Fundamental Training for Individuals Involved in the Care and Use of Laboratory Animals: A Review and Update of the 1991 NRC Core Training Module

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Abstract

Public trust demands that individuals who do research, testing, or teaching with animals use humane, ethical, and scientifically sound methods. Furthermore, the Animal Welfare Act and the Public Health Service Policy require research institutions to provide basic training and to ensure that anyone who cares for and/or works with laboratory animals has the appropriate training or experience relevant to their job responsibilities. Institutions accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International must also provide training programs and ensure the qualifications of personnel. The primary goal of this training is to provide individuals with basic knowledge and to reinforce attitudes and behaviors that help to ensure humane animal care and use. This article provides an overview of the core training module outline and content from the 1991 report of the Institute for Laboratory Animal Research, Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs, as well as pertinent updates for introducing personnel to information regarding the care and use of laboratory animals. Both mandatory and suggested training topics are reviewed, including relevant regulations and standards, ethical considerations, humane methods of animal experimentation and maintenance, and other pertinent topics. Although the fundamental training course content and delivery will vary depending on the nature and complexity of an institution’s animal care and use program, this basic training provides the foundation for more in-depth training programs and supports humane and ethical animal care and use.

Key Words: Animal Welfare Act; basic training; ethics; experimentation; humane methods; occupational safety; Public Health Service Policy; regulations

Introduction

Individuals involved in the planning of a basic training program must understand the purpose of the training, whom to train, when to train, how to train, and finally what topics to cover in training. In 1991, the Institute for Laboratory Animal Research (ILAR) of the National Research Council established the Committee on Educational Programs in Laboratory Animal Science, which developed a report titled Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs (NRC 1991; hereafter referred to as the 1991 Education and Training Guide). The 1991 Education and Training Guide, which continues to serve as a valuable resource for the laboratory animal community, addresses important training questions. It provides an outline and detailed course content for four modules, including a core or basic training module, a species-specific module, a pain management module, and a surgery module. It also provides lists of teaching materials and organizations that can assist with information on the recommended topics. Finally, the report presents information on the development, delivery, and evaluation of education and training programs. The report can be viewed online at the ILAR website (http://dels.nas.edu/ilar_n/ilarhome/reports.shtml) or ordered through the National Academies Press website (http://www.nap.edu/catalog/1592.html#toc).

In this article, we briefly review the core module outline from the 1991 Education and Training Guide and provide updated information as appropriate. This information is intended to serve as a supplement to the original detailed guide. Importantly, because there have been no significant changes to the Animal Welfare Act (AWA) or Public Health Service Policy on Humane Care and Use of Laboratory Animals (PHS Policy) regarding training require-

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1Abbreviations used in this article: 3Rs, refinement, reduction, and replacement; 1991 Education and Training Guide, Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs; 1996 Guide, Guide for the Care and Use of Laboratory Animals; AAALAC, Association for Assessment and Accreditation of Laboratory Animal Care International; AV, attending veterinarian; AWA, Animal Welfare Act; FDA, Food and Drug Administration; GLP, good laboratory practice; IACUC, institutional animal care and use committee; ILAR, Institute for Laboratory Animal Research; IO, institutional official; NAL, National Agricultural Library; OLAW, Office of Laboratory Animal Welfare; PHS, Public Health Service; PHS Policy, Public Health Service Policy on Humane Care and Use of Laboratory Animals; PI, principal investigator; USDA, US Department of Agriculture; VA, Veterans Administration.

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ments since 1985, the 1991 *Education and Training Guide* is still very pertinent to contemporary animal care and use personnel training requirements for programs in the United States. Although training for an international audience is beyond the scope of this article, the reader is referred to the “Invited International Perspective: Education and Training for the Care and Use of Laboratory Animals: An Overview of Current Practices,” which appears in this issue (van Zutphen 2007).

**Why Is Basic Orientation Training Important?**

Research institutions are required to provide training to all personnel responsible for animal care or use according to mandates from the following: the AWA, PHS Policy, the Occupational Health and Safety Act, the Food and Drug Administration (FDA\(^1\)), the Environmental Protection Agency, and the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC\(^1\)) (Kennedy 2002). For a detailed review of the laws and guidelines that address the training requirements, we refer readers to the preceding article in this issue titled “Institutional and IACUC Responsibilities for Animal Care and Use Education and Training Programs” (Anderson 2007).

The 1991 *Education and Training Guide* was published to aid institutions in developing and implementing an education and training program to meet the expectations of the PHS Office of Laboratory Animal Welfare (OLAW\(^1\), previously known as the Office for Protection from Research Risks) and the Animal Care (previously known as Regulatory Enforcement and Animal Care) unit of the Animal and Plant Health Inspection Service, US Department of Agriculture (USDA\(^1\)) (NRC 1991, p. 4). The PHS Policy is regulated by OLAW, and the AWA is regulated by Animal Care. While adherence to regulatory requirements is one of the main reasons that this training is important to an animal care and use program, the 1991 *Education and Training Guide* eloquently describes a higher purpose: “The goal of education and training in laboratory animal care and use goes far beyond meeting stated requirements of regulating agencies. The intent of the requirement for education is to stimulate changes in knowledge, attitudes, and behaviors that will ensure humane care of animals used in teaching, testing, and research” (NRC 1991, p. 109).

From an ethical standpoint, providing appropriate training for laboratory animal users helps to ensure the humane treatment of those animals. From a scientific standpoint, the quality of research is improved when knowledgeable and technically skilled persons are responsible for the care and maintenance of the animals because the number of uncontrolled experimental variables may be reduced. From a resource standpoint, individuals qualified through training are often more effective and efficient in carrying out their job duties, which may result in a reduction in the time and resources required to support or conduct a study. When participants are informed that this training is being provided both because the laws mandate it and because the institution is committed to developing an ethical culture for animal care and use, the trainees gain a better appreciation for the importance of this training.

**Who Needs Fundamental Training?**

As stated above, both the USDA regulations (CFR rev. 2002) and the PHS Policy (PHS 2002) require anyone who cares for and/or uses animals to be qualified to perform their duties and to be provided training. Animal facility personnel, research technicians, principal investigators, institutional animal care and use committee (IACUC\(^1\)) members, and graduate students should all receive formal training. At a minimum, anyone who works with or cares for animals must receive basic training.

In addition, individuals who provide support for an animal care and use program but who do not have direct animal contact should be provided introductory training regarding the program (NRC 1996). Such individuals include administrative personnel who place orders for animals or provide other administrative support for animal facility personnel. Likewise, there are numerous individuals who are not part of the animal program but who provide support to personnel within the animal care and use program or must enter animal buildings as part of their job. These individuals include security staff who monitor the facility, housekeeping staff, occupational health and safety staff, physical plant personnel (electricians, plumbers, and heating, ventilation, and air-conditioning technicians), equipment maintenance personnel, computer support staff, quality assurance personnel, human resources personnel, and contract construction personnel. They should be provided a brief overview of the animal care and use program, be prepared for what they might observe in the animal facility, and be informed about appropriate safety practices. This training also provides opportunities to answer questions or address concerns that these individuals might have about animal research. Their training will not be as extensive and will not include all of the topics suggested in the basic orientation course; nonetheless, their training is important. The key point is that personnel need to be appropriately prepared and qualified to do their job within or in support of an animal care and use program.

**When Should Core Training Be Provided?**

It is never appropriate for individuals to work with animals unless they are fully qualified to do so. Similarly, allowing individuals who do not have a fundamental understanding of animal care and use to enter an animal facility presents a potential public relations risk to the institution. In addition, individuals who do not understand the potential safety issues of entering an animal facility can put themselves or the
animals at risk by not following the appropriate precautions. Thus, a critical goal of core training is for all personnel who work with or support an animal program to understand the philosophy and culture of the institution as it relates to animal care and use.

Many institutions restrict animal facility access to only those personnel who have satisfactorily completed the core training program. Other institutions do not allow individuals to be added to an animal protocol until they have received the appropriate training. Both of these approaches are effective ways to ensure that everyone receives basic training before they work with animals.

The field of laboratory animal science and medicine is evolving rapidly, and new information, technology, and equipment have an impact on the way animals are cared for and used. Participation in continuing education programs helps personnel to remain current, to reinforce the importance of humane care and use, and to ensure regulatory compliance. Each institution must decide when continuing education or retraining on the core training material would be appropriate (Rush 2000, p. 362).

A web-based training module that is available at any time for individual instruction makes training and retraining convenient for personnel and may enhance their participation in the institution’s training program. Periodic distribution of newsletters, emails, and bulletins, website updates, or IACUC open houses can also help to provide new information to employees in a timely manner. The experience of one of us (L.V.M.) suggests that complete retraining on key topics of animal welfare every 2 or 3 years is an effective method of reinforcing the tenets of the fundamental training course (L. V. Medina, Abbott Laboratories, Abbott Park, IL, personal communication, 2006).

How Should Orientation Training Be Provided?

Personnel who attend basic training sessions typically differ in age, gender, education, experience, learning styles, and socioeconomic and cultural backgrounds. As stated in the 1991 Education and Training Guide, “The education and training methods you select will depend on your audience, the objectives that have been set, and the resources you have available” (NRC 1991, p. 4). In a preceding article in this issue, “Training in the Laboratory Animal Science Community: Strategies to Support Adult Learning” (Dobrovolny et al. 2007), the authors discuss these factors and provide a broad overview of different strategies to provide training for adults.

A number of formats are available for presenting basic information, including lectures/seminars, computer-based courses, handouts, and videos. A lecture/seminar format is recommended for presenting most of the core material because this format is well suited for communicating the institutional mandate, is appropriate for groups of any size, and makes the most efficient use of resources (NRC 1991, p. 11). Furthermore, this classroom approach allows employees to interact with one or more key individuals from the program and ensures that they will know whom to approach if they have further questions or concerns. When a classroom format is used, it is important to consider the length of sessions and to avoid overwhelming learners. The recommended presentation time is no more than 3 to 4 hours but is dependent on the size and complexity of the animal care and use program. For example, individuals at a small, rodent-only facility with only one research discipline will require training that is less extensive than the training required for individuals at a large, multi-species, multi-research-discipline animal care and use program. In this amount of time, it will not be possible to deal with the topics in depth; however, it is important to address the legal and ethical aspects of every topic (NRC 1991, p. 11).

Interactive sessions can be used to supplement lecture material and actively engage the trainees. One example is to ask participants how they might respond to a specific scenario in which they are concerned about how an animal is being handled. Prompting trainees to reflect on how they might report a concern about animals helps them to personalize the information and may help them to feel more confident in the event that they actually encounter such a situation later in their work environment.

Computer-based formats such as the ones developed by the Veterans Administration (VA) Medical Research Service (VA 2006, http://www.researchtraining.org), the University of Arizona (UA 2005, http://www.iacuc.arizona.edu/training.html), and the University of Florida (UF 2006, http://www.iacuc.ufl.edu/training.htm) can provide individuals with a general overview of important topics but may not adequately address specific institutional policies. One approach might be to use a computer-based ethics and regulatory component followed by classroom instruction on humane methods of animal maintenance and experimentation and occupational health and safety. The VA site includes web-based courses and examinations for research staff and IACUC members. It also has a section for IACUC administrators or training coordinators to use for reviewing the records of staff members who pass examinations. It is important when setting up computerized training modules to have questions interspersed throughout the course that enable learners to check their understanding of the material. The computer-based format is very efficient and convenient with regard to personnel time, supplies, and effort; however, it is best used as a supplement to the seminar format. Handouts and videos can also serve as useful aids for individuals to use in learning the core material. Training will be most effective when the participants are actively engaged and provided opportunities to personalize the information.

If the budget of an institution allows, it is a good idea to offer refreshments when the training exceeds 1 hour. Generally, short breaks should also be provided for every hour of training time. We endorse the following description and recommendations:
“Most learning requires effort, and prolonged expenditure of effort usually produces fatigue. Also, adults often come to learning activities having already expended large amounts of energy in their family and workplace. It is highly probable that adults will become tired, even in an interesting environment. Once adults become fatigued, their ability to pay attention can readily decline, and the meaning of any activity may diminish. To avoid this problem, selectively give breaks or incorporate physical exercise and energizers into your instructional plan. When long breaks are not possible or are too inconvenient, learners can stand up and stretch or participate in small sets of physical exercises for several minutes. Also consider the possibility of energizers (Weinstein and Goodman 1980), which are very short adult games (ten to fifteen minutes) that can add enjoyment and social contact to the process of renewing energy. A final suggestion: please do not let the clock solely determine when breaks are taken. Fatigue is not chronological. Our flexibility about such matters can greatly enhance the amount of attention learners can give. By investing ten minutes of time on a break “when it is needed”, we may gain as much as sixty minutes of alertness” (Wlodkowski 1999, p. 197).

Who Should Provide Basic Orientation Training?

A trainer must have good presentation skills and be knowledgeable about the topic. When a trainer is passionate about the subject material, his or her enthusiasm is easily conveyed and can help to keep the students’ interest. Trainers for basic training topics may include veterinarians, veterinary technicians, a training coordinator, research staff, the IACUC coordinator, animal care supervisors, or animal care technicians. Depending on the amount of safety information included in the course, a safety specialist might also be involved in this initial training. A very progressive addition to this orientation training is to present a short video with either the chief executive officer, president, institutional official (IO1), or other senior official speaking briefly about the institution’s commitment to humane animal care and use and the adoption of alternatives whenever possible. This type of high-level message helps to set the tone for the importance of these issues to the institution.

A team teaching approach that uses different members of the program staff for various sections of the orientation training demonstrates the importance of all members working together for a common goal. One or a few individuals should be responsible for coordinating the program to maximize efficiency and to ensure that there is a key contact for enrolling people in the training. Trainers must be able to accurately answer questions that arise. If they do not know the answer, they should be able to direct the trainee to the appropriate person or resource for correct information.

Trainers for basic orientation should view this investment of time as an opportunity to lay a solid foundation for building and maintaining an ethically sound animal care and use program.

Importance of Training Documentation

As described previously, the AWA and PHS Policy require that institutions provide training for animal users, but they do not require a standard format for training documentation. The good laboratory practice (GLP1) regulations of the FDA have more extensive training and documentation requirements. These regulations allow institutions to develop record-keeping methods that work within the institution’s document management system but require the documentation to be consistent throughout the facility (Pritt et al. 2004).

Both paper and electronic documentation systems are acceptable, although each system has its benefits and drawbacks. Paper records allow the document to be physically available and for information to be added during a training session. Paper records may, however, be more labor intensive to manage, and they may create regulatory problems if they are lost. Paper records are also not easily accessed from remote sites. Consequently, this less flexible system may not meet the training documentation needs of larger institutions.

Alternatively, many types of electronic training records systems are available. They may be purchased as a generic template or may be created exclusively for a particular institution. Electronic records allow for widespread access to centralized training information and may facilitate the tracking of individual trainees. Some systems automatically generate training reminders, increasing efficiency and reducing human error. Reports are easily generated from the information stored in the system and can be used for regulatory inspections or accreditation site visits. A standard format for training documentation should be used throughout a facility. Regardless of the method used, verification of adequate training is an essential component of any animal care and use program.

Core Training Curriculum

The core curriculum should be based minimally on the regulatory requirements mandated by USDA regulations (CFR rev. 2002) and PHS Policy (PHS 2002) and the guidelines set forth in the Guide for the Care and Use of Laboratory Animals (NRC 1996, or 1996 Guide1). In the current, 7th edition of the 1996 Guide, it is stated that “The . . . qualifications of personnel required to conduct and support an animal care and use program depend on several factors, including the type and size of institution, the administrative structure for providing adequate animal care, the characteristics of the physical plant, the number and species of animals maintained, and the nature of the research, testing, and educational activities” (NRC 1996, p. 13). Thus, beyond USDA and PHS regulatory requirements, additional information should be presented to meet the needs of the institution and their personnel.

Although the federal regulations and policies do not provide specific guidance on the depth to which each re-
Table 1 Training topics required by the USDA regulations and PHS Policy

As listed in CFR 2002 (9CFR 2.32):6

1. Humane methods of animal maintenance and experimentation, including:
   - The basic needs of each species of animal;
   - Proper handling and care for the various species of animals used by the facility;
   - Proper preprocedural and postprocedural care of animals; and
   - Aseptic surgical methods and procedures;

2. The concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress;

3. Proper use of anesthetics, analgesics, and tranquilizers for any species of animals used by the facility;

4. Methods whereby deficiencies in animal care and treatment are reported, including deficiencies in animal care and treatment reported by any employee of the facility. No facility employee, committee member, or laboratory personnel shall be discriminated against or be subject to any reprisal for reporting violations of any regulation or standards under the Animal Welfare Act;

5. Utilization of services (e.g., National Agricultural Library, National Library of Medicine) available to provide information:
   - On appropriate methods of animal care and use;
   - On alternatives to the use of live animals in research;
   - That could prevent unintended and unnecessary duplication of research involving animals; and
   - Regarding the intent and requirements of the Animal Welfare Act.

6. PHS Policy requires that assured institutions base their programs of animal care and use on the Guide for the Care and Use of Laboratory Animals (NRC 1996) and that they comply with the applicable regulations (9 CFR, Subchapter A) issued by the U.S. Department of Agriculture (USDA) under the Animal Welfare Act. The Guide may differ from USDA regulations in some respects. Compliance with USDA regulations is an absolute requirement of this Policy (PHS Policy 2002).

Laws, Regulations, and Policies That Apply to Animal Care and Use

Many new personnel who are engaged in in vivo research are unaware of the laws and guidelines that protect laboratory animals used in research, testing, and education. For this reason, the core training module must include an overview of the laws, regulations, and institutional policies that govern the care and use of research animals. At a minimum, this information should include an overview of the AWA, USDA regulations (CFR rev. 2002), PHS Policy (PHS 2002), AAALAC standards (AAALAC 2007, http://www.aaalac.org/accreditation/rules, see Standards), and, if applicable, GLP standards (CFR rev. 1998). In addition, instruction should include information about the select requirements of the AWA, USDA regulations, and PHS Policy, including IACUC membership and functions, training, record-keeping, and annual report requirements for each government agency as well as noncompliance notification requirements. Finally, if there are state or local laws and/or institutional policies that affect the care and use of laboratory animals, these laws or policies should also be presented as part of the core training program.

Training pertaining to the AWA and USDA regulations should include information regarding mandatory annual unannounced inspections of the animal facility and review of the animal care and use program by the USDA to help enforce the AWA. Persons working with USDA-regulated species should also be instructed that the institution must submit an annual report to the USDA that provides the number of animals used in research according to species and designated pain categories. The importance of IACUC approval before project initiation should also be stressed to the research staff. In addition, investigators must understand that if any procedures are to be changed or added to an existing approved protocol, an amendment must be submitted and approved by the IACUC before variations in animal...
work can begin (CFR rev. 2002). Training should also be given to IACUC members regarding their role in protocol review and semianual inspection of animal use areas. This topic is covered in more detail in the article that appears in this issue titled “Training Strategies for IACUC Members and the Institutional Official” (Greene et al. 2007).

Training regarding the PHS Policy should specify that it applies to PHS-conducted or -supported research; the necessity of complying with the USDA regulations, the 1996 Guide and the U.S. Government Principles (IRAC 1985); and requirements for the assurance statement of the institution. Oversight by OLAW should also be discussed. Accreditation of animal programs by AAALAC should be presented as an entirely voluntary peer-review process that is widely considered to be the best mechanism for obtaining independent, external, expert validation that an organization is meeting high standards of animal care and use. Trainees who work in accredited institutions should understand that the care and utilization of all animals are reviewed during the accreditation site visit that occurs once every 3 years. The definition of which animals are included in the assessment by AAALAC can be found on the AAALAC website (see Definitions). Animal types include traditional laboratory animals, farm animals, wildlife, and aquatic animals. Nontraditional animals, inclusive of invertebrate species, are also included when they are relevant to the mission of the accredited unit.

A brief overview of the GLP standards required by the FDA for nonclinical safety assessment studies should be provided when it is applicable to the institution (CFR 1998). Trainees should understand the importance of creating and following standard operating procedures, the necessity of exact record-keeping, and the role of quality assurance in GLP studies.

**Reporting Deficiencies**

The AWA mandates that all research facility personnel must receive training on how to report alleged deficiencies in animal care and treatment (CFR rev. 2002). Course participants should know whom to contact to resolve minor problems in husbandry and whom to contact for more serious concerns. Trainees should also have a clear understanding of what is meant by protocol noncompliance and animal mistreatment. It is helpful to provide examples of animal care deficiencies, animal mistreatment, and protocol noncompliance that should be reported. Many institutions post their reporting procedures on a website or throughout the buildings in and around the animal facilities. Trainees should also understand that individuals who report concerns about animals are provided legal protection by the AWA against discrimination or other reprisals for reporting concerns or violations. Not only institutional employees but also students and the general public may report concerns (CFR rev. 2002). Although the IACUC is ultimately responsible for reviewing and, if necessary, investigating allegations, the institution can delegate the initial reporting of concerns to the AV, institutional official, chair of the IACUC, IACUC members, deans, or department chairs. The process for handling allegations and the due process given to those who may be involved should be standardized and communicated as part of the training program (Silverman 2000, p. 481).

**Responsibilities of Key Participants of an Animal Care and Use Program**

The core training module must clearly outline the different responsibilities of all of the parties involved with an animal care and use program. This essential information helps to ensure that trainees not only understand their own responsibilities but also know which individuals or groups are responsible for helping them address a variety of important animal care and use issues. This section of the training should include an overview of the responsibilities of at least the following four parties: the institutional leadership (hereafter identified as “institution”); the IACUC; the investigators (broadly defined as those people responsible for the scientific aspects of projects that use animals in research, testing, or teaching); and the attending veterinarian (AV¹).

The institution is responsible for a number of important aspects of the animal care and use program, including the establishment of lines of authority and responsibility for the chief executive officer, the IO for animal welfare, the AV, the IACUC, the research staff, and others as appropriate. The institution is also responsible for establishing institutional policy on care and use of animals, providing appropriate facilities and resources for animal housing and care, appointing the IACUC members, ensuring that all staff involved with the care and use of animals are qualified to carry out their duties, and building public confidence in animal research.

The IACUC is responsible for reviewing and approving activities in which animals will be used and for evaluating the institutional program and facilities at least once every 6 months. The 1991 *Education and Training Guide* provides a detailed description of how the IACUC carries out its responsibilities for the animal care and use program (NRC 1991, p. 44).

The investigators have a number of important responsibilities, which include carefully designing experiments, considering alternatives, ensuring that research staff are qualified and trained, providing for the health and safety of personnel, and recognizing and responding to job-related stress. Furthermore, investigators have an obligation to encourage a scholarly, sensitive, and respectful research environment, to adhere to professional ethical standards, and to maintain and build public confidence in animal research. Again, the 1991 *Education and Training Guide* provides detailed suggestions as to how investigators can fulfill these diverse responsibilities (NRC 1991, p. 46).
The main responsibilities of the AV are to ensure the provision of adequate veterinary care for all laboratory animals and to provide guidance to research staff and others about animal handling, immobilization, anesthesia, analgesia, tranquilization, and euthanasia. In addition, the AV is responsible for directing the housing, feeding, and nonmedical care of the laboratory animals as well as for serving as a voting member of the IACUC.

Ethics and Alternatives

**Ethics**

Due to the inherently personal nature of the subject of ethics, it is difficult to address ethical issues. Nevertheless, their importance should be stressed in the core training program. Trainees who have completed the course should have a good understanding of their responsibility in ensuring the proper care of all animals used in any research, education, or testing environment. The responsibility of animal stewardship cannot be overemphasized. Important cultural differences exist with respect to how animals are viewed and treated. Trainees must realize that no matter what their personal or cultural bias toward animals may be, they must adhere to the expectations of the institution and the public for animal care and use. Trainees should also understand that working with laboratory animals is a privilege that can be lost if it is not handled appropriately.

To introduce this topic, a definition of ethics and applied ethics should be presented. Trainees may also benefit from understanding the difference between utilitarian and deontological approaches to ethical decision-making. Utilitarianism looks at morality by assessing the greatest good for the greatest number (Shapiro 2000; Singer 2000). If the outcome of an action benefits the greater number, the action is deemed correct. Both sides of the research debate can use this argument. Animal rights advocates assert that the discoveries are too few and too narrow to be beneficial, therefore any use of animals in research is unwarranted. Animal use advocates assert that the benefits to both humans and animals are of significant importance, no matter how small (Rowan 2000). Deontological (duty-oriented) theories of ethical decision-making, by contrast, focus on moral obligations and laws as involving and applied to individuals. Deontological theories differ from utilitarianism in that harm of some individuals would not ordinarily be permitted even if the result is overwhelmingly helpful to others.

The use of animals in research has been the center of debate for many years, and the underlying arguments on both sides should be explored. It is difficult to defend one’s own position without having an understanding of the opposing position and views. A brief overview of arguments used by those advocating the humane use of animals for human purposes can be discussed alongside the arguments used by animal rights advocates (Tannenbaum 2000). Having the two viewpoints presented side-by-side can be a powerful way to open dialogue and promote the trainees’ active engagement in an intellectually stimulating discussion.

Ethical considerations should include the potential study outcome, the beneficial contributions to society, and whether or not the potential results justify the likely effects on the animals. Providing an example of a certain animal model of disease such as diabetes, the number of people affected by this disease worldwide, the cost to society to treat people with diabetes, the pain and distress in people with the disease, and the potential pain and distress of the animal model of diabetes can facilitate this discussion. In addition, if the animal species (e.g., chimpanzee) is endangered or threatened, the ethical justification for doing the study must be weighed with great care.

Trainees must also understand that there are many factors to consider when selecting the appropriate model to use in a study. Scientific factors such as relevancy, reliability, simplicity, and accessibility must be carefully reviewed. Ethical considerations include safety of personnel, conservation of species, and humane care and use issues. Economic issues include the cost of the animals and housing, the cost of the labor, and the time to perform the study.

Trainees should also understand the role of laws, regulations, and policies that aim to prevent the mistreatment of animals while providing humane standards for the care and use of laboratory animals. Finally, to round out this topic, participants should be challenged to review and discuss the ethical ideology presented in the document titled *U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training* (IRAC 1985). The websites for organizations such as the Foundation for Biomedical Research (http://www.fbresearch.org) and Public Responsibility in Medicine and Research (http://www.primr.org) provide extensive information on research ethics.

**Alternatives**

One of the most important topics that must be emphasized in the core training program is the need to consider alternatives to animal use. One way to begin this discussion is to provide a definition of alternatives, including the principles of refinement, reduction, and replacement (3Rs, Russell and Burch 1959). The goals of the 3Rs are to refine techniques that help minimize or eliminate animal pain or distress, reduce the number of animals used, and/or replace animals with nonanimal methods. Providing examples of alternative methods that have been adopted at the institution can help personalize this information. Likewise, if the institution has developed an award program to recognize individuals who adopt alternatives, training new employees about the program is an effective way to show the institution’s commitment to this important aspect of animal welfare.

A review of alternatives should include a discussion of pertinent regulatory, ethical, humane, economic, and...
scientific considerations. Reviewing the USDA regulatory language—"The principal investigator has considered alternatives to procedures that may cause more than momentary or slight pain or distress to the animals..."—should also help to reinforce the legal requirement for considering alternatives (CFR rev. 2002). Both the AWA and PHS require institutions to provide training on methodology that reduces or eliminates the need for animal utilization or limits their pain or distress (CFR rev. 2002; PHS 2002). Trainees should be introduced to the useful resource of the Animal Welfare Information Center (http://awic.nal.usda.gov) of the National Agricultural Library (NAL), which provides information that could prevent the unintended duplication of research and reduce or replace the use of animals. Accessible through the NAL is the “ALTWEB: Bibliography on Alternatives to Animal Testing” search engine (http://toxnet.nlm.nih.gov/altweb.html). This is a valuable site to use for animal alternatives searches because it is wholly compatible with PubMed in the format of searches; can be incorporated into search strategies on selected animal research topics; and links to other significant sites such as ALTWEB, the University of California-Davis, and others. For individuals involved in writing protocols, a review of the protocol questions posed about alternatives would also be appropriate in this section of the module.

For every proposed animal research study, trainees must be instructed that the principal investigator (PI) and IACUC are responsible for thoroughly considering whether there is a more humane alternative to the proposed use of animals. Time points for removing sutures and/or wound clips should be discussed. While taking scientific requirements into consideration, every effort must be made to adopt procedures (e.g., the use of analgesics, anesthetics, or tranquilizers) that will prevent or minimize animal pain or distress. The use of a less sentient species is another humane alternative to consider. Finally, the use of objective, humane endpoints is a necessary consideration, especially for animal use that is likely to result in pain or distress. For example, in a mouse cancer study, establishing a maximum tumor size or a minimum body temperature as an endpoint provides more objective and humane methods for determining study termination than allowing mice to become moribund or die from the disease.

The economic rationale for conducting animal research should include consideration of less invasive but more expensive techniques, such as imaging. Similarly, consideration should be given to using animals in multiple studies to reduce the overall number of animals used while ensuring that such use is both ethically justifiable and scientifically valid. In pharmaceutical research, the IACUC and PI share responsibility for ensuring that only compounds that have been tested and look promising in nonanimal screens are advanced to live animal models.

Whenever possible, nonanimal research methods or models should be sought via a literature search to reduce the use of animals. This part of the training can include a brief overview of different options including epidemiological re-

search, human subject research, cell culture systems, chemical analysis, microbiological systems, plants, and mathematical models. An emphasis on statistical design of studies will help to ensure that the fewest number of animals are used to answer the scientific question.

Recognizing and Responding to Pain and Distress

It is imperative to address the recognition and management of pain and distress in laboratory animals as part of the core training program. Providing definitions for terms such as comfort, discomfort, well-being, stress, distress, anxiety, fear, pain, and the moribund state will help trainees to better understand key concepts. It is also appropriate to review the different USDA-defined categories of pain because the number of animals used in each category must be reported to the USDA on an annual basis.

In general, two broad categories are used to describe the components of pain: sensory-discriminative and motivational-affective. The sensory-discriminative component provides sensory information about the intensity, duration, and location of a stimulus causing pain, whereas the motivational-affective component provides information about the severity and quality of the stimulus perceived and the animal’s response to the pain (AVMA 2001). Trainees should understand aspects of pain perception, be able to distinguish between minimal pain and the upper limit of pain tolerance, and be able to identify the duration of pain (e.g., acute vs. chronic). An important point to emphasize is that pain tolerance varies between individual animals and between species. Thus one animal may appear to have a higher pain tolerance compared with another animal on the same study, just as people have different pain tolerance to similar surgical procedures. Examples that are pertinent to the institution should be discussed and might include the following: (1) moderate, acute peripheral pain as would be induced by an injection of formalin into the paw of a rat as a model to study analgesia; or (2) chronic, severe, inflammatory pain associated with the rat adjuvant arthritis model that is commonly used to study better treatments for arthritis.

Methods used to assess pain and to recognize distress in commonly used species should also be reviewed during the core training program. Pain assessment must be based primarily on observations of abnormal behavioral and physiological responses that demonstrate anxiety and fear (AVMA 2001). Carstens and Moberg (2000) suggest that animal appearance is a third category to include with general behavior and physiology, to help assess pain states. This broader evaluation scheme may be more reliable; however, it also contains some inherent difficulties. Specifically, the behavioral signs the authors report as indicators of pain in animals of the same species can be diametrically opposed, yet both can be observed in animals experiencing pain. For example, the rat may express reduced activity or increased aggression as a response to pain (NRC 2000). It
should be emphasized that most animals hide signs of pain because such a sign of weakness may provoke an attack from predators or subordinate members of the group (NRC 2000). Attendees should understand the concept that U.S. Government principle IV proposes: If the procedure would cause pain in a human, we assume that it causes pain in the animal and that the pain should be alleviated (IRAC 1985).

The AWA and PHS Policy require all investigators to consider alternatives to painful procedures (CRF rev. 2002; PHS 2002). Ethical and humane reasoning dictates that animals should not be made to suffer. Methods used to minimize or eliminate pain must be carefully considered and if a painful procedure must be conducted, steps must be taken to reduce the animal’s discomfort. Strong emphasis should be given to the principles of nonmaleficence (cause no unnecessary pain or distress) and beneficence (be kind whenever possible). This training lays the groundwork for developing an institutional culture that promotes animal welfare.

An in-depth discussion about stress as an adaptive process versus distress as a maladaptive process should also be included. Trainees should recognize that stress is not always abnormal or harmful; however, when stress leads to harmful states that the animal cannot adapt to or escape from, then distress and maladaptive behaviors result. Participants should realize that the occurrence of physiological changes as a result of distress could ultimately have an impact on data collection and could invalidate a study. A discussion of the ethical and legal obligations of the institution with respect to minimizing pain and distress in the animals should ensue so that trainees understand their responsibility in helping the institution meet these obligations.

Adequate veterinary care cannot be overemphasized. Trainees must understand the importance of and procedures for promptly reporting all clinical signs of animal illness, pain, or distress to the veterinary group. The veterinarians should advise the scientific staff regarding appropriate interventions for relief of pain or distress including pharmacological and nonpharmacological methods. Teamwork and communication should be underscored as the best approach to minimize pain and distress in the animals. When each member of the team—including the animal care staff, research staff, veterinary staff, and IACUC—works together to provide oversight of the animals, better care with less animal pain and distress is the direct result.

**Information Sources**

A key component of the core training program is to provide course participants with information about the resources that are available to them. The NAL Animal Welfare Information Center and the National Library of Medicine provide services to access information on appropriate methods of animal care and use, alternatives to the use of live animals in research, the intent and requirements of the AWA, and ways to prevent unintended and unnecessary duplication of research involving animals. Search engines such as Medline (http://www.nlm.nih.gov/pubs/factsheets/medline.html) also provide free access to large databases of scientific literature. The Johns Hopkins Center for Alternatives to Animal Testing is another resource for techniques that can reduce the numbers of animals used. If the institution has additional resources such as key veterinary and training personnel, and a library with audiovisual materials, textbooks, and/or journals, participants should be made aware of how to access those services.

**Husbandry, Care, and Importance of the Environment**

Each species of animal that is used in research, testing, or education and that may be subjected to a wide variety of experimental manipulations has unique husbandry needs. It is impossible to cover each species and every potential need in an introductory training course; however, certain key considerations should be introduced. In-depth information may be left for later coverage in species-specific training, pain management training, and/or surgery courses. Emphasis should be given to the following: appropriate handling and restraint, legal requirements for husbandry and care, the scientific and humane importance of proper husbandry and a stable environment, environmental variables that should be controlled and monitored, and environmental enrichment. An overview of the institution’s disaster plan and how to respond to emergencies such as a power failure should also be included. Likewise, the training should include a brief overview of analgesics, anesthetics, or tranquilizing agents; and the need to consult a veterinarian during the design of studies that include any potentially painful procedures should be emphasized. The importance of using aseptic technique during survival surgery and appropriate pre- and postsurgical care should also be mentioned, but these topics should be covered in depth in separate courses. Finally, euthanasia is a key component of every animal care and use program and should be reviewed during the core training program.

The Husbandry, Care, and Importance of the Environment part of the module should include a brief overview of legal requirements such as which species and what aspects of husbandry and care are covered within the scope of the USDA regulations (CFR rev. 2002) and PHS Policy (PHS 2002). Trainees who will not provide husbandry generally do not need to know details about animal care; however, they should understand that there are sound rationales for different husbandry practices. A discussion of species differences can be usable to make this point because animals from tropical climates (e.g., nonhuman primates) require warmer temperature ranges with more humidity than animals that are prone to heat stress (e.g., rabbits), which require cooler, less humid climates. A discussion about how proper husbandry and a stable environment improve the validity of experimental data allows the trainer to discuss which environmental variables can be controlled.
Information should be presented about the macroenvironment (room condition) and the microenvironment (cage condition) and the importance of these factors both to the animals’ health and to research outcomes. Additionally, training should include a brief discussion about why it is important to carefully control and monitor variables such as temperature, humidity, ventilation, population density, properties of illumination including photoperiod, noise, food and water, type of bedding, and sanitation.Trainees should understand their responsibility in helping to ensure that these variables are controlled.

Animals not only have physical needs but also have social needs that should be considered in their housing. Social animals such as mice and pigs should be housed with like members of their species when it is appropriate and compatible with the research protocol. The 1985 AWA amendment added new housing requirements for both dogs and nonhuman primates. Dogs must be provided with the opportunity to exercise unless they are provided twice the minimal housing space that is required. Nonhuman primates must be provided with environmental and social enhancements to promote psychological well-being. Such enhancements help to address their higher cognitive skills and to reduce self-mutilation and stereotypic behavior problems seen in nonhuman primates (Wolfensohn and Honess 2005).

On occasion, environmental emergencies will occur that can have a significant impact on the animals. The 1996 Guide suggests that in the event of power failure, an alternative or emergency power supply should be available to maintain critical services (e.g., the heating and ventilation system) or to support functions (e.g., freezers, ventilated racks, and isolators) in animal rooms, operating suites, and other essential areas (NRC 1996). AAALAC requires institutions to have a well-defined disaster plan that addresses a variety of possible scenarios and to ensure that appropriate responses are made to minimize animal pain and distress as well as to ensure the safety of personnel.

Anesthetics, Analgesics, Tranquilizers, and Neuromuscular Blocking Agents

The goal of the Anesthetics, Tranquilizers, Analgesics, and Neuromuscular Blocking Agents section should be to introduce the importance of utilizing these agents and selecting, with the guidance of a veterinarian, the most appropriate agent and dose for the species and experimental protocol. A complete review of these agents cannot be given in a basic training module; detailed information is best left for a specific course addressing anesthesia, analgesia, and/or surgery. Trainers should define the action and use of the different classes of agents and discuss common agents used in the program for the different laboratory species. A reference chart with agents, dosages, indications, and contraindications can be distributed and can be a helpful resource, particularly for the research staff. Providing examples of why a specific agent would be selected for a specific research study is a practical way to review this topic. Course participants should be reminded that the attending veterinarian or designee must be consulted for any protocol that includes the use of anesthetic, analgesic, tranquilizer, or neuromuscular blocking agents and/or is likely to cause pain or distress. Trainees also need to understand how to support the animal during anesthesia (e.g., keeping the animal warm, providing fluids, and monitoring the depth of anesthesia). Correct dosage calculation and route of administration should also be stressed. The 1991 Education and Training Guide provides additional information that should be delivered as part of an in-depth course on this subject (NRC 1991, p. 53-60).

Depending on how an institution handles controlled substances, information on the Controlled Substance Act should also be covered (CFR 1970) and should include the following: how to obtain a Department of Justice, Drug Enforcement Administration license; how to order scheduled drugs; how to store and properly dispose of drugs; and how to comply with record-keeping requirements.

Survival Surgery and Postsurgical Care

The core training module should address the basic surgical needs of different species and surgical asepsis. Surgery on nonrodent species such as rabbits, dogs, cats, and pigs must be done in a dedicated surgical facility (NRC 1996). Rodent surgery does not require a dedicated surgical facility; it can be performed in a room or part of a room that is easily sanitized and not used for other activities while the surgery is in progress. Common terminology (e.g., major surgery, minor surgery, survival, and nonsurvival) should be introduced to familiarize attendees with the categories of surgical procedures. Major survival surgery “penetrates and exposes a body cavity or produces substantial impairment of physical or physiologic functions” (NRC 1996, p. 61). Minor survival surgery “does not expose a body cavity and causes little or no physical impairment” (NRC 1996, p. 61). In survival surgery, an animal is expected to live for a period of time after recovery from anesthesia. In nonsurvival surgery, an animal is euthanized before recovery from anesthesia.

Instruction should be provided about the importance of using aseptic surgical methods when doing survival surgery. The common notions that animals, particularly rodents, are resistant to postoperative wound infections, or that antibiotics are a “magic bullet” capable of compensating for poor aseptic surgical technique, must be dispelled! Relatively low-level bacterial contamination of surgical wounds may alter the animal’s physiology and behavior and confound the experimental measures even though no clinical signs of sepsis are evident (Bradfield et al 1992). It is important to review techniques that prevent infection, including instrument sterilization, patient preparation, and surgeon preparation. More in-depth discussion of surgical and aseptic
practices should be covered during a separate surgery course.

The extent of postprocedural care that is needed will vary depending on the species and type of study performed. Standard care, nutritional support, wound management, and recognition of and treatment of pain should be reviewed. Standard care includes observing the animal for signs of illness or abnormal behavior and treating the condition under the realm of the protocol to ensure the animal’s well-being. Some animals may require nutritional support and should be given higher caloric and/or more palatable foods along with administration of fluids. Time points to remove sutures and/or wound clips should be discussed. How to recognize wound complications such as infection and self-mutilation and what steps should be taken to prevent or treat the problem should be reviewed. Although it was discussed above, it is important to re-emphasize recognition and management of pain because these responsibilities are also part of the postprocedural care process.

Humane Endpoints and Euthanasia

The concept of experimental endpoints and humane endpoints should be introduced. There should be a careful balance between achieving research goals and addressing animal welfare considerations. If a study causes pain or distress, it is important that the animals are promptly euthanized when the predetermined endpoint is reached and/or data are collected. Death is rarely justified as an endpoint and unexpected morbidity and mortality can lead to the loss of valuable data. Trainees must understand how humane endpoints can be used to minimize animal pain and distress. It is necessary for research staff to describe the specific criteria for humane endpoints in their IACUC protocol, which can serve as the basis for ending a test procedure to minimize pain and distress. The use of distress scoring schemes should be introduced as a way to more objectively determine the status of an animal compared with the subjective determination of how the animal appears.

Unlike PHS policy, training regarding euthanasia is not specifically mandated by the AWA. Nevertheless, because the AWA does require animal users to be qualified to perform their duties, a discussion of euthanasia is therefore appropriate for a basic training course. An overview of both acceptable and conditional methods of euthanasia, how agents may affect tissue and ultimately research results, indicators of death and the need to ensure death (including using a secondary means) should be presented. Reference should be made to the 2000 Report of the American Veterinary Medical Associations Panel on Euthanasia (AVMA 2001) or the most current version. Participants should be reminded that a veterinarian may be consulted to assist them in determining humane endpoints and an appropriate method of euthanasia. Mention of the human animal bond and how euthanasia may psychologically affect some individuals is also worthy of addressing (Russow and Wolfe 2002).

Occupational Health and Safety of Personnel

Each institution should have an occupational health and safety program to protect personnel in their workplace (NRC 1996). Depending on the size of the institution, a person or a department may be responsible for coordinating the program. The topic of occupational health and safety is too complex to be covered in depth during a basic training course. It is best to provide participants with general information on how to identify workplace, procedure, and species-specific hazards and prevent problems from occurring. Participants should also be made aware of other institutional groups such as the radiation safety and biosafety committees, which help to protect their well-being.

Different types of hazards that include physical dangers, chemicals, and biological agents will be encountered when working with animals (Wagener and Stein 2000). Injuries from physical hazards include slips and falls; sprains, strains and crushing injuries from moving equipment; noise, steam, or heat exposure; and cumulative trauma disorders resulting from poor ergonomics. Animals are capable of inflicting injuries such as bites, scratches, and kicks. Sheep, goats, pigs, and dogs by their physical size can cause harm in a number of ways. Accidental sticks from needles are another potential hazard. The institution’s policy regarding sharps disposal and recapping of needles should be addressed. Chemical hazards include exposure to cleaning agents, carcinogenic or toxic agents administered to animals as a part of the research study, and anesthetics. Personnel are most commonly exposed to biological hazards via introduction of infectious pathogens through the experimental process or through naturally occurring agents in the species being used in the study. Another research tool, recombinant DNA technology, presents an additional biological hazard. Safety measures to avoid potential hazardous situations should be stressed. The biosafety committee plays a major role in ensuring the safe use of pathogens. The radiation safety committee oversees the use of x-ray-generating equipment and the use of radioisotopes.

Animal-related allergies may become a problem for anyone with long-term exposure to animal dander, urine, fur, or other biological products. Institutional policies regarding the use of personal protective equipment should be discussed and the proper use of the equipment demonstrated. If the institution uses special housing or other methods to reduce allergen exposure, this subject should be mentioned.

Course participants should be given an overview of zoonoses. It is important to heighten their awareness by providing real world examples of zoonotic diseases (e.g., ringworm or toxoplasmosis from cats, Q-fever from sheep, lymphocytic choriomeningitis virus from biological materials, and cercopitheic herpesvirus type 1 from macaques). Additional training should be provided in species-specific courses.
Advantages and Benefits of Training

Training provides several advantages and benefits for the animals, the personnel, and the institution. A good training program helps to ensure that animals will be properly cared for and used by individuals. This foundation enables the institution to meet regulatory and public expectations with respect to animal welfare. Trained individuals should understand the importance of the animal welfare regulations and guidelines, appropriate housing, care and use, identifying and reporting clinical signs of illness, occupational health and safety needs, and minimizing pain and distress whenever possible. Comprehensive training allows the entire program of animal care and use to improve.

Training affects how individuals will eventually perform on the job and often results in higher job satisfaction because individuals feel that they have been given the appropriate information to succeed at their job. After practicing and developing skills, individuals often have a feeling of increased self-worth and value to their employer (Gonder 2002). Providing a good foundation of training with continuing education encourages individual growth and helps to develop an employee population that is more competent and able to uphold high standards of animal care and use.

Training also fulfills regulatory mandates and ensures that the institution will remain in compliance with applicable laws and AAALAC accreditation expectations. The public concern about inappropriate animal care and use can be partially addressed by ensuring that only highly trained individuals work with the animals. The institution will also reap the benefits of savings in time, effort, and resources because trained employees usually have higher productivity and fewer errors than untrained personnel. Finally, training can also have a positive impact on the research data because trained individuals will recognize when unwanted variables or health issues might affect the data and can promptly intervene to minimize their impact.

Additional courses involving species-specific training, rodent surgery, or other specialized techniques will likely be necessary to ensure that employees have the appropriate training to do their jobs. However, this core training provides the fundamental information and foundation on which the rest of the animal care and use program is built.

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