. Animal Facilities Administration and Management

The resident should acquire working knowledge of the daily operating program. This can be accomplished by involving the resident in the myriad of activities that make up the program. Administrative and managerial activities may include but are not limited to the management and supervision of animal colony personnel; the organization, design and maintenance of the physical plant; the development and implementation of the husbandry program; the fiscal management of the animal facilities; the development of relationships with investigators and the institutional Committee on Use and Care of Animals; and implementation of the requirements for compliance with federal, state, or local laws and AAALAC guidelines. Open discussion of managerial problems between preceptors and residents, acceptance of responsibility by the residents for dealing with some of these problems, and follow-up evaluation of the results of a particular course of action are among the best ways to acquire working knowledge of animal colony operations.

3. Clinical Medicine

Excellence and special competence in clinical medicine related to laboratory animals is what distinguishes the specialist in laboratory animal medicine. If residents are to acquire this competence, participation in a well-organized clinical medicine program is essential. Residents should make regularly scheduled rounds in the animal facilities to diagnose and treat diseases and other abnormalities and to confer and interact with investigators, technicians, and students. It is particularly important to be able to differentiate spontaneous, iatrogenic, and research-related diseases and to recognize the impact of such diseases on research. Residents also should participate in the quarantining and conditioning of animals and in preventive

FIGURE 3 Clinical experience is an essential component of residency training in laboratory animal medicine. Here, a resident and a veterinary assistant work together to provide adequate veterinary care. Photograph by Blanchard Hiatt, University of Michigan.

FIGURE 4 A rotation in the necropsy laboratory is another essential component of residence training. Photograph by Blanchard Hiatt, University of Michigan.

medicine activities. They should learn to utilize tissue and fluid samples in diagnosis and maintain adequate records in all clinical cases. (See Figure 3.)

4. Necropsy and Histopathology

The specialist in laboratory animal medicine must have a good grounding in pathology but is not expected to be a veterinary pathologist. Although a number of veterinarians have attained dual certification, these are separate and distinct specialties. It is desirable to have representatives of both specialties as preceptors in residency programs so that the resident can become familiar with the responsibilities of each.

A good way to acquire experience in the pathology of laboratory animal disease is to spend a portion of the residency on the necropsy and histopathology service. The resident in laboratory animal medicine should know how to perform a necropsy properly (see Figure 4) and should be able to recognize the gross and microscopic lesions (see Figure 5) of the major disease entities of the common laboratory species. Correlation of clinical, gross, microscopic, and laboratory observations also is essential. Thus a rotation in pathology provides an opportunity for the resident to apply laboratory data rationally in the study of disease and its control.

5. Clinical Pathology

Just as a good grounding in anatomic pathology is needed, residents in laboratory animal medicine also must become experienced in clinical pathology. They should have the opportunity to interpret the results of laboratory tests in hematology, urinalysis, and clinical chemistry as applied to the disease conditions encountered in the animal facilities. They should become oriented toward microtechnology to accommodate small sample sizes from species such as rodents and new world primates. They should understand the significance of microbial isolates, while reviewing basic techniques of culturing and identifying pathogenic bacteria, fungi, viruses, and internal and external parasites. Experience in clinical pathology is best acquired during a rotation in a laboratory animal diagnostic laboratory. All institutions that offer training in laboratory animal medicine should have excellent capabilities for laboratory diagnosis of animal diseases.

FIGURE 5 Laboratory animal medicine specialists should be able to recognize microscopic lesions characteristic of the major diseases of laboratory animals.

FIGURE 6 A graduate course in experimental surgery provides an excellent opportunity for resident-graduate student interaction. Photograph by Blanchard Hiatt, University of Michigan.

6. Experimental Surgery and Radiography

Veterinary surgery and radiography also are distinct veterinary specialty fields. However, specialists in laboratory animal medicine often are called upon to direct or supervise experimental surgery facilities and collaborate in surgical research; so they should participate in these activities during the residency period. Relevant experience in anesthesiology and surgical techniques can be acquired through participation in surgical courses and surgical research (see Figure 6). Similarly, residents can be guided by the preceptors in the use of radiographic equipment for diagnostic or research purposes. The objective should be to attain competence in the operation of these facilities, in the postsurgical care of animals, and in the application of surgical and radiographic techniques in research.

H. RESEARCH TRAINING

It is essential that laboratory animal veterinarians receive adequate training in scientific methodology and research procedures. This is necessary so they can conduct independent or collaborative research and understand the needs of investigators to whom they provide animal resource services. Exposure to graduate courses, which may or may not lead to a graduate degree, is desirable. Research training is best accomplished, however, by active participation in ongoing research programs in association with skilled, experienced investigators (see Figure 7). Research training should offer experience in the following:

- formulation of significant research programs
- critical review of the scientific literature
- design of experiments and preparation of research protocols
- laboratory methodology
- data analysis
- biostatistics
- preparation for and presentation of data at scientific meetings
- report or manuscript preparation

FIGURE 7 Training in the principles and techniques of biomedical research is an essential part of education for careers in laboratory animal medicine. A veterinary postdoctoral trainee is shown here performing an *in vitro* platelet retention assay using native whole rabbit blood and a glass bead column. This particular research training is focused on comparative hemostasis. Photograph from Photography Unit, Division of Laboratories and Research, New York State Department of Health.

I. PARTICIPATION IN EDUCATION AND TRAINING OF RESEARCH PERSONNEL AND STUDENTS

Laboratory animal medicine specialists in academic institutions often are expected to instruct research personnel and students in animal research methods. Residents should participate in such programs wherever possible, both as students and as instructors. They should first master and then instruct others in techniques such as handling and restraint of animals, anesthetic methods, injection and bleeding methods, and other aspects of the use of animals. The rewards of this type of activity are well worth the effort. Residents can acquire invaluable technical experience, while simultaneously contributing to the humane treatment of animals and improvement of animal research. The opportunity to interact with research personnel and students also is mutually beneficial and invariably leads to better understanding and support of the animal medical program.

IV Continuing Education

Laboratory animal medicine is a field of expanding horizons. Its boundaries are broader today than they were 10 years ago, and it seems certain that in another 10 years they will be still broader. In addition, it is widely recognized that continued study is necessary to keep scientific knowledge up to date. Therefore to keep up with the field, laboratory animal medicine specialists must continue their education as a lifelong commitment. The relatively small size of the specialty field encourages informal exchange of information among colleagues at scientific meetings, through committee activities, during site visits, and through newsletters. Formal presentations of new information can be fostered at symposia, seminars, workshops, and short courses sponsored by such organizations as ILAR, AALAS, AVMA, ACLAM, and ASLAP. These can be helpful not only to specialists in the field but also to practitioners and other veterinarians who may occasionally serve as consultants. Published proceedings and tape recordings of these meetings provide convenient sources of information when personal attendance is not possible. Regular study of the contents of relevant scientific journals is an essential aspect of continuing education (see Appendix A). Although text books tend to become outdated quickly, they are another important source of information about laboratory animal medicine (see Appendix A). Sabbatical leaves for university faculty members also provide an excellent opportunity to renew and extend professional competence. Laboratory animal medicine specialists should utilize all of these mechanisms to foster continuing professional growth.

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B. AMERICAN COLLEGE OF LABORATORY ANIMAL MEDICINE

1. Introduction

The American College of Laboratory Animal Medicine was founded in 1957 to encourage education, training, and research in laboratory animal medicine; to establish standards of training and experience for veterinarians professionally concerned with the care and health of laboratory animals; and to recognize qualified persons in laboratory animal medicine by certification examination and other means. The College was chartered on February 18, 1957, and is incorporated under the laws of the state of Illinois as a not-for-profit organization. It is a specialty board recognized by the American Veterinary Medical Association.

The College was originally established as the American Board of Laboratory Animal Medicine by eighteen "charter fellows" who had made significant contributions to laboratory animal medicine and were actively engaged in the specialty. The name of the organization was changed to its present form on August 24, 1961, and the term "fellow" was discontinued in favor of "diplomate," a term used by other specialties. The College has grown steadily, and its membership now approximates 250 diplomates.

The basic policies and concepts of the College have not changed since its formation. The testing and certification of qualified veterinarians in this specialty will continue to have the highest priority. The College will continue its endeavor to improve examination procedures and maintain a standard of excellence for diplomates. The educational programs of the College will also receive great emphasis to ap-

prise the membership and the scientific community of advances in laboratory animal medicine.

2. Membership

Membership is open to veterinarians who are graduates of veterinary colleges approved or accreditated by the American Veterinary Medical Association. Nonapproved or nonaccreditated veterinary college graduates may seek membership upon successfully completing the American Veterinary Medical Association's Educational Commission for Foreign Veterinary Graduate (ECFVG) program, effective January 1, 1973, or demonstrate equivalent training and experience. All members must have satisfactory moral and ethical standing in the profession.

Diplomates Diplomates are those veterinarians who have satisfactorily completed the prerequisites prescribed by the constitution and bylaws of the College. They have fulfilled the experience and training requirements; have contributed to the advancement of knowledge of an aspect of laboratory animal medicine; have satisfactorily completed the certifying examination; and have been elected to membership by a majority of the Board of Directors of the College.

Emeritus Members Permanently retired diplomates, upon request, may be removed from active diplomate status and placed on the emeritus roster. Emeritus members shall not have the right to vote or be required to pay dues.

Honorary Members Individuals who have made outstanding contributions to laboratory animal medicine may be elected to honorary membership. No more than one individual may be elected each year. Honorary membership is not limited to veterinarians.

3. Officers

The officers of the American College of Laboratory Animal Medicine are as follows: president, president-elect, immediate past president, and secretary-treasurer. They are elected by the ACLAM diplomates via mail ballot and serve for one year beginning at the conclusion of the annual College business meeting and extending through the succeeding annual College business meeting in the next calendar year.

The Board of Directors consists of the officers and six additional elected diplomates. Such elected members will serve for two years beginning at the conclusion of the annual College business meeting and extending through the annual College business meeting two years hence. The Board of Directors is the administrative and legislative body of the organization and conducts all business, including the certification of diplomates, in accordance with the constitution and bylaws. The board ordinarily meets annually at the time of the American Veterinary Medical Association meeting, but may meet at other places as designated by the president.

4. Committees

Committees are appointed annually by the president, with the advice and consent of the Board of Directors. Standing committees exist for Credentials, Education and Training, Examination, and Nomination of Officers. Other committees are appointed as necessary, to accomplish the aims and implement the policies of the College.

5. Dues

Diplomates shall pay annual dues as established by the Board of Directors. Dues are payable on January 1 of each year.

6. Application for Membership

Application for membership must be submitted on forms provided by the secretary-treasurer of the College and accompanied by the examination fee as established by the Board of Directors. Should an applicant's credentials or qualifications not meet the prerequisites for taking the certification examination, the examination fee will be returned.

7. Prerequisites for Certification Examination

Each candidate must meet the following specific training and/or experience requirements before taking the certifying examination:

1. A minimum of four years of combined training and experiences in laboratory animal medicine following receipt of the veterinary degree is required.
   a. Applicants completing formal training programs in laboratory animal medicine of two or more years duration must have at least one year of full-time experience, approved by the Credentials Committee, not including time spent while enrolled in graduate school or in the postdoctoral program; or
   b. Applicants holding a Masters or Ph.D. degree in a related biological science must have five or four years, respectively, of full-time experience in laboratory animal medicine. None of the experience years may be concurrent with full-time degree work, and at least two years must follow receipt of the degree. The training and experience shall be approved by the Credentials Committee; or
   c. Applicants not meeting requirements a or b above may qualify to take the examination after six years of full-time experience in laboratory animal medi-

cine, as approved by the Credentials Committee. A maximum of one year of experience will be allowed for clinical practice, other than laboratory animal medicine, on the basis of one month for every six months of practice or one year for six years of practice.

2. An article on some phase of laboratory animal medicine shall have been accepted for publication in a refereed journal. The candidate also must have made a major contribution to the work and the preparation of the article.

The qualifications of individuals desiring certification will be reviewed by the Credentials Committee and must be approved by the Board of Directors before the candidates may take the certifying examination.

8. Certifying Examination

The certifying examination of the American College of Laboratory Animal Medicine is given to evaluate the competence of individuals desiring to be recognized as diplomates of the College. The examination is given by the Examination Committee to those applicants who meet the other requirements for membership in the College. Written and practical examinations are given at a time and place announced by the Examination Committee.

The examinations are comprehensive and reflect the importance the College places on the extent of a candidate's knowledge of all aspects of this specialty. The written examination covers the following categories:

1. Biology and care of laboratory animals
2. Diseases of laboratory animals—including diagnosis, treatment, prevention, and pathologic characteristics
3. Comparative and experimental pathology—including diseases of animals which are models of human disorders
4. Experimental surgery and postsurgical care
5. Biostatistics
6. Genetics
7. Techniques of animal experimentation

The practical examination covers the same general categories as the written examination. The practical examination consists of demonstrations and illustrations about which relevant questions are asked.

The examinations are revised each year by the Examination Committee. The written and practical sections are evaluated separately, and a candidate must pass both sections to be considered for membership by the Board of Directors of the College.

If a candidate fails any part of the examination, the candidate is permitted to repeat that part two more times within 26 months of the examination for which he/she is qualified. If the candidate is unable to pass all parts of the examination during this time, and desires to retake the examination, he/she will be required to submit another application, pay another examination fee, and take both parts of the examination.

9. Additional Information

Additional information may be obtained from the ACLAM Secretary-Treasurer, William S. Webster, D.V.M., Department of Animal Medicine, University of Massachusetts Medical School, 55 Lake Avenue, North Worcester, Mass. 01605.

C. TRAINING PROGRAMS IN LABORATORY ANIMAL MEDICINE, COMPARATIVE MEDICINE, AND COMPARATIVE PATHOLOGY

The purpose of these programs is to provide summer fellowship training for undergraduate veterinary students or broad basic training for graduate veterinarians who desire to teach, study laboratory animal medicine, comparative medicine, or comparative pathology, or serve as professional directors of laboratory animal facilities.

Location	Address
NIH-Sponsored Training Programs	
Alabama	Department of Comparative Medicine University of Alabama Medical Center Birmingham, Alabama 35294 Training*: SF, PD
Florida	Department of Laboratory Animal and Wildlife Medicine J. Hillis Miller Health Center University of Florida Gainesville, Florida 32610 Training: SF, PD
Maryland	Division of Comparative Medicine School of Medicine The Johns Hopkins University Baltimore, Maryland 21205 Training: SF, PD
Massachusetts	New England Regional Primate Research Center Harvard University Medical School Southborough, Massachusetts 01772 Training: SF, PD
Michigan	Unit for Laboratory Animal Medicine University of Michigan Medical School Ann Arbor, Michigan 48109 Training: SF, PD
Missouri	Sinclair Comparative Medicine Research Farm University of Missouri Route No. 3 Columbia, Missouri 65201 Training: SF, PD
North Carolina	Department of Comparative Medicine Bowman Gray School of Medicine Wake Forest University Winston-Salem, North Carolina 27103 Training: SF, PD

Location	Address
Pennsylvania	**Department of Comparative Medicine** **Milton S. Hershey Medical Center** **Pennsylvania State University** **Hershey, Pennsylvania 17033** **Training: SF, PD**
Preceptorships and Residencies	
California	Animal Resources Service School of Veterinary Medicine University of California Davis, California 95616 Training: SF, PD
California	California Primate Research Center University of California Davis, California 95616 Training: PD only
Colorado	University of Colorado Medical Center, B-114 4200 East Ninth Ave. Denver, Colorado 80262 Training: SF only
Connecticut	Section of Comparative Medicine Yale University School of Medicine 375 Congress Ave. New Haven, Connecticut 06510 Training: SF, PD
Iowa	Laboratory Animal Resources College of Veterinary Medicine Iowa State University Ames, Iowa 50011 Training: SF, PD
Louisiana	Department of Vivarial Science and Research Tulane University School of Medicine 1430 Tulane Ave. New Orleans, Louisiana 70112 Training: PD only
Louisiana	Delta Regional Primate Research Center Tulane University Covington, Louisiana 70433 Training: SF only
Maryland	Rockville Primate Facility Meloy Laboratories, Inc. 2501 Research Blvd. Rockville, Maryland 20850 Training: SF and interim
Massachusetts	Division of Laboratory Animal Medicine Massachusetts Institute of Technology Building 45, 18 Vassar St. Cambridge, Massachusetts 02139 Training: SF only
Michigan	Department of Comparative Medicine Wayne State University 1400 Chrysler Freeway Detroit, Michigan 48207 Training: SF, PD
Minnesota	Laboratory Animal Facilities Mayo Clinic Rochester, Minnesota 55901 Training: SF and interim
New York	Laboratory Animal Medicine and Services New York State College of Veterinary Medicine Cornell University Ithaca, New York 14853 Training: SF only
New York	Division of Laboratory Animal Medicine School of Medicine and Dentistry The University of Rochester 260 Crittenden Blvd. Rochester, New York 14620 Training: SF, PD
North Carolina	Division of Laboratory Animal Medicine University of North Carolina Chapel Hill, North Carolina 27514 Training: SF, PD
Ohio	Department of Laboratory Animal Medicine R-351 Medical Sciences Bldg. University of Cincinnati School of Medicine Cincinnati, Ohio 45267 Training: SF only
Oklahoma	Division of Comparative Medicine University of Oklahoma Health Sciences Center P.O. Box 26901 Oklahoma City, Oklahoma 73190 Training: PD only
Pennsylvania	Laboratory Animal Resources Pennsylvania State University University Park, Pennsylvania 16802 Training: SF only
Tennessee	Animal Resources Division University of Tennessee Center for the Health Sciences Memphis, Tennessee 38163 Training: SF only
Texas	Department of Veterinary Public Health College of Veterinary Medicine Texas A&M University College Station, Texas 77843 Training: PD
Texas	Division of Comparative Medicine University of Texas Southwestern Medical School 5323 Harry Hines Blvd. Dallas, Texas 75235 Training: SF, PD
Texas	University of Texas System Cancer Center Texas Medical Center Houston, Texas 77025 Training: SF, PD
Texas	Department of Comparative Medicine University of Texas Medical School at Houston 6400 West Cullen St. Houston, Texas 77030 Training: PD only
Texas	University of Texas Health Science Center 7703 Floyd Curl Dr. San Antonio, Texas 78284 Training: SF only
Washington	Division of Animal Medicine School of Medicine University of Washington Seattle, Washington 98195 Training: SF, PD
Wisconsin	Research Animals Resources Center University of Wisconsin Madison, Wisconsin 53706 Training: PD only

Location	Address
Programs for Veterinarians in Governmental Services	
District of Columbia	Division of Veterinary Resources Walter Reed Army Institute of Research Washington, D.C. 20012 Training: PD (limited to persons in uniformed services)
Maryland	Animal Resources Division U.S. Army Medical Research Institute of Infectious Diseases Department of the Army Fort Dietrick, Maryland 21701 Training: PD (limited to persons in uniformed services)
Maryland	Veterinary Resources Branch Biomedical Laboratory, U.S. Army Edgewood Arsenal, APG, Maryland 21010 Training: PD (limited to persons in uniformed services)
Texas	Comparative Medicine Section Veterinary Education Branch USAF School of Aerospace Medicine (AFSC) Brooks Air Force Base, Texas 78235 Training: PD (limited to persons in uniformed services)

*Explanation of training offered: SF = summer fellow program for veterinary students; PD = postdoctoral training for persons having a D.V.M. or equivalent degree.

D. PREDOCTORAL TRAINING COURSE OUTLINE

Programs vary with specific location but usually include the following subjects and activities.

1. Orientation for freshmen
   a. The role of the veterinarian in biomedical research and career opportunities in laboratory animal medicine.
   b. Ethics, regulations, and history of laboratory animal medicine.
   c. Animal models in research.
   d. Husbandry of laboratory animals.
2. Elective subjects
   a. Animal models–selection, procurement, and sources.
   b. Comparative anatomy of common species of laboratory animals.
   c. Biology and nutrition of common species of laboratory animals.
   d. Handling and restraint of laboratory animals.
   e. Diagnosis, treatment, and control of laboratory diseases.
   f. Isolation, quarantine, and conditioning of laboratory animals.
   g. Environmental influences on behavior, health, and research use of animals.
   h. Laboratory animal facility–design, use, and equipment.
   i. Experimental animal methodology.
   j. Biohazard and containment of pathogenic agents.

E. AUTOTUTORIAL PROGRAMS

The following organizations offer audiovisual materials on laboratory animal medicine, techniques, and technology:

1. Audiovisual aids for laboratory animal science: American Association for Laboratory Animal Science, 2317 W. Jefferson Street, Suite 208, Joliet, Illinois 60435.
2. Animal handling Biotech Series 8200: Prentice-Hall Media, 150 White Plains Road, Terrytown, New York 10591.
3. Laboratory animal medicine: Health Sciences Learning Resources Center, T-252 Health Sciences SB-56, University of Washington, Seattle, Washington 98195.
4. Laboratory animal care (LAC): Betzer Productions, Inc., 450 E. Ohio Street, Chicago, Illinois 60611.