Workshop 1.3
Education in animal alternatives

Alternatives to the Use of Laboratory Animals in Veterinary Education

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Summary
About 75 million vertebrates are used worldwide per year for experimental purposes, of which 10 million within Europe. On average, about 2% is used for education and training purposes.
The basis of legislation on the use of animals for experimental purposes is the Three Rs principle of Russell and Burch: replacement, reduction and refinement.
Most legislation contains provisions to protect the animals such as the definition of legitimate purposes for animal use, competence of scientists and animal staff, the use of alternatives and prevention of unnecessary pain and distress. One of the legitimate purposes is the use of animals in education and training, only permitted when the objective cannot be achieved by comparable effective audiovisual or any other suitable methods (Art 25, ETS123).
In many countries, the use of animals for educational purposes in the veterinary curriculum requires approval by the Animal Ethics Committees. Many alternatives have been developed and are already in use in veterinary education such as interactive videos and computer simulations, in vitro cell cultures, slaughterhouse material, plastinated organs, dead animals from a humane/ethical source and clinical case-based practice.
The debate on the use of animals in veterinary education should include the question who benefits: the laboratory animals, the animal patients, the animal owners, the veterinary students, the teachers and/or the management?
Concerning the quality of the veterinarian trained with or without live animals, no difference in surgical performance could be shown so far.
Future aims should include a listing of case studies on available teaching materials in a database and a large-scale controlled international study on replacement methods in veterinary education.

Keywords: veterinary education, laboratory animals, alternatives

Anatomy is one of the oldest medical sciences. Stone-age people were already drawing animal forms about 30,000 years ago, which show certain knowledge of topographical anatomy. Aristotle (384-322 BC) performed detailed dissections on animals in order to extrapolate the results to humans, as in his time it was forbidden to carry out post mortems on humans. He described his findings in his books *Historia Animalium and De Partibus Animalium*. He was one of the first to use experimental animals.

Worldwide about 75 million vertebrates are used as experimental animals per year, 10 million of which within Europe. On average, about 2% is used for education and training purposes.

The basis of legislation on the use of animals for experimental purposes is the Three Rs principle of Russel and Burch:

replacement, reduction and refinement, launched in their book "The principles of humane experimental technique" in 1959.

Replacement means the substitution of live animals by *in vitro* techniques such as the use of cells and tissues, computerised models, videos, simulations and dummies.

The European legislation on experimental animals is based on two documents. In 1986, the Council of Europe launched the Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific purposes (ETS123), followed by the EC Directive for the Protection of Vertebrate Animals used for Experimental and other Scientific purposes (86/609/EEC). These legislative regulations are based on the premise that under certain conditions it is morally acceptable to use animals for experimental and other scientific purposes.

Most laws contain provisions to protect the animals, such as the definition of legitimate purposes for animal use, competence of scientists and animal care staff, the use of alternatives and prevention of unnecessary pain and distress. One of the legitimate purposes is the use of animals in education and training (art. 2, ETS123). In biomedical education, a variety of disciplines use animals and animal tissues in order to acquire knowledge and develop skills. However, procedures involving animals carried out "for the purpose of education, training or further training for professions or other occupations are only permitted when the objective cannot be achieved by comparable effective audiovisual or any other suitable methods" (art. 25, ETS123).

In veterinary medicine the use of animals mainly focuses on learning and practising skills such as animal handling, animal behaviour, dissecting and surgical skills, but may also include understanding of anatomy, physiology, pharmacology and biochemistry. Eventually, the knowledge obtained in this way should benefit the animal itself in the long term rather than human beings, as is the case in the education of medical doctors.

The use of animals in veterinary education is becoming a subject of moral debate and is often opposed on educational and practical grounds. However, the discomfort that animals experience in relation to the purpose of their use should play a major role in this debate. For example, the grade of discomfort will be different for animals used to practice handling skills or for surgical training.

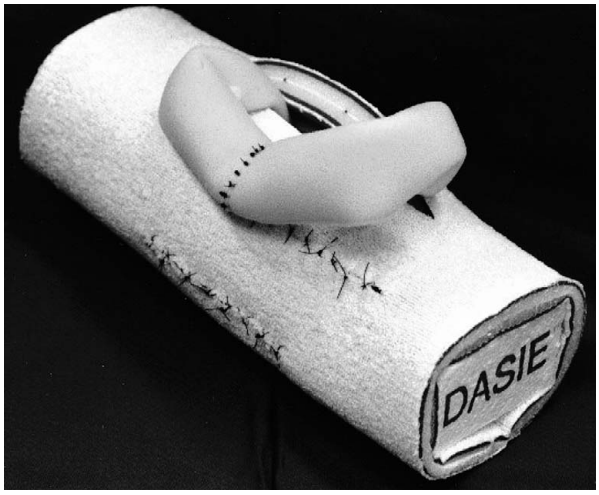

Fig. 1: DASIE™
(dr. David L. Holmberg e-mail: holmberg@uoguelph.ca)

Fig. 2: Critical Care Jerry™ (www.rescuecritters.com)

In many countries, the use of animals for educational purposes in the veterinary curriculum requires approval by the Animal Ethics Committees or Institutional Animal Care and Use Committees. The ethical admissibility of an educational program using animals is judged by balancing the purpose/relevance of the procedure against the suffering of the animal.

Many alternatives have been developed and are already in use in veterinary education such as interactive videos and computer simulations, *in vitro* cell cultures, slaughterhouse material, plastinated organs, dead animals from a humane/ethical source (body donation by owners or veterinary practices), animal shelters and clinical case-based practice, e.g. spaying/neutering of dogs and cats in animal shelters, patient-based practice at a later stage in the veterinary curriculum.

Dummies/simulators can be used to practice skills such as DASIE™ (Dog Abdominal Surrogate for Instructional Exercises) (fig. 1) to teach sterile techniques, surgical draping, instrument handling, incision making, suturing different layers or Critical Care Jerry™ (dog) (fig. 2) or Fluffy™ (cat) on which air and fluid aspiration from the thoracic cavity, jugular vascular access or intubation can be trained.

The rubber Koken™ rat (fig. 3) can be used to train handling, oral gavage, blood sampling from and *i.v.* injection into the lateral tail vein. Bicycle inner tubes covering foam are useful to practice suturing techniques (fig. 4). Both methods are in use in courses on laboratory animal science for scientists and animal care staff (FELASA, Cat. C, A, B).

The artificial rat model (IMTC, the Netherlands) is an aid in training microsurgical skills such as anastomoses and cannulation of the jugular vein.

However, would it be feasible and desirable to replace all experimental animal use in veterinary education? The debate on the use of animals in veterinary education should include the question of who benefits:

Fig. 3: Koken™ rat (www.kokenmpc.co.jp)

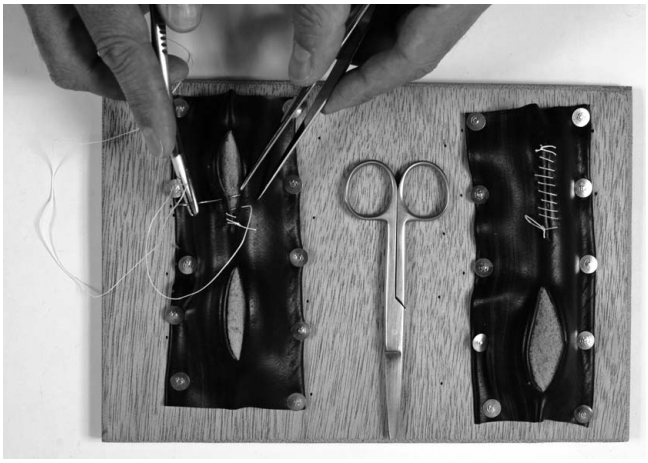

Fig. 4: Bicycle inner tube for suturing (Department Animals, Science & Society, University of Utrecht)

- The laboratory animals? Certainly they will benefit from alternatives as their lives are saved.
- The animal patients? Will they be treated and cared for in a better way when their veterinarians have been trained on live animals in their education?
- The animal owners? Will they accept mistakes in clinical case-based experience being part of the veterinary education, especially when it concerns their own animals?
- The veterinary students? Will the use of animals provide them with more skills and will they be better veterinarians?
- The teachers? Is it rewarding to teach without the use of animals, achieving the same educational results?
- Cost effective? As animals and their maintenance are expensive, the use of alternatives might be cost-effective.

Concerning the quality of the veterinarian trained with or without live animals, no difference in surgical performance could be shown (Balcombe, 2000; Griffon, 2000; Pavletic et al., 1994; White et al., 1992). Evaluation should be performed by a blind assessment by the Veterinary Faculty itself and/or on feedback of the employers' satisfaction in veterinary practices. Rating educational merits by the students themselves might be biased by the wish not to use animals.

Future aims should include a listing of case studies on available teaching materials in a database (EURCA, www.eurca.org) and a large-scale controlled international study on replacement methods vs. traditional animal-based teaching in veterinary education with a sufficient sample size, a blind study design involving several instructors and institutions and including short- and long-term evaluation.

If we could educate veterinary students as effectively without the use of animals, why should we not try?

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Educating the Veterinary Professional about Animal Welfare*

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Summary
For many years, animal welfare organisations have taken the lead in bringing about improvements in animal welfare, as well as helping to change attitudes towards animals. Unfortunately, the veterinary profession has often lagged behind in its support for reform. It is vital therefore that veterinary training includes a good grounding in animal welfare education. In 2003, the World Society for the Protection of Animals (WSPA) and the University of Bristol launched the 'Concepts in Animal Welfare Syllabus' to assist with the teaching of animal welfare in veterinary faculties. The syllabus stimulates focused critical thinking on animal welfare issues.

Keywords: animal welfare, education, veterinary profession

Introduction

Animal welfare has developed into a science in its own right, and, as a result, there is a growing amount of research into this subject. This research is funded by governments and other agencies and is often used as the basis for the reform of animal welfare legislation, and of the conditions under which animals are reared for food, used in scientific research, kept in captivity for entertainment or other purposes, or used as companion animals. As the body of welfare knowledge increases, its inclusion in educational curricula is likely to increase (Hewson, 2006). Welfare issues are also becoming more important considerations of many national and international veterinary associations.

Veterinarians are widely considered to be informed, rational authorities who possess expertise on virtually any topic relating to animals, including animal welfare. Career options for veterinarians include: working in veterinary practices, in research institutes, as welfare advisers for industry (e.g. feed or pharmaceutical) or for the government (e.g. in transport, slaughter and meat inspection). Many veterinarians are driven by a genuine desire to help animals, and this goal can be achieved with a proper knowledge of animal welfare.

Animal Welfare positions of Veterinary Associations

We reviewed the animal welfare positions of the World Veterinary Association (WVA), the American Veterinary Medical Association (AVMA), the British Veterinary Association (BVA), the Australian Veterinary Association (AVA) and the New Zealand Veterinary Association (NZVA). Many of the policies of the NZVA were in line with or exceeded the guidelines developed by that country's National Animal Welfare Advisory Committee (NAWAC), and we used the more-readily available NAWAC guidelines to represent the NZVA's positions in our survey. The five animal-use practices considered were: so-called "battery" cages for laying hens; gestation crates for pregnant sows; small crates and nutritionally-deficient diets for "veal" calves; the use of animals in scientific research and education; and the tail-docking of dogs.

We compared the results of the veterinary review to the available research data on public attitudes towards the five animal-use practices. A detailed report of the results is beyond the scope of this paper, but is available from the authors on request. Briefly, there was widespread and persistent public concern about many aspects of each of the five animal use practices, in all surveyed countries. In contrast, many of these specific concerns were not addressed clearly in the five veterinary associations' positions. All of the veterinary associations either lacked positions on or were not categorically opposed to the close confinement of laying hens, pregnant sows and "veal" calves, although the NZVA did recommend time limits on the use of sow gestation crates, and both the NZVA and the AVA recommended group, rather than individual, housing of "veal" calves. The only practice to which the public and the associations appeared to share a common opposition was the cosmetic tail docking of dogs, although the AVMA did not take a firm stance against this. In the case of animal experimentation, both the general public and the veterinary profession appear to support experimentation for human medical research to some degree, although public opinion remains very critical.

Our results clearly suggest that veterinarians lag behind the general public in their desire for animal welfare reform, unless the positions of veterinarians are not accurately represented by the veterinary associations surveyed. Anecdotal evidence and

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some research (Farm Sanctuary, 2004) indicate that a proportion of veterinarians do care deeply about these issues, and support animal welfare organisations, in some cases taking the lead on animal welfare issues. Furthermore, international veterinary bodies like the WVA, the Commonwealth Veterinary Association, the World Small Animal Veterinary Association and the Federation of European Companion Animal Veterinary Associations have all organised major animal welfare symposia in recent years. Thus, there may be some inconsistency between the apparent level of concern about animal welfare expressed by the surveyed veterinary associations and the level of concern of individual veterinarians and some other veterinary associations. Nevertheless, even if the surveyed associations do not fully represent the positions of the majority of veterinarians, it appears likely that a substantial proportion of veterinarians lags behind the general public in their desire for the advancement of animal welfare issues. We attribute this in part to inadequate education about the science and issues of animal welfare during formal veterinary training.

Trends in veterinary education

The veterinary profession has its origins in agricultural practice, although in the developed world today most veterinarians work primarily with companion animals. Veterinary medical curricula have been modified accordingly over time. Accompanying these changes is the marked feminisation of a previously male-dominated profession. This gender shift is bringing some changes in the attitudes of veterinary students towards animal welfare. For example, a cross-sectional study of veterinary students in their first preclinical year, first clinical year and final year of study showed that the women in each of these groups rated themselves as having significantly higher levels of emotional empathy with animals than did the men. This difference was most marked in the final-year students; moreover, the males in that group showed lower levels of empathy than their peers in the earlier year-groups (Paul and Podberscek, 2000). Research at a US veterinary school has examined veterinary students' attitudes to pain management. Fourth year students were less likely than second or third year students to provide analgesia for certain surgeries (Hellyer et al., 1999). Moreover, it appears likely that there is inhibition of the normal development of moral reasoning ability during the four years of veterinary school (Self et al., 1991).

These findings may be attributable in part to the attitudes of teaching faculty and the examples they set. The apparently reduced concerns for animal welfare might also, in some cases, represent adaptations that enable veterinary students to withstand what could otherwise be intolerable psychological stresses that result from being required to harm sentient creatures in the absence of overwhelming necessity (Capaldo, 2004).

During their training, veterinary students are frequently required to harm and kill animals in preclinical subjects such as anatomy (dissection, often of purpose-killed animals or animals from ethically-questionable sources), physiology, biochemistry and pharmacology ("demonstration" experiments on living animals, usually of long-established scientific concepts, with animals usually killed during or at the end of the experiment). Students have also traditionally been required to practice clinical, surgical and anaesthetic skills by anaesthetising healthy animals, conducting surgical procedures on them, and killing any survivors at the end (not all survive these frequently-lengthy operations) (Knight, 1999).

While many veterinary schools are continuing to refine their curricula to avoid harmful animal use, such use may still be found in veterinary education worldwide, both in preclinical and clinical (surgical) training. Furthermore, students who are not aware of the existence of alternative methods to harmful animal use in education and scientific research are less likely to consider the 3Rs when planning research projects themselves at graduate and postgraduate level.

Discussion

Where harmful animal use is retained in the curriculum and animal welfare education is lacking, it is likely that graduating veterinarians will have a diminished appreciation of animal sentience, and a diminished understanding of animal welfare science and animal welfare issues, all of which will impede their knowledge of the 3Rs and their abilities to guide their clients and the wider public appropriately. This may explain why the veterinary associations we surveyed seemed to lag behind the public in their concern about the welfare of animals in several management systems widely believed to result in poor welfare.

Recommendations

Although animal welfare is necessary as part of formal veterinary education throughout Europe as part of the European Community's move towards harmonisation of professional qualifications, animal welfare education is underdeveloped in most veterinary schools and, we believe, has not received the attention it deserves in the curriculum. However, there are increasing numbers of courses on animal welfare being implemented around the world. Some of these courses are integrated into undergraduate veterinary education. In addition, there are postgraduate courses such as the MSc in Applied Animal Behaviour and Animal Welfare at the University of Edinburgh, Scotland, and the MSc in Animals and Public Policy at the Cummings School of Veterinary Medicine at Tufts University, USA. Moreover, one of the animal welfare mandates of the World Animal Health Organisation (OIE) is promotion of the inclusion of animal welfare in undergraduate and post-graduate veterinary curricula (Anon, 2005).

To encourage the introduction of animal welfare education into veterinary curricula worldwide, the World Society for the Protection of Animals (WSPA) developed an outline of the "Concepts in Animal Welfare" syllabus in 2000. The complete syllabus was developed in collaboration with the University of

Bristol, School of Veterinary Science, and was launched on CD ROM in 2003. The aims of the CD ROM are to help students:

- to develop an understanding of animal welfare relevant to an animal's physiological and psychological well-being;
- to recognise the welfare, ethical and legal implications of animal use practices and to be able to apply critical analyses from each perspective, for different species in different situations; and
- to stimulate focused critical thinking on welfare issues, which can be developed throughout the course and the individual's professional career.

The syllabus comprises 30 theoretical teaching units in PowerPoint format, illustrated topics with practical examples and case studies, questions and assessment materials, suggested reading lists, and additional relevant materials. There are seven core and 23 elective teaching modules covering a wide range of animal welfare topics (tab. 1).

The materials are suitable for use in class as well as for independent study, and they also stimulate interaction between students and with the lecturer. Lecturers can easily adapt the materials to suit their needs, by adding relevant country-specific information or by omitting modules for which there is insufficient time. The CD ROM can be used both at undergraduate and postgraduate level, and it is suitable for use on its own or for integration into existing courses on behaviour, physiology, ethics, or veterinary law. Navigation of the CD ROM is easy, and the presentation of the materials is engaging. The modules build on the experiences of both the University of Bristol, which is one of the world's leading centres for the study of animal welfare science, and WSPA, which has 50 years of international experience in

Tab. 1: Modules of the 'Concepts in Animal Welfare' syllabus

Module number	Topics	Core module
1	Animal welfare introduction	Yes
2	Welfare assessment and the Five Freedoms	Yes
3	Physiological indicators of welfare (1)	No
4	Physiological indicators of welfare (2)	No
5	Immune and production indicators of welfare	No
6	Behavioural indicators (1)	No
7	Behavioural indicators (2)	No
8	Group assessment and management of welfare	No
9	Human-animal interactions	Yes
10	Introduction to animal welfare ethics	Yes
11	Interaction with other ethical concerns	No
12	The role of the veterinary profession and individual veterinarian	Yes
13	Humane education	No
14	Animal welfare organisations	No
15	Protection legislation (1)	Yes
16	Protection legislation (2)	Yes
	-Enforcement and political pressure	
17	Commercial exploitation of wildlife	No
18	Influence of the marketplace	No
19	Farm animal welfare assessment and issues (1)	No
20	Farm animal welfare assessment and issues (2)	No
21	Farm animal transport and markets	No
22	Slaughter of farm animals	No
23	Working animals	No
24	Animals used in entertainment	No
25	Animals in experiments	No
26	Companion animals (1)	No
	-Population control programs	
27	Companion animals (2)	No
	-Wider considerations	
28	Euthanasia	No
29	Wild animal management	No
30	a) Religion and animals	No
	b) War and natural disasters	

advancing animal welfare issues, including collaboration with governments, international organisations and veterinary professional bodies.

To facilitate the implementation of the syllabus, WSPA has organised a series of conferences and workshops since 2004 for over 300 veterinary faculties in Brazil, Central and South American countries, the Czech Republic and other Eastern European countries, Indonesia, India and the Philippines. As a result of the workshop in the Philippines in March 2005, a steering committee was formed, which is currently reviewing the national Philippine veterinary curriculum with a view to including more animal welfare aspects in existing modules on husbandry and breeding. Further conferences and workshops are planned for 2006 in Japan, Brazil, Latin American and South American countries, and Africa. In Colombia, animal welfare will be a compulsory part of the curriculum from 2006.

WSPA does not yet have a complete overview of which universities have implemented all or parts of the syllabus, but we know of many universities, in Australia, Brazil, Canada, Colombia, India, Indonesia, Kenya, New Zealand, the Philippines, South Africa, the United States of America, and many European countries, that are successfully using the resource. An extensive assessment form for users has been developed to help WSPA improve the syllabus even further.

Conclusion

Informed positions on questions of animal use in education and scientific research are associated with humane attitudes and a sound knowledge of animal welfare science. Although that discipline is well-established, with an ever-expanding body of related research, most veterinarians will remain relatively ignorant of animal welfare science and issues unless they learn about them during their formal education. We hope that the "Concepts in Animal Welfare" syllabus will play an important role in assisting veterinarians to develop a sound understanding of this increasingly important field. The syllabus is designed to achieve this by stimulating students to undertake focused critical thinking on welfare issues, not only during their veterinary course, but throughout their entire career.

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User-friendly Curricula on Alternatives for Research Scientists

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Summary
Engaging research scientists in the field of animal alternatives requires relevance and timing that complement the research efforts of each particular person. Presentations are effective when convenient and in a context valued by scientists. Targeted curricula can be designed as part of courses, workshops, or symposia on topics of interest. Websites accompanying the material make it feasible for participants to retrieve the information when needed for an animal use protocol. For locally relevant material, scientists partnered with librarians can build resources that piggyback on existing tools, adapting them for the research interests of participants and their contexts.

Keywords: alternatives, curricula, presentations, scientists, workshops, courses, symposia, 3Rs, research

Introduction

Clarifying the United States Animal Welfare Act (2002), Policies 11 and 12 (United States Department of Agriculture, 1997, 2000) require that researchers conduct specific searches for alternatives to procedures that may cause more than momentary pain or distress. This requirement assigns researchers a searching task on a somewhat different topic than they would normally follow in the literature and is sometimes viewed as a burden. In view of these requirements for compliance with the Animal Welfare Act, it is in the interests of academic institutions to facilitate this searching endeavour and enhance the efficiency of this process.

Several challenges face anyone wanting to advance curricular development for research scientists in the area of alternatives. Scientists work in highly individualised fields of research, using a particular sequence of methods and techniques. They may view searching for alternatives, at least initially, as an irrelevant obligation. But they must address alternatives when they are writing up an animal care and use protocol, so the timing of presenting information to them or building in an easy access for later when needed is critical. A potential for engaging scientists and increasing their interest in alternatives exists if the presentation involves improving access to the research literature in general, or addressing particular questions that matter to the scientist.

Alternatives have the potential to arouse interest and involvement when they are presented within the audience's context of research interests. Targeted presentations designed and presented on-campus for specific courses, workshops, or symposia can complement the other information being presented in that venue and profile the practical value of bibliographic searching techniques for accessing information on alternatives. In this paper we identify three challenges in disseminating alternatives and then present approaches we use at various venues for developing targeted curricula that complement specific topics being addressed for the particular audience. Finally, we propose strategies for generating local support and opportunities to present information on alternatives.

Three challenges in disseminating alternatives

To be effective, disseminating information on alternatives requires a type of teaching, yet there is not a ready-made audience. People at research institutions seeking to upgrade their institutional compliance with the requirement of searching for alternatives might first consider how best to recruit and stimulate a talented teacher and a willing audience for alternatives. In this light, we draw attention to three essential components of an effective program for enhanced searching for alternatives.

Researchers

The fact that searching for alternatives is a requirement sometimes positions this obligation as an onerous task. Scientists in universities who are required to complete animal use protocols are highly accomplished and knowledgeable. They are self-starters, highly focused and motivated to work intensely in their subject of interest. They are accustomed to setting their own objectives. They are proficient in tracking the literature and new developments in the areas relating to their science, and know how to quickly monitor and locate that literature. Their colleagues review their work prior to its publication. Extensive reviews also are strict prerequisites for funding and grant support. Only work that is well-regarded makes the cuts for funding and publication. After surviving such extensive peer-scrutiny, researchers may not readily welcome another requirement that to them may appear frivolous and not directly related to their research. Thus, when crafting curricula on alternatives for research scientists, it is useful to understand that they can be a

challenging audience to engage, or even to get to show up for presentations. The material must be targeted to their interests, and presented at a convenient venue, preferably sandwiched in at an occasion that already promises to attract their attendance.

Technology

The searching for alternatives is less straightforward than a typical search on a topic of someone's line of research. Topics on alternatives are dispersed across many interdisciplinary fields and covered in several general databases as well as some specialised ones (Hart and Wood, 2000). Conducting an effective search that is relevant to the species and topic of the study requires some thoughtful effort (Hart et al., 2005). It is not a reasonable expectation, even for a brilliant scientist, that someone could perform an effective search on alternatives *de novo*.

Nonetheless, the technology lends itself to creating efficient tools, such as search templates, filters, and grids (Wood and Hart, 2004a) and database grids (Hart et al., 2005a). These can simplify searching for alternatives, lead to more effective searches, and create a spillover of more effective searching in the scientists' areas of study.

Librarians as educators to assist in searching for alternatives

Given that searching for alternatives requires an unusual specialised expertise, most institutions lack specialists in this area. For institutions seeking to create pro-active local support toward more effective and efficient searching for alternatives, librarians have the requisite skills to quickly acquire some proficiency and offer assistance (Hart and Wood, 2000). Given the willingness of librarians to provide service and master new subject areas, it is a feasible objective for an administrator or animal care committee to recruit a librarian to become a campus specialist to provide assistance and instruction in the area of alternatives.

Methods and avenues of presentation

The general goal of offering demonstrations on searching for alternatives is to increase scientific literacy. The instruction is provided in the context of the requirement to search for alternatives. Typically, individuals think about searching for alternatives when facing the requirement and at other times the topic is not a high priority. One objective, then, is to have information accessible to the person who needs it, at the precise time when it is needed. The researcher needs to know about alternatives resources, know where to find them, and how to use them. Delivery on the web of the resources is ideally suited for offering access at any time from any place. A second objective during presentations is to increase the valence of the information, and demonstrate its practical value and relationship to science in general and its potential for assisting the person in being more effective in searching.

Due to the requirement to search for alternatives when preparing a protocol, there are some teachable moments when researchers are seeking to learn. Nonetheless, this topic does not promise to draw an enthusiastic audience. Building a constituency of interested people can be the biggest challenge. With this in mind, in each of the contexts for presentation described below, an effort is made to tailor the information to the occasion and audience, and to provide a web page on the specific topic. The web page allows easy review of the presentation and facilitates the person returning to the specific techniques when needed later. With the accessibility of the internet, the information can be delivered almost anywhere, anytime, as needed by any user.

Courses

Information on alternatives can be offered in courses for undergraduates, graduate students, and veterinary or other professional students. For example, the presentation for an undergraduate course on companion animal biology, ANS 42, Introductory Companion Animal Biology, focuses on companion animal welfare (Wood et al., 2005a). This designed website is used to demonstrate topics related to husbandry of dogs and cats, behavioural indicators of welfare, and behavioural effects of spay/neuter surgery.

Separate courses for veterinary and graduate students address mouse behaviour and biology: PHR 408, Mouse Behavior and Biology, and PMI 280, The Mouse as an Experimental Model for Human and Animal Diseases (Wood and Hart, 2005a). The presentation and specialised website on alternatives includes provides ready access to a variety of searching tools on mice and alternatives that we have developed, along with links to classic resources offered by the Jackson Laboratories and a variety of other specialised resources on mice.

A mentored clinical research training program associated with a masters degree comprises junior clinical faculty of the medical and veterinary schools who are being groomed to conduct their own research programs. A presentation to this group focuses on the animal care and use protocol and standard operating procedures used by various campuses (Wood and Hart, 2005b).

Workshops

Workshops can either be sponsored on the specific topic of alternatives, or presented as part of a broader topic for the animal care, primate, or general research community. Each year, we offer workshops for the veterinary laboratory animal residents from the California National Primate Research Center and from the Center for Laboratory Animal Science at the University of California, Davis (Wood and Hart, 2005b). These workshops provide a general overview of alternatives, animal subject protocols, and standard operating procedures, and offer hands-on instruction with computer searching. Most valuable, perhaps, is that participants can raise unique problems they are experiencing, that would not be covered in a general overview, e.g., dealing with ants in the animal room.

Additional workshops are developed and presented on-site with hands-on instruction as tailored tutorials for visiting veterinarians, including the USDA Animal and Plant Health Inspection Service Preceptor Veterinary Fellows each year, and visiting librarians. Presentations on other campuses with animal care personnel and librarians are tailored to the particular needs and research interests of the community.

Symposia

Symposia or conferences can be effective as collaborative ventures focusing on timely topics. We use this approach for an annual symposium co-sponsored with the California National Primate Research Center. Topics are selected on emerging new techniques that are relevant to alternatives, and for which we develop tailored presentations on, for example, new methods of imaging (Wood and Hart, 2004b), or cell culture and explants (Wood et al., 2005b). Once again, a special web page is prepared and configured that users can conveniently access following the presentation. This method of instruction offers support to users in efficient searching within their context of the course material or working setting, such that the alternatives curricula supplement their needs.

Conclusions: Generating local support and opportunities to present information

The sequence of providing effective, user-friendly curricula on alternatives for research scientists gets underway by identifying a librarian who would be interested in learning and educating about alternatives. A second step is identifying opportunities for presenting material to interested audiences of researchers. Personalised presentations as opportunities arise for campus courses, and workshops or symposia on special themes, can gradually build an interested constituency that recognises and appreciates the value of the information on alternatives.

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Animals and Alternatives in Biomedical Education in the Baltics

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Summary
The use of animals in biomedical education has decreased substantially during the last decade in Baltic countries. There are several reasons for this decrease: i) introduction of legislation regulating use and care of laboratory animals; ii) demand from students for the use of alternatives in teaching; iii) improvement of alternative methods and equipment; iv) feasibility of alternative teaching materials. Relatively high price of alternatives, lack of computers and modern A/V equipment at universities, difficulties of students with foreign languages are among the main factors limiting the increase in the use of alternatives.

Keywords: laboratory animals, alternatives, education

Introduction

Three countries – Estonia, Latvia and Lithuania – located along the East cost of the Baltic Sea share many common features in history, economy, and culture therefore quite often these countries are taken as an unit and called Baltic countries or Baltics instead of listing all three names. Laboratory animals have been used in research and education in the Baltics for a long time but there was no laboratory animal science at that time. Whereas well-known political and social changes in the 90ies strongly influenced the situation with laboratory animals – people became aware that a special scientific field such as laboratory animal science does exist and this area can not be neglected. During the last 15 years laboratory animal science was established and developed in Baltic countries – there was established Baltic Laboratory Animal Science Association (Balt-LASA), Lithuanian Laboratory Animal Science Association (Lith-LASA), the first textbook "Basics of laboratory animal science" was published in Lithuanian language, and a legal basis regulating use and maintenance of laboratory animals has been created (Ruksenas and Simkeviciene, 2003).

As long as laboratory animals are used in biomedical education the special emphasis on implementation of the principle of the 3Rs – replacement, reduction and refinement – has to be done. In this aspect changes in the field of laboratory animal science occurred in Baltic countries and are of high value.

Animals in biomedical education

Two main forms of teaching are used in biomedical sciences – lectures and practicals. With respect to the use of animals lectures are less interesting, because irrespective of the style of lectures – classical or modern – based on the latest audio/video tools, lectures usually do not accommodate use of live animals. Therefore the practicals are the main activity related to the use of laboratory animals.

From the point of view of methods used practicals can be subdivided into two opposite groups – based only on the use of animals or those using alternative methods, with the broad spectrum of practicals using both – animals and alternatives in between.

When we consider the use of animals in practicals few questions raise up: i) is it justifiable to use animals for this purpose? ii) what are the advantages and disadvantages of using animals?

Considering the first question there are very active and long-lasting discussions with solid arguments on both sides. As a result it is difficult to give a finite response to this question. Leaving aside ethical, moral issues one of the main questions helping to solve this problem could be – how does the use of animals in teaching comply with the objectives of teaching? After analysis of many curricula for biological and medical programs the clear answer emerges that in many cases objectives of programs could be achieved equally well without using animals. This is a serious argument for the reduction of the number of animals used in biomedical teaching.

However, for time being animals are not taken out completely from the teaching process and this poses a question about the advantages and disadvantages of this way of teaching over alternatives. The main and probably the only one advantage of using animals is "realism". This means that in performing animal-based experiments students are able to experience what a live animal is – what is it's body composition, temperature, heart beat, how does it breaths etc. In addition to this students can learn (at least to some extent) to handle animals and this in turn can change the attitude towards the animals.

Naturally, the use of animals has a number of disadvantages as well and finances are among the most important ones. In 2004 all three Baltic countries joined the European Union (EU) and this implies that these countries have to follow European legislation, including legal acts regulating the use and care of animals used in experiments. Taking into account the fact that just a little more than 10 years ago there were no regulations concerning laboratory animal science a substantial investment is required into the area of laboratory animals in order to conform to these regulations. Even if there is compliance with EU regulation, animals are "costly" experimental objects, because they are expensive themselves, maintenance is costly etc.

Another factor against the use of animals in education is a growing awareness of the society and its concern about animals. There are no extreme acts or manifestations against the animal users in the Baltics, as they are in some other European countries. But this issue is discussed in the media from time to time therefore it has to be taken into account. Finally, there is one more disadvantage of animal use in teaching – this is the well-known variability in biological data and to some extent the unpredictability of experimental outcome. Usually students have only limited time for practicals, whose results they have to report. On the other hand most of them are not experienced in animal experimentation. Altogether this leads to the possibility to fail during practicals which could have distressing effect on students.

Despite the discussed advantages and disadvantages, animals continue to be used in biomedical education and this raises another question – how many animals are used for this purpose, what species of animals are used? To answer this question some surveys have been performed. In 1996 the Lithuanian Laboratory Animal Science Association (Lith-LASA) performed a survey aiming to evaluate what number of laboratory animals and for what purposes they were used in Lithuania. It turned out that 21,000 of animals were used in total and 2,300 or 11% of these were used for teaching (Simkeviciene et. al., 1998). Figure 1 illustrates the distribution of the animals used by species. This distribution is rather typical – rodents are dominating over other species (comprise over 70% of all animals).

Another survey aimed to assess the use of laboratory animals in teaching has been performed in 2004. The numbers of animals were much lower if compared to the year 1996 – 8,000 animals in total and 1,360 or 17% were used for teaching. Figure 2 illustrates distribution of animals used for teaching by species. Distribution is very uneven – frogs comprise 80% of all animals used in teaching.

The comparison of data from 1996 and 2004 leads to a very clear conclusion – the number of animals used in total and in teaching particularly, were substantially reduced during the eight year period. However, the extent of this reduction is different – the total number of laboratory animals used declined much more – by 64% as compared to the reduction of number of animals used in teaching (by 41%). The reason for this difference goes back to the 90ies, when well-known political and economical changes in all three Baltic countries occurred. Among the numerous consequences of these events were serious changes in the area of science and education. In biomedical sciences this was expressed by the reduction of experiments performed using animals. As a result less animals were used. The coverage of education did not change so drastically therefore the reduction of the number of animals used in teaching is less pronounced.

The situation in Latvia and Estonia is similar to the one described in Lithuania, but the numbers of animals used for teaching are different: over 100 animals/year were used in Latvia and no animals were used in biomedical education in Estonia. The much lower number of animals used for teaching in Latvia can be explained by the smaller number of educational institutions delivering biomedical programs. The use of animals in biomedical education was stopped completely a few years ago in Estonia. Since that time these animals are only used for purposes other than teaching in this country.

Overall it can be concluded that the number of animals used in education is reduced – what are the reasons for that?

The introduction of legislation complying with EU legislation regulating the use and care of laboratory animals is among the main factors causing a reduction in the number of animals used. For example, there are the following acts of law related to laboratory animals in Lithuania: Law on Animals Care, Handling and Use, 1997; Veterinary Regulations on Breeding, Handling and Transportation of Laboratory Animals, 1998; Rules of Good Laboratory Practice, 1999; Rules on the Use of Laboratory Animals in Scientific Experiments, 1999. These legal acts impose requirements for both care and maintenance of laboratory animals and competence of personnel working with animals. To comply with legal requirements financial resources are required and this is the second limiting factor.

A rather new and unexpected factor in the Baltics is a changing attitude of students towards the use of animals. Students started to question the sense of using animals in practicals, possibilities to replace by alternatives etc. As a result in some Universities the use of animals for teaching has been stopped. Two more reasons are

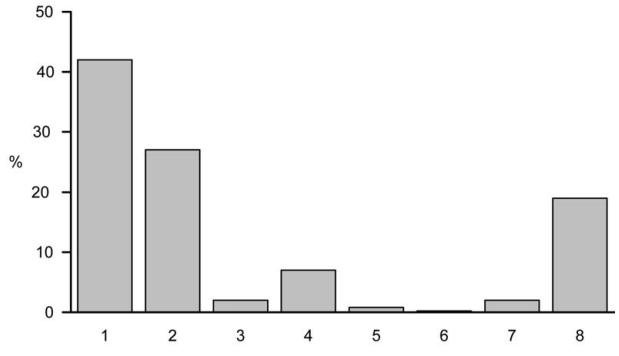

Fig. 1: Distribution by species of laboratory animals used in Lithuania in the year 1996. 1 – mice, 2 – rats, 3 – guinea pigs, 4 – rabbits, 5 – dogs, 6 – cats, 7 – birds, 8 – others.

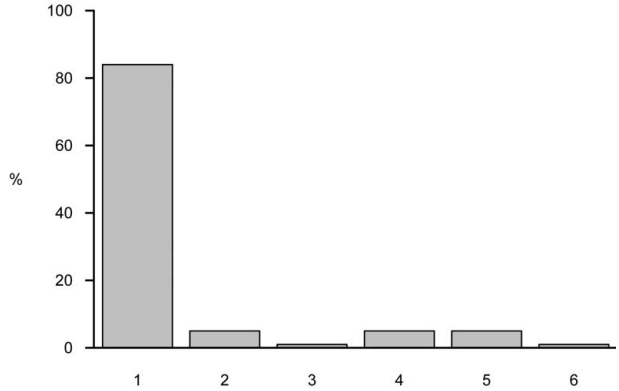

Fig. 2: Distribution by species of laboratory animals used for education in Lithuania in the year 2004. 1 – frogs, 2 – fishes, 3 – rats, 4 – mice, 5 – birds, 6 – rabbits.

related to alternatives: i) constantly increasing quality of alternatives makes them more and more suitable for replacement of animals; ii) the growing economy of Baltic countries and the reduction of prices of alternatives increase the feasibility of alternatives which in turn causes a reduction of the number of animals used.

Alternatives in biomedical education

Alternatives used in biomedical education in the Baltics can be grouped into three categories – computer-based simulations and self-experiments, models/mannequins and cell cultures. The most popular are computer-based alternatives and models, whereas cell cultures just started to be used. What are the advantages of using alternatives in education? First of all, it is the attractiveness of these methods, this especially concerns computer-based alternatives. This is defined by technological changes – the young generation is growing up in a computerised environment – already from kindergarden they are used to computers, the amount of information available via computers is growing every day. Therefore students easily and enthusiastically accept information provided via computer-based setups. As a result this increases their interest in performing practicals and finally taking in information. Flexibility is another factor contributing to increasing popularity of computer-based alternatives. Flexibility means that having even a basic setup for self-experimentation it is easy to configure it for performance of different experiments in a short time.

And last but not least – the economical factor. If animals are used in teaching they have to be kept in proper conditions, i.e. it is necessary to have well equipped animal facilities run by qualified specialists. And both – facility and specialists are very costly compared to alternatives, especially in the long perspective. Taking into account permanent shortage of finances at universities this is serious argument in favour of alternatives.

Alternatives are attractive, but they are not ideal, so what are the disadvantages of using alternatives? The first and main is what could be called "lack of life". This means that even the most sophisticated alternative can not simulate the feeling one experiences by handling a live animal. For example any of the best virtual models of rat or dog used for practicing purposes are far behind live animals in this respect. This aspect is of particular value for students planning to work with animals in their future. Another disadvantage could be described as the ratio between cost and quality of alternatives. The problem is that there are rather many alternatives available on the market and new ones are constantly appearing, most of them are not cheap, but quality is not always corresponding to price. This problem becomes much sharper in the case of limited financial resources. And finally there is one more problem related to alternatives – language. Usually alternatives are developed in the main European languages which still are literally "foreign" languages for some part of our students because their knowledge of foreign languages is far from sufficient. This restricts the use of computer-based alternatives, because students can not understand comments or texts presented and as a result they can not work independently, without the permanent guidance/translation of a teacher. Hopefully this is a short-lasting problem which fades out in the next few years.

Finally, there is one more factor limiting the use of computer-based alternatives – in general, institutions of higher education in the Baltics are lacking computers and modern audio/video equipment in lecture halls and laboratories. But the recent development of the economy allows to expect that in the close future this obstacle will disappear.

Overall, advantages of alternatives are taking over disadvantages and as a result they are increasingly used in the universities of Baltic countries. The most popular and successfully used computer-based alternatives are the following: "How your body works", "The dynamic human", "The virtual physiology lab", "SimNerv", "Human Physiology", "Laboratory simulation for Human Physiology Exercises".

Turning to commercial equipment used for self-experimentation the list is much shorter – the setup from "BIOPAC" is the most popular in Estonia and Lithuania. There is one more custom developed setup "ComLab" available in Lithuania. This setup was developed within the Leonardo da Vinci program a project financed in cooperation with numerous European partners. It turned out to be a very successful and efficient product compared to commercial setups by technical characteristics, at a fraction of their costs.

Conclusions

1. The number of laboratory animals used for teaching in Baltic countries is constantly decreasing.
2. Alternatives are successfully implemented in curricula of biomedical programs.
3. The principle of 3R's is being successfully implemented in Baltic countries.

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Educating Scientists on Alternatives. A Continuous Process

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Summary
Already from the start of their study in one of the biomedical sciences should students be made aware of the fact that animal experimentation is not always an obvious choice in biomedical research and that in many instances 3Rs models can and should be used. During laboratory classes, whenever possible, animal free teaching models should be considered and used. Also, when it is regarded essential to have the students work with experimental animals, they should be informed on the consequences and the concerns of the society.
Every scientist designing animal experiments should be qualified and aware of the 3Rs. The Laboratory Animal Science course, where Replacement, Reduction and Refinement (3Rs) are the main themes, offers this qualification.
Scientist should be continuously stimulated to consider the 3Rs when planning animal experiments. The animal ethics committee requests that 3Rs models have been considered before an animal experiment proposal is approved. This requirement and subsequent verification of an expert on alternatives ensures that scientists are (made) aware of possible 3Rs models in their field of interest.
Several journals now require a statement that the 3Rs have been considered and applied. Furthermore, several science organisations focus on the development, acceptance and information exchange of 3Rs models.
Education on 3Rs models cannot be a one-time event, but should be a continuous process that educates scientists also on new developments that can be applied to replace, reduce and refine animal experimentation.

Keywords: 3Rs, continuous education, attitude

Introduction

The consideration of replacement, reduction and refinement (3Rs) of animal experiments is nowadays regarded as essential, both for improvement of research and animal welfare. "The successful implementation of the Three Rs heavily depends upon the education and training of those persons involved in research and testing" (Balls et al., 1995). Education and training should be focussed on the existing and newest advancements, but also at the development of an attitude, including the consideration of 3Rs methods, towards experimental animals.

Education is a two-party process; it involves teaching and learning, with the aim to get a change in behaviour and sometimes attitude. In general, this is a "voluntary" process, which takes place during the education at schools and universities. Learning, and change of behaviour, can also be obtained by an interaction with the environment, which may not always be on a voluntary basis.

With regard to the implementation of the 3Rs, the most effective way to educate scientists is during their study in one of the biomedical sciences. Many developments, new techniques, strategies and legislation may contribute to the 3Rs. Therefore, regular updating or continuous education on recent developments of scientists should receive more attention in order to get a better implementation of the 3Rs.

This paper examines opportunities for continuous education.

Students

Although in some countries animal experiments are still performed at primary and high schools, in most cases students are exposed to these types of experiments for the first time during their study in one of the biomedical sciences.

These experiments are generally performed under controlled conditions and supervised by skilled teachers (see also Teachers). The study should reflect the common practice with regard to experimental animals: these are not always an obvious choice but should only be used when absolutely necessary to reach the learning goals. In all other cases, alternatives should be considered and used. It is the experience that, in general, students are very conscious and critical about animal experimentation during their study and are willing to listen to opinions of different stakeholders in order to form their own opinion and attitude. In addition, they have taken initiatives to inform each other on available alternatives in education (Jukes and Chiuia, 2003).

New scientists

EU Directive 86/609/EEC (Anon, 1986) states that only competent persons, having appropriate education and training shall perform animal experiments (Article 7.1 and Article 14). To harmonise the requirements on education and training at the European level, the Council of Europe (Anon, 1994) and FELASA (Wilson et al., 1995) have proposed more detailed

provisions for a course on laboratory animal science (LAS). After completion, scientists are qualified, but not yet experienced, to design and perform animal research. The LAS course should cover several aspects related to animal research, including ethics and alternatives. The total duration of the course should take at least 80 hours.

Particularly with regard to alternatives, the following subjects should be included in the course (Wilson et al., 1995):

- Defining alternatives;
- Replacement, reduction or refinement of animal use;
- Survey of alternatives;
- Possibilities and limitations of alternatives;
- Alternatives in education and research.

In several countries, the completion of FELASA-type courses is now compulsory to qualify for directing and designing animal experiments. To further contribute to the harmonisation of the laboratory animal science courses, FELASA has established an accreditation system (Nevalainen et al., 2002).

Established scientists

After the completion of the laboratory animal science course, scientists who qualify to perform animal research normally do not automatically get updated on the progress of 3Rs methods for the rest of their career. Still, these are the persons that design the experiments. Some of them have the attitude to consider the 3Rs when designing an experiment, others may loose their original dedication to the 3Rs, while a third group may still think that animal experiments are the only way. Though it may seem difficult to directly inform these scientists, there are several ways to continuously make them aware of the importance of considering the 3Rs when designing an experiment. Continuous education can be obtained through in-house training courses (Suzuki, 2005), or by external factors that will be explored in more detail below.

Animal ethics committees

In most European countries committees that evaluate proposed animal experiments have been established, either on a compulsory, by legislation, or voluntary basis. Their names may vary from Animal Experiments Committees to Institutional Animal Care and Use Committees, but are generally referred to as animal ethics committees (AEC). Some are nation-wide, others are linked to institutions. Although their affiliation and composition may be different, they evaluate protocols for proposed animal experiments and discuss whether all 3Rs have been considered. In several countries, an experiment can only start when there is a positive advice or decision from an AEC.

Although not established to educate scientists, these committees can have a strong influence on scientists. First of all, by carefully chosen questions in the application form, the scientists are forced to critically assess their proposed experiment in all aspects and to reconsider the planned use of animals. Most committees request information on whether 3Rs models (alternatives) have been considered and why these cannot be applied. The most difficult item to be assessed by the committee is whether the potential benefit of the experiments outweighs the potential suffering of the animal.

Some of the aspects that should also be assessed by the AEC and on which the scientists should give detailed information are the level of painful procedures and methods to relieve suffering, the applied statistics to use the minimum number of animals to reach significant results, and the humane endpoints that will be applied to minimise animal suffering.

Symposia

One way to inform scientists on recent developments in the 3Rs is by organising focussed meetings. Unfortunately, organising symposia on 3Rs methods generally attract people that are already aware of the importance of the 3Rs. The persons at whom the symposia are really aimed do often not participate in these events. To inform them on the recent developments on the 3Rs, they have to be met in their own environment. Many scientific meetings are organised each year on topics that involve animal experimentation. During these events, sessions, lectures and demonstrations could be organised to raise awareness on the 3Rs.

The European Resource Centre for Alternatives in higher education (eurca (de Boo et al., 2004)) is an organisation that actively promotes alternatives in education at various national and international scientific meetings, by demonstrating animal-free teaching methods and by giving presentations on these subjects.

At the national level the responsibility for this type of information exchange could be taken by national organisations on alternatives like: NCA (Nl), REMA (Sp), SSCT (Scandinavia), ZEBET (G) and NC3RS (UK).

At the international level these activities could be organised by ECVAM, IVTIP, ESTIV and ECOPA.

Journal policies

To most scientists it is crucial to have their results published in a respectable scientific journal. Journals have set quality criteria that manuscripts have to meet for publication. Generally, these criteria cover only scientific and format aspects. Most journals that publish research on animals require from authors that a statement be made on the ethical use of animals. This requirement should be clearly stated in the author's instructions. Furthermore, journal referees should be instructed to assess whether the 3Rs have been satisfactorily considered in the submitted manuscript.

The first activities in this area were taken during the second World Congress on Alternatives and Animal Use in the Life Sciences in 1996 (van Zutphen and Festing, 2000). Out of the 47 journals scanned, 25 had no policy with regard to 3Rs (Boisvert, 1997). Guidelines were prepared and sent to editorial boards of journals that publish animal-based research (FRAME, 1999; van Zutphen and Festing, 2000).

The aspects that should at least be dealt with are:

- Statement on the followed ethical procedures;
- Justification of species and number of animals;
- Clear description of applied methods to keep animal suffering to an absolute minimum.

During a recent scan, 12 of the 25 journals do still not require a statement from the submitting authors on the ethical aspects of animal research.

Policies science organisations

Most, if not all, countries have established national science organisations. These organisations have their own research institutes and strongly influence basic research performed in their countries. In Europe, the European Science Foundation (ESF) is the umbrella organisation for the national science organisations. Through ESF policies, and the subsequent endorsement by the member organisations, there can be a direct influence on research. In 2000, the ESF adopted the position paper on the "Use of animals in research". In this document, the ESF strongly supports the principles of the "Three Rs" (Foundation, 2000; van Zutphen, 2004). As a consequence, efforts ought to be taken to replace the use of live animals by non-animal alternatives, to use the minimum number of experimental animals that is required for obtaining meaningful results and to refine procedures, so that the level of pain and suffering is minimised.

The ESF postion paper gives a strong signal to its member organisations to apply 3Rs methods. Furthermore, science organisations that endorsed the position paper can now be held accountable for the consequences of this endorsement.

Policies funding organisations

Most research projects are funded by external resources. Funding organisations preferably fund high-quality research. They could play an important role in the implementation of the 3Rs by having submitted protocols involving animal experimentation evaluated by an AEC before taking them into consideration for funding. The consideration of the 3Rs should be one of the criteria for funding.

One of the biggest funding organisations, the European Commission (EC), also funding animal experiments, does require ethical evaluation of experiments (http://europa.eu.int/comm/research/conferences/2005/recs/index_en.htm).

The EC, as funding organisation, does require "that research activities would not contravene fundamental ethical principles". However, the ethical principles of the EC only refer to humans used in research, not to animals.

When funding scientific research involving animals, the EC should at least state that the principles laid down in Directive 86/609 EEC (Anon, 1986) and the European Convention (Anon, 1991) should be respected.

With the Seventh Framework Programme to be started in the near future, a clear policy of the EC when funding research programs that likely involve animals is required. This policy should at least require an ethical review of proposed animal experiments.

National and international regulations

In the end, the most powerful way to have the 3Rs implemented is by national regulations. At the European level, both EU and European convention have established guidelines on animal experimentation.

With regard to the 3Rs the European Directive states:

- An experiment shall not be performed if another scientifically satisfactory method of obtaining the results sought, not entailing the use of an animal, is reasonably and practically available (Art. 7 {2}).
- In a choice between experiments, those which use the minimum number of animals, cause the least pain, suffering, distress or lasting harm and which are most likely to provide satisfactory results shall be selected (Art. 7 {3}).

The EU directive 86/609/EEC (Anon, 1986) is currently being revised to meet current developments. It is of utmost importance that the EU countries and those that have ratified the European Convention implement the guidelines in the national legislation.

Moreover, to be effective, every country should also have an active inspectorate in place.

Teachers

Most scientists also have responsibilities in teaching students with regard to the implementation of the 3Rs. In the end, university teachers contribute to the students' attitudes toward experimental animals. By their lecturing and choice of laboratory classes, they demonstrate the common practice with regard to experimental animals and this way contribute to the development of the students' attitude.

Since most teachers are also scientists, their awareness of the 3Rs can be raised through most of the above-mentioned activities.

To contribute to the students' attitude the teachers should:

- Make sure that the learning goals are clearly defined;
- Choose the optimal learning model, dependent on careful analysis of the learning goals;
- Always use alternatives when possible;
- Keep invasive animal experiments to an absolute minimum;
- Give an introductory lecture in case animal experiments are regarded as the only way to teach the learning goals, to discuss current ethics with regard to animal use and substantiate why for this purpose experimental animals will be used;
- Offer additional non-animal alternatives;
- Contribute to the attitude formation of students with regard to experimental animals.

Conclusion

Informing (future) scientists on the 3Rs is not only a matter of educating students in biomedical sciences. Several activities may raise the awareness on the 3Rs of scientists who are not directly involved in the field of the 3Rs. These activities should receive more attention. Experience shows that "frapper toujours" i.e. confronting scientists with the 3Rs whenever possible, will eventually result in a change of behaviour and may result in a change of attitude. The responsibility of these initiatives is not only with national and European government, but also with national and international 3Rs organisations.

In the end, both science and research animals will benefit.

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The Use of Animals in Research, Testing and Teaching in New Zealand – A Legal Perspective

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Summary
Part 6 of the Animal Welfare Act 1999 (New Zealand) provides that a person (which by definition includes an institution) may only use an animal for the purposes of research, testing or teaching if the person is a code holder or is authorised by a code holder, the research, testing and teaching is approved by an institutional animal ethics committee and carried out in accordance with any conditions imposed by the AEC.
Legal provisions such as the Animal Welfare Act are not intended to be, nor should they be used, as an insurance policy. The concept of AECs approving animal use protocols "just in case" without careful inquiry is an abuse of legal process and may be unnecessarily time consuming and costly for the applicant, the code holder and the animal ethics committee. It is critical that all the legal requirements of the Act are met.
Part 6 of the Animal Welfare Act 1999 embodies the legal provisions of the 1984 amendment to the Animals Protection Act 1960 and practices that developed until 1998. Where Part 6 of the Act does not apply to a particular animal use Part 1 will apply. This paper focuses on determining which part of the Act applies to specific animal use in research, testing and teaching and provides a guide to assist AECs in determining when approval under Part 6 of the Act is required.

Keywords: legislation, manipulation, teaching, animal use

Introduction

On 1 January 2000 the Animal Welfare Act 1999 (New Zealand) commenced. Part 6 of the Act provides the framework for regulating the use of animals in research, testing and teaching. This Part of the Act embodies the legal provisions of the 1984 amendment to the Animals Protection Act 1960 together with practices that developed until 1998 when the Animal Welfare Bill (No. 2) was drafted. Where Part 6 of the Act does not apply to a particular animal use in research, testing and teaching, Part 1 applies.

This paper is based in the principles of legal interpretation, it is not a scientific paper, nor is it based on an ethical analysis. In applying the tenets of legal interpretation to the use of animals in research, testing and teaching, the provisions of the Animal Welfare Act 1999 must be considered as a whole as well as the purposes of Part 6.

Part 1 establishes a duty of care for animals. The owner and every person in charge of an animal must provide for its physical, health and behavioural needs.[1] Person in charge, "in relation to an animal, includes a person who has that animal in that person's possession or custody, or under that person's care, control or supervision."[2]

Part 6 of the Act deals exclusively with animals used in research, testing and teaching. While this Part has sometimes been regarded as a "stand alone" Part, it must still be read in the context of the whole Act. Before an animal can be said to be "used" in research, testing and teaching there must be a "manipulation". The definition of research, testing and teaching is implicit in that the term means:

(a) Any work (being investigative work or experimental work or diagnostic work or toxicity testing work or potency testing work) that involves the manipulation of any animal; or
(b) Any work that
  (i) Is carried out for the purpose of producing antisera or other biological products; and
  (ii) Involves the manipulation of any animal; or
(c) Any teaching that involves the manipulation of any animal.[3]

In each instance the work or teaching is qualified as involving a manipulation, which means interfering with the normal physiological, behavioural, or anatomical integrity of the animal by deliberately–

(a) Subjecting it to a procedure which is unusual or abnormal when compared with that to which animals of that type would be subjected under normal management or practice and which involves–
  (i) Exposing the animal to any parasite, micro-organism, drug, chemical, biological product, radiation, electrical stimulation, or environmental condition; or
  (ii) Enforced activity, restraint, nutrition, or surgical intervention; or
(b) Depriving the animal of usual care.[4]

Legislation is not intended to be used as an insurance policy on a "just in case" basis. The practice of treating all animal use in research, testing and teaching as a manipulation without careful inquiry is not only an abuse of process, i.e. using regular legal process for a purpose not contemplated in law, it involves

[1] Animal Welfare Act 1999, section 10
[2] section 2
[3] section 5
[4] section 3

unnecessary time and cost to the researcher, tester or teacher, to the institutional animal ethics committee, to the code holder, to the Ministry of Agriculture and Forestry in collating statistical records, and time and cost of reviews. The Animal Welfare Act 1999 provides a legal framework for the use of animals in research, testing and teaching.

Legal interpretation is a discipline that seeks to interpret the words and terms used by Parliament and examines what was intended by Parliament. While it is not an exact discipline it is governed by legal precedent and statute. Shortly before the Animal Welfare Act 1999 was passed the Interpretation Act 1999 commenced. The method to be applied to legal interpretation is unequivocal:

Ascertaining meaning of legislation

(1) The meaning of an enactment must be ascertained from its text and in the light of its purpose.
(2) The matters that may be considered in ascertaining the meaning of an enactment include the indications provided in the enactment.
(3) Examples of those indications are preambles, the analysis, a table of contents, headings to Parts and sections, marginal notes, diagrams, graphics, examples and explanatory material, and the organisation and format of the enactment.[5]

Part 6 states its purposes in section 80 where it is set out that its principal purpose is to ensure that, *inter alia*, the use of animals in research, testing and teaching is confined to cases where there is good reason to believe the findings and benefits will enhance understanding of human beings, animals, or ecosystems or the maintenance and protection of human or animal health or welfare.[6]

A further purpose includes ensuring that animals used in research, testing and teaching have their physical, health and behavioural needs met. More specifically, a purpose of this Part can be found in the expression of the Three Rs.

In 1959 Russell and Birch first published *The Principles of Humane Experimental Technique*[7]. The authors considered "the ways in which inhumanity can be and is being diminished or removed" in experimental technique by–

Replacement – the substitution for conscious living higher animals of insentient material

Reduction – reduction in the numbers of animals being used to obtain information of a given amount and precision

Refinement – any decrease in the incidence or severity of inhumane procedures applied to those animals which still have to be used.[8]

The Act echoes these principles in that a further purpose of Part 6 is –

(b) To promote efforts –

(i) To reduce the number of animals used in research, testing, and teaching to the minimum necessary:

(ii) To refine techniques used in any research, testing, and teaching so that the harm caused to the animals is minimised and the benefits are maximised:

(iii) To replace animals as subjects for research, and testing by substituting, where appropriate, non-sentient or non-living alternatives:

(iv) To replace the use of animals in teaching by substituting for animals, where appropriate, non-sentient or non-living alternatives or by imparting the information in another way.[9,10]

Part 6 of the Act uses the words "use" and "manipulation" interchangeably. The heading of Part 6 is the "Use of Animals in Research, Testing and Teaching". Using the rule of interpretation of the Interpretation Act 1999, the heading clearly means that in Part 6 the term "use" means "manipulation" as "manipulation" is implicit in the definition of "research, testing and teaching".

The term "use" is not defined by the Act, but using the *noscitura a sociis* rule, "a word is known by its context" or "a word may be known by the company it keeps", the term "use" must take its meaning from its context. In Part 6 it can only mean "manipulation" rather than the wider common meaning of "the act of using a thing for a purpose … utilisation or employment for or with some aim or purpose".[11] A group of animals used to explain anatomy or physiology without physical intrusion into their bodies is a use of animals for the purpose of teaching – but it is not necessarily a manipulation. Similarly other benign uses of animals in teaching where there may be some physical handling may not be a manipulation, e.g. teaching veterinary nurses bandaging techniques uses animals in teaching but is hardly a manipulation.

While the term "project"[12] does not refer to research, testing and teaching, nor to animals, the term still needs to be read in the context that the whole of Part 6 is concerned with research, testing and teaching, so it is patently obvious that it does relate to animals. It would be absurd to say that because the definition of a "project" means *inter alia* "any experiment or series of related experiments, forming a discrete piece of research" means that a physics or engineering experiment requires animal ethics committee approval when clearly the term does not require that.

Despite the practice that all use of live animals in a research, testing or teaching project must gain approval from an animal ethics committee that is not the case in all circumstances of animal use, particularly when it is a benign use for teaching purposes. While by far the majority of animal use will require institutional animal ethics committee approval it is only when a number of interconnected elements are present that the use of an animal becomes a manipulation and thus comes within the scope of Part 6 of the Act. These elements can be summarised as:

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5 Interpretation Act 1999 section 5

6 Animals Protection Act 1960 section 80 (1)

7 Russell, W. M. S. and Burch, R. L. (1992). *The Principles of Humane Experimental Technique*, special edition. Universities Federation of for Animal Welfare, Potters Barr.

8 Russell & Burch, 64

9 section 80 (2) (b)

10 section 5 (3)

11 *The Shorter Oxford Dictionary On Historical Principles* (1973). Oxford: Clarendon Press, 2441.

12 section 2

- The species of animal and the living state of that animal
- The purpose for which the animal is used
- Whether or not the animal is manipulated.

Before considering the first step there is a presumption that the applicant has considered non-animal alternatives to the proposal in the spirit of the Three Rs and that this prior consideration can be demonstrated to the institutional animal ethics committee.

The species of animal

Only animals as defined by the Act are subject to Part 6. The Animal Welfare Act 1999 provides that –

"Animal"–

(a) Means any live member of the animal kingdom that is –
  (i) A mammal; or
  (ii) A bird; or
  (iii) A reptile; or
  (iv) An amphibian; or
  (v) A fish (bony or cartilaginous); or
  (vi) Any octopus, squid, crab, lobster, or crayfish (including freshwater crayfish); or
  (vii) Any other member of the animal kingdom which is declared from time to time by the Governor-General, by Order in Council, to be an animal for the purposes of this Act; and

(b) Includes any mammalian foetus, or any avian or reptilian pre-hatched young, that is in the last half of its period of gestation or development; and

(c) Includes any marsupial pouch young; but

(d) Does not include –
  (i) A human being; or
  (ii) Except as provided in paragraph (b) or paragraph (c) of this definition, any animal in the pre-natal, pre-hatched, larval, or other such developmental stage:[13]

The Act applies to all vertebrates and some invertebrates; it applies to the foetus of any mammal or the pre-hatched young of any bird or reptile, provided it is in the second half of development; humans are excluded.

The animal needs to be living, in other words animal tissue or dead animals do not come within the scope of Part 6 of the Act but the method of obtaining the dead animal may still come within the scope of Part 1.

The purpose for which the animal is used

The next step is to determine the purpose for which the animal is being used. Is it to be used for research, testing or teaching? Research is defined as:

(a) Any work (being investigative work or experimental work or diagnostic work or toxicity testing work or potency testing work) that involves the manipulation of any animal.[14]

Testing is defined as:

(b) Any work that –
  (i) Is carried out for the purpose of producing antisera or other biological products; and
  (ii) Involves the manipulation of any animal.[15]

Teaching is defined as:

(c) Any teaching that involves the manipulation of any animal.[16]

This last definition still does not define "teaching", which can best be described as "to show by way of information or instruction; to impart or convey knowledge of; to give instruction or lesson in (a subject)."[17] There should be some structure to the imparting of information before it can be said to be teaching, such as in a class or tutorial group. It can hardly be said that a farmer showing a farm hand the correct method of milking a cow is "teaching" in the context of the Act.

Whether or not the animal is manipulated

There are two conditions that need to be considered before it can be said that an animal is "manipulated".

First, there must be some interference with the normal physiological, behavioural or anatomical integrity of the animal by deliberately subjecting it to a procedure that is unusual or abnormal when compared to that which animals of that type would be subjected under normal management or practice and which involves exposing the animal to any –

- Parasite
- Micro-organism
- Drug
- Chemical
- Biological product
- Radiation
- Electrical stimulation
- Environmental condition
- Or enforced activity, restraint, nutrition or surgical intervention.[18]

Alternatively, there must be some interference with the normal physiological, behavioural or anatomical integrity of the animal by deliberately depriving the animal of usual care.

"Interference" is not defined by the Act but "to interfere" can be understood to mean "to obstruct a process, to interpose so as to affect some action, to meddle with."[19]

One of the Three Rs reflected in section 80 (2) (b) is–

(ii) To refine techniques used in any research, testing, and teaching so that the harm caused to the animals is minimised and the benefits are maximised:

Some assistance can be gained from clause (ii) where it refers to potential "harm caused to animals". One test as to whether a particular interference can be said to be interference in the physical, behavioural or anatomical integrity of an animal is to determine whether or not the animal will be harmed. If harm is a likelihood then clearly there is a manipulation. The converse implies that if the use will cause no harm to the animal, or there is no real likelihood that harm will be caused, then it may not be a manipulation at all. But each project needs to be assessed by

[13] section 2
[14] section 5(1)(a)
[15] section 5(1)(b)
[16] section 5(1)(c)
[17] *Shorter Oxford Dictionary,* 2550
[18] section 3 (1) (a)
[19] *Shorter Oxford Dictionary,* 1094
[20] section 4

the institutional animal ethics committee on a case-by-case basis before it can be said that there is no manipulation. Where there is no manipulation Part 6 will not apply.

Where a particular use of an animal has been determined not to be a manipulation under Part 6, the owner of the animal, usually the institution, and the person in charge of the animal, each have a legal responsibility under Part 1 to ensure that the physical, health and behavioural needs of the animal are met.[21] In particular the provision of –

(a) Proper and sufficient food and water;
(b) Adequate shelter
(c) Opportunity to display normal patterns of behaviour:
(d) Physical handling in a manner which minimises the likelihood of unreasonable or unnecessary pain and distress:
(e) Protection from, and rapid diagnosis of, any significant injury or disease, –

being a need which, in each case, is appropriate to the species, environment, and circumstances of the animal.[22]

As a further aid the applicant must be able to express the intent of the project for it is the deliberate subjection of the animal to physiological, behavioural, or anatomical intervention that determines whether or not a use is a manipulation. For example, in teaching a veterinary student how to intubate an animal there is a clear intention to submit the animal to a teaching project that will interfere with the physical integrity of the animal by surgical intervention and therefore it is a manipulation. On the other hand the same student may be taught the correct way to pick up and hold a cat but in the process drops it. There is no intention in the project to drop the animal so it is not a manipulation, which must involve "deliberately subjecting it to a procedure."[23] Nonetheless, there will be some other provision of the Act, such as the requirement to ensure physical handling in a manner which minimises the likelihood of unreasonable or unnecessary pain or distress,[24] which would apply to the negligent handling of an animal. Similarly, if a group of laboratory animals was deprived of nutrients as part of an experimental project, clearly that is a manipulation. But if laboratory animals were deprived of food due to negligence, it is not a manipulation but a failure to provide for the physical, health and behavioural needs of the animals.

The test then as to whether or not an animal is being manipulated is in the analysis of each element of manipulation. Unless all elements are present it is not a manipulation. In summary, before it can be said that there is a manipulation there must first be an intention to use an animal for research, testing or teaching, and secondly there must be an interference with the normal physiological, behavioural or anatomical integrity of the animal by deliberately subjecting it to a procedure that is unusual or abnormal, or by deliberately depriving it of its usual care. If any one element is missing the animal use is not a manipulation.

Exceptions

An animal is not deemed to be used for the purposes of research, testing or teaching, and therefore no code of ethical conduct is required, where an animal is in the immediate care of a veterinarian and the veterinarian believes on reasonable grounds that the manipulation will not cause the animal unreasonable or unnecessary pain or distress, or lasting harm; and the manipulation is–

(i) For clinical purposes in order to diagnose any disease in the animal or any associated animal; or
(ii) For clinical purposes in order to assess the effectiveness of a proposed treatment regime for the animal or any associated animal; or
(iii) For the purposes of assessing the characteristics of the animal with a view to maximising the productivity of the animal or any associated animal.[25]

There are some specific exclusions from the definition of "manipulation":

(a) Any therapy or prophylaxis necessary or desirable for the welfare of an animal; or
(b) The killing of an animal by the owner or person in charge as the end point of research, testing, or teaching if the animal is killed in such a manner that the animal does not suffer unreasonable or unnecessary pain or distress; or
(c) The killing of an animal in order to undertake research, testing, or teaching on the dead animal or on pre-natal or developmental tissue of the animal if the animal is killed in such a manner that the animal does not suffer unreasonable or unnecessary pain or distress; or
(d) The hunting or killing of any animal in a wild state by a method that is not an experimental method.[27]

Where an animal is killed as the end point of research, testing and teaching, the act of killing is excluded from the provisions of Part 6 provided the animal is killed in a manner that does not inflict unreasonable or unnecessary pain or distress.[28] Any prior treatment or handling of the animal so killed that constitutes a manipulation continues to be covered by Part 6 and therefore does require a code of ethical conduct and the project does not need to be approved by an institutional animal ethics committee.

Further, an animal is not deemed to be used for the purposes of research, testing or teaching where the manipulation involves routine breeding, marking, capturing, translocation trapping, weighing or taking measurements of animals or work carried out with the principal objective of certain functions under the Conservation Act 1987 or the Fisheries Act 1996.[29]

Recording statistics

Statistics in the Annual Report of the National Animal Ethics Advisory Committee (NAEAC) for 2003 record that in that year 320,911 animals were manipulated in research, testing and teaching, and a range of tables that follow uses the term "use" or

[21] section 10
[22] section 4
[23] section 3 (1)
[24] section 4
[25] section 5 (2) (b)
[26] section 5 (3)
[27] section 3 (2)
[28] section 3 (2) (b)
[29] section 5 (3)

"usage". It is noted that the published statistics record "animal usage" rather than "animal manipulations". It is possible that these statistics have been overstated by the reporting of "animal usage" that was not by definition "manipulation". Regulation 5 of the Animal Welfare (Records and Statistics) Regulations 1999 requires the reporting of information recorded under regulation 4 by requiring every code holder to record information relevant to animals manipulated.

While section 183 enables regulations requiring every code holder to keep information in relation to inter alia the numbers and species of animals used , the word "used" must be interpreted by the noscitura a sociis rule, and also by the definition of "code holder"[32] as being a person carrying out research, testing and teaching, which by definition requires a manipulation to be present. In this context the term "used" is incapable of meaning "any use" whether or not there is a manipulation. There is no requirement to record or report information relevant to animals used where there was no manipulation. Clearly the statistics are intended to refer to manipulations.

The 2003 statistics include 78,520 (24.4%) that were reported as "no suffering" and 195,451 (60.1%) were reported as "little suffering".[33] – some, particularly in the "no suffering" class, may well have fallen short of the threshold of being manipulated. If that were the case the statistics may be over-reported. Unless each institutional animal ethics committee is carefully inquiring into the precise "use" of animals in each application, "uses" that do not meet the threshold of "manipulation" may be inadvertently included in the reported statistics.

How the reported use of animals is classified in terms of its impact is dealt with in depth by a contemporary paper by Williams, Mellor and Marbrook presented in the 5th Congress session *Ethical Review – Good Practice* and Outputs.[34]

Conclusion

Institutional animal ethics committees are charged with approving or not approving projects that use animals in research, testing and teaching.[35] Institutional animal ethics committees should also, as part of that process, consider carefully whether an application under consideration does in fact propose to manipulate any animal. By applying these guidelines it may well be that many uses of animals in research, testing or teaching will not be classed as manipulations at all and, thus, institutional animal ethics committees will be saved the task of approving and monitoring projects and recording statistics relating to projects for uses that the Animal Welfare Act 1999 does not intend to come within the scope of Part 6.

However, it is not intended that this paper be used as a convenient legal loophole for researchers, testers and teachers. For the protection of the integrity of both the applicant and the institute it is strongly recommended that where an animal is to be used in research, testing or teaching, and where no manipulation to the animal is apparent, the institutional animal ethics committee should make careful inquiry into the nature of the application and its intent and record its decision as to whether or not the proposed use is a manipulation. Should it be determined that the application does not involve a manipulation of an animal, the owner of the animal (the institution) and every person in charge of the animal still have a legal duty to ensure that the physical, health and behavioural needs of the animals are protected.[36]

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[30] Annual Report of the National Animal Ethics Advisory Committee, 2003

[31] section 183 (1) (c)

[32] section 183 (2)

[33] Annual Report of the National Animal Ethics Advisory Committee, 2003

[34] Williams, V., Mellor, D. and Marbrook J. (2005). *Revision of a Scale for Assessing the Severity of Live Animal Manipulations*

[35] section 99

[36] section 10