



Responsibilities – The 4th R



**Proceedings of the ANZCCART
Conference held in Canberra,
Australia 3rd – 5th September 2006**

ANZCCART 2008

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Contents

	Page
Programme	1
Numbers of animals in teaching – how far have we come and where are we going? - Rosemary Einstein	4
Traditional versus Computer-based Dissections in enhancing learning in a tertiary setting: a student perspective - Mary Peat	5
Integration of alternatives to animals in practical class teaching in Pharmacology - Jane Ward	15
Ethical and effective acquisition of knowledge and skills in life science education and training – Nick Jukes	19
The responsibilities that flow from The Australian code of practice for the care and use of animals for scientific purposes - 7 th edition. – Elizabeth Grant	33
The use of live animals for teaching purposes. – Laura Parry	38
The Australian Animal Welfare Strategy – Allan Sheridan	39
Address on Regulation of the Use of Animals for Scientific Purposes - John Braithwaite	40
Knowing One's Rs from an Elbow: A Chair's View of the 4 th R – Richard Herr	41
The 3R's – a performance assessment from a Category C perspective – Robyn Sullivan	45
Responsibilities of Institutions and the Animal Welfare Officer – Denise Noonan	46
Education in Animal Ethics – Our ultimate responsibility – Margaret Rose	51
Responsibility and Accountability – ArieH Bomzon	52
Training of Animal Users in Research Institutions: a practical review of individual and institutional responsibilities - John Schofield	59
Responsibilities of NSW schools using animals - Sally Bannerman	68

The Role of Government in Animal Based Research and Teaching – Deb Kelly	73
Responsibility - how do you spell that? Applying ethics to animals – Erich von Dietze	79
Developing an Animal Ethics Database system for a National Research Company – Grant Shackell	87
Development of responsible recreational fishing and fish handling practices – Howard Gill	96
The Implications of the Principle of Equal Consideration for Animal Research – Rupert McCallum	109
The Role of the Monitoring Officer as Part of a Quality Assurance Program - Andrea McFarland	116
Humane Teaching Methods Demonstrate Efficacy in Veterinary Education – Andrew Knight	119
Electrode-Tissue Interface: Development and findings of an <i>in vitro</i> model – Carrie Newbold	150
Replacement of the Use of Animals in Inhalation Toxicology - Amanda Hayes	155
POSTER ABSTRACTS	164
The Development and Implementation of Guidelines for the Housing and Care of Laboratory Animals – Peter Johnson	165
Animal Ethics Infolink: A Web-Based Information Resource – Lynette Chave	166
A Progressive Policy on Animal Use and Alternatives in Life Science Education and Training - Nick Jukes	167
Access to and training in alternatives to facilitate the implementation of best practice education - Nick Jukes	168
Veterinary education based on humane alternatives - Siri Martinsen	169
Animal carcinogenicity studies: implications for the REACH system - Andrew Knight	170
Chimpanzee experimentation: the necessity of a ban - Andrew Knight	171

2006 ANZCCART Conference

Rydges Lakeside Hotel, London Circuit, Canberra

3rd – 5th September 2006

Programme

Sunday 3rd September:

12.30pm: Registration Desk Opens

2.00pm: Welcoming Address: Prof Warwick Anderson (CEO, NHMRC)

2.15pm Rosemarie Einstein (University of Sydney) Numbers of animals in teaching: How far have we come and where are we going?

2.45pm Mary Peat (University of Sydney) Use of traditional versus computer – based dissections in enhancing learning in the tertiary setting.

3.15pm Afternoon Tea

3.45pm Jane Ward (University of Melbourne) Integration of alternatives to animals in practical class teaching in pharmacology

4.15pm Nick Jukes (InterNICHE, UK.) Ethical and effective acquisition of knowledge and skills.

5.00pm Group / Panel Discussion:
How can an AEC effectively address the issue of “Replacement” in research and teaching proposals?
Should we count the number of animals “saved” by the use of replacements and if so, how?

5.30pm Light Refreshments & Further Discussions (Lake Burley Griffin Room)

Monday 4th September: Responsibilities – The 4th R (Sponsored by NHMRC)

- 8.30am Elizabeth Grant (NHMRC Animal Welfare Committee) Responsibilities that flow from the Australian Code of Practice for the care and use of animals for scientific purposes 7th edition.
- 9.00am Laura Parry (University of Melbourne) The use of live animals for teaching purposes.
- 9.30am Allan Sheridan (DAFF) Responsibilities of the Federal Government: The Australian Animal Welfare Strategy (AAWS) and what it means for the use of animals in research & teaching.
- 10.00am John Braithwaite (ANU) The relationship between government agencies and institutions: Framing legislation based on the COP.
- 10.30am Morning Tea**
- 11.00am Richard Herr (Chairman UTAS AEC) Knowing one's Rs from an elbow: A chair's view of the 4th R.
- 11.30am Robyn Sullivan Is the AEC System meeting its responsibilities?
- 12.00 noon Denise Noonan (AWO, University of Adelaide) Responsibilities of institutions and the Animal Welfare Officer.
- 1.00pm Lunch**
- 2.00pm Arieh Bomzon (National Animal Ethics Committee of Israel) Responsibility and accountability.
- 2.30pm Margaret Rose (Prince of Wales Clinical School) Education in Animal Ethics - our ultimate responsibility.
- 3.00pm John Schofield (University of Otago, NZ.) Training of Animal Users in Research Institutions: a practical review of individual and institutional responsibilities.
- 3.30pm Afternoon Tea**
- 4.00pm Sally Bannerman (Department of Education and Training NSW) Responsibilities of NSW schools using animals.
- 4.30pm Deb Kelly (Department of Environment and Heritage, SA) The role of government in animal based research and teaching.
- 5.00pm Panel Discussion
- 5.30pm End of Session

7.00pm for 7.30pm - 11.30pm Conference Dinner (First Floor, Rydges Lakeside)

Tuesday 5th September: Proffered Abstracts and Student Presentations

- 9.00am Erich von Dietze (Murdoch University) Responsibility – How do you spell that? Applying ethics to animals.
- 9.30am Grant Shackell (AgResearch Ltd. NZ) Developing an animal ethics database system for a national research company
- 10.00am Howard Gill (Murdoch University) Development of responsible recreational fishing and fish handling practices.
- 10.30am Rupert McCallum (University of New South Wales) The implications of the principle of equal consideration for animal research
- 10.45am Andrea McFarland (Garvan Institute) The role of the monitoring officer as part of a quality assurance program
- 11.00am *Morning Tea***
- 11.30am Andrew Knight (Animal Consultants International) Humane teaching methods demonstrate efficiency in veterinary education. Under review.
- 12.00 noon Finalist in the 2006 Australian Museum Eureka Prize competition: Carrie Newbold (CRC for Cochlear Implant and Hear Aid Innovation). Development of an *in vitro* model for investigating changes at the electrode – tissue interface of bionic ears.
- 12.30pm Winners of the 2006 Australian Museum Eureka Prize competition: Amanda Hayes, Shahnaz Bakland and Chris Winder (School of Safety Science, University of New South Wales). An *in vitro* exposure method for toxicity assessment of air contaminants.
- 1.00pm **Conference Close.****

Numbers of animals in teaching – how far have we come and where are we going?

Rosemary Einstein
The University of Sydney

In order to answer the first question. “how far have we come?”, we need to know “***where did we start?***”. In the past, animals were routinely regarded as the most effective way of demonstrating biological phenomena. In many scientific disciplines, undergraduates used live animals in practical classes and the animal numbers used were very high.

The next logical question is “***why change?***”

A number of factors combined to change the way the use of animals in teaching was regarded. There was pressure from students, their teachers and the wider community to limit the use of animals in teaching. Improvements in technology, initially videotapes and, more recently, sophisticated interactive computer programs, offered high quality teaching packages as alternatives to animals for teaching. The financial burden of animal-based practical classes also became a very important consideration. As both the numbers of students and the costs of animals increased, at a time that funding to departments was being reduced, the use of alternatives became very much more attractive.

So, “***how far have we come?***” At the University of Sydney, the total number of animals used in practical teaching in 1995 was approximately 5% of the number in 1970 and the decline has continued. For example, in the case of mice, while about 55000 were used in teaching at the University of Sydney in the early 1970s, we currently use about 500 per year (<1%) and student numbers have more than doubled over that time.

The final question is “***Where are we going?***” or “is there a need for animals to continue to be used in teaching?”

Financial and other considerations still apply – more so than ever with increased student numbers and ever-shrinking funds. However, recent advances in molecular biology have had a dramatic impact on the nature of research in biomedical sciences and there is no doubt that theoretical knowledge and practical skills in this area have become important components of the education of graduates in these disciplines. As a result, in some areas, there has been a change of focus, away from whole animal experimentation.

I think there still are places where animal-based experiments are a necessary part of education and the Code of Practice recognizes this – after careful consideration of the educational objectives and demonstration that using animals is the only way to achieve these objectives.

While knowledge of processes at a molecular or cellular level is valuable, the whole animal is so much more complex than the sum of its parts that, at this time, only experimentation in the whole animal can provide definitive answers. As long as this situation pertains (and a major change is not yet in sight), there will be a real need for individuals with skills to perform such experiments. Employers might not expect recent graduates to have mastered a wide range of practical skills in animal-based experiments, they do, however, have a right to expect that applicants for research positions will have had sufficient exposure to such procedures to establish whether they are physically, intellectually and emotionally prepared to embark on a career which involves this component of biological research. In the UK, the pharmaceutical industry has become so desperate for graduates who have any training in *in vivo* techniques that a funding partnership between Research Councils, University Funders and the UK Pharma Industry has awarded more than £11million to four research centres to regenerate training in animal research skills for undergraduate, postgraduate and postdoctoral scientists.

Last, but by no means least, it is generally assumed that the “known facts” students see demonstrated in experiments on animals can be described in text books. However, the rewarding sense of discovery, stimulation and excitement of an experiment provides a unique opportunity to really engage and educate the students. Unfortunately, it is difficult measure the outcomes of enthusiasm and inspiration which are more abstract, but, in educational terms, of the highest value.

Traditional versus Computer-based Dissections in enhancing learning in a tertiary setting: a student perspective

Sue Franklin, Mary Peat and Alison Lewis

School of Biological Sciences
The University of Sydney, Australia

Abstract

This paper describes a study investigating both the use and usefulness of laboratory dissections and computer-based dissections, in a tertiary, first-year human biology course. In addition student attitudes to dissection were investigated. Data were collected from enrolled students using quantitative and qualitative survey instruments. Students were questioned about their usage and perceptions of the usefulness of the resources provided, and their attitudes towards the use of dissections for learning in human biology.

The real dissection was used as a learning resource by 80% of the student cohort while only 15% used the computer-based dissection material. In addition 5% of students reported that they did not use either the real dissection material or the computer-based dissection. Of those students who did use the computer-based dissection, two thirds of them found it useful for learning both structure and function of body systems. Of those students who used the real dissection, 72% found it useful for learning structure but only 62% found that it helped in learning function. Of the entire cohort surveyed, 90% agreed that biology students should dissect an animal to help learn about anatomy. These outcomes reinforce the need to offer a variety of learning experiences that target different styles of learning.

Introduction

In first year biology at The University of Sydney students dissect a variety of animals and animal parts, both invertebrate and vertebrate, in order to facilitate understanding of structure and function. The source of the animals is clearly explained to the students. In particular, students in the human biology course dissect cat cadavers, a range of mammalian body parts from the abattoir (eg. sheep heart-lung plucks, shanks and kidneys, and ox eyes) for observation of structure. Cane toads are used to demonstrate nerve conduction. It is considered that dissection enhances the knowledge and understanding of internal organs, their relationships and their functioning, and that maximum learning is most likely to be achieved by maximising the personal experience of the reality being taught (Wheeler, 1993).

The use of dissections, however, especially of mammals, within biology courses, is becoming more controversial, leading teachers and students to reconsider the value of these procedures in the classroom. In fact a growing number of general biology courses in UK universities have abandoned the use of dissection in the practical part of the course, partially in response to "animal rights" issues (Heron, 1992). Typical alternatives to using animals for dissection are 3D models, slide-tapes, videotapes of experiments, self experimentation, videodiscs and computer simulations (Langley, 1991; Strauss and Kinzie, 1991; Quentin-Baxter and Dewhurst, 1992; Kinzie et al, 1993). Akpan (2001) has extensively reviewed issues associated with using computer simulation in biology teaching. Based on our experience over the

past ten years, these options appear to fulfil the majority of objectives required for our courses. Most biology students do not require skills in instrument use, such as those used for dissection, for their future employment, and if necessary these can be obtained with non-animal materials (Langley, 1991). It has also been shown that when students offered an alternative to rat dissection using models and charts, are compared to students who completed the dissection, there was no significant difference in their written examination results, in particular for those questions based on the dissection (Downie and Meadows, 1995). However, the examinations tested factual knowledge not practical skills. Their study also found that although the dissection was regarded as one of the most interesting practicals in the course, it also achieved the highest disapproval rating because it involved the taking of life. Similar studies have found that interactive videodisc simulation was as effective as an actual dissection of a frog in promoting student learning (Kinzie et al. 1993). It was also shown that students using the simulation as preparation performed a subsequent dissection more effectively than students receiving no preparation (Kinzie et al., 1993). Predavec (2001) found that first year undergraduate biology students, using a computer-based rat dissection, gained higher marks than those using the real dissection, including those questions that tested knowledge of structures as well as relating their functions and were also better able to identify structures in real dissected rats. Predavec suggests, as possible reasons for the increase in marks, the flexibility of time using the computer-based instruction, the ability to see structures clearly and the absence of smell (Predavec, 2001).

At The University of Sydney, over the last ten years an increasing awareness of animal rights issues and ethnic/cultural sensitivities to whole animal and animal parts dissections has led to changes in the structure of our practical classes. In particular, the amount of animal

material necessary has been reduced due to the introduction of group work and the replacement of some dissections by computer-based material. Many of our students no longer need the hands-on experience of performing animal dissection, particularly as the emphasis is on understanding the functional anatomy of the animal rather than manual dissection skills. We have also developed several computer-based simulations, which allow students to investigate mammalian structure and function as a supplement to, or as an alternative to animal experiments and dissections. Predavec (2001) suggests that computer-based alternatives to dissection have a number of potential advantages, including the flexibility to allow students to work at their own pace, the ability for revision, and the opportunity to be better able to associate structures with names and functions.

A different approach is to retain dissections but to allow students to opt-out and use other materials. Downie and Meadows (1995) have shown that an opt-out scheme is workable and that, in their study, an average of 11.5% of students chose to opt-out of the dissection but still performed well on written examination questions based on the dissection laboratory. Currently students at The University of Sydney are being offered the computer-based materials as an opt-out alternative to the real dissection, thus giving them a choice of materials in their learning. Like Downie and Meadows (1995), who found that 70% of students accepted the distinction between animals killed for dissection purposes and those killed for other purposes, we do not offer an opt-out for abattoir material where the animal was killed for other purposes.

Very few studies have been carried out in tertiary education to determine the use, and perceptions of use of dissections by teachers and students, (Downie and Meadows, 1995; Predavec, 2001). With the recent provision of both real and computer-based (= opt-out) dissection resources, for the study of biology at The University of Sydney, it was important

to gain an understanding of the use and relative usefulness of the material in order to help inform the debate on the replacement of animal cadavers in tertiary student laboratories. Given this environment, this paper examines the role of real and computer-based dissections on the attitudes and learning opportunities for a large group of first year undergraduate students as determined from their perceptions.

Description of the "virtual" (computer-based) dissection materials.

The computer-based cat cadaver dissection materials were introduced in 2000 to be used for new learning, revision or as an instructional alternative. The computer-based materials are accompanied by paper-based materials and are fully integrated into the curriculum. The computer-based materials are available on computers in the laboratory, on a CD sold to the students and via our online virtual learning environment (<http://fybio.bio.usyd.edu.au/vle/L1/>).

The computer-based materials have been designed to provide some realism (see Figure 1) with information about the origin of the cadaver. This introductory information is followed by a dissection using a virtual scalpel (see Figure 2). Students were expected to either use a part-dissected cat cadaver to handle and explore its body parts (learning by experience and discovery), followed by use of the computer-based dissection to review their understanding of the systems; or they could just use the virtual materials. Students also have the opportunity to use the virtual materials, either via the Internet or their biology CD, for revision later.

The perceived benefits of the computer-based dissection materials are their flexibility of use (any time/any where), the ability to provide interaction in the form of informative "pop ups" with extra information and the natural

colour/realism of the material. The realism of the "fresh" virtual material is in contrast to the real cat cadaver, which is preserved with all organs and structures uniformly brown in colour, making them harder to differentiate.

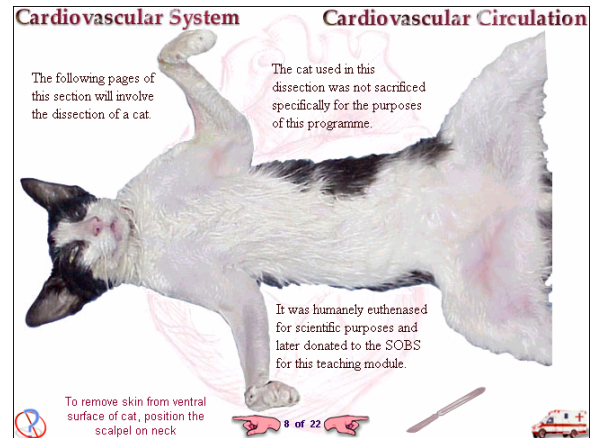


Figure 1. The cat cadaver prior to dissection by the student (user). Students dissect the cat using the scalpel. Help is available by clicking on the ambulance. Students can progress forwards or backwards through the dissection by using the "hands".

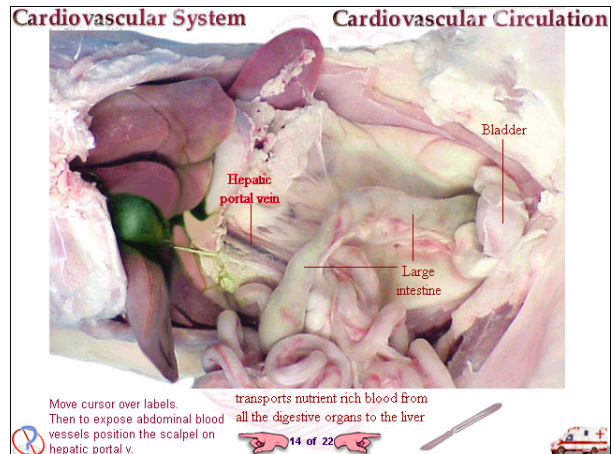


Figure 2. Cat cadaver dissected to show abdominal organs and blood vessels. As the cursor moves over the labels a "pop up" appears (above the "hands") giving information about the structure indicated.

Methods

The students enrolled in the first year human biology course (n=800) are randomly timetabled into one of fourteen laboratory sessions by the university timetabling

computer. In 2001, students in four randomly selected laboratory sessions were asked to complete a qualitative and quantitative survey instrument, administered several weeks after the provision of both the real and computer-based dissection materials. Participation was voluntary and anonymous. Students were questioned about their usage of the resources, in particular their reasons for use or non-use of the real and computer-based dissection materials. Their attitude to dissection in biology was investigated using a four-point Likert scale, with students classifying statements according to whether they strongly agreed, agreed, disagreed or strongly disagreed with them. A combination of qualitative and quantitative survey questions as well as focus group discussions were used to target student perceptions of the usefulness of the materials to their learning. Open-ended questions were thematically analysed and categorised (Denzin and Lincoln, 1994).

Results and Discussion

The response rate to the survey was 88%. Since the students are randomly assigned to laboratory sessions it was assumed that this sample was representative of the entire cohort.

Use of dissection resources

The majority (80%) of students used the cat cadaver dissection material (see Table 1). A proportion of the students (15%) chose to use the virtual computer-based dissection material as an opt-out during the laboratory session, which is slightly more than the 11.5% of high school students opting out in the Downie and Meadows (1995) study. In addition 36% of the students had used both types of dissection resource provided during the laboratory session and a small number (5%) of all students surveyed had not used either resource. Although the data set from this 5% of the cohort is small, the open-ended responses indicate the students were not

motivated to study and thus had not used the resources provided.

Resource	Use of resource n=200
Cat cadaver	80%
Virtual cat as opt-out	15%
Neither	5%
Both cat cadaver and virtual cat	36%

Table 1. Usage of dissection resources

Reasons for use/non-use of dissection resources

Student responses to open-ended questions about their use/non use of dissection resources were categorised thematically.

- **Use/non-use of cat cadaver**

Of the 80% of students who used the real cat cadaver, approximately half indicated that they did so for the hands on approach and that the material was easier to observe and “more real”. About a third of the students said they did it because they had to, or it was there, and a much smaller group indicated that they used the dissection to help support them in their learning.

Of the 20% of students who did not use the real cat cadaver, their reasons for not using it included the appearance of the cadaver (40%) and ethical and emotional issues (16%). There was also a preference for the virtual materials (18%), due to a perception that they are less confronting and more pleasant to use. These views are reflected in responses to open-ended questions.

Because it looks horrifying

I'm very sensitive to dead animals. I don't believe animals should be treated in such a way, left open for all to see.

It still looked like a cat, too much emotional connection. I tried but became emotional.

- **Use / non-use of virtual computer-based cat cadaver**

Of the 15% of the cohort who only used the virtual cat, many (46%) indicated that their reason for using the computer-based materials was that it was more convenient and/or easier to use, suggesting a preference for the “opt-out” option provided instead of using the real cadaver. This view is expressed by the open-ended response below.

If there wasn't the option of the virtual cat dissection I would have (done dissection) but as there was an option I decided it was more pleasant.

Others (33%) indicated their reasons for use were that they had been instructed to do so, by the laboratory manual, as part of their private study requirements for the course.

About one third (36%) of students had used both the cat cadaver and the computer-based dissection material shortly after they were introduced into the course. Approximately two thirds of this group (69%) indicated that the reason for using the computer-based material as well as the cadaver was to study/revise/prepare. Others (12%) found the material to be easily accessible at home, again indicating a use for private study.

Of the students who used the real cat cadaver but not the virtual materials their reasons for non-use included a preference for the real materials (33%), not enough time (26%) and computer issues (15%) relating to access and lack of skills. Other studies have shown a similar lack of uptake, by students, of computer-based resources (Franklin et al, 2001; Oliver and Omari, 2001).

Student attitudes to the use of animal cadavers for learning in human biology

Students were asked to score, on a four-point Likert scale, their attitudes to the use of animals in biology classes and the usefulness of dissections to enhance learning. For simplification the “strongly agree” and “agree” scores have been added together as

have the “disagree” and “strongly disagree” scores. The results are shown in Table 2.

Attitude statements	Those who used cat cadaver (80%)		Those who did not use cat cadav (20%)	
	Agree %	Disagree %	Agree %	Disagree %
Biology students should dissect an animal to help them learn about anatomy	97	3	77	23
Dissection makes biology more interesting	95	5	74	26
I believe dissection is an effective way to study the anatomy of an animal	98	2	80	20
To help me learn anatomy, there are more practical activities than dissection	40	60	51	49
Dissection increases my respect for animals	53	47	24	76
Dissection is not a useful way to learn about the structure and function of animals	9	91	18	83
Dissection is an unpleasant activity	19	81	61	39

Table 2. Student attitudes towards dissection in first year biology

Looking at the responses in Table 2, and leaving aside the obvious bias from those students who had used the cat cadaver, it is interesting to note that the non-users were strongly in favour of biology students using animal dissections (77%) to enhance learning, yet did not take up this opportunity themselves. In addition this group of non-users were also of the opinion that dissection makes biology more interesting (74%) and that dissection is an effective way to study anatomy (80%). Whilst these responses are not as strong as with the user group (93%,

91% and 95% respectively), they do pose the question “Why would students feel so strongly about the usefulness of a resource, yet not avail themselves of it?” These findings are similar to those in the Downie and Meadows (1995) study in which only 60% of opt-out students thought dissections should be omitted from first year biology with the remainder either uncertain or taking the opposite position.

Neither group of students had a strong opinion either way as to whether there are more practical activities than dissection to help them learn anatomy. This may be due to the students not realising what alternatives are available.

Student attitudes were polarised on the issue of respect for animals. Of the students who used the real cat cadaver, 53% agreed that dissection increases their respect for animals whereas 24% of those who did not use the cat cadaver agreed with the statement. This may well be an emotive issue. Orlans (1991) argues that cat and dog dissections arouse especially strong objections, because these species are companion animals and often treated as members of a human family. In the current study this view is reflected in responses to open-ended questions.

I guess at that time I felt really turned off seeing the organs of a dead cat. I think using another animal would've been better, not a cat, I love cats

I would have thrown up all over it. I have a cat. I love that cat.

As might have been anticipated attitudes to dissection as an activity differed between the two groups. Whilst it might be expected that a large proportion of non users of the cat cadaver would perceive dissection to be an unpleasant activity in fact only 61% agreed with the statement that dissection is an

unpleasant activity. The fact that 39% of the non-users did not agree with the statement is interesting, perhaps indicating that these students were opting-out for ethical/emotional reasons rather than the appearance of the cadaver. Of those students who used the cat cadaver only 19% agreed with the statement that dissection is an unpleasant activity.

Perceptions of usefulness to learning

Students were asked to categorise how useful they found the cat cadaver and the virtual dissection materials to be for their understanding the structure and function of body systems. The results in Figure 3 show that more students (72%) perceived the cat cadavers to be useful/ essential for their learning and understanding of the structure of body systems compared to the 66% who perceived computer-based dissections to be more useful. In contrast, more students (66%) found the computer-based dissections to be more useful/essential for their learning and understanding of body functions than the cat cadaver (62%).

Illustrating again how different media can be used for different inputs/outcomes, many remarked in the open-ended responses on the usefulness of both the cadaver and the computer-based dissection, indicating that the former was probably more useful for understanding structure and interrelationships, and the latter for function.

Using the cat cadaver made it easier to identify the body 'bits' but the computer was useful in providing more information - using both was excellent it was real, and you were able to see what all the organs really looked like; you could move them and see their actual position.

Using both is excellent - the cadavers are better for forming an understanding of structure and computers are useful for understanding process (student emphasis).

These findings indicate that both forms of learning resource can play an important role in developing student understanding.

In addition to the high scores associated with using dissections to help with understanding structure (Figure 3), responses to the open-ended question, “What do you see as the advantages/disadvantages of using animal cadavers as a learning resource compared with virtual animal dissections”, support these data. Two thirds of the students (67%) were in favour of the hands-on/real life nature of using dissections (even though the cats are pre-dissected and preserved), with 11% perceiving the 3-dimensional nature of the material as an advantage.

Can display live (sic) cat easily and can move organs around and can follow through the system better!

Hands on learning is much better than 'virtual' learning.

You could move the parts around and see them in 3-D.

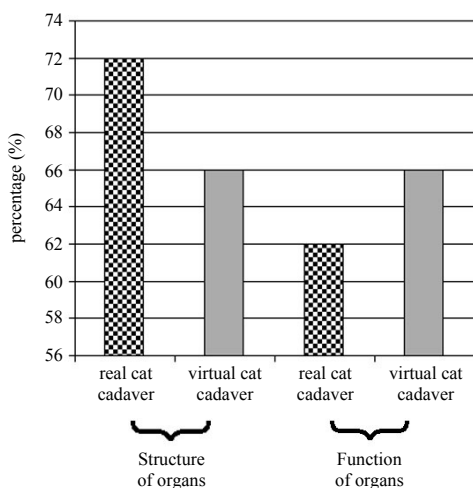


Figure 3. Usefulness of cat cadaver versus computer-based materials in understanding structure and function

On the other hand perceived advantages with the computer-based material were identified in only 18% of the responses, the most frequent being on the clarity of information

and ease of following it on the program (14%).

On the VM (virtual material) more info is given which is great, however hands on experience with real cats is a great advantage!

One of the main messages was that many students perceived the real dissection to be better than the computer-based material as a learning resource, as can be seen in the responses below.

With cat cadavers you can examine more closely the systems within the cat as you can move things around to get a better idea of where things are placed and can see where they are attached. The virtual dissection was probably a lot more detailed and informative, but the cadaver provided a better idea of where things fit in.

Advantages of using animal cadavers is (sic) that it gives us a real idea of the organs etc. The virtual animal dissection explained all organs and presented it realistically. However with the animal cadaver we were more interested in the physical organs than their function.

When asked the question: "What did you like/dislike about using the cat cadaver" the positive comments reflected students' preference for using 'real' material, which also gave them a better understanding of the anatomy, especially the spatial attributes of organs within the body.

I liked working with a real specimen and investigating the true nature of the digestive system: it seems to all come together better looking at something real rather than a diagram in a textbook.

The negative comments about the use of cadavers focused on the issue of preserved, pre-dissected and sometimes rather old-looking material, with 20% of responses

relating to the unpleasant nature of the material.

It made me a bit queasy, but it was beneficial for learning.

I didn't like seeing the cat lying there, dead, and cut open.

Interestingly the majority of the students recognised the advantage of the use of the real dissection even though they found it distasteful. This reinforces the findings of Downie and Meadows (1995), who found students rated the rat dissection as one of the most interesting practicals in their course, even though it achieved the highest disapproval rating. However it has been suggested (Kinzie et al, 1993) that the use of a simulation is not the equivalent of performing a laboratory dissection, and that simply viewing a dissection on a screen does not have the same sensory experience or sense of personal discovery as a real dissection. This is confirmed by the student comments about the cat cadaver below:

Very good - allows interest and enables touch of texture, smell etc to get a full sensual experience of what organs etc are really like.

You can see more doing it for yourself, notice texture etc., which can't be represented on a computer. Gives real experience. Can be a bit messy/smelly.

Students were also asked to categorise how useful they found the dissection materials to be for developing co-operative learning experiences and developing an independent approach to learning. The majority of students (71%) perceived the cat cadaver experience to be more useful than the computer-based dissection experience (47%) in developing co-operative learning skills, which is to be expected as students work in small groups to investigate the cat cadaver. However more students (64%) perceived the computer-based experience as more useful in developing an independent approach to

learning than the real cat cadaver experience (51%). It has been suggested (Quentin-Baxter and Dewhurst, 1992) that the benefits of computer-based simulation materials are that they offer a large amount of supporting and reinforcing information, and that students are able to work at their own pace. Quentin-Baxter and Dewhurst (1992) recommend that students using computer-based simulations as alternatives to animal dissection should be encouraged to use them in groups to enable discussion about the material, paralleling the situation where students exchange information while carrying out a practical dissection. Our data show that 78% of students who were using the computer-based dissection materials used them alone, thus not having the opportunity to discuss the content with their peers. This may not be a disadvantage if the students are using the material for revision purposes, however care should be taken to fully integrate these materials into the classroom situation to maximise their usefulness. It also illustrates the problem of providing access to resources in an online medium, which are often accessed at the individual student's leisure, when the preferred educational model is to use the resources in group mode. Ensuring students have a clear understanding of why the resources have been developed and how they are expected to be used within the overall course structure will be critical to their ultimate success and return on investment.

Educational Implications

This study focused on the comparative value of real and computer-based dissections in a tertiary, first year biology course. Overall the data indicate that, most students find both real and computer-based dissections useful for their studies, illustrating the value of offering a diverse range of materials to provide students with a rich learning environment. A proportion of students (8%), however, found both methods of dissection "of no use" to their learning, which reinforces the

requirement for academic departments to continually review their resources to ensure they meet student needs and learning styles. In addition, the data showing that selected students found the computer-based dissections of no use indicate that the development of such resources, which are often costly, must be carefully justified and comprehensively integrated into the course of study. The data also indicate that the provision of opt-out materials is welcomed by a proportion of the students (potentially 120 out of a cohort of 800), who, for a variety of reasons, find the real dissection material not to their liking. This suggests that in the tertiary sector opt-out schemes are workable and that at The University of Sydney we should continue to develop and provide these types of materials.

While for the majority of students surveyed both resources were perceived to add value to learning, a number of critical factors emerged relating to the implementation of computer-based resources within tertiary teaching programs. These factors include questioning whether to continue the replacement of the real dissections with computer-based ones or to provide both types of dissection resource. The trend for removing animal cadavers from laboratory classes is likely to continue with added pressure from both an expanding student population and community expectations as represented by the Animal Ethics Committee (Wheeler, 1993). The distribution of responses for the use of both cadavers and computers would indicate that there is little difference between the effectiveness of the two types of instruction but that the majority of students value the provision of both types of learning resource. At The University of Sydney for as long as practicable we will offer the real dissection materials but will continue the development of computer-based materials to be used by students as either an opt-out option or for preparation and revision.

Acknowledgments

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Integration of alternatives to animals in practical class teaching in pharmacology

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Abstract

Both educational and scientific reasons have been used to justify the continued use of animals in the teaching of pharmacology to undergraduate students as part of their training. In the Department of Pharmacology at the University of Melbourne, a specific goal has been to achieve an appropriate balance between meeting learning objectives and the ethical responsibilities for the use of animals for experimentation.

The numbers of animals used for teaching purposes in Pharmacology at Melbourne has decreased by 75% over the last 10 years, despite teaching significantly larger cohorts of students in a greater range of courses. The major contributor to this reduction has been replacement of many assays requiring animals or their tissues with computer simulations, cell-based assays, and video footage. However, when actions of drugs can only be clearly demonstrated using isolated tissues, animal numbers have also been reduced wherever possible by using multiple preparations obtained from animals best illustrating relevant aspects of pharmacology.

Recently, a novel approach has been adopted in the teaching of *in vivo* immunotoxicity. This practical was previously conducted requiring multiples of mice per student group. However, a multimedia demonstration of the techniques required to prepare and analyse tissue samples from the mice has now been integrated. In addition to reducing the requirement for animals, this combination of multimedia and hands-on experience informs the students to handle animals with respect, and to apply the techniques with improved reliability. Student feedback to this balanced approach reinforces our perception that practical experience with animal and tissue-based assays is valued by the students as well as being educationally valuable.

Discussion

What do we want students to learn?

It is critical that practical classes for undergraduate students of medicine and veterinary science students provide opportunities for acquisition of skills applicable to their future working life, and knowledge relevant to their clinical practice. For these vocational courses and also for biological research training, it is important that students gain an understanding of the

underlying principles of pharmacology that form the basis for the definition of drug targets. It can be argued that the quantitation of the therapeutic, toxicological and behavioural effects of drugs on isolated tissues and in whole animals also provides students with critical insights into the processes by which mechanisms of drug actions can be elucidated. An important goal in teaching pharmacology at the University of Melbourne has been to strike the appropriate balance between these key learning outcomes and the ethical responsibilities for the three Rs -replacement, reduction and refinement in the use of animals for experimentation.

As part of this commitment, academic staff ensure that students understand the process whereby approval for animal use in practical classes is obtained, and create awareness that this approval is predicated upon demonstrating that the use of animals is essential to meet educational objectives. This is achieved through provision of course material for all pharmacology subjects that introduces students to the guiding principles of institutional ethics committees and for the responsible use of animals in teaching and research. When discussed in context of specific practical applications, students are made aware that approval is based on arguments of harm versus benefit, considering animal numbers, experimental design and type of intervention as well as the educational value of each practical. In this way, students come to appreciate that the use of animals in practical classes is a privilege that comes with responsibilities - to respect the animal and its tissues, and to make the most of the learning opportunities provided.

Current animal use in Pharmacology at the University of Melbourne

Between 1995 and 2005, the total number of students studying pharmacology at Melbourne University as part of their undergraduate degrees in science, medicine, veterinary science, optometry, dentistry and physiotherapy degrees has increased from under 500 to well over 1000 students. Increasing practical class sizes by the same factor has not been possible due to logistical limitations in laboratory capacity, so there has also been an increase in the annual number of practical classes conducted, from 67 to 103 classes.

Despite these changes, the numbers of animals used for teaching purposes has decreased from 701 in 1995 to 171 in 2005 (Figure 1). These decreased numbers in the face of increased demand reflects an ongoing commitment to implement a variety

of strategies to replace animal-based practicals or reduce animal numbers where appropriate.

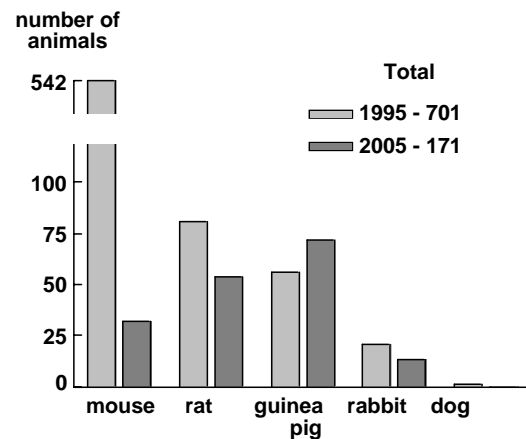


Figure 1: Comparison of animal use by species in the teaching of pharmacology at the University of Melbourne in 1995 and 2005.

General principles of animal use

Assays requiring animals or their tissues have been replaced when educational objectives could still be met using alternative teaching modalities to illustrate the same pharmacological mechanisms. Where possible, there has been the introduction of computer simulations of various experimental systems or immortalised cell line-based assays to achieve the same learning outcomes. However, our perception that there are significant educational benefits in retaining some animal-based practicals is supported by numerous comments from student surveys regarding their practical class learning experience. These include statements from veterinary students that:

- practicals which involved computer simulation were not as effective as using live/killed animal/animal part.
- computer pracs are less interesting than the “real” pracs which were excellent.
- the pracs are an excellent way of learning pharmacology – they have been the place where all the pieces came together.

In certain teaching exercises, in which we consider the actions of drugs can only be demonstrated using isolated tissue samples, animal numbers have been reduced whenever possible by using multiple preparations from a single tissue within the same animal e.g. a single guinea pig or rabbit ileum is sufficient for a class of 60 students. In all cases, the types of tissues and species of animals are selected for the lowest level of sentience at which the relevant aspects of pharmacology, including diseases and their therapy, can be best illustrated. For this reason, a practical for medical students demonstrating effects of anti-asthma agents using guinea pig tracheal tissues has been retained, despite the requirement for a slight increase in the numbers used over the 1995-2005 period due to an increase in student enrolments and numbers of classes. However, reductions in the use of mice, rats, rabbits have been achieved over the last ten years, with the single practical using a dog last conducted in 1995 (Figure 1).

In addition to these strategies for appropriate replacement and reduction, a formal system has been introduced whereby the availability of other tissues for secondary use is made known to other researchers within the department and faculty. This will have contributed to reductions in animal use beyond the practical teaching programme.

Specific examples of changes in animal use

(1) Therapeutics

The introduction of other teaching modalities has decreased the % of practicals using animals to illustrate therapeutic actions of drugs from 100% in 1995, to 50% in 2005. While retaining critical “wet” practicals, alternatives have included computer simulations of drug effects and a student-based self-experimentation program to demonstrate the effects of an antihypertensive agent.

(2) Behavioural pharmacology

The behavioural effects of a wide range of centrally acting drugs in mice are now demonstrated using video footage rather than using large numbers of mice on an annual basis. This has been the greatest contributor to the significant reduction in the use of this species for practical teaching (Figure 1), while still allowing students to develop key observational skills without the need for annual repetition of experiments. The introduction of an advanced practical unit for a small student cohort with a specific interest in following a career in biological science now offers the opportunity for this more committed group to be exposed to the use of animals for behavioural studies in a research context.

(3) Toxicology

A novel multimedia approach has recently been adopted in the teaching of *in vivo* toxicity, examining the effects of corticosteroids on the immune system in mice. Students watch an introductory video demonstrating the techniques required for the practical session, before working in small groups preparing blood or tissue samples from control and treated mice humanely killed by trained personnel. In addition to analysing samples they have prepared, students have access to an on-line interactive program developed at the University by Professor Margaret Morris and the Biomedical Multimedia Unit to quantitate the toxic effects of the drug on the blood.

The integration of multimedia with hands-on experience guides the students to handle animals and tissues with respect, to apply the required techniques effectively, and to analyse data appropriately. By improving the reliability of data generated by students, both the drug effects and the biological variability in the response can be clearly illustrated.

Student feedback to this balanced approach was recently obtained with a questionnaire of their opinions on both the educational

objectives of the practical and their level of engagement in the practical (Figure 2).

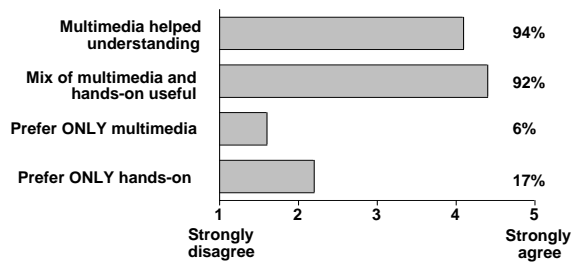


Figure 2. Student questionnaire responses for the 2006 immunotoxicity practical that combines multimedia with a hands-on approach using mice.

Average responses on a scale of 1-5 and the % that agreed or strongly agreed with each statement were obtained from 36 students who completed the practical.

The scores obtained and the following additional comments made by students in the survey strongly support the combined approach as a means to facilitate student engagement and understanding.

- Multimedia was good because it clarified instructions/procedure before starting ‘wet’ work.
- The mix of multimedia and hands-on dissection was effective to help understand the prac.
- Use of animals for experiment is very essential in my opinion for purpose of furthering our knowledge in the research field in years to come.

Conclusion

Analysis of the use of animals in teaching of pharmacology practical classes over the last 10 years at the University of Melbourne demonstrates that significant replacement and reduction in animal numbers has been achieved. Reflection on the potential for further changes is balanced by our perception that the retention of practical experience with animal and tissue-based assays is valued by the students as well as offering significant educational benefit.

Ethical and effective acquisition of knowledge and skills in life science education and training

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Abstract

The design of life science curricula and courses for professional training involves choices about the tools employed to meet their objectives. Ensuring that a tool - or combination of tools - is the most appropriate, requires an awareness of developments in technology, educational practice and ethics. Information resources and opportunities to assess such tools are also important. While laboratory animal experimentation continues to play a role in many practical classes and training courses, innovative and humane 'alternatives' are increasingly being developed and implemented, reflecting a growing commitment to best practice and fiscal responsibility, as well as the interest and demands of students.

Alternatives are humane educational aids and teaching approaches that can replace harmful animal use for effective knowledge and skills acquisition. They may be non-animal alternative tools such as multimedia software and Virtual Reality (VR); digital video; training models, mannekins and simulators. They may also be alternative approaches such as student self-experimentation; the use of ethically sourced animal cadavers; and the learning opportunities associated with clinical work on animal patients. In this presentation, specific examples of alternatives will be given, as well as case studies that show that in many institutes they are no longer considered 'alternative', but the norm. Published studies provide further evidence of their value.

InterNICHE has been working internationally to promote and encourage the implementation of alternatives for 18 years, helping to catalyse full replacement of harmful animal use and building a broad network with contacts in over 50 countries. The presentation will give examples of InterNICHE projects and resources. These include printed information resources such as the book from Guinea Pig to Computer Mouse (2nd ed.) which gives details of over 500 alternatives, with reviews and case studies; an Alternatives Loan System for trial, assessment and demonstration of alternatives; the Humane Education Award to support local development and implementation of alternatives; empowerment of student conscientious objectors; video and website resources; and conferences, outreach visits and training.

The provision of these resources reflects the InterNICHE belief in the importance of catalysing progressive curricular change to the benefit of students, educators, animals and the professions. With reference to the InterNICHE Policy and experience, recommendations will be made for ethics committees, for university policy towards student choice, and for legislation.

This presentation provides a basic overview of alternatives to harmful animal use in education and training, as well as the resources that InterNICHE offers. Many readers will be familiar with some of these methods and indeed may have developed and implemented such teaching and training aids already.

InterNICHE is the International Network for Humane Education. Formed in 1988 as EuroNICHE, we are based in England with a committee of over 35 National Contacts stretching from Brazil to Belgium, Israel to India.

As both a network and an organisation, InterNICHE works with teachers to introduce alternatives to harmful animal use and with students to support freedom of conscience. We aspire to work in a fully inclusive way, looking for common ground and win-win solutions. We are committed to supporting the most ethical and effective ways of gaining knowledge and skills in life science education.

Within biological science, medical and veterinary medical education, animals have historically played a central role in laboratory practical classes. The relationship between the animals and the students, therefore, has usually been one of harmful animal use. However, despite the many animals that are still used in experiments or killed for dissection every year, profound changes are taking place.

The InterNICHE vision is one of a fully humane education, where teaching objectives are met using humane alternative methods and where compassion, respect for life and critical thinking skills are valued and developed. It is an education where students have freedom of conscience and where the negative relationship with animals has been transformed to the positive through full replacement of harmful animal use.

I will show how full replacement is not an unrealistic vision but one that is reasonable and desirable and in fact, one that has already been achieved in a growing number of universities across the world.

All of us are aware of the concept of the 3R's - the Reduction, Replacement and Refinement of animal use, as described by Russell and Burch (1959). But for education it is now possible to refine this conventional definition of an alternative. Developments in technology and in ethical thought, as well as examples of replacement from within all the disciplines of the life sciences, mitigate for such a refinement.

Specifically, the definition of alternatives within education can be made stricter so as to comprise only replacement alternatives; and can be broadened to include approaches that involve neutral or beneficial work with individual animals. Such a definition goes beyond the 3R's of Russell and Burch. It is more appropriate to the nature of knowledge and skills acquisition within life science education and reflects the present-day possibilities and opportunities for replacement.

Alternatives therefore, are progressive learning tools and teaching approaches that can replace harmful animal use or complement existing humane education. Indeed, in some countries, humane approaches within certain fields are the tradition. 'Alternative' teaching approaches - by tradition or by modern choice - are therefore often the *norm*.

We also need to define harm. Harm comprises any action, deliberate or otherwise, that impinges on an animal's current or future well-being by denying or limiting any of the following freedoms:

- Freedom to live
- Freedom to express full natural behaviour
- Freedom to be part of a social structure and ecosystem
- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom from fear and distress

This is a very strict definition of harm, but harm is a serious matter and should not be trivialised. Moreover, it is entirely possible to meet the standard teaching objectives of life science practical courses - and many more objectives - using humane alternatives that involve no harm or can actually benefit individual animals.

Alternatives comprise a range of different tools and approaches, often used in combination:

- **Film and video**

Film and video are used across the world to supplement practical work and to illustrate processes that need further explanation. They are also low-cost and easy to make. Professionally-performed dissections can often impart more knowledge than dissections performed by students themselves, or can better prepare students for real dissection using ethically sourced animal cadavers. Digital video is very flexible and can be incorporated into multimedia alternatives and presentations.

- **Models, mannequins and simulators**

The model is the traditional anatomy learning tool, comprising a plastic or latex representation of an animal or organ, dissected or with removable parts. Life-like mannequins can support effective training of clinical skills such as animal handling, blood sampling and intubation. Basic surgery skills, from eye-hand co-ordination to suturing and anastomosis, can be gained using simulators. Perfusion of ethically sourced animal organs using dynamic simulators allows for realistic surgery practice and advanced computer-assisted simulators of the human body can better prepare students for critical care scenarios. These alternatives help students gain confidence and competence through repeated practice before entering the real life clinical situation with animal or human patients.

- **Multimedia computer simulation**

Software alternatives are what many people think of when alternatives are discussed, but software is just one learning tool that can be employed to support effective learning and

mastery of skills. Computer-assisted learning (CAL) has brought great benefits to life science learning and high quality powerful software has been available since the mid-1990s with programs that can offer virtual dissections for anatomy lessons and well-equipped virtual laboratories for experimentation.



CAL can provide extra levels to the learning experience, as well as a degree of excitement due to its often innovative nature. Visualisation and understanding of structure and function can be enhanced through video clips, high-resolution graphics and images, the ability to highlight or dissolve away different organ systems and options to magnify images or compare tissue between species. Virtual labs, typically simulating animal preparations and experiments in physiology and pharmacology, can support the development of enquiry skills and an understanding of the interplay between complex and related phenomena.

At the more expensive end of computer applications to learning there is true Virtual Reality (VR), which is currently used by only a few of the richer universities in some countries and mostly within human medicine only. Specific clinical and surgical procedures can be practiced in an immersive, sensory environment and even the sense of touch - haptics - can be simulated through the use of special 'data gloves'. This is a rapidly evolving use of computer potential that has applications particularly in endovascular and endoscopic procedures. Over time it will no doubt be available to a greater number of

students as well as to professionals who need to re-train specific procedures or perform a simulation in advance of the procedure itself.

Just as an airline pilot is expected to train using flight simulators in order to be fully versed with all likely scenarios, so must all students who will be working with patients have achieved the required mastery. The risks and ethical constraints of a pilot practicing in a real airline with real passengers are clear enough; we should be making sure that the future doctor or surgeon trains effectively with the best tools and not taking any risks or violating any ethics during that training.



- ***Ethically sourced animal cadavers and tissue***

Although few students will actually use animals in their careers, many zoology students and all future veterinarians will require hands-on experience of animals and animal tissue. The use of ethically sourced cadavers and tissue is an alternative to the killing of animals for dissection and surgery practice. The term ‘ethically sourced’ in this context refers to cadavers or tissue obtained from animals that have died naturally or in accidents, or that have been euthanised secondary to natural terminal disease or serious non-recoverable injury. Animals that have been harmed or killed to provide cadavers and tissue are not considered ethically sourced, nor are those sourced from places where harming or killing is commonplace. The InterNICHE Policy provides a more comprehensive definition of

this term and addresses other uses of animals and alternatives too.

Body donation programs linked to veterinary teaching hospitals and independent practices can provide supplies of cadavers and tissue ethically. Tufts University School of Veterinary Medicine in the US has a ‘client donation program’ whereby companion animal guardians can consent to donating the cadaver of an animal for use in teaching. All the cadaver requirements for veterinary anatomy, clinical skills and surgery training are met through this program, which was initiated by an individual student and adopted by the teachers and administrators. The animal guardians choose between the donation program and having the animal cremated or returned for burial, but they are aware that cadavers donated to education spare others being killed. Members of the public are therefore consciously involved in supporting replacement in life science education and such links between the public and the university are very positive.

- **Clinical work with patients**

Experience with patients is the norm within medical education and although the growing use of problem-based learning approaches is providing more clinical experience to enhance the education, an increase of work with patients could further replace harmful animal use. In veterinary medicine, clinical learning opportunities could be expanded considerably to replace animal experiments and to better prepare students for the professions. A progressive approach to learning veterinary surgery might involve the student mastering basic skills using non-animal alternatives, moving on to ethically sourced cadavers for experience with real tissue and finally performing a significant amount of supervised work with animal patients to gain skills such as wound management and basic surgery.

Shelter sterilisation programs are a huge potential resource for students, with castration

and spay procedures being observed, assisted and then performed by students. This is realistic and relevant training for students who may graduate to perform many sterilisations in their careers. The clinic can also teach students many other skills that the lab cannot: experiencing and dealing with the clinical environment and its demands, appreciation of the diversity of patients and clinical situations and communication skills with work colleagues and animal guardians. Crucially, the students will gain valuable experience from having been present and involved in the whole process of dealing with a patient, including diagnosis, the operation, and post-operative care.

Companion animal ‘volunteers’, such as visiting dogs, can provide other clinical skills learning opportunities. In these cases only rewards are provided and the animal is in control of whether the non-invasive practical continues.

• **Student self-experimentation**

For further experience of the living body, the consenting student is an excellent experimental animal. We do not need animal experiments to bring engagement and excitement. The intense involvement and self-reference of such experiments makes them highly memorable and supports effective learning. EEG, ECG, nerve conduction and many other tests can be performed using basic lab equipment or specially produced apparatus. Self-experimentation may also be useful for future veterinarians, who, like rats, dogs and cats are also mammals and who can perhaps better understand the nature of being a patient if they themselves have been consenting subjects of non-harmful experiments.

• **In vitro labs**

A number of recently published studies have shown that for some toxicity tests, *in vitro*

technology is providing results that are more repeatable and more reliable. In other words, it is better science in comparison with animal-based tests - and certainly better value for money. The rapid development and uptake of *in vitro* technology in research and testing needs to be supported by student familiarity with the techniques, and *in vitro* practicals can provide this experience. Animal tissue and cells used for such work can be sourced ethically and within some cell biology practicals, the use of animal tissue and cells can be replaced directly with plant material. For studying cell respiration and electron transport, for example, mitochondria can be sourced from turnips, potato or beet instead of rat liver. With ethically sourced animal preparations, or with plant material, therefore, such *in vitro* practicals can then be considered as alternatives.

• **Field studies**

Students of biology, zoology, ethology and ecology may often find themselves in situations where animals are studied in a laboratory setting as a model for nature, or they will be faced with interaction with wild animals that is invasive or otherwise harmful to the animals or their habitat. However biology is not just experimentation, nor does its study require harm. Much of the knowledge gained about animals and nature has come from observation and other non-invasive field studies. This tradition of studying animals within their natural environment is a particularly rewarding alternative to harmful animal use which could be developed and explored in order to replace some lab animal practicals in the above disciplines.

When considering alternatives such as those described above, the range of tools and approaches that are suitable to implement at a university will be defined partly by the economic and practical opportunities and limitations that it faces.

- The successful implementation of alternatives impacts on many spheres:

- **Pedagogics and quality of learning**

As well as the advantages of the different types of alternatives already described, over 35 published academic studies have shown that students using alternatives perform at least as well as those using animals in conventional, harmful ways. Combinations of alternatives applied to the educational process will clearly do even better: teachers committed to good curricular design will have ‘audited’ their courses and chosen the best tools and approaches to meet the identified teaching objectives. The negative lessons of the hidden curriculum - that animals are disposable tools, for example - will no longer be learned, and many positive messages will have been given. Positive attitudes towards animals can be engendered, the need for conscientious objection is obviated, and the learning environment is further improved as a result.

We should also ask whether the animal experiments have themselves been assessed or audited. It is rare that this is the case and of course, it is typical of the culture of orthodoxy to require only the challenger to defend his or her ideas.

I believe it is a serious mistake to see alternatives as ‘not the real thing’ or as ‘not authentic’. The assumption is that animal experiments are the real thing. However this is not true – we are focussing on acquisition of knowledge and skills and the best ways to achieve that. So the ‘real thing’ is how well the students learn, for specific practical classes and specific learning objectives, such as the mastery of a specific procedure. For many life science students, hands-on experience of animals and animal tissue, which is sometimes confused with ‘the real thing’, is never needed (indeed, a significant proportion of pharmacology students in the UK go into the field of insurance). When hands-on experience is genuinely needed at a

specific stage of education or training, neutral or beneficial interaction with living animals, or the use of ethically sourced cadavers, can provide further authentic experiences that complement the authentic non-animal approaches.

- **Life science philosophy**

The roots of medicine and veterinary medicine are in healing, not harming. The imperative *Primum non nocere* is not an idle comment without relevance and the harmful use of animals is contrary to the fundamental tenets of these professions. While the physician may occasionally harm in order to heal, this is not the case when educating the future professional. Similarly within biology, harmful animal use is counter-intuitive. Biology often seems to be more necrology than the study of life. Studying and affirming life can be achieved with alternatives and such approaches help reconnect the life sciences to their positive roots.

Alternatives can also help support the practice of critical thinking. The scientific method itself is really just a formalisation of critical thinking and essential scientific skills such as problem-solving and good experimental design are often treated as very important in many software products. When students or teachers question the orthodoxy - which is often the orthodoxy of animal experimentation - and look for innovative, alternative ways of doing things, they are involved in critical thinking. This practice should be nurtured.

- **Emotional and ethical literacy**

Sensitivity, empathy and compassion all play essential roles in society and reflect cultural values, practices and skills that are important to protect and develop. They are essential within science too, because it is people - thinking and feeling people - who are

practicing science and who are engaging with other people and with animals.

There is significant evidence of the desensitisation of students through harmful animal use. This may be a result of the hidden curriculum, which teaches that life can be violated, or it may be a deliberate policy to 'harden' students, in the belief that this is a necessary part of moral development or the cost of scientific endeavour.

In fact, desensitisation and the denigration of the emotional realm help neither students nor science. Understanding and exploring the often complex emotions associated with challenging aspects of the life sciences is surely preferable to denial and ignorance. The mind and the emotions are always present and are never separable. It is not emotion that hinders objectivity, but a lack of critical thinking or of awareness of the whole picture.

A commitment to ethical science and to open ethical discussion in the classroom will help the future professional to be more able in ethical decision-making and can encourage a strong sense of personal and social responsibility. Emotional and ethical literacy will always benefit science, but they may demand the use of alternatives rather than the killing or harming of animals.



- **Accessibility and civil liberties**

A leading Jain academic advised adherents of Jainism that they should not enter medicine because of the required dissection and vivisection. Should life science education

discriminate according to religion and ethical commitment? Recognition and validation of such commitment through the use of alternatives will ensure that all students who would not have entered the life sciences because of harmful animal use can now participate and contribute. This increased accessibility is relevant for all students, but in many countries this will also have a significant positive impact on increasing the number of women in the life sciences.

For those who are already students, the threat of academic or psychological penalty when conscientiously objecting is a form of discrimination and the lack of opportunities to use alternatives is limiting students' experience of best practice learning tools and approaches. Compulsory harmful animal use is unacceptable coercion, and can cause psychological trauma for students. It also risks costly court cases - one university was ordered to pay US\$95,000 to a student for denying her freedom of conscience. Animal use in education is clearly an ethical issue and by dealing with it through discussion and action, teachers will demonstrate that science and ethics can be compatible and that problems can be faced rather than denied. This is a good lesson for future scientists for learn.

There is certainly a growing interest in alternatives and students' rights in Australia and New Zealand from the students themselves, which is reflected in the conscientious objection policies that universities are adopting. For example, there are policies at Wollongong University, the University of New South Wales, and Murdoch University. 2005 was the first year that students from each Australian veterinary school graduated without killing animals in their surgery training.

- **Practical impact**

Environmental and animal welfare

Animals caught in the wild, animals bred, caged, killed or experimented on do suffer harm and the scale of the suffering is as great

as it is unnecessary. Conventional animal use is not acceptable from the perspective of animal ethics. Taking animals from the wild can seriously disturb local ecosystems and has contributed to the decline of some species, such as leopard frogs. Threatened or endangered species, including dogfish, are also caught for educational use in some countries. Moreover, the toxic chemicals used for preparing the millions of animals killed each year have a damaging environmental and health and safety impact. If high quality alternatives can replace such use, then from the animal welfare and environmental perspectives alone the logical conclusion is replacement.

Economic benefits

Several studies have shown that the use of alternatives provides significant economic benefits to universities. The direct and indirect costs associated with the use of animals are removed and after purchase or development, most alternatives can be used for several years. While the initial outlay of computer hardware may be high, many universities in the west and elsewhere already have such equipment and the costs are anyway recovered over time. Software with hundreds of high quality anatomy images or a well-equipped virtual laboratory is inexpensive compared to the cost of the real laboratory with similar equipment. Moreover, some alternative approaches just make good use of existing untapped resources and are therefore free – for example, those of clinical learning opportunities. Teachers can also make their own learning tools, using their own experience and according to their specific course requirements. Indeed, it is the teachers themselves who have developed most alternatives that are currently available, usually motivated by the economic and pedagogical advantages.

Life science education deserves further investment to provide all students with the most effective and ethical methods for acquisition of knowledge and skills.

Personal and institutional reputation

Many producers of alternatives have found their personal and institutional reputations enhanced by their work, and some high quality software has won awards for multimedia design or teaching innovation and success. Many academic papers have been published by teachers who have developed and implemented alternatives. The enhanced reputation of teachers amongst students has also been a positive result of efforts to improve teaching and to respect students' ethical concerns. Reputations can also be seriously damaged by negative media publicity or legal challenges occasioned by communication breakdown and student-teacher conflict. Resolution of ethical problems in the classroom in advance of such action is clearly preferable, especially as co-operative solutions can usually be found.

Legislative requirements

Personal and collective responsibility for curricular change is always preferable to that forced by diktat. Until such responsibility is widely taken however, legislation is a useful tool for implementing alternatives and for modernising education. The use of alternatives accords with the letter and spirit of many national laws and international conventions and directives, which state that alternatives should be used wherever possible. As there are examples of alternatives being successfully used for practical course in all disciplines, it could be asked whether harmful animal use is in fact illegal.

How does InterNICHE help realise the vision of full replacement of harmful animal use? The network offers a range of information and other resources to teachers, students and others to empower them to facilitate change. These resources include:

- *from Guinea Pig to Computer Mouse*

Published in 2003, *from Guinea Pig to Computer Mouse* is a major 520-page book in four parts.

Part A provides the background to animal use in education, describing alternatives and their pedagogical advantages, as well as looking at their broader impact. Dr Jonathan Balcombe reviews published papers that assess alternatives in terms of student and trainee performance and Dr Lara Rasmussen addresses the concept of curricular design and the best ways to meet teaching objectives. Part A also looks at the role of conscientious objection in curricular transformation and gives a review of the philosophy and practice of InterNICHE.

Part B comprises case studies written by university heads of department who have implemented alternatives and replaced harmful animal use. They share their experiences of the process of change and the advantages of using alternatives. The authors include:

Dr Hans Braun (Institute of Physiology at Marburg University in Germany). Dr Braun co-developed the award-winning Virtual Physiology series of virtual laboratories, such as SimNerv, which have fully replaced the animal experiments for students in his institute.

Although he was initially very much in favour of continuing the conventional animal experiments in the face of student protest, Braun found that the students were much more active in practical classes with the simulations and were successfully learning how to experiment and make use of their knowledge.

Dr Henk van Wilgenburg, is a pharmacologist from the University of Amsterdam in the Netherlands. Van Wilgenburg developed the 'Microlabs' collection of computer simulations and in his chapter, questions the relevance of conventional animal experiments

when obtaining and interpreting data can be achieved so effectively with advanced computer software. He also advises on the process of implementation of alternatives, particularly preparation of staff and the lab environment, as well as cost allocation between hardware, software and support.

Dr Mykola Makarchuk from Kyiv State University in the Ukraine. Makarchuk is a biologist who has successfully replaced animal practicals with student self-experimentation and computer simulation for the teaching of human and animal physiology. He explains that the challenges facing replacement in former Soviet countries, especially in terms of cost, availability and opportunities to trial alternatives and also draws a comparison between broader social changes in the Ukraine and improved attitudes towards animals.

Prof Garry Scroop, physiologist from the University of Adelaide in Australia. Scroop has implemented 'research project practicals' for students, which comprise semester-long self-experimentation practicals based on research methodologies to support learning of problem-solving strategies. Instead of students producing contrived results from brief, poorly-supervised animal experiments - which Scroop sees as typical of many practical classes - the alternative approach is specifically designed to encourage critical thinking. It also provides opportunities for teamwork, and fully replaces the animal use. The approach has been recognised nationally as an example of best practice and has now been emulated at other departments and universities.

Dr Amarendhra Kumar from Tufts University in Boston, USA. Tufts University School of Veterinary Medicine runs the sustainable client donation program for ethically sourced cadavers. In a survey, 97.5% of students questioned preferred to use donor - ie ethically sourced - animals. 0% wanted to use animals that had been killed for the purpose and 2.5% didn't care either way. The School's reputation for using

just ethically sourced cadavers is part of the attraction for new students.

Dr Daniel Smeak from Ohio State University, USA. Smeak has developed a range of portable skin/suture pattern and hollow organ simulators for use with training videos for highly effective manual skills acquisition. Students can practice again and again, both in the lab and at home and then progress on to ethically sourced animal cadavers before their clinical rotations. Over 5000 animals from shelters have been sterilised by students working under supervision, increasing student exposure to clinical experience as well as increasing the rate of adoption of animals to nearly 100%. The experience of Smeak is that mastery of surgery skills can best be achieved through application of such alternative tools and approaches.

Dr Lara Rasmussen and colleagues from Western University of Health Sciences, USA. The country's newest veterinary college is zero animal consumptive and has a 'reverence for life' philosophy. A skills-oriented curriculum which optimises the use of progressive, humane learning tools and has a strong focus on clinical work and strategic alliances will ensure only beneficial or neutral interaction with animals for veterinary students. If this can be done within veterinary medicine, then it can certainly be done in human medicine, where the focus should surely be on the human body rather than animal experiments.

Part C of the book is the Alternatives File, which comprises the majority of the publication. This is a database of over 500 alternative products, detailing for each their application, specifications, and source. The section is divided according to discipline, such as anatomy, anaesthesia and critical care, physiology and pharmacology. Each discipline is then subdivided according to medium - software, video, models, mannequins and simulators and finally web-based alternatives. The Alternatives File comprises up-to-date and original research and includes some alternatives that have never before been marketed or shared.

Part D comprises over 1000 further resources such as on-line curricular material, printed resources, recommended reading, details of alternatives loan systems and organisations worldwide, as well as full contact details of producers.

The Appendix presents the comprehensive 10-part InterNICHE Policy on the Use of Animals and Alternatives in Education. Over 10 language translations and a CD and DVD version of the book are under production. The book is available for free download on-line at the InterNICHE website www.interniche.org, and over 500 copies of the book in hard copy have been distributed by InterNICHE to all ethics committees in Australia.

- ***Alternatives in Education***

This 33-minute video, produced in 1999 and available in nearly 20 languages, is an exploration of alternatives within anatomy, physiology, pharmacology, clinical skills and surgery. Interviews with university teachers who have developed and implemented alternatives are complemented by visual demonstrations of a range of tools and approaches. The multiple benefits and pedagogical superiority of alternatives compared to conventional lab animal use are explained using specific examples. The video is also available on-line.

- **Alternatives Loan System**

This is an evolving library of over 100 of the best alternatives, established to practically support the process of replacement worldwide. Contents include multimedia software, videos, models, mannequins and simulators from a variety of disciplines, chosen for their pedagogical value and potential for replacement. Teachers, students and others can borrow items from the Loan System and can trial them to assess their

relevance to their own specific curricula and to familiarise themselves with some of the best products available.



The library is co-ordinated from Europe, with alternatives available for free loan to all countries worldwide. Borrowers pay only the return shipping costs. The project has made over 200 loans to 40 countries, comprising over 4000 usages of individual alternatives, since its establishment in 2001/2002. As a tool for facilitating implementation, the value of the Loan System is indicated by a number of positive results: significant teacher use and the high number and wide geographical range of loans, positive feedback on the resource from borrowers, subsequent purchase and implementation of products and direct replacement of harmful animal use. Products are also taken to conferences and are used during InterNICHE outreach tours and training.

Small-scale micro-Loan Systems have been established in Brazil, Russia, Ukraine, India and Japan. The impact in Russia in particular has been great. These seed projects of the much larger international Loan System illustrate how much can be done with seed funding to support small-scale but highly effective and sustainable projects.

- **Humane Education Award**

This annual Award of 20,000 Euro is a grant program targeted at teachers and others who can bring about replacement through the production of new alternatives or the purchase

and implementation of existing products. The Award has historically focused on different regions and now has a fully international focus.

One project comprised the production in Romania of veterinary physiology software and the establishment of a computer simulation laboratory using reconditioned computers. Together these have replaced the annual use of nearly 1000 animals and with the alternative being freeware; it is available for free worldwide distribution and use. A second project comprised a compilation of pharmacology freeware. This has been distributed free to over 3000 pharmacology and pharmacy teachers across India, and is also available worldwide.



Other projects include the production of the first-ever camel anatomy software; the purchase and implementation of advanced physiology self-experimentation apparatus; the establishment of specially perfused cadaver labs for 'live' surgery practice in veterinary medicine; and investigations into the preservation in tropical climates of abdominal organs of (ethically sourced) animal cadavers for use in surgery training.

- **Freeware**

The freeware funded through the Award is being produced in other languages to support effective implementation. The 'Physiology Simulators' CD is now available in Russian, for example and that of the 'CAL Pharmacology Compilation' CD is under production. It is hoped that new translations

and new freeware will become available in the future.

- **Website: www.interniche.org**

The InterNICHE website is the largest existing website on alternatives in education. It provides a wide range of information and resources on-line, including comprehensive background to the issues, news, student testimonies, and links to producers, product reviews and external resources. This is currently available also in a range of languages, and new resources are continually being added. Greater interactivity will also be integrated.

- **InterNICHE Conference**

InterNICHE holds a major international conference every few years, offering leading international and local speakers, challenging workshops, an alternatives centre with some of the latest teaching products and room for discussion and networking. Delegates include teachers, product developers, students, legislators and animal protection campaigners. The most recent conference, 'Alternatives in the Mainstream: Innovations in life science education and training' was held in Oslo in May 2005, and had delegates from 32 countries.

- **Other conference visits, outreach tours and training**

Both the author and National Contacts have co-organised and spoken at a wide range of international and national events on alternatives. Larger outreach tours have also taken place, including visits to Russia and India. These visits allow the presentation of the InterNICHE vision, demonstrations of alternatives, distribution of resources, and support for local humane education initiatives. A 7-week nationwide speaking

tour of India in early 2003 also allowed the distribution of 1200 copies of *from Guinea Pig to Computer Mouse* to teachers and students of dozens of institutes from cities across the country. In the same year, two Japanese veterinary students visited all of Japan's veterinary universities to speak and present a range of products from the InterNICHE Alternatives Loan System, exposing most of the country's veterinary teachers to alternatives, many for the first time.



Using the Loan System and the skills of local trainers, over 400 university educators were trained in alternatives and animal welfare in 2004 at seminars in over 10 cities across India. This project was organised by InterNICHE in conjunction with the World Society for the Protection of Animals (WSPA) and many committed local organisations and was the first of its kind worldwide that provided training at a national level. The Multimedia Exhibition at the 5th World Congress on Alternatives and Animal Use in the Life Sciences in 2005 was also organised by InterNICHE using Loan System items, with National Contacts and collaborators as trainers. Further demonstrations and training are planned for conferences and outreach tours in Europe, Latin America, Africa, the Middle East and elsewhere during 2006 and 2007, beginning with a small exhibition and demonstrations of alternatives at the ANZSLAS/AATA National Conference.

Provision of the above resources reflects the InterNICHE belief in the importance of

catalysing progressive curricular change and of implementing best practice approaches.

Supported by the wide availability of cutting-edge learning tools and by the commitment of many organisations and individuals, the replacement of harmful animal use has been gaining momentum across the world. The multiple positive impact of alternatives means that this replacement is to the benefit of students, teachers, animals and the life sciences. It is a win-win situation.

Until curricular transformation involving full replacement has been achieved everywhere. However, we believe that ethics committees should deny permission for all harmful animal use in education and training. They should also support teachers in effective information retrieval on alternative tools and approaches and on curricular design issues. Student choice policies should be implemented so that conscientiously objecting students are not denied access to superior learning methods. Legislation itself should reflect the widespread availability, existing use and multiple benefits of alternatives by banning harmful animal use for education and training. The *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* requires that alternatives are used wherever possible and it is possible in all practical classes. This is already a start, but only a start. It is a responsibility of ethics committees to make this happen - and indeed a responsibility of teachers, particularly veterinarians, who perhaps have one of the most important potential roles in animal welfare.

Limiting progressive change is a rather primitive dualistic philosophy which tends to dominate modern science and society at times. This creates binary opposites such as 'culture and nature', 'humans and animals', 'science and ethics', 'animal users and animal liberationists'. The maintenance of such a worldview may provide psychological

security for its subscribers, but it is not an honest or imaginative view of reality and its possibilities. Indeed, polarised positions tend to support each other and contribute to inertia and the continuation of problems, rather than provide opportunities for honest communication and progressive change.

I am not saying that there are never any conflicts of interest and certainly freedom for all life will always win for me, in any sphere, when resolution is perceived as impossible. However, a good rule of thumb is that there is always more common ground and there are always more mutually agreeable solutions, than meet the eye. In education, for example, there is a need for veterinary students to perform dissection. The conventional view is that it is a choice between killing animals for dissection, or not gaining the anatomy and surgery skills. But the real solution is the use of ethically sourced cadavers to meet those needs, with no ethical compromise necessary. In this case, the binary opposites of *idealism* (that is, the vision of fully ethical practice) and *realism* (the cadaver requirements for veterinary skills acquisition), have been fully transcended. Vision and practicality are not, after all, mutually exclusive.

This example and indeed this presentation about alternatives in education and training demonstrate how science and ethics can be fully compatible rather than exist in opposition. With the confidence that ethical solutions can and should be found for the vast majority of actual or perceived conflicts of interest, we can look for or build creative solutions and do so in the here and now, which is always the best time to act.



Like many people in Britain, I had ancestors who left for a new life in Australia, New Zealand and the US a hundred years ago or more. One came over here under very interesting circumstances. I understand that my 5x great uncle was George Loveless, leader of the Tolpuddle Martyrs. Along with others he was transported here from England for daring to meet under a tree with fellow farm workers in order to support each other and defend their basic rights. Now such rights are seen by all of us here as normal, as a given.

I think this illustrates how what may seem revolutionary at first can over time become fully acceptable and seen as mainstream. In the case of animal use in education, this shift has already occurred, primarily focused on ensuring more effective acquisition of knowledge and skills, but also for ethical and fiscal responsibility. In much of the world, the alternatives are the norm, and the word 'alternatives' is not even used because these are now the standard teaching approaches. Moving with the times is crucially important to ensure best practice, but we can also choose to be leaders.

The responsibilities that flow from The Australian code of practice for the care and use of animals for scientific purposes - 7th edition.

Elizabeth Grant, AM

Chairman, NHMRC Animal Welfare Committee

Abstract

The *Australian code of practice for the care and use of animals for scientific purposes* (the Code) is in its 7th edition. It is incorporated into animal welfare legislation in all Australian states and territories and compliance with it is mandatory. Other countries have used it as the basis for their own guidelines on animal welfare and it is highly regarded internationally.

The Code provides principles by which researchers, institutions and animal ethics committees are guided. It is not meant to be a prescriptive document; rather it is a self-reflecting process that is backed by legislation.

Like any system of self-regulation (as opposed to government oversight as is the case in the UK), the Code places emphasis on responsibility. Responsibility falls on the shoulders of researchers, teachers, Animal Ethics Committees (AEC), institutions, animal carers and all those involved in the use of animals for scientific purposes. The importance of individuals and institutions meeting their responsibilities is exemplified by the fact that Sections 2, 3 and 6 of the Code focus on, or specifically refer to 'responsibilities':

- **Section 2:** focuses on the responsibilities of institutions and their AECs, with emphasis on establishing and supporting AECs. It outlines the responsibilities of the AEC, the chair and the operations of the AEC. This includes assessing proposals, monitoring the progress of approved projects, reporting on their activities and handling any problems that may arise with the use of animals within the institution.
- **Section 3:** highlights the responsibilities of investigators and teachers that use animals in their work and covers issues associated with the planning, conduct and reporting of work. It outlines responsibilities in areas such as anaesthesia, analgesia, monitoring, care and euthanasia among other things.
- **Section 6:** introduces the responsibilities of teachers wishing to use animals in schools and outlines some of the basic requirements that must be met.

Other issues relating to 'responsibilities' under the Code will be discussed during this presentation and discussion.

Fourth R – Responsibility

Over many years we have identified the 3Rs – Replacement, Reduction and Refinement – as the basis of the Code, and the basis for most of our activities when we use animals for scientific purposes. However, the fourth R – Responsibility – is possibly the lynchpin of the Code because without recognising our responsibility as the overarching factor of

compliance with the Code, institutions, AECs, researchers, animal care staff and teachers will struggle in their day-to-day activities where the care and use of animals is of primary concern.

The Animal Welfare Committee of NHMRC identifies their responsibility in the terms of reference: To be responsible to the NHMRC through the Research Committee, for the

regular review and, if necessary, revision of the Australian Code of Practice for the care and use of animals for scientific purposes (the Code) and other NHMRC documents related to animal welfare. This term of reference sets in place the procedure for reviewing the Code and ensures that there is a process for maintaining and initiating documents under the auspices of NHMRC. Despite Professor Anderson's statement yesterday that the Code would be revised in this triennium, it is unlikely that this will happen.

The Code emphasizes the responsibilities of all who are involved in research and teaching using animals, with specific paragraphs on each.

In section 1 on general principles for the care and use of animals for scientific purposes, we are introduced to the responsibilities of certain groups of people.

Investigators and teachers who use animals for scientific purposes have a personal responsibility for all matters relating to the welfare of animals. They have an obligation to treat animals with respect and consider their welfare in all aspects of their work. Institutions where animal experimentation is undertaken through their AECs must ensure that all use conforms to the standards of the Code. They are required as part of their responsibilities to provide a Statement of Compliance to the NHMRC AWC each year, and fulfil the requirements of the Deed of Agreement with NHMRC, which includes compliance with all NHMRC codes, guidelines and policies.

Scientific and teaching activities cannot commence until written approval is obtained from their AEC, this responsibility flows on to the animal care staff whose responsibility it is to allocate animals for research and teaching purposes. No animals can be allocated until the AEC approval is final.

All acquisition care and use of animals for scientific purposes must accord with the

Code, and all relevant legislation at Commonwealth, State or Territory level.

This certainty sets the scene for all involved to be aware of their responsibilities. The Code then goes on to be very specific about the responsibilities of individuals and groups of people who use animals for research and teaching.

Section 2 of the Code details the responsibilities of Institutions and their Animal Ethics Committees. Looking at institutions in the first instance they must implement processes whereby the governing body is assured of compliance with the Code and legislation – this they can achieve by:

1. Establishing AECs which are responsible to the governing body or its delegate, or if the workload in the institution is small, consider having a formal agreement with an external AEC.
2. Ensure compliance with the Code and legislation.
3. Ensure that those using animals in their institutions are aware of their responsibilities including education and training.
4. Respond to recommendations from the AEC where changes to operations may be envisaged.
5. Address concerns from the AEC, investigators or animal care personnel where non-compliance with the Code is reported. It is a responsibility of the institution to have in place written procedures to deal with non-compliance and grievances related to the AEC process. These procedures must define the reporting mechanisms and responsibilities of all parties to ensure a fair and effective process.

To assist with this, the Animal Welfare Committee is trialling a Non-

Compliance flow chart as a guide to institutions and AECs to provide natural justice and a clear outcome in any non-compliance issue. We are aware, each year, when addressing statements of compliance, of the lack of consistency across the board when issues of non-compliance are dealt with by individual AECs.

6. Ensure that the welfare of animals is a priority for the AEC – this includes some involvement in any building modifications or new facilities for animal housing.
7. Provide guidelines to address any emergency such as fire or power failure and ensure that there is a mechanism for these to be dealt with effectively.
8. Provide AECs with the necessary resources required to fulfil the Terms of Reference, which are identified in the Code. This includes administrative assistance, resources for orientation and education of members and remuneration for members – either a payment or out of pocket expenses. This issue is becoming much more important, where independent members are faced with very heavy workloads and long meetings during a working day.
9. Reviewing, on an annual basis, the activities of the AEC, assessing the Annual Report, and meeting with the Chair at least yearly.
10. Ensuring that the AEC Chair, members and staff are well aware of the policies of the institution regarding the care and use of animals, and guidelines on confidentiality, freedom of information legislation, legal requirements, privacy policy and commercial considerations, including approval of applications which have commercial-in-confidence issues.
11. Implementation of mechanisms to deal with enquiries and complaints concerning the use of animals within the institution, and ensuring all

personnel including students are able to voice concerns without fear of repercussions.

12. Establish procedures for resolution of disagreements between AEC members, between the AEC and investigators or teachers or between the AEC and the institution.
13. Provide information on disease hazards and OH&S issues likely to affect animal care staff.
14. Ensure that facilities have appropriately trained and skilled staff and that there is an adequate number of such staff to carry out the duties required.
15. Provide access to veterinary and diagnostic services.

It is the responsibility of the institution to see that a triennial external review of the institution and the AEC is undertaken. This review should be independent of the institution and should establish evidence that all scientific and teaching activities involving the use of animals are adequately justified, that the welfare of those animals used is given due consideration and that the AEC is effective, taking into account its terms of reference as set out in the Code. The effective operation of the AEC in all aspects of its responsibilities, is central to ensuring that an institution meets its responsibilities under the Code.

The Code Liaison Group is working on a consistent approach to these independent reviews across Australia.

Responsibilities and operation of AECs.

Primarily the AEC must ensure, on behalf of the institution that all care and use of animals complies with the Code. They must also ensure that AECs apply a set of principles that govern the ethical conduct of people whose work involves the use of animals for scientific purposes. They must ensure that all use of

animals is justified, that animal welfare is of utmost importance and that the principles of Replacement, Reduction and Refinement are incorporated.

The AEC must have terms of reference which are publicly available and include provisions which:

- Ensure that the membership of the AEC will allow it to fulfil those terms of reference.
- Approve guidelines for the care of animals that are bred, held and used for scientific purposes.
- Monitor all aspects of the acquisition, transportation production, housing, care, use and fate of animals.
- Ensure that the standards of the Code are maintained.
- Have guidelines which describe the appointment – ie appointment or retirement of members and processes in place to address conflicts of interest.

Describe the approval, request for modification or rejection processes of applications under consideration.

- Ensure that only studies which are essential and justify the use of animals are approved.
- Have a mechanism for withdrawal of approval, for emergency treatment or euthanasia.
- Maintain a record of all activities of the committee, and perform all other duties required by the Code.

A new paragraph to the 7th Edition details the responsibilities of the Chair, who should either hold a senior position in the institution or, if an external appointee, be assured by the institution that the necessary support and authority will be provided to enable the position to be effective and in accordance with the Code.

The Chair must:

1. ensure compliance with the Code and with the policies and directions of the institution;
2. have a process in place to ensure decisions of the AEC are conveyed to applicants in a timely manner;
3. have a relationship with the institution whereby administrative issues are dealt with as a priority including resourcing;
4. oversee all aspects of reporting and review of the operation of the AEC, including maintenance of records and ensuring the availability of such records for such reviews be they internal or external.

AECs have responsibilities for:

- Establishment of operating procedures, including Standing Operating Procedures.
- Setting guidelines for investigators and teachers for the information required, not only to comply with the Code, but also to confirm with any additional requirements which the individual AEC may require.
- Identify the process of assessing proposals, which may be different in each AEC.
- Setting guidelines for monitoring of projects – identifying the responsibilities of the animal facility manager, the investigator or teacher and members of the AEC.
- Establishing requirements for reporting of projects by researchers and teachers reporting of AEC activities to the institution and to the AWC through the statement of compliance.
- Where projects involve more than one AEC, establish procedures that are to be followed.
- Where projects come from non institutional applicants, establish a process which will cover the requirements of the Code, the institution and the institution from whence the application comes. The process must include a formal agreement between the institution and the applicant.

Investigators and teachers have a personal responsibility for all matters related to the welfare of animals they use. The responsibilities begin when an animal is allocated and ends with its fate at the end of the project.

Responsibilities for investigators and teachers also include:

- The level of supervision, and the assurance that the researcher or teacher and their teams have the appropriate skills to carry out the research proposal.
- The proposal complies with the relevant sections of the Code and any special requirements of the institution.
- The activity does not begin until written AEC approval is received.
- If working with another institution, the AEC is notified.
- Arrangements for an emergency, if the researcher or teacher is unavailable.
- Choices of species are appropriate for the scientific purpose to be undertaken.
- Maintenance of records of the use and monitoring of animals used for scientific purposes; these records should be comprehensive and be available for review by the institution and external reviewers.
- Notification of adverse and unexpected effects that impact on animals' wellbeing, advice to AEC on completion or discontinuation of a project, and an annual report to the AEC or more often if it is a requirement of the AEC approval.

Where animals are obtained from interstate or overseas, it is the responsibility of the investigator or teacher to ensure compliance with all requirements governing the import, capture, handling and transportation of such animals.

- It is the responsibility of the institution's investigators and teachers AECs to ensure that facilities are appropriately staffed, designed constructed, equipped and monitored to achieve a high standard of

animal care and fulfil scientific requirements.

- The institution must ensure that supervision of all personnel in breeding and holding facilities have appropriate skills, qualifications and experience.
- To ensure high standards of animal care, it is important to have well trained committed personnel; it is a responsibility of the institution to encourage and promote formal training in animal science and technology.
- The institution is also responsible for the health and well being of personnel who handle animals and regular health checks are recommended in the interest of personnel and the animals.

It is evident that the Code is very clear on the responsibilities of all who are involved in the care and use of animals for scientific purposes – all too often we focus on the 3Rs and forget that without the 4th R, we cannot hope to comply with all aspects of the Code and State and Territory legislation.

Research plays an essential role in the development and wellbeing of our society. The community forms its view on research not only by its outcomes but also by the standards by which it is carried out.

Through integrity, honesty and a commitment to excellence, institutions and researchers fulfil their responsibility to the community, encouraging public support for their research and maintaining their own and Australia's reputation.

This is a quote from the *Australian Code for the Responsible Conduct of Research*. (It is a draft document that is currently revising the joint NHMRC-AVCC Statement and guidelines in research practice, being prepared by NHMRC, AVCC and ARC).

I believe this quote epitomizes the basis of all medical and health research conducted in Australia, including all research using animals.

The use of live animals for teaching purposes.

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Abstract

The use of live animals in teaching programmes for undergraduate students in biology and physiology is always questioned. Many audio-visual teaching aids and computer model systems are currently available to demonstrate scientific theory, but they cannot replace the experience gained through handling and observation of live animals in experimental situations. This is particularly true for behavioural measurements. Therefore, an essential aspect of undergraduate teaching and staff training should involve practical classes where course participants learn to develop a high standard of ethics and care when working with live animals.

In our Faculty of Science undergraduate animal physiology course, we teach humane handling and restraint in cane toads, mice and rats. Students also learn proper injection techniques and how to record basic physiological parameters such as water intake, oxygen consumption and reproductive status. Two important themes of the course are: i) explaining the important role of the *Animal Experimentation & Ethics Committee* in approving any experimental procedure for teaching, and ii) the implementation of the “Reduction and Refinement” principles of the 3R’s. This is achieved in this subject because we teach experimental design to minimize the number of animals used and have developed experiments that require non-invasive behavioural measurements to be taken. In addition, our students learn to develop a proper attitude and respect for the animal at all times during experimentation. Based on feedback from the students, this gradual introduction of using live animals in experiments generates greater student confidence and a heightened awareness of key animal welfare issues in scientific study.

In conclusion, we believe that the use of live animals in undergraduate physiology courses not only makes a significant positive contribution to the teaching of this subject but also influences attitudes on animal welfare. This is achieved when the teaching is of a high standard and the outcomes of the experiments are clear and measurable. It is important that the reasons behind the use of live animals in scientific study are always made clear to the students, and that discussion on moral issues is encouraged throughout the course.

The Australian Animal Welfare Strategy

Allan Sheridan

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Australian Government Department of Agriculture, Fisheries and Forestry (DAFF)

Abstract

One inescapable fact about animal welfare is that everyone has an opinion about it. This could be a consequence of the Australian community's high proportion of involvement¹ and identification with animals.

Arrangements to provide for good animal welfare outcomes across Australia have not been consistent between jurisdictions. This may have arisen from the fact that animal welfare, under current Constitutional arrangements, is a matter controlled by State and Territory governments within Australia. The Australian Animal Welfare Strategy (www.daff.gov.au/aaws) was developed collaboratively over 5 years by the Australian Government with assistance from the National Consultative Committee on Animal Welfare. Contributors to its development include Commonwealth and State and Territory Governments, animal welfare organisations RSPCA Australia and Animals Australia, the Australian Veterinary Association, animal use industries and the Australian public. It received national endorsement in May 2004 and the Australian Government has provided \$6 million as 'seed' funding to assist with its implementation over 4 years, from June 2005 to mid-2009.

The Strategy is based on a national consultative approach and a firm commitment to high standards of animal welfare to build on the current animal welfare framework in Australia. It recognises that animal welfare practices should be outcomes focused and science - based, taking account of social and economic factors and whole of community standards. It provides for greater harmony and consistency across Australia and clarifies the roles and responsibilities of individuals, the community, and industry and government organisations in improving animal welfare outcomes. It is very important to recognise that the AAWS covers animals by virtue of their intrinsic value to Australians, and accepts that we owe them a duty of care as society's needs and activities impact on animals. Its scope includes all sentient animals in Australia, including feral pests.

A stocktake of current animal welfare arrangements has now been completed for each of the six sectors of animals covered by the Strategy, namely:

- animals used for the production of food and fibre and other products;
- animals used in research and teaching;
- companion and guide animals;
- animals used for recreation, sport and display;
- aquatic animals, and
- native and introduced wildlife and feral animals.

Next steps include the finalisation of sectoral and national 'action plans' that detail where collaborative efforts to improve the current state of play under this framework can best be applied by all stakeholders. The presentation will review arrangements currently in place, with some emphasis on the research and teaching sector, and with consideration of 'responsibility' for animal welfare outcomes.

¹ Current estimates are that over 80% of Australians will have a pet at some stage in their life.

Address on Regulation of the Use of Animals for Scientific Purposes

John Braithwaite

Regulatory Institutions Network
Australian National University

One question this presentation will ask is whether it is possible to adopt a continuous improvement approach to promoting animal welfare in science? A related question is whether it is possible to harness the natural systems for the production of science to animal welfare goals, as opposed to creating more and more regulatory structures. This leads to a discussion of the possibilities of triple loop learning under the auspices of the NH &MRC on how to improve and how to craft principle-based animal welfare codes, where principles are brought to life by case studies that demonstrate their application. The ideal of responsive regulation, and of the regulatory pyramid, will be explained and considered for application to the use of animals in science.

Knowing One's Rs from an Elbow: A Chair's View of the 4th R

Richard Herr

Chair, University of Tasmania AEC

It would be a mistake to assume that an animal ethics committee's responsibilities are limited to those arising under the code of practice. The code certainly provides the alpha through its identification of the 3 Rs but it certainly should not be seen as the omega of AEC responsibilities. The 4th R is broader than just the black lettering of the code of practice. One simple way of expressing this is to observe that AECs have obligations not just under the code but to it as well. Arguably, there are a number of obligations that members accept when they take on appointment to an AEC. This brief presentation seeks to identify and review the range of responsibilities that arise across the entire process of securing ethics approval for the use of animals in research.

There are two important caveats to the views advanced in this paper. The perspective from the Chair is necessarily broader than that of other individual members of the AEC but it is scarcely omniscient. The challenge for the Chair is to help the AEC function as an effective team to meet all its responsibilities including those of the Chair itself. In my case, the challenge has the added piquancy of operating "out of theatre" – that is of being a Chair without having been an animal researcher. Hopefully, perhaps, George Bernard Shaw got it right when he observed that "we are made wise not by the recollection of our past, but by the responsibility for our future." In that case, there may be some utility in the views of a non-specialist who has tried to find his way around the 3 Rs to meet the 4th R.

Responsibility: A detachable burden easily shifted to the shoulders of God, Fate, Fortune, Luck or one's neighbour. In the days of astrology it was customary to unload it upon a star. ~Ambrose Bierce, *The Devil's Dictionary*, 1911

Ambrose Bierce may have got it right when he sardonically suggested that it is the human character to attempt to evade responsibility by shifting the blame ["responsibility"] to other forces. Certainly, the phrase "all care but no responsibility" rolls easily off the tongue when an official, clerk or service provider wants to suggest that he will make his best effort but cannot guarantee the outcome. Nonetheless, responsibility is unavoidable whenever discretion is used and the greater the discretion the greater the concomitant responsibility. The central problem for animal ethics committees is just how much

discretion do they have and how large a burden of responsibility does this bring with it? The 3Rs define much of the discretion available to AECs but they should not be construed to limit too narrowly the obligations on an AEC. The 3Rs do not sum together to equal the 4th R. It would be a mistake to assume that an animal ethics committee's responsibilities are limited to those arising under the Code of Practice. The Code certainly provides the alpha through its identification of the 3 Rs but it certainly should not be seen as the omega of AEC responsibilities. The 4th R is broader than just the black lettering of the code of practice. One simple way of expressing this is to observe that AECs have obligations not just under the code but to it as well. Arguably, there are a number of obligations that individual members accept when they take on appointment to an AEC and additional extra liabilities they incur as part of a collective decision making process. This brief presentation seeks to identify and review the

range of responsibilities that arise across the entire process of securing AEC approval for the use of animals in research from the perspective of the Chair.

There are two important caveats to the comments advanced in this paper. The viewpoint of the Chair is necessarily broader than that of other individual members of the AEC but it is scarcely omniscient. The challenge for the Chair is to help the AEC function as an effective team to meet all its responsibilities including those of the Chair itself. In my case, the challenge has the added piquancy of operating “out of theatre” – that is of being a Chair without having been an animal researcher. Hopefully, perhaps, George Bernard Shaw got it right when he observed that “we are made wise not by the recollection of our past, but by the responsibility for our future.” In that case, there may be some utility in the views of a non-specialist who has tried to find his way around the 3 Rs to come to terms with the full implications of the 4th R.

The 4th R as Administrative Obligations

In many ways, the Rs in *Robert's Rules of Order* summarise the Chair's responsibility to the committee. Meetings must be run in a way that is fair and efficient. This may sound reasonably simple but anyone who has suffered through an inefficiently run meeting or who feels they were denied the opportunity to have an adequate hearing will recognise the difficulties that failure from the Chair can create. Finding people willing to contribute through participation on an AEC can be difficult enough without driving them away due to poorly run meetings, including wasting their time. It is normal tension for the Chair to have to balance the need to insure all views are heard adequately and still make certain the meeting moves along expeditiously. [At times, this tension can lead a Chair to reflect on new meanings for reduction, replacement and refinement but then I would not be surprised if the same thoughts with a different focus were running through the heads of committee members!]

Making certain that meetings are procedurally correct is just as important to the Chair as ensuring that the meetings provide a satisfactory consultative arena for the members. Decisions of the committee should never be administratively flawed. AECs have a responsibility to the applicants to guarantee that they have received natural justice and substantive fairness. I believe all decisions should be reviewable by the University ombudsman or some similar external process. Thus, it is the responsibility of the Chair to ensure, as far as possible, that AEC decisions will not be challenged on the grounds of an administratively defective process. This duty requires the Chair to have a reasonable grasp of natural justice, the Code and meeting procedure. Capriciousness in applying decisional standards could invalidate even correct decisions if a review establishes serious inconsistencies in the assessment process. No AEC should ever attempt to hang the “all care; no responsibility” sign on its meeting room door. In today's increasingly litigious world, such a sign offers no protection.

A responsibly run meeting goes a long way to protecting the interests of the research institution, the AEC and the applicants. In addition to these and most importantly for all the members of the AEC, procedural rectitude will extend the 4th R to guaranteeing that the 3Rs are appropriately implemented. The welfare of the animals needed for research and teaching can only be adequately protected if the 3Rs are applied in a fair and reasonable way – that is, the members of the AEC, both individually and collectively, meet their responsibility to the Code fully.

The Chair's responsibility to the AEC goes well beyond that of ensuring the procedural fairness and smooth running of committee meetings. A Chair has to front for the committee to protect the integrity of the decision-making processes of the AEC. Unhappily as is expected to be the case today outside this venue, there are those who vilify and harass those who participate in the work of AECs. Thus, it is increasingly the norm to

protect the public exposure of committee members by preserving their anonymity. The consequence for a Chair is a greater obligation to be the public face of the AEC when necessary. I have found this to be such a severe problem overseas that, on occasions, I was unable to speak with fellow AEC Members or Chairs as I had not established my credentials before arriving. This is an unfortunate development, especially for me as a Political Scientist, since it works against the principle of transparency in decision-making. It would not be felicitous for me as a Chair either if it becomes genuinely necessary, but so far it has not been an imposition in Tasmania.

The Chair has a number of other responsibilities on behalf of the AEC. In my case, the Chair has the responsibility of presenting the annual claim for the committee's budget. In the main, this follows a well-travelled path and the University of Tasmania has been highly supportive of the AEC's financial needs. However, this is the occasion when the Chair is able to promote the interests of individual members of the committee by arguing the case for funding to enable members to attend relevant workshops and conferences such as this. I liaise with the University's animal welfare officer and coordinate with the committee's executive officer to ensure the animal houses and other holding facilities are regularly inspected and projects approved by the AEC are appropriately monitored. The same arrangements apply to the responsibility to introducing new researchers to the Code and to underscore their obligations to pursue ethical research with animals and to explaining any changes in the Code or University policy to established researchers.

The Code of Practice [2.1.1 (ix)] requires the Chair to meet annually with the delegate of the governing body (for me, the University) to discuss the operation of the AEC and comment on the AEC's annual report. This is a necessary occasion for the Chair to acquit the work of the committee and to report on

issues and matters of concern from the AEC to the institution. Naturally, it is not the sole opportunity for such communication but being structured into the annual agenda tends to concentrate the mind. I use it as an aide-mémoire in our calendar to invite ideas, suggestions and comments from the AEC as to any matter the committee wishes to present to the University administration. Of course, the Chair then must serve as the conduit back to the committee when the University responds to the issues or concerns raised or, as has occurred recently, reacts to our triennial external review.

The 4th R as Obligation to the Future

The annual meeting with the delegate of the institution (in my case, the Deputy VC for Research) offers one specific opportunity to mobilise the expertise and experience of the AEC to advance the general aims of animal ethics. Some of the more difficult ethical concerns an AEC faces in its regular meetings revolve around moral dilemmas as to the validity of some types of research. That is, sometimes the ethical issue for some members of an AEC is whether the research ought to be undertaken at all. This falls within the policy guidelines of the institution. I cannot pretend this is an easy matter to resolve or that all members will agree on what is general institutional policy and what is appropriately in the discretion of the AEC. However, I believe it is the Chair's duty not only to pass on such concerns to the institution during the annual meetings, but also to pursue the matter on behalf of the AEC if required.

More than this, I believe AECs have an ongoing obligation to monitor the contentious issues revealed by their regular meetings and to pass on any relevant advice or information to the NHMRC's Animal Welfare Committee, to the University, to the researchers and/or to industry on how to advance the 3Rs. This may well be the highest expression of the 4th R and it should never thought beyond the capacity of any AEC. To undertake this task well, however, the Chair must accept the principal obligation for coordinating the AEC's views

and pursuing the ideas advanced in this forum. Under the pressure of time it is easy to temporise and allow the broader ethical issues to be put off until a more convenient time. The time, energy and expertise that all members bring to the approval process are precious, however, and the Chair has some responsibility, I believe, for seeing that as much value is extracted from this as possible. Being part of a positive feedback loop for the legislation and regulations that advance animal welfare is a very important way of value-adding. Such feedback should come from the research institution, the community and the AEC itself.

Last year the Tasmanian Government put out an “Issues Paper” for a review of the *Animal Welfare Act 1993 (Tas)*. As Chair, I headed the sub-committee to draw together the collective wisdom of the AEC to react proactively on two fronts. Initially it was necessary to assess the likely implications of the changes being considered in the “Issues

Paper” and to prepare advice to the University on those matters of importance to the AEC. Secondly, we used the opportunity to feed back into the University response to the State review process advice on improvements to the existing legislation.

Opportunities to engage at this level are rare, of course, and responsibility for the future more often expresses itself through less dramatic but no less meaningful ways. As Chair I am constantly involved with our executive officer, the AWO and the committee in reviewing our procedures, updating forms and finding more imaginative and effective ways of insuring compliance with the Code and the 3Rs.

There is a real responsibility here as it helps to maintain the legitimacy of the animal ethics process in the eyes of the researchers and lecturers who are obliged to approach the AEC each year with their applications.

Perhaps some day we will even be able to eliminate the atavistic but genuine anguished cry of a recent applicant who, when asked for further information, retorted, “*For god sake, it’s only a goldfish!*”

The 3R's – a performance assessment from a Category C perspective

Robyn Sullivan

Abstract

The principle of development and implementation of the 3R's (Reduction, Refinement and Replacement) is a fundamental tenet of the Australian system for the regulation of animal use in scientific research and teaching. In the early adopter States, the principle of the 3R's has been an objective of the regulatory framework now for two decades. Twenty years on, how has this largely self-regulatory system performed against its key objective?

A truly objective assessment of performance is not possible in the absence of a structured and targeted system of performance measurement. However, a subjective assessment by a Category C member with experience across 4 Animal Ethics Committees (AECs) over the past 15 provides a perspective to stimulate discussion.

Positive and negative experiences with Reduction, Refinement and Replacement in the AEC context are reviewed concluding, in the opinion of the Category C representative, there is not only potential to improve our performance in the 3R's but a responsibility to incorporate measurement mechanisms to objectively track our progress in the 3R's.

Formal strategies with measurable objectives to deliver excellence in achievement of the 3R's are now required. The challenge is for researchers, institutions and their AECs - as they each have responsibility for the development and application of the 3R's - to collaborate in the development of a systematic approach within their organisations to facilitate rigorous pursuit of the 3R's. An environment conducive to such initiatives requires a focus on and leadership in the promotion of the 3R's by research funding bodies, federal, state and territory governments.

Responsibilities of Institutions and the Animal Welfare Officer

Denise Noonan,

Animal Welfare Officer, The University of Adelaide

Abstract

Institutions are permitted by governments and the public to use animals for scientific purposes, and are accountable to them for this use. This presentation will briefly summarise the responsibilities of institutions as detailed in legislation, the *Australian Code of Practice for the care and use of animals for scientific purposes* and other animal welfare Codes and guidelines, and outline the strategies used by institutions to ensure compliance. These strategies encompass effective communication, governance, policy-making and operational procedures, audit and risk management.

The responsibilities of institutions, investigators, teachers and Animal Ethics Committees are overlapping and interwoven by the Code of Practice to ensure that animal use is ethical, humane and compliant. This encourages a team approach, and requires involvement and cooperation of personnel from within and outside the institution. Institutions appoint personnel and provide resources to assist the team, such as the Chair and Secretariat of the Animal Ethics Committee, Officers with specific responsibilities for animal ethics and welfare, and persons with veterinary and animal care expertise. The roles and responsibilities of the Animal Ethics Officer/Animal Welfare Officer as members of the team will be discussed. Examples will be given of effective teams in large and small institutional settings.

Institutions are permitted by governments and the public to use animals for scientific purposes, and are accountable to them for this use. The responsibilities of institutions and individuals are detailed in legislation, the *Australian Code of Practice for the care and use of animals for scientific purposes* (“The Code”) and other animal welfare Codes and guidelines. Section two of the Code provides detailed information about the responsibilities of institutions, and their need to ensure and demonstrate compliance with the Code and the relevant State legislation that controls animal welfare and the use of animals for scientific purposes.

The strategies used by institutions to ensure compliance encompass effective communication, governance, policy-making and operational procedures, audit and risk management. Institutions are comprised of a great many individuals and work groups, therefore a team approach to accountability

and compliance is used. This requires involvement and cooperation of personnel from within and outside the institution. The responsibilities of institutions, investigators, teachers and Animal Ethics Committees (AECs) are overlapping and interwoven by the Code to ensure that animal use is ethical, humane and in accord with legal obligations and public expectations.

Institutions appoint personnel and provide resources to assist the team, such as the Chair and Secretariat of the Animal Ethics Committee, Officers with specific responsibilities for animal ethics and welfare, and persons with veterinary and animal care expertise. They also provide resources to support the involvement of government regulators (e.g. licence and other fees, personnel with liaison duties), community and animal welfare groups and the general public (e.g. training and support for AEC members, media and public communication).

The roles and responsibilities of AEC members and the AEC Chair & Secretariat have been discussed elsewhere in these proceedings. This paper will now outline the roles of the institution, the institutional Ethics and Compliance Officer and/or the institutional Animal Welfare Officer.

From the Code, Section 2.2.34:

“Institutions should consider appointing an officer with veterinary, or other appropriate, qualifications who is authorised by the AEC to ensure that projects are proceeding in compliance with the Code and the decisions of the AEC.”

The Animal Welfare Officer is therefore an employee of the institution with day-to-day responsibilities for animal welfare and animal ethics compliance. The details of this person’s responsibilities are determined by the institution and the AEC, rather than the Code. Some institutions have an Ethics and Compliance Officer who fulfils the regulation and ethical oversight role on behalf of the institution. Others may employ a veterinarian to provide veterinary care and advice, and include duties such as oversight of the conduct of scientific and teaching projects and participation in AEC meetings. Usually these institutional Welfare and Ethics officers are involved in an operational capacity, and also manage or co-ordinate other institutional personnel in such a way that the responsibilities of the institution are met.

Responsibilities of the Institution (Code Section 2.1)

The Code provides a detailed list of responsibilities, and these may be grouped under the following headings:

1. Governance, policy & compliance
2. Review
3. Education and training
4. Consultation; and
5. Provision of support and resources

1. Governance, policy & compliance

Briefly, the Code requires that institutions:

- Establish (or access) one or more AECs responsible to the governing body or delegate to ensure all scientific use of animals complies with legislation and the Code.
- Ensure that the AEC approves institutional policies and guidelines for animal care and use, including effective emergency response procedures.
- Ensure that institutional policies are implemented and that projects are conducted in compliance with the Code and the decisions of the AEC.

Institutional policies & guidelines for animal care and use are developed in consultation with the AEC, and authorised by senior management in accordance with institutional procedures. They may be developed by an institutional officer such as the Animal Welfare Officer, an Ethics & Compliance Officer, a policy-making committee, or the AEC Chair and Members.

Institutions need to ensure that their policies are implemented, and that animal use within the institution is compliant. This is a shared team responsibility, however typically there is a procedure and mechanism in place for the institution and the AEC to monitor compliance. For example, the AEC makes decisions concerning animal use, mindful of institutional policies. The AEC Chair and the Institutional Officer member(s) assist by providing information and advice on institutional policy to investigators. Approved projects are then monitored by the AEC, with the involvement of a delegate such as the Animal Welfare Officer in some cases. Both the AEC and the Institutional Officer report to the Institution (refer Figure 1).

- Establish mechanisms to respond to enquiries or complaints concerning animal use, and to fairly resolve disagreements between stakeholders.
- Respond to AEC recommendations and concerns, including disciplinary action of

institutional personnel, to ensure compliance with the Code.

Strategies to ensure compliance with the above responsibilities include:

- The development of effective communication and organisational reporting lines.
- A structure for governance of the organisation, and a mechanism for developing and authorising institutional policies, procedures and guidelines.

Example: Development of Operational Procedures for management of disputes & grievances

The NHMRC Draft Guidelines for management of instances of non-compliance with the Code provide a framework which can be used by institutions when developing their own operational procedures. AECs and institutional officers and managers collaborate in the development of a policy or procedure specific for the institution, based on the NHMRC framework. In some cases, a

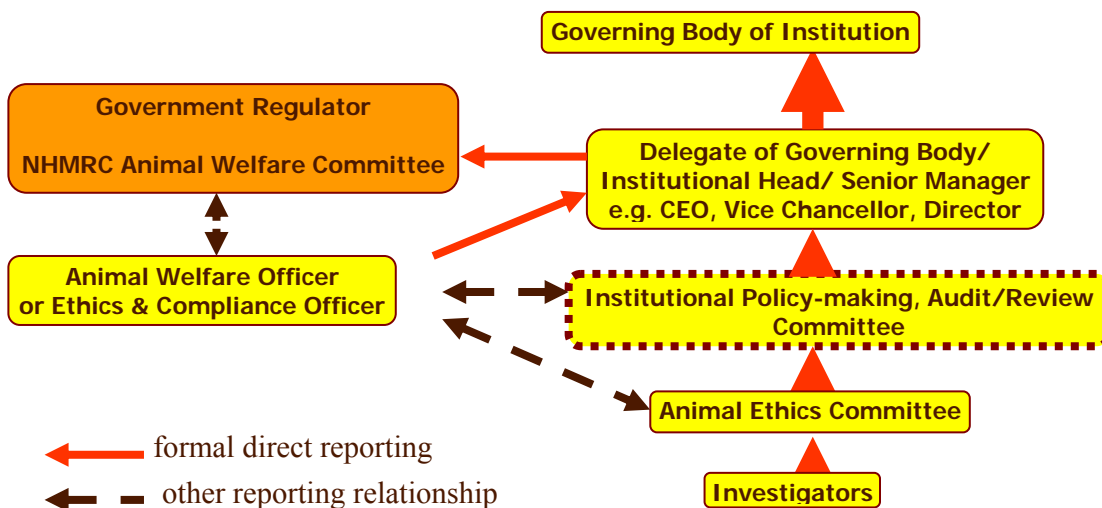
separate policy-making committee may be utilised (comprising members of the AEC, institutional officers and/or managers) to facilitate this process.

Consultation with other stakeholders regarding draft versions of policy documents may be the next step. Institutional policies for dispute resolution, grievance procedures, disciplinary procedures should be in accord with those developed by other sections of the organisation (e.g human resources, quality assurance, research management) and be appropriately authorised by the institution. Once authorised, they need to be widely advertised or made accessible throughout the organisation.

- Promotion within the institution of a Social Responsibility culture.

(N.B. **Social Responsibility:** Where an entity such as a government, corporation, institution or individual has a responsibility to society in addition to their obligations to the law and to their shareholders.

Figure 1: Generalised organisational reporting structure



Corporate social responsibility: a company's obligation to be sensitive to the needs of all of the stakeholders in its business operations. Enterprises accept an obligation to make decisions based on ethical or Sustainable Development Principles, and use Triple Bottom Line accounting when reporting outcomes. **Triple bottom line accounting** means expanding the organisation or company reporting framework for reporting financial performance by also adding reporting on environmental and social performance. (Source: Wikipedia)

- Use of Audit & Risk Management tools
These "tools" are methods of thinking, researching, observing, assessing and recording risks of adverse events. Once recorded, risks can be reported and studied, and decisions made about them. Although generic, these "tools" can be tailored to audit and manage animal ethics and welfare compliance matters. (N.B. **Risk:** often used synonymously with "probability" of a loss or threat. **Risk Assessment:** the probability of an event occurring, combined with the impact that event would have under different circumstances. **Risk Management:** a central part of many organisational strategies to reduce the likelihood of serious loss or adverse events. Institutional reputations that take decades to build up can be ruined through incidents such as corruption scandals or environmental accidents. These events can also draw unwanted attention from regulators, courts, governments and media. Building a 'doing the right thing' culture within an organisation can offset these risks). (Source: Wikipedia)

2. Review

The Code requires that institutions:

- Conduct an annual review of the operation of the AEC, and undertake an external triennial review of institutional animal care and use.

- Undergo an external triennial review of institutional animal care and use, and the AEC. (as detailed in Appendix 1, Code)

3. Education & Training

The Code asks institutions to provide investigators, AEC members and all relevant personnel with education and training in their responsibilities under legislation, the Code and institutional policies on Animal Care and Use, Occupational Health & Safety, Privacy and Confidentiality. Institutional Officers liaise with the AEC and co-ordinate the planning and conduct of the education and training program. Institutional managers and supervisors identify the personnel that require training. Training may be provided in-house, or by external training providers.

4. Consultation

The institution has an obligation to seek comment from the AEC on all matters that affect animals, including building/modifying animal facilities. The institutional Officer has a liaison role which enables them to communicate with other sections of the organization (e.g building maintenance, property management) on behalf of the AEC.

5. Provision of support and resources

The Code requires that institutions:

- Provide the AEC with resources and administrative assistance required to fulfil its Terms of Reference, and operate as set out in Code Section 2.2
- Ensure animal care by providing adequate numbers of trained animal care staff and that adequate veterinary services are available.

Case Study: Training and support for AECs

Institutions can support AEC members by providing:

- Electronic and hardcopy essential reading kits
- timely posting of hardcopy Meeting Agendas

- a laptop computer for electronic Meeting Agendas
- access to internet and intranet training sites
- email discussion lists
- access to use of libraries
- sandwich lunch for long meetings
- reimbursement for out-of-pocket expenses:
- travel & petrol costs, telephone calls, fax & photocopy charges
- honorarium payment
- confidential document disposal service
- AEC Secretariat- telephone advice/assistance/information for Members
- demonstrable support of the AEC by senior personnel
- appreciation of voluntary service of community members

Examples of Training available for AECs available on websites include:

- The Canadian Council for Animal Care (CCAC)

http://www.ccac.ca/en/CCAC_Programs/ETCC/Intro-coretopics-Web11.htm

- ANZCCART

<http://www.adelaide.edu.au/ANZCCART/resources/#AEC>

- Animal Ethics Infolink

<http://www.agric.nsw.gov.au/reader/arrp-education-training/arrp-resources-for-aec.htm>

- State Government/Territory department responsible for animal welfare

e.g Victorian government -Dept. Primary Industries Bureau of Animal Welfare

<http://www.dpi.vic.gov.au/dpi/> **follow link to Animal Welfare**

Other examples would include:

- Provision of institutional support for AEC Members to attend training courses for AECs provided by government regulators.
- Conducting training days & seminars for AECs provided by Institutions, NHMRC, ANZCCART, and Animal Welfare Groups.

Reference: Wikipedia, the Free Encyclopedia.

http://en.wikipedia.org/wiki/Main_Page

Education in Animal Ethics – Our ultimate responsibility

Margaret Rose

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Abstract

The basic tenet of the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* (the Code) is that there is an ethical imperative in our decision as to if and how animals are used in these circumstances.

The Code sets out the principles which provide an ethical framework to guide and inform our consideration of the issues but also identifies the responsibilities of the various parties involved such that the arrangements within which individuals exercise their responsibilities are clarified and processes for accountability are transparent. Further, principally the Code operates in a self-regulatory system so that assessment processes at all levels should be supported by an education program which promotes awareness of the issues and supports the application of the principles of the Code in a critical and informed way.

This paper will argue that the framework for ethical review and the arrangements for responsibility and accountability are intricately linked and must be so if the aims of the Code are to be achieved. Education programs must be directed towards forging an understanding of this link as well as providing the skills and knowledge which will support the responsible conduct of science in this often challenging and difficult area.

Responsibility and Accountability

Arieh Bomzon

National Animal Ethics Committee of Israel

Abstract

The scientific research enterprise is built on a foundation of trust. Scientists trust that scientific results reported by their colleagues are valid. Society trusts that the results of research reflect an honest attempt by scientists to improve the quality of our lives and environment. This trust will endure if those associated with scientific endeavour devote themselves to exemplifying and transmitting the values of ethical scientific conduct.

Those of us involved in research, testing and teaching involving the use of animals have an additional obligation, namely responsible conduct when using animals. Society has granted such individuals privileges that enable them to conduct animal-based investigations without fear of prosecution under animal cruelty laws. Accordingly, legislation such as the Animals (Scientific Procedures) Act (1986) (UK) are referred to as “enabling acts”. They are called so because they guarantee protection of animal users, as well as delineating the conditions and circumstances under which animals can be used, maintained and bred for experimental purposes. In some countries, these conditions and circumstances under which animals can be used, maintained and bred for experimental purposes are delineated in guidelines published by the National Academy of Science, Canadian Council on Animal Care, Federation of European Laboratory Animal Science Associations (FELASA) or Australian Code of Practice for the Care and Use of Animals for Scientific Purposes and other government and non-government agencies.

While these guidelines share considerable information on the housing, care and use of laboratory animals, they are documents that precisely set out, describe and explain the nature, properties, scope and essential qualities of our responsibilities. In contrast, these documents do not implicitly state to whom we are responsible or are accountable.

Many professional organizations, such as lawyers, doctors and veterinarians are self-policing. Therefore, laboratory animal veterinarians can be held accountable by their peers if they are negligent or deficient in the execution of their professional commitment to the care of experimental animals. Moreover, the disciplinary committee of the veterinary profession has the legal right to remove the name of a member and cancel the licence to practice. Scientists who conduct experiments on animals usually belong to a society of their scientific discipline (American Physiological Society). However, these organizations cannot cancel the privilege to conduct or prevent a member from continuing to conduct animal-based experiments in cases of misconduct. Instead, accountability is facilitated by a convoluted process of self-policing managed by the institutional animal ethics committee, funding agencies and journal editors.

Irrespective of the method of self-policing, veterinarians and scientists generally do not want a change in this status quo of self-policing. In fact, some scientists are unlikely to want the present laws to be increased or strengthened and actively resist and fight any new proposed legislation. Despite these desires, society has begun to demand and has succeeded in its quest for accountability in Canada and the United Kingdom through new legislation based upon duty and culture of care.

Preamble

As a practicing scientist for more than 30 years, I have conducted many animal-based research investigations. I have also been actively involved in the regulatory oversight of animal experimentation in an academic

institution since 1985 and more recently, nationally, as a member of the National

Council for Animal Experimentation in Israel. During the course of these activities, I have often had reason to reflect upon the notions of responsibility and accountability and on the whether regulatory oversight enhances the

quality of animal-based investigation. These reflections have prompted three questions:

Question 1: Who are you?

Question 2: Where are you going?

Question 3: To whom are you accountable?

It would be premature to answer these questions immediately; rather, I will first present some thoughts and comments to provide necessary background, and only then give you my answers.

Responsibility

The Oxford Dictionary has a circular definition of responsibility in that the item to be defined is present in the defining clauses: “A charge, trust, or duty, for which one is responsible; a person for whom or thing for which one is responsible”. The Merriam-Webster Online Dictionary defines responsibility in a different way. It maybe a better definition than that of the Oxford Dictionary because it smacks of assigning blame: “liable to be called on to answer” or “liable to be called to account as the primary cause, motive, or agent”. Lastly, Wikipedia identifies different categories of responsibility. Within these various categories, two are relevant to animal experimentation: moral responsibility and professional responsibility. Focusing on moral responsibility, Wikipedia defines it as being concerned with the harm caused to an individual, a group or community by the actions or inactions of another individual, group or community. The term can also refer to a set of principles and judgments shared by cultural, religious, and philosophical concepts and beliefs, by which humans determine whether given actions are “right” or “wrong”. These concepts and beliefs are often generalized and codified and thus serve to regulate the behaviour of members of a group and/or society.

According to Orlans, individuals involved in animal experimentation are classified as

“animal users” and this group of animal users (1) believe animals can be used for product testing, research and teaching; (2) have guidelines by which their activities are conducted; and (3) want to police themselves⁽¹⁾. Implicit in this classification is recognition that animal users have a responsibility towards the animals under their care. In this regard, scientists and their affiliated institutions have recognized that they must act responsibly when conducting animal - based investigations. This responsibility is succinctly stated by Savla: “Informed and well-trained scientists have the privilege, but not the automatic right, to use animals as experimental subjects. This privilege must not be abused”⁽²⁾. It is evident that the term “responsibility” is being used in a different way to that stated in the definitions. Here, “responsibility” refers to the future and says something like “scientists have a duty to act in such a way that the animals are treated fairly and are not harmed”. Accordingly, permissible activities or codes of good practice designed to avoid the abuse of animals, ranging from breeding, humane endpoints, methods of euthanasia, assessment of pain and distress, experimental design, housing, nutrition, occupational health and safety and transport for almost all laboratory animals, together with delineation of responsibilities, have been published in a plethora of guidelines by all regulatory authorities and laboratory animal professional societies throughout the world⁽³⁻²⁸⁾.

Consequently, the co-existence of good science and good animal care is now widely accepted. Accordingly, I propose that the following concept of responsibility has evolved. If scientists can justify their research and comply with the laws / guidelines / recommendations laid down by regulatory authorities, their science will be good because their research animals have good welfare, are more cooperative and are less stressed⁽²⁹⁾. As a result, scientists and their affiliated institutions will be rewarded with (a) **fame** expressed as:

1. Personal recognition by their peers through publication in journals with high impact factors because their science is better than those who did not conduct their animal-based science according to the rules or were inhumane,

2. Frequent flyer miles for the scientists because the scientific audience is now global and they desire to be invited or are invited to publicize their findings, and

3. Brownie points from the non-scientific community because the scientists who use animals are less cruel and wasteful than they we really needed to be,

and (b) **fortune** expressed as receipt of:

1. more research funds for individual scientists to continue conducting their humane animal-based research, and

2. more investment/endowments for the scientific institutions to improve their existing animal care facility in order to maintain disease and stress-free research animals in captive environments.

Accountability

The Oxford Dictionary defines accountability in a circular manner using the word "account" in the defining clause: "liable to be called to account; responsible *to* persons, *for* things". The meaning of accountability in the Merriam-Webster Online Dictionary is similar but adds the phrase "obligation or willingness to accept responsibility" in the definition. Wikipedia presents a better, more general definition that is somewhat vague by stating that accountability is an ethical concept with several meanings that are often used synonymously with such concepts as answerability, [responsibility](#), blameworthiness, [liability](#) and other terms associated with the expectation of account-giving.

Against this background, to whom are scientists and institutions liable to be called to

account? Firstly, scientists and institutions are accountable to the animals themselves. This accountability is affected through a proxy advocate, the institutional animal ethics committee. This committee has the authority to (1) approve experiments before they are commenced, (2) stop approved experiments that deviate from the approved protocol through post-approval monitoring, or (3) immediately terminate when animals are suffering excessive pain or distress that cannot be relieved. Post-approval monitoring is a process designed to ensure that animal experiments have successful outcomes by (1) being the eyes and ears of the institutional animal ethics committee and attending veterinarian (2) ensuring animal well-being, and (3) ensuring regulatory compliance. In so ensuring, the process (1) facilitates the science of animal-based investigation, thereby becoming a resource to the research community and (2) protects the institution by using its findings for public accountability and satisfying societal concerns about animal usage.

Accountability has extended beyond institutional boundaries. In 2003, the editors of the peer-reviewed Journal of Clinical Investigation forced the retraction of a paper published in the journal after they became aware of discrepancies between the institutional-approved and published protocol for animal use. This prompted the journal's executive editor to comment: "Our (scientists) contribution to the scientific public record is built on a foundation of trust and integrity. The community has to be able to trust that the results we report from others are valid. Research journals play a vital role in the advancement of science through certification and dissemination of findings from authors to readers. In essence, journals place a stamp of credibility on data published within their pages, so it is essential that the findings reported therein are not only scientifically legitimate but also ethically sound"⁽²⁾.

In the Anglo-American world, governments are also extending their authority to the

process of accountability on animal use. Bill C-10 in Canada grants animals a status different from human beings and property, and failure to provide adequate care is a punishable offence. The Animal Health and Welfare Bill (Scotland) and the Animal Welfare Bill (England and Wales) are new acts of legislation committed to the promotion of animal welfare and individuals will be required to take preventive action before suffering occurs. These bills have only limited application to animals in research establishments because their welfare is regulated by the Animals (Scientific Procedures) Act 1986. However, these bills align welfare standards for farmed animals with developments in scientific understanding and non-farmed animals which are largely protected by laws formulated in the early twentieth century. In practical terms, the Scottish legislation requires animal owners to care for their animals properly, and seemingly innocent acts that could cause suffering, such as leaving a dog in a car on a sunny day may mean that the dog's owner has failed in his/her responsibility to care for it.

Consequently, a pyramid concept of accountability for individuals involved in animal-based investigations can now be described. If scientists do not follow the laws / guidelines / recommendations laid down by their governments / institutions / animal ethics committees, the science will be bad because the research animals do not have good welfare, do not co-operate and are stressed⁽²⁹⁾. Accordingly, recalcitrant scientists will **perish** because (1) animal ethics committees will make their lives difficult by continuous surveillance of approved projects and not approving any new applications to conduct animal-based research; (2) journals will not publish their animal-based science; (3) their place of employment will encourage them to seek employment elsewhere; (4) institutional and government authorities may initiate/conduct inquiries into their research activities through their offices of research integrity; (5) they will no longer be able to obtain funding for future animal-based

research; and (6) they may be prosecuted under animal welfare acts. Collectively, these measures may result in these individuals ceasing their animal-based research activities or conducting their future research using non-animal alternatives in order to survive.

The Scientist's Perspective – A Personal View

Scientists abhor meddling. Furthermore, they feel that their work is increasingly governed by layers of rules intended to, among other things, protect animal subjects, to prevent misuse of grant funds and to control the use of harmful materials⁽³⁰⁾. As animal users, they do not want a change in the status quo and have, for the most part, convinced regulators and governments that they can and should police themselves⁽¹⁾. Accordingly, it should not come as a surprise that they are unlikely to support any moves to have existing regulations strengthened or increased.

In 2006, Devries and his colleagues reported data from a series of focus groups that described the kinds of behaviours that working scientists believe to be most threatening to the integrity of the research enterprise⁽³⁰⁾. Although the authors were investigating "normal misbehaviour", I believe their findings to be relevant to how scientists view the system of regulation of animal experiments and, in particular, the activities of animal ethics committees. To one of the questions, one responder replied: "If you ask why the rules are being bent, it's, in some cases, because too many rules have been implemented that obstruct you getting the necessary things done . . . there get to be so many rules and you're doing anything you can to dodge around those rules without totally stepping over the line . . . they implement more rules and then there's more individuals that go, like, 'This is a ridiculous rule, how do I get around that?' ".

One should also not forget that scientists have a large stake in supporting the core value that keeps their profession from becoming a guild. A scientist should place the welfare of the animals they use above the welfare of their fellow animal-based scientific colleagues in order to belong to the scientific profession. Failure to rigorously monitor the competence of individual scientists will quickly turn the scientific profession into an organization of mutual aid and protection of its members or a guild.

Extrapolating these comments to the regulatory oversight of animal experiments, I believe that regulators have trained scientists to complete, or they have learnt how to complete, the application forms in such a way as to get approval for their animal-based investigations. As a result, we now have regulatory compliance. However, I am not convinced that we have ideological commitment because I still hear some administrators and members of animal ethics committees referring to recalcitrant animal-based investigators as slow learners, institutional dinosaurs or modern day Luddites.

The Public's Perspective – A Columnist's Opinion and a Personal View

In the June 11, 2006 issue of the Sunday Times (United Kingdom), Simon Jenkins, one of its columnists, published an article called "Don't panic – or our culture of caution will be the death of us". While this article referred to the response of the Metropolitan Police following several failures in their efforts to combat terrorism in London, I would like to make a point in the context of animal experimentation by quoting some key sentences from the article.

"The public have traditionally taken the bonafides of authority on trust"

"The edifice of such trust is crumbling"

"Fewer individuals trust professional competence, be it personal or institutional"

"Saddle any profession with too much intrusion and oversight and it will lose confidence in its own judgements"

"The public will also lose confidence in that community"

"As transparency advances, trust recedes"

"Professional hyper-caution is now an epidemic, raging and choking its way into every corner of research". "Risk aversion has become a professional illness"

Placing these quotations in the context of responsibility, accountability and the present status of regulatory oversight of animal experimentation, laboratory animal veterinarians, scientists and animal carers are individuals who contribute to a better society. The process of regulatory commitment is slowly converting them into risk-averse contractors to a bureaucratic cost centre. If the process of regulatory oversight is allowed to continue, we run the risk that nobody, including those actively involved and the public will believe what the animal-based research community will say.

Finally, scientists who are members of animal ethics committees often complain that the system has become a burgeoning administrative load. In addition, I have heard increasing criticism that animal ethics committees are losing their effectiveness in safeguarding the rights and welfare of laboratory animals because concern with the protection of the animals can no longer be limited to the creation of better systems of surveillance and reporting.

Conclusion

What are my answers to the three questions that I posed initially? I think that I still know the answer to the first. I am a scientist and veterinarian who is contributing to better society. On the second question, I think that we are losing our way and/or sight of our objectives and maybe beginning to suffer from "We're the Pharkaarwee" syndrome. On the third question, I am beginning to think

that there just might be too many regulators and/or too many regulations.

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Training of Animal Users in Research Institutions: a practical review of individual and institutional responsibilities

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Abstract

As the American novelist, Mark Twain, once remarked, “Few things are harder to put up with than a good example”. This paper attempts to present a challenging scenario which occurred at a prestigious research institute. The graduate students working in the research laboratory of a well respected senior scientist seek guidance from the newly appointed Animal Welfare Officer, regarding some sick animals. These experimental subjects have undergone major surgeries. The animal model was developed by the scientist many years previously. As the case unfolds a range of serious concerns and issues are revealed. These lead to a review of both institutional and individual responsibilities.

The confrontation presents difficulties for the institutional officials who are charged with the duty of legislative compliance. And the remedial actions proposed, are not well received by some personnel involved in this drama, as they require significant changes in behaviour and some additional costs.

A summary is presented of the strategies used to ensure that responsibilities are appropriately and formally delegated.

Once upon a time, at the ‘Fletcher Christian Institute of Biological Sciences’, located on Pitcairn Island in the middle of the Pacific ocean, there was a new Animal Welfare Officer appointed. Sally Smith had previously spent the last 6 years in private veterinary practice on Easter Island. She looked forward to working at ‘The ‘Fletch’ as it was fondly referred to by the locals. The institute had a long and infamous history of research into genetically transmitted diseases. One of the more unique features of the island’s fauna is the population of rats; *Rattus pitcairnei* which inhabited the southern end of the island. This species had been bred in captivity by researchers at the Fletch since 1953, when the significance of its mutation was first discovered by Dr William Bligh, the current Chairman of the Endocrinology Department at the Fletch. Briefly, these

animals have a mutation on chromosome 18, which results in a lack of *l*-gulonolactone oxidase. This enzyme is critically important in the synthesis of ascorbic acid from glucose. Essentially, these rats require a source of Vitamin C in their diet, as do guinea pigs, humans, non-human primates, the red-vented bulbul bird and some species of bats. All other species of animals can synthesise Vitamin C without a dietary source.

Dr Bligh had based a long academic career on this mutation and had published widely on its use as an animal model of connective tissue repair. According to Dr Bligh, the species also has other genetic defects which relate to a blood clotting disorder, differential erythrocyte membrane permeability and anomalies of the lens of the eye.

Sally is keen to examine these animals, as she is particularly interested in animal models. Her first exposure to these unique rats occurred following a call from Deepak, a distraught student working in Bligh's research laboratory.

Sally is asked to examine some post operative rats. She observes animals with weight loss, dehydration, distended abdomens and hunched postures, displaying back arching and belly pressing. Some rats also have diarrhoea. These animals had recently had their second surgery. Deepak explains that the surgery is a two-stage procedure, a bile duct cannulation, followed by a thoracic duct cannulation.

'How long have these animals been like this?' Sally asks the student.

'Well it's the diarrhoea that got me worried' replies Deepak.

'What do you make of this back arching and belly pressing?' asks Sally.

'What do you mean- back arching and pressing?' The student is puzzled. 'Well like I said, it's the diarrhoea that's the problem; this back business is just normal for rats - didn't you know that?' Sally decides that now is not the best time to give the "rat pain 101 lecture" to this student.

The anaesthesia used is reviewed. Deepak explains that tribromoethanol (avertin) is given at as a 5% solution at a dose of 300mg/kg by IP injection. 'Anaesthesia out of the Ark', comments Sally sarcastically. But this sarcasm is lost on Deepak; it's the only anaesthetic regime he has ever used. On questioning, it is apparent that Dr Bligh started this anaesthetic regime many years ago and has not changed since.

Apparently this student learned how to make the avertin from the senior PhD student in the lab. Clear bottles are used, in order to see any sediment that might precipitate. They are stored on the window shelf. New batches are mixed up every 4-5 months as needed.

Sally decides to treat the sick animal with fluids, analgesics and schedules a revisit the following day. In the meantime she asks the secretary of the AEC to give her a copy of Dr Bligh's protocol for this study, and plans to read it over night.

The secretary supplies a copy of the protocol. It was approved 5 years ago and provides a comprehensive scientific review of the literature and a broad outline of the scope of the research programme. Specific details of the procedures to be performed on rats are vague and indicate that "rats will be anaesthetised and the thoracic duct cannulated; following recovery from the first surgery, the bile duct will then be cannulated the following week." A number of personnel are listed on the protocol, but not Deepak. Sally hopes to meet some of these named individuals at her next visit.

The following day Sally returns to find the animal no better and decides to euthanase it. Deepak is distressed about this decision. However, Sally is determined and asks Deepak to euthanase the rat. Deepak is about to administer a tail vein injection of potassium chloride solution, when Sally asks, 'what's in the syringe - who instructed you to euthanase rats this way?'

'Oh- that's how we always do it', replies Deepak. Sally fills a syringe with Nembutal, from a bottle which she carries in her pocket and Deepak injects the rat.

Sally performs a post mortem back in her lab. She notices that the laparotomy abdominal skin wound has a foul smelling discharge. Gut stasis, volvulus and torsion are present caused by multiple adhesions in the abdominal cavity.

On the third visit Sally asks to see any other rats that have had surgery. In the back room adjacent to the lab is a small, dimly lit, poorly ventilated area containing 15 cages of rats, all in various stages of post-operative recovery. The smell of ammonia is overpowering and makes Sally's eyes water. She asks the

student 'why aren't these animals housed in the central animal facility at the Fletch, on the other side of the campus?'

'Well', replies Deepak, 'it's a long story, but basically, Dr Bligh likes to keep them in here so we can keep a close eye on them. Actually I think he's allowed to do this - some arrangement with the Dean of the Institute. Anyway, it's much cheaper; do you have any idea how expensive it is to keep them over at that other place?' Sally has to admit that she doesn't yet have any idea of the cost structures.

Determined to establish the condition of the animals in the 15 cages, Sally asks Deepak to bring them into the main laboratory by the window so she can examine them one by one.

The results of the physical examination are discouraging, as many of the rats are in poor condition. Some have wound discharges; all have a red discharge about the eyes, nostrils and a few have a strange red discolouration on the back of the neck. Several appear to be lame and have difficulty moving about the cage. Sally asks to see the monitoring records for all 15 cages. Deepak suddenly realises that he has to go demonstrate at a lab class on the other side of the campus. He shows Sally the record book for the rats in the cages and departs in haste.

Left alone in the research laboratory, Sally is able to look around. The stereotaxic apparatus on a nearby bench is soiled and the ear bars are bent.

Inside the rat holding room on the floor, is a mess of dirty cages and water bottles containing slightly brown water. The cages lack any kind of identification.

The instruments used for surgery are stored in a covered stainless steel dish. Some of the artery forceps have congealed blood stuck in the serrated jaws. Sally can find no containers of disinfectant, or cleaning agents in the lab. The bench sink is stained with

purple dye and rust marks are prominent where the tap drips.

Cockroaches are seen climbing over the rat cages and under the bench.

The post op monitoring sheets are not found. The only records are the date of surgery and initial body weight and treatment group number.

Sally attempts to call Dr Bligh on her cell phone, but is forced to leave a voice message, as he is not available.

Sally administers subcutaneous fluids and analgesics to several rats, washes out the water bottles and refills them. She removes the five most severe cases from their cages into a single cage and leaves a note for Dr Bligh. The note advises that she will euthanase them back at the central facility in the Fletch and report in the following day.

The necropsy findings on the five rats mirror the first case. Except several also have haemorrhages around the joints and particularly around the teeth, in addition to the red staining around the neck, nose and eyes.

Next day Sally visits the secretary of the AEC and asks for a run-down on the way the committee arranges meetings. 'Oh we don't actually meet', replies the secretary, 'we do it all by email- much better that way you know. The members of the committee fill in the comments section of the form. If they want a meeting they just have to indicate that on the form'.

'So tell me', inquires Sally, 'do they ask for a meeting?'

'Oh no', replies the secretary, 'they all seem quite happy with the arrangement. They are very busy people you know!'

'Well I'm sure they are', confirms Sally. 'But isn't there some kind of legislative requirement for the committee to meet? I mean, I'm new to all this - as you may know I've spent the last 6 years in private veterinary practice on Easter Island. The last thing I

want to do is rock the boat here, but it doesn't seem right?

'Well', replies the secretary, 'you obviously haven't heard about the arrangement then?'

'Arrangement? What arrangement are you referring to?'

'Look, I can't help it if they didn't brief you properly - I haven't got time for all this you know'.

'Can you tell me about the arrangement please', demands Sally.

'Well then', says the exasperated secretary. 'The chairman of the committee has approved a special arrangement for certain designated "Centres of Research Excellence" to be operated autonomously. So far we've just got the one'.

'And who might the chair of the committee be?' asks Sally; as the horrible truth starts to dawn on her. 'No wait a minute- let me guess? Dr William Bligh? And the one Centre of research Excellence is his lab right?'

'Exactly so'- beams the secretary, now relieved that this confrontational and irritating, island hopping veterinarian has finally appreciated the finely tuned and well organised AEC machinery, that distinguishes the Fletch.

Now more aware of the political landscape, Sally decides to revisit the Bligh laboratory and arranges to meet Deepak there the following day. Deepak introduces Thomas, who is the senior student in the lab. Thomas is frantically writing his PhD thesis and is not pleased to be interrupted. Deepak figures he might need support for whatever follows.

Sally asks for the monitoring records of the operated rats. 'But I gave them to you the other day' replies Deepak.

'You mean those notes scribbled in the red folder? Is that the best you guys can do?' Thomas interjects: 'But that's all we have ever done- what's the problem? 'Actually monitoring is really not that much of a

problem you see. Anyway, the rats sleep for 3 days following the surgery so we do them on a Friday and check them out on the Tuesday. Generally we do several animals at once and keep them in one cage together so they keep each other warm.'

Sally decides an alternative line of questioning. 'Okay maybe you don't write down all the details, at the least can you tell me how many surgeries, how many survive and what other problems you have been having - I note that laboratory hygiene does not appear to be a priority?'

'Well' admits Deepak 'we typically have a 20% mortality rate, this is normal, but not a problem though- the animal folks just breed us more. Dr Smith says it's a feature of this rat strain. Most problems occur at the second surgery.'

Sally asks, 'I noted some lameness and wound infections, is this normal as well?'

'But it's a known fact that rats are resistant to infections', says Thomas. 'I reckon it's the diet mostly'.

This has Sally suspicious; 'what do you mean by that?'

'Well you know this is a special rat- right? It needs Vitamin C in the diet. Sometimes we get the food mixed up and they get the mouse food by mistake. You know it only takes about 6 weeks for them to develop scurvy?'

'So who is responsible for the rats on a daily basis?' asks Sally. Deepak looks at Thomas and Thomas looks at Deepak. 'Mareva' they say in unison. Mareva is the junior Masters student in the lab, recently arrived from Sydney.

'And who shows Mareva what to do?' asks Sally. Apparently Mareva was trained by Deepak, who was trained by Thomas, who was trained by his predecessor. Dr Bligh did the initial training of his first post-graduate student, but that was 8 year ago.

‘It works surprisingly well’ says Thomas. ‘It’s the; see one, do one, teach one’ system- you know- how medical students are taught?’ ‘So how do you lot remember all these details?’ asks Sally. ‘Do you have SOPs or some equivalent?’ ‘What’s an SOP?’ asks Deepak. ‘Never mind’ replies Sally, now exasperated at these two students.

‘One final question’ asks Sally. ‘The protocol for this rat work doesn’t seem to list you guys at all?’ Thomas is defensive.

‘Now wait a minute, I know I’m on the protocol because Dr Bligh told me he had put me on the list’. ‘Well not on the copy I looked at last night’, replies Sally.

Mareva and Sally meet quite by accident the following day at the student cafeteria. They quickly establish a common interest; underwater hockey. Over a coffee Sally encourages Mareva to talk about her new experience working in the Bligh lab. Apart from Mareva’s opinion that, ‘Thomas is hot,’ she has little positive to say about the scene. Mareva has not developed any allegiance to the Bligh laboratory and talks freely. The training is entirely dependent on the motivation of the student teacher, without any formal guidelines to follow.

Sitting in the outer office of the Dean of the Institute, Sally reviews her list of concerns. She is nervous about her decision to see the Dean. ‘Professor Fryer will see you now’, invites the Dean’s secretary.

‘Well Dr Smith, may I call you Sally? How can I help? I understand that you have visited Dr Bligh’s research lab. Rather impressive don’t you think?’

Sally explains that she has been unable to contact Dr Bligh and given the animal welfare concerns, which she has personally observed in his laboratory, she felt the matter should be referred to the Dean’s office. Professor Fryer

indicates that Sally should take up her concerns with Dr Bligh in the first instance. ‘That’s just the problem’ explains Sally, ‘he’s not around and I can’t contact him and his students don’t seem to appreciate the welfare issues. As a practitioner, I am not very impressed with the culture in that laboratory. I hope this is the exception at the Fletch. We don’t have other labs in the same situation here do we?’ Professor Fryer starts to look uncomfortable. ‘I mean, one starts to question who is responsible for the condition of the Bligh research animals’, Sally adds cautiously.

Professor Fryer explains that Dr Bligh is an international expert in his field and as such he is out of office, away from the island quite a lot. ‘All the more reason for his animals to be cared for within the centralised facility, instead of by students, in my view Professor’, challenges Sally. Fryer is now even more uncomfortable. He is secretly wishing the problem would go away. ‘I must say Dr Smith, that William has always given me assurances that all is well in his lab and that there are no significant problems. After all, he is the chair of the Animal Ethics Committee. I trust you were aware of that fact Dr Smith?’

This fact had not escaped Sally at all. It only added to her misgivings about the problems she had noted so far, and she had only been on campus one week. Sally also noted that the Dean was getting quite defensive and she decided that a new approach was required.

‘Professor Fryer, may I call you John? What we have here is clearly an opportunity to build on the fine research activity of Dr Bligh’s laboratory. There are a number of significant issues, which have surfaced so far. There may be more issues. None of them are insurmountable, but clearly the lines of responsibility need some clarification. I am sure we can work all this out’. John Fryer starts to relax somewhat. Maybe the day will not be a total disaster.

‘Okay Sally’ replies the Dean, ‘what did you have in mind?’

Sally had done her homework by reviewing the Code of Practice for Pitcairn Island and the Animals Research Protection Act 1995, while she was on the ship which transported her to the Island. She was able to quote, quite accurately from this legislation. She thought it would be helpful to toss into the conversation, the Principles of the 3 Rs. ‘The 3 what?’ demands the Dean. While Sally can explain the Russell and Burch principles quite comprehensively, she can see that Fryer is really not interested.

‘Tell you what Sally’ says Fryer optimistically, ‘why don’t you write me a report about all this and I will consider it’. Sally can see such a report disappearing into a bureaucratic black hole. However she has a final strategy to offer. ‘Fair enough John, I will give you a report, but in the meantime, I will continue to euthanase animals that in my opinion, have met internationally accepted humane endpoints, regardless of their perceived scientific value. In fact some of those rats I told you about are so sick, as to be useless for research data.’ The Dean agrees. ‘In addition’, adds Sally, ‘we need to put a stop to any more surgeries performed in the Bligh laboratory, effective immediately. And in my opinion, you can expect ‘it’ to hit the fan once Dr Bligh returns to the Fletch, given his reputation. And I would hope that you can advise him of this course of action. It would be better coming from the Dean, rather than from some new Animal Welfare Officer, that he’s never met.’ The Dean is rather crestfallen, but agrees. ‘Oh, and one more thing Professor’ replies Sally, ‘I got a lovely set of pictures of all those sick rats in the Bligh laboratory!’ As an afterthought, she adds, ‘You know, I think these Centres of Excellence need serious re-evaluation.’

Sally prepares a report as follows:

Professor John Fryer, Dean, Fletcher Christian Institute of Biological Sciences

I write at your request, to present my review the animal care programme at this institution, based on my observations, findings and discussions with a number of personnel during the first two weeks of my appointment to the Animal Welfare Office. Given the short time I have been on campus, please regard this as an interim report in the first instance. I feel sure that additional issues may come to light with time. I have chosen to set out my concerns through a review of levels of responsibility within the organisation. There are several areas which overlap. Some recommendations are suggested for your consideration.

Institutional responsibilities

I have concerns regarding institutional responsibilities. A review of the Code of Practice for Pitcairn Island and the Animals Research Protection Act 1995, suggests that the Fletch does not appear to take the legislation seriously. Evidence for this is as follows:

1. The Act clearly requires the institution to have an annual review of their animal care programme. The records I have had access to indicate that the last review was seven years ago.
2. This institution has committed to the Pan-Pacific Animal Welfare Assurance Programme by giving written assurance that it will provide appropriate and internationally acceptable animal housing facilities for all researchers. In fact, it accepts research grants from the Pan-Pacific Neurological Society, on that basis. I note that a large percentage of the PPNS funding is directed to Dr Bligh’s lab. In my view, the conditions in this laboratory are unsatisfactory and substandard.
3. There appears to be a double standard in respect of animal housing facilities. While the centralised facility at the Fletch is commensurate with international standards, there are a number of small Departmental animal holding units which certainly are not. Dr Bligh’s laboratory unit appears to be the worst case on campus. But there are others which need significant work.
4. Personal arrangements to accommodate the wishes of senior academics appears to be a significant anomaly. For example,

the private arrangement in the Department of Endocrinology is at odds with other Departments which are required to use the centralised facility.

5. The Fletch allows an AEC system to operate in a manner which does not comply with the legislative mandate.
 - a. The committee does not actually meet.
 - b. The committee does not do site inspections
 - c. In my view, the committee has no working knowledge of what is actually going on at the institution.
 - d. Committee membership has not changed in 8 years. While this is not strictly a legislative requirement, it is indicative of the inertia and disinterest, in my view.

AEC responsibilities

I have concerns regarding AEC responsibilities. A review of the Code of Practice for Pitcairn Island and the Animals Research Protection Act 1995, suggests that the Fletch does not appear to take the legislation seriously. Evidence for this is as follows:

1. The AEC has not had a physical meeting for 5 years. All business is done by mail. This mode of operation was not intended by the legislators and is not in keeping with the spirit of the Act- in my opinion.
2. The committee does not appear to be fully informed as to the experimental procedures it approves. This is because the AEC application does not require complete details of animal use.
3. As a direct result of #2 above, the committee is allowing less than acceptable practices to be used on experimental animals. For example, the anaesthetic regimes, approved for use on some animals in some labs are outdated. Current best practice regimes are not in common use.
4. The committee does not visit research areas, as is required by the legislation. In the absence of any other mechanism, the committee cannot claim to know what is

happening within the institution's animal research areas.

5. The addition of new personnel, such as students or technicians to research studies using animals, does not appear to be recorded, tracked or managed in any meaningful way.

Principal Investigator responsibilities

I have concerns regarding Principal Investigator responsibilities. A review of the Code of Practice for Pitcairn Island and the Animals Research Protection Act 1995, suggests that the Fletch does not appear to take the legislation seriously. Evidence for this is as follows:

1. In one major and significant case, a researcher has consistently failed to employ anaesthetic regimes which meet current practice standards. Animals suffer as a direct result, because they are denied the benefits of new analgesic and anaesthetic techniques. This contravenes Section 6.1 of the Code of Practice, which requires researchers to take all reasonable steps to ensure the welfare of animals, in accordance with good practice and scientific knowledge.
2. The training of students appears to be a major concern. I have observed a number of students working with their experimental animals. While these students are clearly well-intentioned, they have been let down by lack of appropriate and relevant training in the procedures required for their thesis work.
 - a. Training appears to be managed by the 'see one, do one, teach one' method. It is a recognized learning system; however, it fails at the Fletch, because the new incoming student is taught almost exclusively by their outgoing student predecessor. There appears no direct instruction from the acknowledged expert. Consequently there is programme drift, with no checks and balances within the system.
 - b. Training appears to be managed solely at the discretion of individual labs. I have witnessed a wide range of training methods for even the most basic of skills.

- Some PI's do this well, most seem to lack the knowledge to actually train their own students.
3. Animal welfare is an area of significant vulnerability at the Fletch. The Code and the Act clearly make the PI responsible for the welfare of their own research animals. I have observed animals without any post-operative pain control. Those researchers performing major survival surgery in rats do not recognize the signs of pain in the rat. Hence there is no incentive for them to consider analgesia. This is compounded by a lack of direction from the AEC on this important welfare issue.
 4. The monitoring of animals following experimental surgery appears quite variable. One particular lab doesn't monitor animals for the three days they take to recover from general anaesthesia. Again this is the responsibility of the researcher.
 5. The use of students as cheap labour, *in lieu* of full time animal care technicians is false economy and inappropriate. Students are seldom committed to the welfare of the animals, and oftentimes resent the work load. They quite rightly have other priorities.

Suggested recommendations:

1. Fletcher Christian Institute of Biological Sciences should draft and then implement a number of policies in respect of animal use for experimental purposes. These should cover the key areas of:
 - a. Veterinary care
 - b. The use of centralised animal housing facilities
 - c. Analgesics and anaesthetics to control pain
 - d. Euthanasia methods
 - e. Training of students in experimental techniques
 - f. Monitoring of animals while on research
 - g. Operational performance of the Animal Ethics Committee
2. The research procedures performed in Dr Bligh's laboratory should be stopped immediately. All subsequent surgeries should be performed within the centralised animal facility under the supervision of an experienced surgeon.
3. Students working in the Bligh lab should receive appropriate training in surgery, anaesthesia and pain management, before being allowed to operate on any more animals.
4. The animal housing 'arrangement' in Bligh's lab should be withdrawn immediately and all animals housed in the central facility.
5. The AEC should be reconvened with additional new members. Any existing members, who wish to withdraw, should be given the opportunity to do so. I suggest that some younger new researchers from the other Faculty be engaged.
6. The appointment of an alternative chairperson should be made within the month. Dr Bligh should be invited to remain on the committee.
7. The AEC should arrange to meet on a regular basis. My estimation is that meetings every two months would be sufficient. The meetings should be formally recorded.
8. A training programme should be set up and a budget assigned to ensure that all eligible personnel attend some training, appropriate to their requirements. I would suggest some kind of modular training, designed to cope with the range of training needs.
9. An Animal Facility Working Party should be established, with representatives from all the Departments using experimental animals. The manager for the centralised facility should be an ex officio member of this group. The working party should hold a series of seminars around campus to review how the Fletch will ensure compliance with the Code and the Act.
10. All researchers should be required to attend one of these seminars.
11. The Animal Welfare Office can assist with training as long as a realistic budget is agreed upon.
12. Institutional finances are not my concern, however, I would offer the view that attendance at training should not be optional and that the cost of this training should not be a limiting factor. In my opinion, training is simply an institutional overhead which must be covered.

I have provided a detailed list of my concerns regarding the Bligh case in Appendix A, for your information. If I can provide any further information please feel free to contact me. Thank you for the opportunity to comment on these areas of vulnerability. I look forward to working with your office on these important issues of

responsibility. I will be pleased to show you photocopies of the clinical cases of *Rattus pitcarine* at your convenience.

Sincerely
Dr Sally Smith

Appendix A:

A summary of problems identified at the site visits made to Dr Bligh's laboratory and assigned level of responsibility for these problems.

#	Issues	Student	PI	AEC	Institution
1	Lack of post-op pain control	√	√	√	√
2	Unable to identify signs of pain	√	√		
3	2 major surgeries without sufficient recovery time between	√	√	√	
4	Outdated anaesthetic, incorrectly mixed, should not be used for survival surgeries, inappropriate dose rates	√	√	√	
5	Euthanasia with KCl by iv route is inhumane in conscious animals	√	√	√	
6	Lack of post-op monitoring	√	√	√	
7	Septic surgical wounds –suggests lack of appropriate aseptic techniques	√	√	√	
8	Student erroneously believes rats are resistant to infection	√	√		
9	Lack of appropriate veterinary care for sick rats in research lab	√	√	√	√
10	Unacceptably high mortality rate	√	√	√	
11	Unable to recognize signs of stress in rats- red eye/nose discharge with fur staining of the neck	√			
12	Housing conditions in research lab are unsatisfactory		√	√	√
13	Lack of laboratory housekeeping- soiled equipment- cockroaches		√		
14	Lack of disinfectants in lab		√		
15	AEC does not meet as required			√	√
16	Lack of detail on the AEC form			√	
17	AEC does not visit labs as required			√	√
18	AEC committee membership stagnant			√	
19	Lack of training for students		√	√	√

Disclaimer:

This paper was written to discuss and illustrate issues relating to the 4th R; 'responsibility' in the context of a tertiary research institute. All characters and institutions in this paper are fictitious and any resemblance to real persons, living or dead is purely coincidental.

Responsibilities of NSW schools using animals.

Sally Bannerman

NSW Schools Animal Welfare Officer

Schools like other institutions in NSW that use animals for the purposes of teaching, are required to comply with the Animal Research Act. Institutions that use animals for the purpose of teaching must be accredited with the NSW Department of Primary Industries (DPI) as animal research institutions and have access to an animal ethics committee.

To ensure this compliance the NSW Department of Education and Training (DET), the Catholic Education Commission (CEC) and the Association of Independent Schools of NSW (AIS) have established the Schools Animal Care and Ethics Committee (SACEC) for monitoring the use of animals for teaching and research purposes in their schools. There are approximately 3500 schools in NSW that may use animals for teaching and research purposes.

The Animal Research Regulation sets out special conditions in relation to the use of animals in schools. These conditions are interpreted for teachers in the document, *Animals in schools: Animal welfare guidelines for teachers*. This document provides five categories of activities, specifying who can use the animal and in what way, so that the welfare of the animal is protected. Each activity must be linked to an appropriate educational objective.

In general the nature of animal usage in schools is low impact, teaching students the skills of observation and responsibility for the care of animals, e.g. keeping a pet in a primary classroom, or teaching livestock husbandry procedures, e.g. high school agriculture.

Teachers keeping native animals (mostly snakes and lizards) require SACEC approval in order to acquire a scientific licence from the Department of Environment and Conservation.

A major challenge for animal welfare in schools is to inform all the teachers who may use animals in their teaching. With approximately 3500 schools and anywhere between 1 and 80 staff members at each school, there are a large number of teachers who need to be aware of the legislation and know where to go to find specific details if required. To assist with this dissemination of information, schools in NSW have been provided with the following:

- *Animals in schools: Animal welfare guidelines for teachers* (2001)
- *Animals in education*- CD ROM based training package (2004)
- *Animals in schools* poster and brochure for primary schools (2004)
- *Animals in schools* web site at www.schools.nsw.edu.au/animalsinschools
- Animal care & ICT in agriculture professional development workshops (2006).

The school context

All of us went to school and many of us have children of our own at school, but what do we know about schools in 2006.

Schools vary depending on their communities but in general schools are given the job of solving the world's problems. The list of topics that schools are often asked to educate students about ranges from literacy and numeracy through to responsible citizenship and personal safety to healthy lifestyle,

fitness and drug education. All this needs to be achieved while preparing students for a fulfilling and appropriate career when they leave school.

Schools are complex environments, as well as teaching such a range of topics, they work with people who vary in age from five through to 18 years old and who come from a diverse range of backgrounds and experiences and have an equally diverse range of expectations and ambitions.

How are animals used in schools?

Animals are used for teaching in NSW schools in broadly four different ways.

- Developing students' skills in relation to responsible animal care and management.
- Developing students' skills in observing animals to enhance their understanding of the behavioural characteristics of species.
- Developing students' skills of investigation where the purpose is to improve methods of animal management or to improve production.
- Assisting student to develop empathy with and respect for animals.

Legislation

In relation to the use of animals, schools in NSW, comply with the Animal Research Act (1985), the *Australian code of practice for the care and use of animals for scientific purposes* and a range of other pieces of legislation, such as POCTAA, the Companion Animals Act and the National Parks and Wildlife Act.

The three school sectors jointly fund the work of animal welfare support in schools including the Schools Animal Welfare Officer and the Schools Animal Care and Ethics Committee (SACEC). This cross sectoral support is provided by the:

- NSW Department of Education and Training (DET)
- Catholic Education Commission (CEC)

- Association of Independent Schools of NSW (AIS).

Approximately 3,500 schools in NSW may use animals for teaching and research purposes. DET and CEC schools are accredited through their organisations while independent schools individually seek accreditation from the Department of Primary Industries.

Each school must be issued with an Animal Research Authority every year by the SACEC.

The Animal Research Regulation sets out specific conditions in relation to the use of animals in schools. The SACEC, in consultation with the ARRP, prepares a list of approved activities that link each procedure with an appropriate educational objective. These approved activities are classified into categories according to the level of impact on the animal.



School performances by outside agencies that have animals as part of their exhibits – category 2 activity



Mustering, drafting, capture, restraint and handling of non-free living domesticated animals – category 2 activity

The Animal Research Authority permits;

- Student participation for activities in categories 1-3
- Teacher demonstration only, for activities in category 4
- Student participation for collection, observation and release of tadpoles (frogs).

Written approval from the SACEC must be sought prior to:

- Students carrying out category 4 or 5 activities
- Teachers demonstrating category 5 activities
- Teachers or students carrying out any activity that is not on the approved list.



(a) Non-invasive measurement of body weight – category 2 activity (b) Castration of immature lambs - category 4 activity

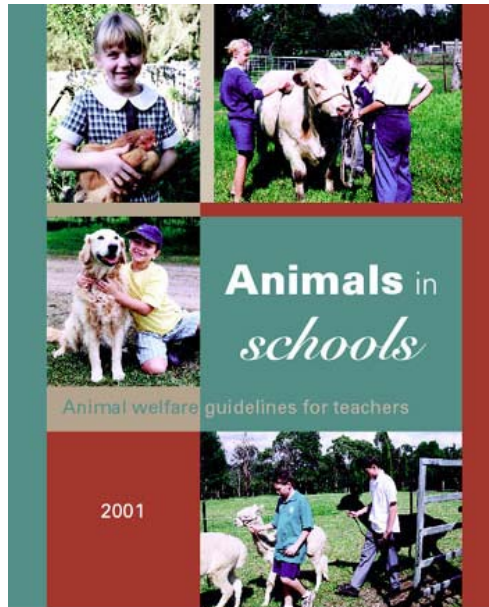
Challenge of animal welfare in schools

There are approximately 3,500 schools, spread throughout the state, with between 1 and 80 staff members at each school. These large numbers of teachers need to be aware of the legislation and know where to go to find specific details if required.

This is done by providing information that can easily be updated and is accessible to all.

Animals in schools: Animal welfare guidelines for teachers

- Interprets the legislation
- Describes the roles and responsibilities of all personnel associated with animal usage
- Provides a list of approved activities and their categories
- Provides information about issues that commonly arise
- Provides species notes for those animal species that are considered suitable for use in schools and are commonly used for teaching and demonstration.



Animals in education



- CD ROM based training package
- Self assessment exercise that allows the teacher to gain certification
- Sections designed for primary teachers and secondary teachers.


Animals in schools poster and brochure

- Targets primary schools
- Promotes awareness and discussion about the care and responsibility for animals
- Informs both students and teachers



Animals in schools web site

www.schools.nsw.edu.au/animalsinschools




Animals in Schools


▶ Compliance Process ▶ Species Information ▶ Application Forms ▶ Resources ▶ Legislation

The purpose of this web site is to assist schools to satisfy the requirements of the *Animal Research Act 1985* (NSW) and the *Australian code of practice for the care and use of animals for scientific purposes*. This advice applies to all schools of the NSW Department of Education and Training, Catholic Education Commission and to those participating schools of the Association of Independent Schools of NSW.

Navigate the web site using the five buttons in the blue bar.



Animal welfare in agriculture
New Agricultural Technology teaching materials



Australian native animals
Find out about recent changes to licences for keeping native animals.

Professional development workshops

- In 2006 professional development workshops for teachers are being held at various locations around the state
- Developed to assist teachers:
 - Gain a greater understanding of sound animal welfare practices
 - Explore teaching strategies that may be used when dealing with ethical, welfare and legal issues related to the use of animals in agriculture
 - Become familiar with the *Animal welfare in agriculture* teaching web site materials
 - Become familiar with a variety of online resources suitable for use in teaching agriculture.

- Managing the work of the SACEC
- Developing resources
- Carrying out inspections.

Schools Animal Care and Ethics Committee

- Meets six times a year
- Considers applications for category 4/5 activities and scientific licence approvals
- Reviews applications from independent schools
- Inspects approximately 16 schools each year
- Provides advice to the school sectors
- Investigates complaints.

Schools Animal Welfare Officer

Full-time officer support teachers through:

- Phone calls and email advice
- Visiting schools to speak at staff meetings and professional development days
- Investigating complaints
- Providing advice to other directorates of the DET, the CEC and independent school principals
- Liaising with the Board of Studies, DPI, DEC, DLG, Ministry for Police, RSPCA and Animal Welfare League
- Correspondence

The Role of Government in Animal Based Research and Teaching

Deb Kelly

Manager Animal Welfare Department for Environment and Heritage SA

Abstract

The Objective of Government

The broad objective of government in any context is to ensure that the social, economic and environmental benefits of an undertaking outweigh the costs. In this context, “social” includes human and animal health, safety and welfare.

The Aims of Government in Research and Teaching

To meet this overall objective in the field of animal based research and teaching, governments, researchers and the public expect that:

- Animals are not used unnecessarily for scientific purposes;
- The learning or research outcomes achieved are valid;
- Directly or indirectly those results have a positive triple bottom line benefit;
- The animals that are used are treated appropriately and with consideration; and
- The public can be assured that these aims are being achieved.

The Factors that Matter

The public (in general) has confidence in government monitoring, legislation and external review as quality assurance measures. However, the factors that influence every day life for the animals used for scientific purposes are the attitude, skill and facilities of the animal house and research personnel.

Good animal welfare starts at the local level. Good public confidence starts at the government level. Somewhere in the middle is the Code of Practice for the Use of Animals for Scientific Purposes. It provides the link between the government and the researchers and guides both institutional and government policies and procedures.

Conclusion

Governments cannot monitor and oversee every interaction with every animal. Intervention will be after the fact. The factors of greatest importance to the animals are those not in the public eye or mind. Institutions and their staff ensure the quality of life of the animals. Governments and other external authorities set the standards and provide the public assurance that they exist. True animal care is the responsibility of those who use and manage the animals.

This leaves the question of prioritisation. Where should government and institutional resources be directed? The animals would benefit if they were directed locally, the public assurance would be enhanced if they were directed at the factors more visible to them. Both governments and institutions must strive to balance the interests of the animals and those of the public.

Napoleon Bonaparte once said that he planned every campaign in detail and then decided what to do when he got there. I am taking his advice today. Previous speakers have covered many of the points I had planned to discuss in my presentation and given the hour and the fact that we are

running behind time, I have decided not to bore you with the presentation I had prepared, but rather simply talk to you about the role of government in regard to animals in research and teaching.

The Objective of Government

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- The public can be assured that these aims are being achieved.

To understand the role of government, it is important to appreciate a few fundamental principles about law, government and the public service.

There is no such thing as a perfect Act or regulations. The original ideas come from people and the legislation is drafted by people. Law applies to the whole of a jurisdiction so every effort is made to consider every situation which might arise - which is almost impossible. For example, the South Australian Dog and Cat Management Act requires all councils to hold any dog that has been found wandering at large, for 72 hours to give the owner a chance to reclaim their dog. I was in a remote area of South Australia recently and the council had trapped a totally wild dog. It was terrified and nobody was going to claim it. It posed an occupational health and safety threat because

it was wild and it was arguably cruel to keep that dog caged for three days. The Act says that a dog can be killed if, by reason of age, disease or injury it is impractical to keep it. In this case, none of these criteria applied so, by law, it had to be impounded. If my Golden Retriever were wandering at large, that is fair enough. I would be furious if a council impounded her and immediately killed her - but the Act was not written with this wild dog in mind. Now that the weakness has been identified, we are considering ways to amend either the Dog and Cat Management Act or the Prevention of Cruelty to Animals Act to address the situation. People who develop legislation write what they think is right but it is tested in the real world, either through this sort of issue arising or by lawyers interpreting the legislation and testing it in the courts.

The second point about law is that it is the minimum standard demanded by the majority of society. It cannot represent best practice.

Dogs need food water and shelter from the elements, but they really like to sleep on the bed. We can legislate that dogs be provided with adequate and appropriate food, water, exercise and shelter but we cannot legislate that they have to be permitted to sleep on the bed because it is not a minimum standard of dog husbandry. Similarly, the law says that the maximum speed a car may be driven in the suburbs is 60 km per hour. A sensible person would realise that if the roads are wet and slippery and visibility is poor, it is a good idea to slow down - but the law cannot demand that. The speed limit is 60 kph.

Finally, the law is not meant to please everybody all the time. Most people would agree with the 60 kph speed limit - until they are expiated for doing 65 in a 60 zone. The law prescribes a minimum standard of behaviour that society as a whole will accept.

Many people consider the government and the public service to be the same thing. They are not. The government is very similar to a large corporation. It has a Board of Directors, the

Members of Parliament and a Chairman of the Board, the Premier or the Prime Minister. They are elected by the shareholders, who are the electorate - tax payers like you and me. Just like a large corporation, the government has a triple bottom line accounting system. That success or failure is not simply measured in economic results but in social and environmental outcomes as well. Many large corporations contribute to social and environmental outcomes - for example MacDonalDs sponsor the Ronald McDonald House as a community service, which is terrific. The difference between governments and corporations is simple one of emphasis. The government has to do the things that are not commercially viable for anyone else to do. The big ticket budget items for government are health, education, police and social security. Those four probably consume at least 59% of the budget of most jurisdictions. If a private company informed its shareholders that it was going to invest that sort of proportion of its total income on social issues, the share price would plummet. But that is what the electorate expects of government - whilst maintaining a sound economic basis for the jurisdiction. Those functions will never be on a user pays basis, it would be unreasonable to expect the victim of a home invasion to pay for police attendance or for the home invader, if convicted, to pay for his prison accommodation. So, the major difference between government and a corporation is one of emphasis. The corporation shareholders have a primary focus on economic outcomes but expect the company to be a corporate good citizen and consider social and environmental issues, whilst the government's electorate expects it to perform in the social arena first whilst giving due consideration to economic and environmental issues.

The public service is the paid employees of the government. It has two roles. First and foremost, it serves the government of the day. Just like a large corporation, decisions are made by the elected Board members and the staff implements

those decisions. When a party is standing for election, they develop policies. The electorate considers those policies and determines which suit their needs and wishes the best and votes accordingly. When a government comes into power the electorate expects those election promises to be fulfilled and the public service is obliged to implement them. Of course, the public service can make recommendations and the government will usually consider them - but it does not have to do so. If in its election platform a party stated that if elected they would ban helicopters (as a totally random example) and were elected, the public service would be obliged to do everything they can to find a legislative mechanism to ban helicopters.

The second role of the public service is to serve the public. That involves the routine administration of daily life, the maintenance of government assets, helping people and all the other functions that the public service has to do to keep the system ticking over. This concept can be difficult for public servants, particularly in areas such as the environment and animal welfare. Most people who work in these areas are passionately committed. It can be difficult to step back and acknowledge that implementing the policies of the elected government is the highest priority and serving the public comes next.

In this framework the role of government in research becomes more apparent. Every political party has, to a greater or lesser extent, stated that animals must be treated fairly. In every Australian jurisdiction it is legal to use animals in research and teaching if certain conditions, such as adherence to the Code of Practice for the Use of Animals for Scientific Purposes, are met. Therefore, the public service will administer animal based research and teaching and will do all it can to ensure that such activities consider the welfare of the animals at all time. The public service is accountable to the government and the government is accountable to the electorate. The electorate are very interested in animal research and have a right to know,

so the public service has to provide that information to them. This is done through websites, publications, speaking to people, collation of statistics, preparation of annual reports and many other mechanisms.

To Achieve these Aims Government must Work with Institution and Welfare Groups

<i>Animals are not used unnecessarily for scientific purposes</i>		
<i>Government Role</i>	<i>Institution Role</i>	<i>Welfare Group Role</i>
Appropriate legislation Establish oversee AEC's Inspection / Monitoring	AEC support, status, finance Animal Welfare Officer Peer pressure, review	Constructive criticism Participation Promoting alternatives
<i>The learning or research outcomes achieved are valid with bottom line benefit</i>		
<i>Government Role</i>	<i>Institution Role</i>	<i>Welfare Group Role</i>
Prioritisation of funding Funding processes Provision of training	Peer and AEC review Animal house standard Researcher training	
<i>The animals that are used are treated appropriately and with consideration</i>		
<i>Government Role</i>	<i>Institution Role</i>	<i>Welfare Group Role</i>
Legislation Appointment of inspectors AEC appointments	AEC support / influence Animal Welfare Officer Internal policies, SOP's	Constructive criticism Participation
<i>The public can be assured that these objectives are being achieved</i>		
<i>Government Role</i>	<i>Institution Role</i>	<i>Welfare Group Role</i>
Appointment of inspectors Statistics collection Reporting /auditing/ monitoring	Publication of results Transparency of processes Good communicatio ns	Acknowledge improvement Encouraging better techniques

These activities do, in their own right create a dichotomy in priorities and activities as I don't think the provision of annual reports or statistics has any significant impact on the welfare of an individual mouse in an animal house or laboratory somewhere - but it does matter to the public.

Previous speakers have said that the most important factors influencing the welfare of animal used in research and teaching are the skills and experience of the people who handle them. I would disagree. I think the attitude of the animal house staff and the researchers is the most important. We can teach skills and with time experience will be gained, but a poor attitude is much more difficult to change and a person will never be a good animal handler with a bad attitude no matter how skilful they are. We cannot regulate attitude and even if we could, how could we police it?

There is no law that enjoys 100% compliance. I was listening to talk back radio a while ago and a woman was complaining about power black outs. That got me thinking. I have never timed it but I would guess at my house, we have about three hours a years without power. Just say that is the average across the entire power grid. There are 24 hours in a day and 365 days in a year so three hours without power is about a 0.034% failure rate - or looking at it the other way, a 99.966% success rate, which is not bad really. If we want to take that up to 100% we would need to totally duplicate the system and maintain the duplicate so if a storm brought down a power line, or a car hit a power pole, the backup system would click in. That would be extremely unsightly and very expensive. If we want a 100% compliance rate with the law relating to animal use, we would need a police officer in every lab and every animal house. That would be expensive and inconvenient and not an effective use of public money. So maybe 100% compliance is unrealistic and we should be aiming for 99% and committed to continuous improvement.

The government is well removed from the mouse. By definition, reports and audits occur after the event, so they will not prevent incidents from occurring in the first place but can ensure that remedial action is taken such that they do not reoccur. The only people who can ensure that things do not go wrong in the first place are the people at the coal face who are managing, handling and using the animals. Government and legislation cannot ensure that the behaviour of these individuals is always appropriate. Institutions, animal ethics committees, animal house staff and researchers themselves have a far greater capacity to look after the welfare of each mouse. The government has a far greater capacity to ensure that the legislation is right and that the public is provided with factual, unbiased information on the standards and **Animal Influence versus Public perception**

safeguards in place to place a legal obligation on those with the responsibility for the mouse to do the right thing.

The Factors that Matter

The public (in general) has confidence in government monitoring, legislation and external review as quality assurance measures. These are all removed from the factors that really matter to the animals on a day to day basis. The factors that influence every day life for the animals used for scientific purposes are the attitude, skill and facilities of the animal house and research personnel.

	Animals' perspective	Public's perspective	Government Role	Institution Role
Animal house staff	*****	*	TAFE courses	Staff selection/support
Animal House facilities	*****	***	University funding	Funding priorities
Researcher attitude	*****	****		Staff selection/support
Researcher training	*****	****	Undergraduate funding	Post grad supervision and training
AW Officer	*****	*****		Staff selection/support
AEC	*****	*****	Appointment	Section / support
Institution policy	*****	*****		Development and review
The Code	*****	*****	Regulation	Compliance
External Inspectors	*****	*****	Appointment and authority	Cooperation
External Audit	****	*****	Coordination and delivery	Cooperation
Annual Reporting	***	*****	Receipt, feedback, public information	Provision
Statistics	*	*****	Collation and dispersal	Provision and quality assurance
Legislation	**	*****	Maintenance and review	Input into processes and results

Good animal welfare starts at the local level. Good public confidence starts at the government level. Somewhere in the middle is the Code of Practice for the Use of Animals

for Scientific Purposes. It provides the link between the government and the researchers and guides both institutional and government policies and procedures.

The following is based purely on my personal perceptions and is presented to foster thought and debate.

As the importance to the public increases, the importance to the animal decreases.

It seems to me that we can improve compliance by providing staff training; we can improve facilities by improving institutional funding. We can improve enforcement by increasing inspections and other auditing procedures or we can improve public information by upgrading websites, publications, providing seminars and all sorts of other strategies. But resources are limited so it is important to prioritize and use what we have to greatest effect.

There is a genuine desire within government and the institutions to ensure, to the best of our ability, that animals are treated well and there is a genuine desire to inform the public. However, the big question remains, what is

the best way to achieve these goals and where should our priorities lie?

Conclusion

Governments cannot monitor and oversee every interaction with every animal. Intervention will be after the fact. The factors of greatest importance to the animals are those not in the public eye or mind. Institutions and their staff ensure the quality of life of the animals. Governments and other external authorities set the standards and provide the public assurance that they exist. True animal care is the responsibility of those who use and manage the animals.

This leaves the question of prioritisation. Where should government and institutional resources be directed? The animals would benefit if they were directed locally, the public assurance would be enhanced if they were directed at the factors more visible to them. Both governments and institutions must strive to balance the interests of the animals and those of the public.

Responsibility - how do you spell that? Applying ethics to animals.

Dr Erich von Dietze

Manager, Research Ethics, Murdoch University

Abstract

Growing up we are told to “become (more) responsible”, but what exactly does this mean? What is it to be responsible and how do we know when we are being responsible? We are taught that responsibility involves being answerable for the consequences of our actions. Yet, for instance, when teaching my children to drive I have no physical control over the motor vehicle (*I am not doing anything*), but I am held responsible for *their* actions. Parents, doctors and counsellors are commonly held to have various levels of moral or professional responsibility for others. Parents are sometimes held accountable for the actions of their children. A psychologist can be held partly responsible for a suicide if that psychologist could have predicted it and potentially acted to prevent the suicide from occurring. In other words, there are times where we are said to be responsible even for the actions of others.

This leads us, further, to ask: am I responsible for what I *do* just as for what I *do not do*? Am I ever responsible for the actions of others even if I have no direct influence over them? What about the more controversial question of responsibility for any unforeseen effects of my actions (or to what extent am I responsible for the unpredictable)? Furthermore, some responsibilities may be retrospective. For instance, I know that I am responsible for the consequences of my failure to stop at a traffic light; but is the moral responsibility the same for not causing an accident as for not having prevented one?

Approaches to responsibility often assume a direct connection with issues such as our ability to exert at least some direct control over the consequences of our decisions, and with ideas such as accountability, rational conduct, and reasoned decision making. Yes, we also recognize that there is collective responsibility – we have responsibilities as members organisations (or members of AECs), of groups and communities. This raises yet more questions such as how far we as individuals are responsible for the actions of the organisation, group or community as a whole.

Ideas about moral responsibility derive largely from human ethics. How can these be ‘translated’ into animal Ethics codes and practices? In forming our animal ethics we frequently look to the prevailing debates in human ethics for guidance, except that there is some belief that animals hold a different moral status to humans. It is instructive to examine the ideas of moral theorists in this regard.

My responsibility for the animals under my care involves moral obligations. Is my responsibility for a fish in a tank the same as that for a dog or cat? What about my responsibility for a primate? Some of the decisions we make about animals in teaching / research involve euthanasing them. What kind/s of accountability do we have for these life/death decisions? We are told to reduce, refine, replace, but is this really sufficient by way of reasoned criteria to demonstrate moral responsibility?

This presentation will examine a number of issues emerging from the concept of moral responsibility which can illuminate our approach to animal ethics.

Introduction

In this paper I seek to make three key points:

- That the concept of responsibility is inherently complex.

- That the concept of responsibility is probably not a useful ‘4thR’ that we should seriously consider adding to

the current 3Rs - Replace, Reduce, Refine².

- That the concept of responsibility can help us to bind the other 3Rs together and may assist us in making ethical evaluations about animal use in science. ‘

The focus of my comments will be largely on ideas associated with ‘individual responsibility’. While aware of issues around communal, mutual, social and other iterations of responsibility, discussing these would require another paper.

The word responsibly originates from the Latin – *respondeo* – meaning to promise something in return for something else. It relates, in its origin, to the giving of an opinion, advice, decision or answer – for example, giving such a response in court. The idea of promising something in return indicates that the concept of responsibility evolved out of at least two related concepts - the *relationship* we have with the person who is asking for the opinion, advice, decision or answer and the *reason* why we are giving the opinion, advice, decision or answer. In a court of law, for instance, we might be called to give testimony or professional advice due to our knowledge of the person or of the situation under examination; this is the *reason* why we are called to give the evidence. But in the context the relationships we have with the accused, with the lawyers, and with others, we may choose to give this testimony willingly or unwillingly. The German word for responsibility *Verantwortung*, which literally means *to answer*, echoes these origins of responsibility as being answerable for our actions.

Responsibility: A complex concept

Growing up we are told to “become more responsible”, but what exactly does this

² These 3Rs are the cornerstone principles of the *Australian code of Practice for the Care and Use of Animals for Scientific Purposes*.

mean? What is it to be responsible and how do we know when we are being responsible? A common response is that responsibility involves being answerable or accountable for our *actions* and for the *consequences* that flow from them. Yet, there are many things I do where I might argue that I should not be held to account (or at least not entirely held to account) for the consequences of that action. Am I just as responsible for what I *do* as for what I *do not do*? For instance, while preparing food in the kitchen and cutting my finger (I might claim that it was an accident, I did not do it intentionally); or pushing a child on a swing and the swing gives way (it was unexpected, I did not *do* anything to cause the swing to break), or when teaching my children to drive and I have no direct physical control over the motor vehicle but nevertheless bear full responsibility for driver and vehicle. Should I be held equally responsible for the consequences of my lack of concentration as for an accident or equipment failure? To what extent am I responsible for the actions of someone who I am supervising but where I have no direct or immediate control over their actions? In each of these examples I arguably do have at least some responsibility. I might argue that my responsibility can be diminished – by my failure to concentrate, by equipment failure or by my inability to control how someone else behaves. These examples also begin to underline the blurred distinction between moral, legal and other forms of responsibility.

So now we have a much more complex picture, and there are different types of responsibility – moral, legal and others. I have also introduced the idea of diminished responsibility. We also have various layers of responsibility – to ourselves, to others, to employers, to our profession, to the law, to society etc. Each of these responsibilities has some similar features and some that are distinct. On top of this, there are also retrospective responsibilities. Retrospective responsibilities are usually understood to be about the responsibility for things we either did or failed to do and the consequences of

the action or inaction. This, however, raises the further and more controversial issue about the extent to which we can be held responsible for something we did not prevent even if we could have; for instance I did not prevent a burglar from entering my home and he tripped and injured himself while in the house. From here we move on to asking about the extent to which we can be held responsible for the unforeseen or unforeseeable effects of our actions, those things that at the time are entirely unpredictable. In other words, it might be one thing to be held responsible for something within our control but quite another to be held responsible for something that is essentially chance or coincidence. In unravelling the concept of responsibility we need to be mindful of all of these complexities.

I referred above to professional responsibilities. In many cases these are codified through accepted standards such as legislation and codes of ethics. These standards, such as those contained in animal welfare legislation and in the animal ethics code remind us that professionals have specific responsibilities and duties, which require the application of standards often more rigorous and demanding than the standards we ordinarily apply in daily life. This is due in part to the specialist training and the position of trust held by professionals. For scientists, this trust is also about the potential applicability and benefits of their work to the wider community; and as a consequence of this, the community demands high standards of responsibility and accountability.

Responsibility, as a concept, does not exist by or in itself; it exists only within the wider standards that we adhere to. Responsibility must be integrated into the whole network of community, professional, personal, legal, moral and other standards we have.

Responsibility: a closer look

Ethics, as Peter Singer (1993) reminds us, is about the values that guide the decisions we make in daily life. The task of ethics, is to help articulate those values and assist us in assessing and applying them thoughtfully. Thus, ethics require us to think systematically about what it means for us to live in the world and how we interact with it. In broad terms, ethics challenges us to ask questions such as: “What are the norms by which I am to live?” “What should I do in any particular situation?” “How do I justify my decisions or actions?” Ethical or moral thinking is multi-dimensional, and the concept of responsibility is one element of this. However, Wallace (1994) and Lucas (1993) argue that responsibility is not just an element in itself, but that which holds the rest together. It is like the glue that binds contemporary applications of ethical debates, in that it helps give coherence to the whole of the ethical domain.

In the literature there are at least four types of theory about responsibility:

- 1) Actor theories: – here the focus for responsibility lies in the connection between the person and their acts. The emphasis is that we are directly accountable for our deeds.
- 2) Social theories: – here the focus for responsibility is grounded in social practices and is expressed or reinforced largely through praise and blame. The emphasis is that responsibility is located in or expressed through roles and social positions (eg the VC is ultimately responsible under the Animal Welfare Act for the university staff’s management of animal research even though the VC did not do anything personally).
- 3) Relational theories: – here the focus for responsibility is grounded in the event, in or in the encounter with others i.e. it is part of the relationship. This is typically where professional responsibility is taken to reside. A professional (e.g. counsellor or lawyer) has a specific role which regulates their relationship with their clients and which thus

gives specific (and usually codified) responsibilities.

4) Coherence model: – here the focus for responsibility is located in the features of the whole – actor / agent, interaction and context. Under this model, responsibility encourages us to think about the whole moral life, but as a concept in / of itself it does not specify what is good / right etc.

So what then does it mean to be responsible? In the simplest sense, the concept of responsibility follows from the concept of moral duty. Responsibility assumes that we have the capacity to understand and fulfill our duties and that therefore we can be held responsible or accountable – whatever that may mean, in any given set of circumstances.

Let me try to work through the concept of responsibility by developing a scenario. I have brought some highly confidential documents with me to the conference. Having no document shredder handy, I decide to carefully burn them in the bathroom of my hotel room. While I know that it is a non-smoking room, I have not been smoking. Furthermore, there is no smoke detector in the bathroom. Later, in my defence, I will argue there was never any instruction – verbal or written – that I could not burn paper in the room, although common sense *might* suggest that I should have known better than to burn paper in a hotel room. Unfortunately the fire spreads. Perhaps I might agree that I have been foolish, but certainly I would not (or at least not yet) agree that I had committed any offence. What if the fire spreads and damages hotel property – does that alter my responsibility at all? Does it matter whether or not I tried to put it out with the fire extinguisher in my room? Later, when the fire spreads to other rooms and someone is injured or even killed, does this change my responsibility at all? There are two questions of responsibility in this scenario - the initial action of burning the papers, the intention of which was to keep information confidential; and the further responsibility of not taking appropriate action to prevent the fire from

spreading. The consequences of a relatively simple action have unpredictably blown out of control.

In this scenario there are a number of interlinked questions about my moral responsibility, my legal culpability and my ethical accountability. There are questions about what I did, what I did not do or failed to do and what I failed to predict or prevent. The way we resolve these is telling for the concept of responsibility. Some key questions include: “What were my intentions in this situation?” “Were my actions *reasonable*?” “Did my actions match my obligations at all levels?” “Could or should I have predicted the possible outcomes?” “Do I have the ability to understand the consequences of my actions – in other words, do I have sufficient cognisance to be able to be held accountable?” All of these questions have ethical, social, philosophical, legal and other implications. All of these questions, together, point towards my responsibility in this situation. In an instance such as this we often invoke the concept of ‘common sense’: I should have known, as a mature adult that burning paper in my hotel room is an unwise action. In other words, we link the concept of responsibility to other equally complex concepts such as common sense and wisdom.

All I did in this case was to set a small fire. What if it had been on my property in the barn and then spread to the bushland nearby, would my responsibility be any different from setting the fire in a hotel room? I could potentially argue the ‘it accidentally got away from me’ case more strongly? The problem with this entire approach to responsibility is that it is founded on a need to ascribe blame. Once we know who or what to blame, we assume that we have identified where the responsibility lies. We might, however, ask what purpose exactly is there, in ascribing blame (Robinson 2002)³. Should the person

³ Roughly speaking, we seem to have inherited the concept of blame from Roman thought where *pax romana* led to allocating blame, whereas the Greeks focused more on locating praise. It is a bit like one

who pulled the trigger take all the blame? What about the person who sold the gun and the bullet, or the person who manufactured them, or the person who designed and developed them? Are we seeking to ascribe blame to satisfy legal processes, for social change, for influencing gun laws or for some other reason? This idea of purpose or intention is itself, yet another level of complexity as Neurath and others have demonstrated.

In asking the question about responsibility associated with *what* was done, we need to ask the further question: does it matter *who* did it? This brings us back to the point about responsibility by virtue of our role. For example, parents and professionals (e.g. doctors, lawyers or counsellors), are commonly considered have various levels of moral or professional responsibility for others. Parents are sometimes held accountable for the actions of their children. A psychologist can be held partly responsible for a suicide; if that psychologist could have predicted it and if he / she could potentially have acted to prevent the suicide from occurring. In other words, there are times when we can be responsible in various ways for the actions of others.

Schweiker (1995) puts the point well in arguing that there is significant confusion about the meaning of responsibility in our society:

In late-modern Western cultures responsibility is criticized for placing inordinate demands on persons. Yet, the idea of responsibility is also essential for contemporary beliefs about human life and the world in which we live. Oddly enough, contemporary social life requires belief in responsibility in order to sustain its view of the world and

tradition that finds what has gone wrong and who is at fault and another which looks for what is going right and who should be commended.

yet must deny it with respect to basic orienting values. Here is, I judge, the root of moral confusion in current cultures. Beliefs about the nature of agents and the world in which they live and act is inconsistent with the values that persons believe ought to guide their lives (Schweiker 1995:29)

... the problem facing culturally diverse and technologically advanced societies is confusion about which values, norms and beliefs ought to guide our lives at the very moment when human power is expanding radically and in previously unknown ways. (Schweiker 1995:31)

As I have been arguing, responsibility is a really complex concept.

Applying Responsibility to animal ethics

Ideas about moral responsibility derive largely from human ethics. How can these be 'translated' into animal ethics codes and practices? The way the 3Rs (Reduce, Refine, Replace) are currently contextualised in the Code assumes that all efforts are made to reduce the total use of animals in science⁴. The 3Rs further assume that AECs will apply ever stricter standards in their efforts to support the principles towards overall reduction of animal use, working with scientists to achieve refinements and replacements.

The ethical question about using animals for scientific purposes hinges, at least in part, on whether or not animals are moral agents i.e. whether they make independent moral judgements or decisions. Although animals make instinctive choices, whether or not they

⁴ While the number of animals used by universities for teaching purposes is clearly decreasing, rather ironically overall numbers of animals used in research seem to be increasing.

make decisions at all, let alone moral decisions, is controversial. Some may argue that we should include higher order animals, such as primates or dolphins, in the category of moral agents. While these species may have higher order responses, whether they therefore also have higher order reasoning or any of the abstract thinking required for moral decisions remains a vexed question. The problem is that if we concede that *any* animal has moral decision making capacity, then we are on the route towards giving *all* animals at least some moral capacity, which becomes problematic for our desire to use animals in research. Yet, it is wrong to give animals no moral status at all; they are after all living beings and as a consequence of which we have certain moral duties and responsibilities. "...in general, although *we* are morally required to behave in certain ways toward these animals, it would seem inappropriate to hold *them* morally responsible for their behaviour." (Fischer & Ravizza 1998:78, italics in original).

To put it another way, we need to consider whether we have responsibility *for*, responsibility *to* or *towards* animals. The animals in our care do not, ... have responsibility for their actions. The distinction here depends on what moral status we assume animals to have.

A common analogy used in this debate is a case, such as that of a young child so disabled that it has no clear comprehension or understanding, that all experiences are merely momentary physiological reactions. Then we ask why is it considered unethical to conduct experiments on this child where it is ethically permissible to conduct the same experiments on an animal? What, in a case such as this, is the distinction between a higher order animal and a retarded human being? This, of course, is part of the classic argument against the use of animals in science.

Like the young child, the animal is unable to give any consent (let alone informed consent), they are in an unequal relationship with us,

we have direct power over them, they are unable to withdraw consent, they are unable to give feedback, and the like. In other words, the standard criteria we apply for research participation with humans cannot apply to animals. On the other hand, whether we even should apply these ethical criteria continues to be controversial.

The example shows just how vexed and complicated the assessment of our moral responsibility for animals is. If we require that moral decisions are based on the ability to comprehend intellectually, to recognise the nature of the decisions that are required and to respond appropriately, then we need to take the animal's interests seriously and our duty – first do no harm. We recognise that we have moral responsibility for sentient beings, and just as we would recognise a special duty to protect the child in the analogy, so we also have special duties towards animals.

All of this can readily be used to argue that we should not utilise animals for research purposes. Indeed, some philosophers such as Hadley (2005) argue precisely this case. Hadley's argument revolves around consent: It is uncontroversial that it would be wrong to use non-consenting humans as research subjects. Given the physiological similarity between humans and animals it is wrong to use non-consenting animals as research subjects. Since animals are unable to give informed consent, it is thus wrong to use animals as research subjects, regardless if their treatment is entirely humane. "It is just arbitrary discrimination to think it is wrong to use non-consenting human beings but right to us nonhuman animals" (Hadley 2005:1)

However, I argued earlier that there are levels and layers of responsibility and that these are part of our abilities to make informed judgments. There are also distinctions to be made about research. For instance, observational, farm and animal husbandry research which has minimal impact on animals is one thing. Straightforward tests or an effort towards conservation without

endangering other species is also a relatively simple matter. However, medical or surgical interventions are ethically far more complex. In other words, the concept of responsibility may lead us to accept some kinds of research with animals even if we do not accept all kinds of research (indeed, it may lead us to reject some forms of research we currently accept).

One problem, as I have argued, is that we have extended responsibilities even at times where we may not control the direct consequences of our actions - and this applies, I posit, particularly in the case of animals.

The Code identifies responsibility as a key issue. It carefully aligns responsibility with a Duty of Care that demands commitment to the welfare of animals. In other words, the Code aligns responsibility with obligations in respect of others – professional and personal obligations. It assumes that I must be responsible not only for my actions and their consequences, but also for my failures to act, for things I do not prevent. The code makes two interesting statements in this regard: “Investigators and teachers who use animals for scientific purposes have personal responsibility for all matters relating to the welfare of these animals. They have an obligation to treat the animals with respect and to consider their welfare as an essential fact when planning or conducting projects” (Code 1.4). “Institutions using animals for scientific purposes must ensure, through an AEC that all animal use conforms to the standards of the Code.” (Code 1.5)

The authors of *The Australian Animal Welfare Strategy* (2005) make a similar point even more broadly: “All people who have animals in their care have a responsibility to ensure that they have adequate knowledge, training and skills to apply in the protection and the welfare of animals. These people have an enduring obligation to seek expert assistance where necessary to ensure the welfare of animals.” (The Australian Animal Welfare Strategy, 2005:19). The document

argues that by simply being members of the community, we have a responsibility towards animals. In which case, the document suggests that this responsibility is fulfilled through our duty of care towards animals. It indicates that this duty includes the need to “Understand, support, promote and apply animal welfare best practice as it is contained in relevant legislation, codes of practice, guidelines and quality assurance programs ...”. In other words, simply as members of the community we may have some – even if indirect – responsibility for how animals are cared for in every walk of life, including science. We are all responsible together, even if we are not ourselves involved in any research using animals because we stand to benefit from the results of that research.

So, where is all this leading? The concept of responsibility is inherently complex. When we apply the concept of responsibility we should be aware of this complexity and take care to ensure we apply a range of moral reasons in our arguments to justify using animals for any particular project. Suffice to say, by way of a conclusion, the concept of responsibility is a great deal more complex than it appears at first glance and so we need to give it sustained attention. These complexities mean that responsibility will not readily translate into the 4thR, but responsibility is a big part of the glue that holds the existing 3Rs together.

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Developing an Animal Ethics Database system for a National Research Company

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Abstract

AgResearch is New Zealand's largest Crown Research Institute (CRI) and a significant part of its work relates to research involving animals. Studies undertaken, range from simple pastoral grazing trials involving farmed animal species, to the use of more controversial technologies such as cloning and genetic modification of laboratory rodents. AgResearch has a total of 670 professional science staff of which at least half are staff who will potentially be involved in animal experimentation. The company has five main campuses and manages 15 farms nationwide.

There are four regional Animal Ethics Committees all bound by the single AgResearch Code of Ethical Conduct (CEC) for the use of animals in research, testing and teaching. In addition, these committees act as the parent Animal Ethics Committee (AEC), for 30 external companies or consultants who undertake animal-based research. These parented companies have a total of around 250 registered database users.

This paper describes an electronic Animal Ethics database that can be accessed by all AgResearch staff, and by registered users employed by all parented organisations. The system can also be accessed by external AEC members and externally contracted staff. The database is an ASP.Net web application with a Microsoft SQL database platform. It is a parameter-derived questionnaire generator, which allows the design of a range of different tailor-made applications/reports. New forms/reports can be linked or 'parented' of to another already on the database. At various points during processing, automatic emails are generated to relevant individuals reporting on the progress of the application.

There are several levels of security within the system, which contains Application, Reporting, Monitoring and Statistics information as well as SOPs and the administration required for exempted non-veterinary research staff to administer approved Animal remedies and Veterinary medicines. The stringent security procedures maintain the integrity of the database and restrict access to any documents to only those people authorised to view them.

Submission of a project for consideration by the Animal Ethics Committee is blocked until all individuals that are involved in the manipulation and management of animals, statistical analysis of the project and management of the research have electronically signed the document. Animal ethics committees are then able to audit editing changes if a project is required to be re-submitted. The system logs all activity associated with an application within the database once it has been submitted and allows automatic collection of animal use statistics.

Approximately 850 users have used the system since it went live in April 2004.

In the 2005 calendar year the four AgResearch AECs processed 281 AE Applications, 171 modifications to approved applications and 935 reports.

In conjunction with other linked databases, the system provides a sophisticated coverage of document and data storage, retrieval and access that enables a very large volume of Animal Ethics activity to be effectively monitored, assessed and reported on.

Background

AgResearch is New Zealand's largest Crown Research Institute (CRI). About half of the 660 professional science staff and a smaller

proportion of the 330 support staff are involved in experimental work that involves animals in one way or another. The company operates 17 farms with staff being located on 6 campuses (3 North Island, 3 South Island).

A large part of the research involving animals consists of relatively simple pastoral grazing trials for determining the grazing effects on pasture growth and production and/or the effects of different pasture types on the growth, development and physiology of grazing animals. However, some staff investigations focus on more controversial technologies such as cloning and genetic modification.

There are four regional Animal Ethics Committees all bound by a single AgResearch Code of Ethical Conduct (CEC) for the use of animals in research, testing and teaching. In addition, these committees act as the parent Animal Ethics Committee (AEC), for 31 external companies or consultants who undertake animal-based research. These parented companies have a total of 246 registered database users.

The AgResearch AECs consider more than 400 Applications per year, involving some 50,000 animals. The majority of manipulations undertaken by AgResearch staff (~88%), fall within the NZ categories 0 (No suffering) and A (Little suffering). Just under 4% of manipulations fall in the x (Very severe) category, however most of these are related to legislated testing for toxicity levels of marine algae etc. In terms of the species used, the majority are either grazing ruminants or laboratory rodents, but there are also small numbers of invertebrate pests and wild birds used as well, frequently to investigate the efficacy of repellents.

As with all similar institutes in New Zealand, AgResearch is bound by the Animal Welfare Act 1999 part (6) in terms of using animals in experiments. In addition, several other Acts must be complied with and these include: Agricultural Compounds and Veterinary Medicines Act 1997, Animal Products Act 1999, Hazardous Substances and New Organisms ACT 1996, and the Official Information Act 1996. Although Animal Ethics Committees are not necessarily responsible for ensuring compliance with these Acts, the Animal ethics system is the

most logical place to lodge any information that relates to them.

This large and disparate group, and the associated compliance requirements, requires a powerful database system to maintain all of the Animal Ethics data for the company and its parented organisations. To achieve this AgResearch has developed a series of databases. This paper deals specifically with the Animal Ethics Database.

AgResearch's Animal Ethics Database

Requirements

The requirement was for an electronic database that would record all animal experiments and associated information. It had to be designed in such a way that the move from the hardcopy system already in place was as painless as possible.

Most importantly, the database had to provide an audit trail. Under the Act there is provision for all Animal Ethics Committees to be independently audited in order for their "Approval to Operate" to be continued.

All SOPs needed to be lodged in the system so that they could be accessed by any staff, and/or members of the Animal Ethics Committee.

Because of the large number of parented companies using AgResearch's CEC, the database had to be accessible from outside the organisation.

Given this wide usage there were several security criteria that had to be met. Only people authorised to do so can view any application, once approved applications could not be altered and outside users could only access the database on a secure internet connection.

Database specifications

The database is an ASP.Net web application with a Microsoft SQL database platform. It is designed as a parameter-derived questionnaire generator to provide total flexibility, which allows the design of a range of different tailor-made applications/reports. It enables linking or 'parenting' of one application/report to another. At various points within the processing of an application, automatic emails are generated to relevant individuals reporting upon the progress of the application. There is the ability to make 'blog' entries against an application. These "blog" entries are specifically designed to record monitoring notes, comments from the committee, responses from the applicant and anything else that may be deemed appropriate from time-to-time. Supporting documents in a .pdf format may be uploaded to any application or report. Automated analysis instantly provides for the generation of animal use statistics returns to MAF requirements.

The AgResearch Animal Ethics Application Database was designed in-house and within the security parameters it is available to all internal AgResearch users. It is available to authorised external users via a secure portal.

Elements of the Database

The database is an information storage facility, not a word-processing package. Therefore, it has limited formatting and no spell checking capability. Supplementary information that requires specific formatting such as timetables of events, copies of supporting manuscripts, graphs or tables of previous data etc is able to be attached as .pdf files.

Compulsory documents:

AE Application

This contains the full details of the application. The AE Application form is

required to be completed using 'Lay language' and asks questions aimed at obtaining all the information required to comply with the CEC and the Animal Welfare Act.

These include:-

- A description of the aim, experimental design and methods of the proposed work
- A list of any statutory requirements needed for the work to proceed (e.g. ERMA, DOC, NZFSA, etc.)
- A scientific justification as to why the work should be done and what benefits it is likely to produce.
- Justification as to why it is necessary to use animals, and what alternatives have been considered
- Justification of the need to use the specific species, strain or breed of animal proposed
- Details of how the animals will be cared for prior to, during and after the manipulations. This includes detailed information on what traits and behaviours will be monitored and how often the monitoring will occur
- A justification for the numbers of animals used with a requirement for either details of a 'power analysis' or comments and sign off by a biometrician that these are the minimum required to provide statistically meaningful results
- Details of any manipulation(s) that will take place, an assessment of the likely stress or suffering these will cause the animals and details of what steps are being taken to alleviate or minimise this
- Where surgical manipulations are involved the subsequent fate of the animal, the type and levels of anaesthesia and analgesia to be used have to be specified along with details of the post operative care and monitoring
- Where any level of stress or suffering is envisaged, then a list of 'humane study

endpoints' is required. These are points at which the work will be terminated and the animal either humanely euthanased or given the necessary veterinary directed treatment required for recovery. The endpoints must at least comply with those in the NAEAC "Good practice guide".

- The application must also contain a set of contingency plans – detailing what steps will be taken if unexpected situations arise.
- In addition to these animal ethics requirements the application form requires the details of all chemicals, drugs, veterinary and human medicines etc that will be administered to the animals to comply with the requirement of the Agricultural Compounds and Veterinary Medicines (ACVM) Act 1997.
- Finally the form has a list of all personnel involved with a list of their duties and relevant experience. All personnel are required to electronically sign off that they have read and understood the proposal and that they agree to comply with all statutory requirements regarding the use of animals in research, testing or teaching.

Once the application form has been completed and electronically signed off it is submitted to the relevant AEC and its contents assessed at the next meeting of that committee. The committee's decision or further questions are also electronically communicated to all personnel named on the application and once 'APPROVED' the work may proceed. Upon the completion of the work a series of monitoring reports are required.

AE Report A

This is an animal welfare report and must be completed and lodged as soon as the project is finished. In this report any animal welfare issues must be disclosed and discussed. The report requires input from the person responsible for the animals and asks for

information or suggestions on how things could be improved for the animals. It is required even if there are no animal welfare issues.

AE Stats

A separate form designed for easy gathering of statistics of animal use for MAF. A separate form must be completed for each species. These forms are to be submitted with the AE Report A.

AE Report B

A science report that describes the outcomes in terms of the science of the project, that is to be completed within 6 months of the end date of the project. In this report any experimental design flaws must be disclosed, any unusual results reported and any information that might be useful for future work described.

Occasional documents

AE Modification

If there is to be any change to an aspect of an already approved project an AE Modification form must be submitted. This is required for ANY changes made after Approval, including changes of dates, personnel, numbers of animals etc. A Modification is treated in the same way as the original application and must go through the full approval process.

AE Tissue collection

This abbreviated application form is used whenever samples are collected from animals that are euthanased as part of an approved project and tissue is being collected by a person not otherwise involved in the project or if tissue is to be collected from animals at slaughter. The form is to register the fact that the tissue has been collected, and that it did not involve any non-approved manipulations.

This form does not carry reporting requirements.

INTERIM Report

Interim reports may be made by anyone connected with an application, including the committee. Such reports may be requested by the committee, added after a monitoring visit, or be attached by personnel in response to interesting or unusual observations made during the course of the project. These reports are often used as periodic updates on progress of Applications with an approval of longer than 12 months.

AE Complaint

Any person with access to the system who believes that animal welfare is being compromised in a research situation can submit a complaint to the AEC. This is included in the database with all the security and audit trails of any other document. Any member of staff can make a complaint if there are reasonable grounds; they do not have to have any connection with the project concerned. Complaints can also be lodged directly with the AEC chairman or Animal Welfare Officer who will then complete the necessary complaint documents.

Blog Notes

Notes can be added to any of the AE forms by anyone named on the application, or by members of the AEC. These can include the response by the applicant to requests from the AEC or the response from the AEC to information supplied by the applicant or a named person. Notes are added as Blogs.

- There is a dropdown series of headings to indicate what type of note the blog is. These vary from an administrator note (inserted to note any changes made by the administrator) to a Veterinarian note,

which allows the vet to make comment specific to the project.

- Each blog is automatically numbered and logs the name of the person adding it, the type of note and the date.
- When the blog is saved, the database automatically emails the personnel and the chairman and secretary of the appropriate Animal Ethics Committee.

-

Internal Drug Administration Order (IDAO)

So that AgResearch staff can operate under the Royal Society code to the ACVM Act, on the use of human and veterinary medicines in research, testing and teaching organisations, an **IDAO** for each drug that will be administered during the experiment is required. This must be signed by the station veterinarian or animal welfare officer. While this is not an Animal Ethics requirement, it is required for ACVM compliance and the database is the most logical place to store the information.

Using the Database

Document parenting

Once an Application is created, all subsequent documents that relate to that Application (Modifications, Reports, Stats, pdfs etc.) are parented to it as they are created. The original document lists all of the parented information, the current status of all reports etc. and any .pdf files, which are hyperlinked for easy navigation.

Editing

All documents are living until they are submitted. They can be accessed and edited at the applicant's leisure, the same as any other computer file. Each 'page' of the document is filled in and saved separately.

- Some of the administration detail fields are mandatory to ensure that details are captured.
- If an applicant wishes to create a new document that is substantially the same as one previously approved. The complete text of the original can be imported in, to save time, and then edited as appropriate.

Communication

The system supports a set of auto emails that are designed to alert all personnel and/or the appropriate AEC executive members (chair, secretary and animal welfare officer) of the current status of the various documents.

- When a document requires approval by the named personnel they can be notified from within the system that the document is awaiting their input.
- Similarly, when the input has been made the personnel can notify the applicant. When the last signature is received the system automatically alerts the applicant that the document can now be submitted.
- When a document is submitted the executive members of the AEC committees are notified.
- Whenever an AEC decision is made, all personnel named on the document are notified.
- When anyone adds a note/comment or appends a document the appropriate executive committee members are notified.
- In addition the executive AEC members have access to a system which enables them to generate emails to remind applicants about reports that are due / overdue and these are sent out monthly.
- Some parented organisations require sign-off every document by a specified person. The system allows such persons to be added to every document generated by users from that organisation automatically.

Audit

Once an application has been submitted an audit copy is kept. If a committee requires the application to be resubmitted either with changes or answers provided to specific questions the status of the application is changed to 'RESUBMIT' and editorship is returned to the applicant and other personnel. Any changes made under this status can be seen on screen so that the committee can compare them in two ways. Firstly, that any requested changes have in fact been made, and secondly what un-requested changes have also been made.

When an AEC decision on the status of the application is made, a note or comment can be added to the auto email that is sent to the personnel involved indicating any conditions or comments. This decision and note is automatically blogged and recorded.

Committee decisions

When a, AEC decision is made on the status of a project after submission, that decision is attached to the document as a blog.

Each status change generates a standard message indicating reporting times etc. If the committee

- have further requirements these can be entered in a message space.
- When the status is saved an auto email including any extra message is generated and sent to all named personnel.
- The system automatically enters reporting dates against the project when it is approved. These are shown on the AEC page, and can be used later to generate lists of delinquent reporting.

User assistance

The database has an in-built HELP function for every page of every document, as well as

generic HELP features on menu pages. For internal users the administrator has a remote assistance capability, which permits real-time access to any of AgResearch's computers, so that the user can view corrective procedures on-screen.

Security

There are several levels of security inherent in the database that protects the integrity and ability to audit the information lodged.

Accessing the database

All internal AgResearch users can currently access the database. However, to be able to see any document in the database, the user must be named on it. This ensures that the information contained in any application or report is only available to authorised persons.

All external users must have special authorisation to access the system. Their entry into the database is a two-step procedure. Approved outside users can access the system via a secure server. Access to the database itself is then via a personalised password. Once inside the data base, an external user has the same privileges as an internal user.

Protection of database information

When a document is created it is given the status NEW and can be edited by any named person.

Once an application or a report has been 'SUBMITTED' it is locked so that no further editing can be done. The exceptions are that comments or notes can be added to the form at any time and further documents can be attached as .pdf files. These are not removable by anyone other than the administrator.

If a document is required to be edited after it is submitted, the committee can change its status to RESUBMIT. This unlocks the document for editing, and activates an audit

copy that allows the committee to check that only those changes requested have been made.

When the committee is satisfied the project can be given the status APPROVED, CONDITIONAL or PROVISIONAL, it is locked to all editing and cannot be altered.

A project can also be SUSPENDED or TERMINATED. The documents then remain locked and cannot be edited.

An applicant can CANCEL a document at any time prior to it being submitted. In this case it retains the same conditions as a NEW document and can be edited and submitted at a later date.

Electronic signatures

All verification and signatures of acceptance/approval etc are recorded via electronic signatures. The database recognises approved participants by their login and password. Where people without access to the system are mentioned on a form they sign a hard copy of the form, which is then appended to the application as a .pdf file.

Standard operating procedures (SOPs)

Standard Operating Procedures can be lodged in the database, after approval by an AEC, and referred to by an Applicant to save repetition of information in the database. AgResearch users can only see AgResearch SOPs, and parented organisation users can only see the SOPs that are pertinent to their own organisation. In this way, commercially or IP sensitive SOPs are only available to those users authorised to have access to them. To ensure that SOPs remain as they were approved, they are loaded as html files and cannot be edited.

This also applies to Prescription Animal Remedy coversheets.

Administrator changes

Occasionally errors are made. For example a .pdf file can be added to a document

incorrectly. This can be corrected by the administrator on the request of the applicant. From time to time there are staff changes and new personnel must be added to (or removed from) an already approved project in order for reporting conditions to be met, or for Modifications to be linked to the original application.

New personnel can be added by the administrator after an application is approved, if those personnel require access for future work. This access is read only
In all cases a blog note is added to the parent application by the administrator indicating that the change has been made, the date, why it has been made and who requested it.

Reporting

Animal use statistics can be generated in a linked Excel pivot table by a single mouse click. These statistics can be customised to specific organisation, location, species or AEC etc.

Associated tools

Animal Ethics sharepoint site

This site was developed using “Microsoft share point” and provides all AgResearch staff with access to a range of documents including; the AgResearch CEC and associated quality assurance documents; AgResearch policies and best practices related to Animal Welfare, Ethics and the Handling of Drugs etc. In addition, access to a range of National Animal Ethics Advisory Committee (NAEAC) documents and best practice guides are provided along with links to a range of web sites related to animal welfare (including Animal Rights Organisations), alternatives to the use of animals and to MAF and NAEAC journals and other publications.

Another linked “AEC” share point site with access restricted to chairpersons and secretaries of the four AgResearch AECs is

used to store all AEC minutes, reports, animal use returns and other significant AEC correspondence.

The Animal Ethics Gateway site has a direct link to the AgResearch Animal Ethics Database.

Animal Tools ~ drug and veterinary medicine administration

This is a “Delphi software” developed SQL Database used to record all manipulations and drug administrations to all farm animals in AgResearch.

It is used for the collection of the records required for compliance with the Royal Society Code to the ACVM Act in relation to the use of veterinary and human medicines in research, testing and teaching.

It has unique identification for all AgResearch owned farm animals and is linked to the Animal Ethics Application Database. The approval of an application in that database provides “Animal Tools” with an approved AE Application number which allows the farm managers to allocate animals to that specific application.

A reporting function is available that can indicate the status of any individual animal relative to withholding periods for administered drugs and also a summary of drug usage in relation to any application.

OneStop database interrogator

A second computer application sits behind the database. This has the ability to mine the database and generate reports on different analyses of the information contained in it. As with any typical database, the reporting system enables specific queries to be made for different user requirements.

Typical analysis requests include

- listing all the applications made to any or all combinations of the AgResearch AECs
- further limiting this information to specified dates

- listing all applications that pertain to a specified individual user
- generating a list of reports that are due but are yet to be received

Summary

The AgResearch Animal Ethics Application Database caters for the whole of NZ's largest CRI plus registered users from external parented research organisations and individuals. The database went live in April 2004. The titles of all Applications processed by AgResearch's Animal Ethics Committees prior to that date were lodged retrospectively. Approximately 850 users have used the system to date.

The database contains a comprehensive set of documents that provide an Audit and analysis trail for a total of 30 research organisations including AgResearch.

Stringent security procedures maintain the integrity of the database and restrict access to any documents to only those people authorised to view them.

In the 2005 calendar year the four AgResearch AECs processed 281 AE Applications, 171 modifications to approved applications and 935 reports.

In conjunction with the other linked databases the system provides a sophisticated coverage of document and data storage, retrieval and access that enables a very large volume of Animal Ethics activity to be effectively monitored, assessed and reported on.

Development of responsible recreational fishing and fish handling practices

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Abstract

The number of people who go fishing for recreation is increasing in most parts of the world. For example, the Western Australian Department of Fisheries estimate that the number of people fishing in that state has increased from just over 600000 to approximately 700000 over the last decade. This increase in people fishing is made up entirely of people fishing from boats, indeed the number of shore based anglers has fallen. Concomitant with this increase in boat anglers has been an increase in the availability and use of sophisticated depth sounders (fish finders) and Global Positioning Systems (GPS). Thus, not only has there been a large increase in the number of boat anglers but also an increase in their efficiency, with a recreational angler now being able to find fish holding habitat and aggregations of fish with his/her sounder and then accurately mark the spot on a GPS unit and return to the spot time and time again. Faced with the dilemma of increased fishing pressure managers have implemented many reforms to fishing rules that are aimed at ensuring the sustainability of stocks. Two major tools used are lower bag limits and changes to size limits, the latter may be simply the increase of the minimum size permitted to be kept or the introduction of slot limits where the aim is to ensure that not only do fish get to breed at least once but larger more fecund fish are protected. Another common approach to minimizing the impacts of recreational fishing on sustainability is through the adoption of catch and release fishing where anglers either retain no fish or only enough fish for their immediate needs, i.e. they do not fish for the freezer but for the sport. Such practices are now increasingly promoted by Recreational Fishing Advisory and Representative bodies (e.g. Recfish Australia and Recfishwest), angling clubs (e.g. Australian National Sportsfishing Association and Australian Anglers Association) and in the media (e.g. Rex kissing fish). However, whilst all of these measures are laudable in their attempts to maintain fish stocks, what about the welfare of individual fish? In this paper we report on several projects funded by the Fisheries Research and Development Corporation that include major components aimed at minimizing trauma to recreationally caught fish.

Introduction

The number of people who go fishing for recreation is increasing in most parts of the world, with forecasts suggesting that, whilst participation rates in some developed countries are likely to fall as the population ages, the overall number of people fishing will increase (see for example Thunberg, 1999 and references therein). This world-wide increase in the number of recreational fishers is mirrored in Western Australia where a recent study by the Western Australian Department of Fisheries estimated that the number of people fishing in that state had increased from just over 600,000 to just over 700,000 during the last decade (Nathan

Harrison, Department of Fisheries pers. com.). In Western Australia, this increase in people fishing is made up entirely of people fishing from boats, indeed the number of shore based anglers has fallen. Associated with this increase in boat anglers has been an increase in the availability and use of sophisticated depth sounders (fish finders) and Global Positioning Systems (GPS). Thus, not only has there been a large increase in the number of boat anglers but also an increase in their efficiency, with a recreational angler now being able to find a fish holding habitat and aggregations of fish with his/her sounder and then accurately mark the spot on a GPS unit and return to the spot time and time

again. Increases in gear efficiency and the increased availability and affordability of 4WD recreational vehicles and GPS units also increase the impacts of shore and freshwater anglers in WA and elsewhere in the world.

Faced with the dilemma of increased fishing pressure managers have implemented many reforms to fishing rules that are aimed at ensuring the sustainability of stocks. Two major methods are lower bag limits and changes to size limits, the latter may be simply the increase of the minimum size permitted to be kept, or the introduction of slot limits (minimum and maximum size limits) where the aim is to ensure that not only do fish get to breed at least once but larger more fecund fish are protected. Another approach commonly promoted by anglers is the practice of catch-and-release fishing in the belief that they maintain their enjoyment of the sport whilst minimizing the impacts of recreational fishing on sustainability. Catch-and-release fisheries may target wild fish or, as is increasingly the case in Europe, target fish that are stocked into natural or man-made water bodies (Lyons *et al.*, 1999). In Australia catch-and-release practices are now increasingly promoted by Recreational Fishing Advisory Committees (RFACs) and other representative bodies (e.g. Recfish Australia and Recfishwest), angling clubs (e.g. Australian National Sportsfishing Association and Australian Anglers Association) and in the media (e.g. Rex Hunt kissing fish).

Whilst the measures described above are laudable in their attempts to maintain fish stocks, what about the welfare of individual fish? How can we minimise trauma to the fish? Perhaps the easiest way would be to ban recreational fishing, but with a large proportion of the population considering themselves fishers, e.g. in 2001 19% (3.36 million) of all Australians went fishing (Campbell and Murphy, 2005) and in 2005 approximately a third of the population of Western Australians fished (Nathan Harrison, Department of Fisheries pers. com.), to

paraphrase Sir Humphery Applebury, “That would be a very courageous decision indeed Minister!” It is, unlikely that recreational fishing will cease or that the numbers of fishers will fall in the foreseeable future, but it is likely that more fish will be caught and more of these fish will be released in the hope that they survive. Thus, it is particularly important that anglers consider the implications of their pastime on the welfare of individual fish and that the success of catch-and-release practices depends on the capacity of the fish to survive capture and the care taken by individual anglers in handling the fish. This is an increasingly important issue as anglers fish deeper waters where the effects of stress and barotrauma (pressure related injuries) have greater impact, and whilst we cannot affect the physiological capacity of fish species to withstand barotrauma the question is one of ensuring fishing practices minimise stress and maximise survivability.

Researchers, funding bodies and recreational organisations are also increasingly realising the above and also the fact that they have a responsibility to:

- 1) Develop protocols for recreational fishing that minimise the trauma to fish,
 - 2) Educate fishers on why such protocols should be followed
- and
- 3) Ensure that these protocols are followed.

In this paper we report on the history, development and preliminary results of a project being undertaken in Western Australia that includes major components aimed at minimizing trauma to recreationally caught fish. The project, “Management and Monitoring of Fish Spawning Aggregations within the West Coast Bio-Region”, is funded by the Fisheries Research and Development Corporation (FRDC) under the aegis of their

National Strategy for the Survival of Released Line Caught Fish.

Management and Monitoring of Fish Spawning Aggregations within the West Coast Bio-Region (FRDC project 2004/51)

Background - In the early to mid 1990s an international recognised fishery that targeted aggregations of Samson Fish (*Seriola hippos*) that form in deep waters off the Perth metropolitan coast during the summer months was being developed (Figures 1 and 2). The large size, powerful swimming ability and propensity of Samson Fish to take artificial lures (metal jigs, Figure 3) resulted in the fishery gaining a national and international reputation and so it experienced a rapid expansion. However by the year 2000, two of the charter operators who were instrumental in developing this fishery (Allan Bevan and Colin Baron) and a keen recreational angler (Garry Lilley) began to have concerns regarding the effects of catch-and-release fishing on Samson Fish. Their main concerns were firstly, as fish were being caught from depths of between 80 and 200 metres they

would suffer barotrauma due to rapid decompression. The most obvious signs of barotrauma in teleost fish are the eversion of the gut out of the mouth and the eyes bulging out of their sockets (Figure 4). The second concern was that if fish were caught on light tackle with prolonged capture times the fish would suffer severe stress related injuries that may result in death at a later stage or lead to a reduced reproductive output. For example, stress has been shown to cause changes in reproductive hormone levels in fish that result in changes to courtship behaviour, fecundity, egg and larval size and survival (see Cooke and Suski, 2005 and references therein). Discussions between these charter operators, concerned fishers and staff at the Department of Fisheries WA and the Centre for Fish and Fisheries Research at Murdoch University, resulted in a research plan to investigate this deep-water fishery. The main foci of the plan were to develop protocols for best fishing and fish handling practices, ensure that fishers were made well aware of these practices and voluntarily adopted them, and to establish an ongoing monitoring program to be undertaken by anglers beyond the life of the research project.



Figure 1. A Samson Fish (*Seriola hippos*) of approximately 1.2 metres on the boarding platform of a fishing boat. Note the damp surface and the deck hose used to provide oxygen rich water to the gills whilst the fish is waiting to be released with the aid of a release weight. Normally the eyes of the fish would be covered with a wet towel or damp hand but this photograph was produced to educate fishers about the procedure).

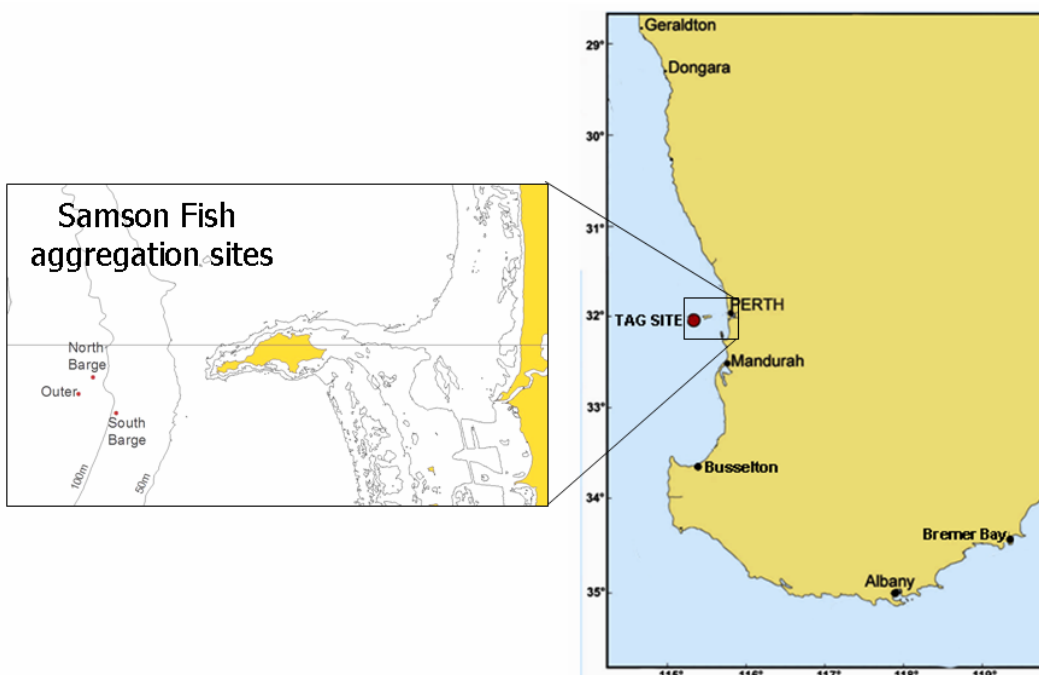


Figure 2. The Perth metropolitan coastline showing Rottneet Island and the main area targeted in the Samson Fish recreational fishery.

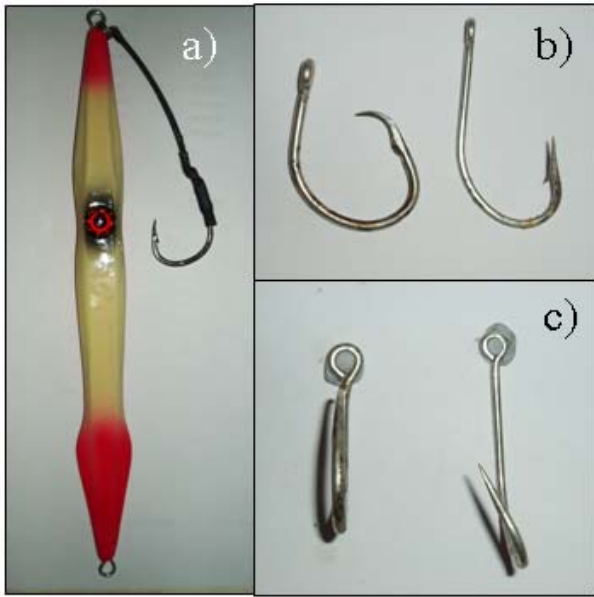


Figure 3. a) A metal jig used to catch Samson Fish. Note the single hook, with barb crushed, attached to the front of the lure, this system reduces deep hooking and aids in easy de-hooking and rapid release of the fish thereby reducing trauma. b & c) a non-offset circle hook (left) and an offset J-hook right.



Figure 4. A Mulloway (*Argyrosomus japonicus*) with an everted stomach and bulging eyes, the obvious signs of barotrauma.

Methods

After extensive advertising in fishing magazines and fishing columns in local papers, information sessions and clinics were held for approximately 270 participants in summer 2004/05. During the information sessions the importance of the research, the ethical considerations of fishing and animal welfare and the need for rigour in the collection of data were all explained and discussed. In the clinics fishers were shown how and where to apply tags using fish previously collected by the investigators for the biological component of the project. At all stages, the importance of minimising trauma to the fish was stressed, whilst also noting that we wanted anglers to continue their normal fishing practices. Anglers were then provided with a tag kit per boat and data sheets. In addition to latitude and longitude, angler, tagger, tag number and fish length the data sheets also included sections for how high the fish was lifted from the water, fishing method (i.e. jigs or baited hooks), line class (breaking strain), hook position, lift method, revive (release) method, release condition and a comments section where anglers could provide other details, e.g. was the fish bleeding, had the fish been previously tagged, etc. (Figure 5).

Anglers were constantly updated about the results of the tagging exercise through the written and electronic media, and through a series of follow-up information sessions.

During the following season (summer 2005/6) the tagging was continued and a trial that examined the short term post release survival of Samson Fish conducted. In the latter trial, fish were caught from a variety of depths and transported to a large research vessel and placed in a 2m diameter by 15m deep enclosure or 'sock' attached to the drifting vessel. Up to 11 fish were in the 'sock' at any one time, where their health/behaviour was monitored via video for between 6 and 36 hours. On completion of the observations the 'sock' was retrieved, the fish euthanased in an

ice slurry and blood removed for analysis of lactate and cortisol in order to estimate recovery time of the fish from the stress of fishing. After blood had been removed an internal examination of the fish was performed to determine any gross signs of internal damage and the gonads removed and placed in formalin fixative prior to histological examination.

As for the 2004/5 season anglers were constantly informed of our findings through the print and electronic media and follow-up information sessions.

Results & Discussion

Tagging – Over the two years of the project 5464 Samson Fish were tagged and currently 60 tagged fish have been recaptured, with two fish being recaptured 210 and 278 days later close to Kangaroo Island, South Australia (approximately 2500 km from Rottnest Island). Such a low recapture rate could be seen as indicative of very high level of fishing induced mortality. However, it is likely that the low recapture rate is more likely a result of the sheer numbers of fish out there. This supposition is based on the facts that echo sounding shows that the four schools targeted can be up to 200 metres long, 100 metres wide and rise from the bottom to depths of 40 to 60 metres; echo sounding and video footage demonstrates that the fish are densely packed; there are other less accessible schools of Samson Fish that are not heavily fished (and there are almost certainly schools that have yet to be discovered); recapture data suggest that fish not only move between schools but only remain in the schools for a few weeks.

Post release survival trial – Preliminary analyses of data collected during the sock trial suggest that: 1) most Samson Fish survive capture from depths up to 200 m., 2) gross morphological signs (and effects?) of barotrauma on Samson Fish are minimal, 3) any mortality occurs within the first 5 hours post release, and 4) the time between capture and release is critical. Detailed histological

examination of gonads and the determination of blood lactate and cortisol levels have yet to be finalised.

Fishing protocols for Samson Fish - Based on the sock trials and preliminary analyses of the tag sheets returned by anglers and tag returns the following broad statements can be made and protocols developed for the Samson Fish fishery:

1). Almost all lure caught fish were hooked in the hinge of the jaw and very few were bleeding. All fish that were deep hooked and the vast majority of fish that were bleeding were caught on baited hooks. However, current studies from elsewhere in the world indicate that the use of circle style hooks (i.e. hooks in which the point points directly at the hook shank rather than being parallel to the shank) the shank rather than the plane being offset by as much as 15°) would result in less deeply hooked fish and less trauma (see with no or only a minimum offset (i.e. the plane of the hook point is parallel or close to the plane of Cooke and Suski, 2004 for a review of hook damage by different style hooks). Thus, jigs with single barbless hooks are the preferred method of capture, whilst bait fishermen should use barbless circle style hooks with minimum offset. If barbless hooks are unavailable hooks anglers can use pliers to crush or break the barb on barbed hooks.

2) The sock trial clearly demonstrated that the longer fish are out of the water the greater the mortality, it is also almost certain that sub-lethal trauma increases with time out of water. These findings are in agreement with several published studies that consider reducing the time out of water is a critical factor in minimising trauma to angled fish (see Cooke and Suski, 2005 and references therein). We recommend that anglers therefore limit the time fish are out of the water and can attain this by using the following

strategies; a) unhook fish in the water if possible, b) use barbless hooks or crush the barb on barbed hooks to make unhooking easy and fast, c) if deep hooked, cut the line a few centimetres outside the mouth (this stops the line interfering with feeding), do not try to perform 'surgery' on the fish, d) if fish are removed from the water for dehooking and tagging, have all necessary equipment to hand, work swiftly and ensure that fish are placed on a wet, cool surface, e) if fish are removed for photographs, ensure that the camera is ready and everyone knows where the photographer and subject will stand/sit before removal from the water and then get the fish back into the water as quickly as possible, do not take dozens of photographs just to get the perfect shot, the welfare of the fish is paramount!

3) In their natural environment fish are supported by water, a medium which is far denser than air. So if fish have to be brought on board, do not gaff them, do not use grips to lift them by the lower jaw, do not lift them by the tail or gills as this causes unnecessary trauma. Use a knotless landing net or, if lifting by hand, support the whole fish.

4) Preliminary analysis of tag return sheets and our observations on the water suggests that the longer it takes to bring the fish to the boat, the more likely difficulties will occur when releasing the fish, i.e. the released fish will not swim strongly back to the school and may float on the surface. Use appropriate line classes, i.e. 24kg and above, do not use line classes lighter than this to gain points in competitions or for 'bragging rights', evidence from other studies shows that long capture times often result in increases in lethal and sub-lethal effects (Cooke and Suski, 2005).

5) We have found that the most effective way of returning Samson Fish is to 'spear' them back into the water. This procedure

entails supporting the weight of the fish with one hand just behind the head and under the gut, and the other around the caudal peduncle (the narrow wrist section anterior to the tail). The fish is then speared head first into the water, in the vast majority of cases the fish will swim strongly back to the school below (underwater video shows just how quickly fish recover when this method is used). In contrast fish that are dehooked and then gently released tend to swim downwards for a short distance before resurfacing and floating off. This method of spearing fish back into the water also seems to be effective for other species such as Pink Snapper (*Pagrus auratus*) and Silver Trevally or Skippy (*Pseudocaranx dentex*).

If a fish returns to the surface and floats, lines should be immediately brought in, fishing ceased, and the fish followed and retrieved as quickly as possible. On retrieval the health of the fish should be assessed, if the fish appears relatively healthy it should be released with the aid of a release weight. The release weight is a large lead sinker to which is attached a large barbless hook that has a swivel and clip on its shank and a crimp on its bend, the latter stopping the swivel from coming free (Figure 6). The weight is attached to a hand-line or rod and reel (preferably all ready set up and specifically used for this purpose). The hook is then placed in the jaw of the fish and the fish released, the weight quickly takes the fish to deeper water, compressing the swim bladder and gas in sinuses as it descends (Figure 7). This procedure can thus be seen as having the same effect as rapidly recompressing divers suffering barotrauma. Once the fish has reached approximately 40 metres a series of sharp tugs on the line frees the fish, it is worth noting that one can often feel the fish start to swim strongly and release itself well before this depth is attained. In the case of fish that the angler deems to be less healthy or tired (little or no movement and shallow and rapid movement of the gill covers) or if the release

weight needs to be made ready, the fish should be swum by the side of the boat or brought onto a wet, cool boarding platform and have a deck hose placed in its mouth, this procedure ensures that the well oxygenated water is passed over the fishes gills (Figure 1).

6) Fish revived using a deck hose should have their eyes covered with a wet hand or towel to reduce the effects of U.V. damaging their retina. Once the fish shows signs of revival (deep slow movement of the gills and strong tail beats) it should then attached to a release weight and released. Although the low number of recaptures currently precludes statistical validation of the effectiveness of the release weight, the fact that tagged fish that anglers considered in very poor condition and released using this method have been recaptured after more than a year at liberty suggests that the method can only benefit the welfare of the animal.

In addition to these protocols for catch-and-release fishing we also suggest to anglers that they should also adopt the following practices:

7) If anglers intend to take some fish for a meal then the best practise is to place the fish in an ice slurry and then bleed the fish by cutting the gill bars or area in front of the heart just behind where the gill plates join. The ice slurry not only rapidly anaesthetises/euthanases the fish and is, in our opinion, the most humane way of killing the fish, but it also ensures that the flesh is of the highest quality. For fish that are too big to be easily anaesthetised in ice slurry, we suggest that bleeding the fish is the next most humane way to kill the fish. This is based on the fact that as fish have far less blood than tetrapods they bleed to death within seconds. Using a sharpened metal spike placed just above and to the rear of the eye to pierce the brain (*iki jimi*) has been promoted strongly as a rapid, and thus humane, way to kill fish.



Samson Science Tagging Datasheet

Please return sheets or direct queries to Mike Mackie or Paul Lewis
c/o WAMRL PO Box 20 North Beach WA 6920
Ph 9246 8444 Mob 0427 472 121 or 0427 774 551

Fish for the future



Date 08 / 01 / 2005 Vessel Shipe Skipper M. Mackie Crew P. Lewis, A Roland
 Tag Colour Yellow Main Tagger M. Mackie Fish Lift Height 1 m

School Name or Latitude and Longitude	Angler Tagger (if not main)	Tag 1 Number	Tag 2 Number If required	Fork Lt (in cm)	Fishing Method	Line Class	Hook Postn	Lift Method	Revive Method	Release Condition	Comments eg, bleeding, details of old tag, Note Other lift method, hook position, or details of release method etc
1 North Barge	P. Lewis	1234	1235	121	JIG Bait	less 15kg 15-30kg 30Hkg	MOULF Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	All good
2 North Barge	A Roland,	1236	1237	125	JIG Bait	less 15kg 15-30kg 30Hkg	MOULF Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	Towed for 5 mins
3 32°01.999 115°19.555	P. Lewis	1238	1239	101	Jig Bait	less 15kg 15-30kg 30Hkg	Moult Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Floated/Revived Died	Bleeding badly, wouldn't go
4 32°01.999 115°19.555	M. Mackie, P. Lewis	1240		91	Jig Bait	less 15kg 15-30kg 30Hkg	MOULF Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	Not main tagger
5 32°01.999 115°19.555	A Roland,	1255		102	JIG Bait	less 15kg 15-30kg 30Hkg	MOULF Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	Tag already in correct position, not re tagged
6 33°01.999 115°19.555	A Roland,	9999	1241	103	JIG Bait	less 15kg 15-30kg 30Hkg	MOULF Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	Very Old Tag 1/2 way down tail re tagged
7					Jig Bait	less 15kg 15-30kg 30Hkg	Moult Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	
8					Jig Bait	less 15kg 15-30kg 30Hkg	Moult Gut Other	NET LEADER Tail Other	Sheared Towed Deck hose Release wt	Healthy Floated/Revived Died	

Figure 5. The data sheet provided to anglers tagging Samson Fish.



Figure 6. A release weight.

However, the exact position of the brain, and thus spiking location, vary between species, and many species have fairly small brains and very thick skulls. We therefore recommend that unless fishers are trained in how to perform iki jimi for a particular species, or, have prior experience with that species, then iki jimi should not be promoted as the most humane way to kill fish. These thoughts are borne out by the example of a former employee of Murdoch University's ethics office, who, believing that iki jimi was the most humane way in which to kill fish, attempted the procedure when barramundi fishing in the Kimberley. Both her and her husband were horrified at how difficult it was to perform the procedure on large fish that have thick skulls and small brains. They quickly reverted to using an ice slurry and bleeding as the most humane way deal with their



Figure 7. A Westralian Jewfish (*Glaucosoma hebraicum*) suffering barotrauma (note bulging eyes) being recompressed and released with the aid of a release weight. Photograph courtesy G. Lilley.

catch. Another reason for not using iki jimi is that researchers are increasingly using frames collected from recreational fishers in their biological studies thereby reducing the number of animals killed specifically for research. Almost all such studies require accurate estimates of the age structure of the population. The age of a fish can best be determined by counting the rings on their otoliths (much like ageing trees) and these bones are found in capsules at the rear of the brain, a position that almost ensures they will be destroyed by the iki jimi spike. Thus, any reduction in the number of animals used in a study is negated.

- 8) If anglers have caught their bag limit or are catching undersize or unwanted species stop fishing and move on, in other words, fish for the future not the freezer

and do not subject unwanted animals to needless trauma.

Angler uptake and feedback – Through our ongoing dialogue with recreational anglers via clinics, training and information sessions, and web chat sites we have noticed an increased awareness and voluntary uptake of our suggested best practices. For example, without telling people to change their fish landing and releasing methods we found that in 2005/06 less fish were reported as ‘floaters’ than in 2004/05 (115 cf 137) despite an increase in the number caught-and-released (3038 cf 2417). This also coincided with anglers using the release weight 102 times compared with only 25 times in 2004/05. In addition when a floater was seen it was not uncommon for another boat that was closer to the fish than the boat which had released it to stop fishing, retrieve the fish and then use a pre-rigged release weight to successfully return the fish to the depths. It was also noticeable that the vast majority of anglers targeting the schools were well aware of the need to use appropriate tackle to catch these powerful fish, and on the few occasions that some anglers were using inappropriate line classes anglers in other boats politely offered advice and education! Inputs from fishing tackle retailers also suggests that anglers not directly involved in the project but targeting these fish are buying suitable equipment and release weights.

In addition to the uptake of the protocols we have seen, we have also had a fair degree of input into more general catch care and welfare policies developed by the Western Australian Department of Fisheries and RFAC (<http://www.fish.wa.gov.au/docs/pub/CatchCare>), Recfishwest (<http://www.recfishwest.org.au/PolicyCatch&Release>), and the National Strategy for the Survival of Line Caught Fish (<http://www.info-fish.net/releasefish>).

A further benefit we believe comes from training sessions, constant media updates and a true collaboration between researchers and

anglers in that both researchers and anglers gain a better appreciation of and increased respect for the fish they are catching. This has led to many charter operators and anglers reporting that they now no longer measure the success of the days fishing just by the number of fish caught. Rather a successful days fishing is now one in which a few fish are caught, one or two of which may be humanely killed for later consumption, and the others are returned to the water suffering as little trauma as possible. Anglers also gain a great deal of satisfaction knowing that successful collaborations with researchers in the initial stages are more likely to lead to the long term maintenance of monitoring programs and the sustainability of their sport. We would like to think that the increased awareness of trauma and fish welfare fostered during the Samson Fish project will also make anglers think about these issues when fishing for other species.

Conclusions

In this paper we have reported on one of several projects funded by the FRDC which aim to develop ways that minimise trauma to a range of popular recreational line caught fish. These projects have two main strategies: 1) the determination of species-specific catch-and-release protocols, and 2) the uptake of these protocols by anglers. How successful has this project been?

Development of protocols – In the case of Samson Fish we have perhaps been fortunate in working on an animal that is apparently particularly robust in that it rarely suffers obvious signs of barotrauma, i.e. extruded stomach, bulging eyes or gross internal damage. This is probably a result of certain anatomical novelties found in this and some related species (manuscript in preparation). The majority of the protocols developed are those that would apply to most species, however, we are unaware of the spearing technique being used anywhere else and also seems to work well with Pink Snapper (*Pagrus auratus*) and Silver Trevally or

Skipper (*Pseudocaranx dentex*). It is, therefore, also likely to work with a wide range of other species and will be promoted through the scientific and popular media.

The recapture of tagged Samson Fish that had floated and that anglers had reported as in poor condition demonstrates that the release weight is likely to increase the survival and reduce the trauma in fish suffering barotrauma. Furthermore, while very few Samson Fish show major signs of barotrauma, fish that do such as Westralian Jewfish (*Glaucosoma hebraicum*) and Blackarse or Breaksea Cod (*Epinephelides armatus*) have also been recaptured after being released using the release weight. Indeed, it was with these fish in mind that Gary Lilley conceived and developed the release weight. It may well be that the release weight is one of the greatest innovations when it comes to the welfare of fish that are to be released, whether these species are targeted in catch-and-release sport fisheries, are released because of statutory considerations, i.e. outside of size and/or bag limits, or are unwanted by-catch. Currently authorities around the world advise anglers to 'vent' or 'fizz' fish that are showing obvious signs of barotrauma, this procedure involves puncturing the swim bladder through the side of the fish with a hypodermic needle. Although this procedure may increase survival rates in the hands of experienced researchers using sterile techniques (McLeay *et al.*, 2002), it is unlikely to have as good a result when performed by the majority of anglers who are unlikely to use sterile techniques and hypodermic needles. Furthermore, venting is obviously a major invasive procedure, that at a minimum causes damage to the body wall and swim bladder, may lead to infection, and will affect the ability for fine positional control thereby reducing the ability to feed and avoid predators.

Will anglers do the right thing? – As the Samson Fish project clearly demonstrates some thinking anglers will try to do the right

thing for the fish and fishery. This project and many others in Australia and elsewhere in the world have been developed by anglers. The release weight was conceived and designed by an angler who saw a need to improve the welfare and thus survival rate of fish suffering barotrauma. Whilst the majority of anglers may not be involved in instigating research projects or calling for changes to legislation our project also shows that anglers will change their fishing practices when the need for these changes is fully explained, the uptake of our protocols before they were formally published clearly demonstrates this. We further believe that for responsible recreational fishing and fish handling practices to become the norm, researchers must provide easy to follow protocols that are based on good science and that the science behind these protocols must be explained in clear and concise lay terms. This is perhaps the biggest challenge and it is the responsibility of scientists who are working in this area of animal welfare to ensure that they can communicate their results to the end user. If the reasons for changes to practices are not made easily accessible then it is unlikely that they will be accepted and many anglers will just carry on using inappropriate techniques.

Unfortunately we have to admit that some anglers are not that bothered about the welfare of the fish. This minority group falls into two camps, the first group consists of those people who just haven't really thought about the welfare of the fish. With education this group is likely to slowly come round. It also helps if you can show other benefits of following certain protocols, for example, we can point out that by using appropriate line classes they will catch more fish and lose less tackle, so they get more fun and spend less money. When explaining what is the most humane manner to kill fish we also explain that the quality of the flesh will be far better than if the fish are just tossed in a bucket and left to slowly die. And of course there is the second group who need sticking on a big hook!

Future directions – As noted earlier it is unlikely that the numbers of recreational fishers will decrease in the immediate future. It is also likely that the proportion of anglers practicing catch-and-release will increase. It is therefore imperative that researchers and anglers are aware of their responsibilities to develop, promote and use fishing and fish handling practices which minimise trauma and thereby maximise the welfare of individual fish. As different species react to the trauma of fishing in quite different ways, researchers must focus on developing protocols that are species specific (Cooke and Suski, 2005). Equally important is that mechanisms are set in place that ensures the take up of these practices and their ongoing use once specific research projects have finished. This uptake and continuation is only likely to occur when recreational fishers and the recreational sector, with support from researchers, takes stewardship of ongoing monitoring programs that can be used to modify protocols as new information becomes available.

Brochures and protocols are available in hard copy or as PDFs from the senior author.

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The Implications of the Principle of Equal Consideration for Animal Research

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Abstract

We examine arguments for and against the principle that an acceptable moral theory must work to give the interests of all sentient beings equal consideration. In particular, we consider Carl Cohen's "natural kinds" argument for the proposition that being a sentient member of the species *Homo sapiens* is a sufficient condition for having a special moral status which all nonhuman animals lack. We examine what would be necessary in order to defend animal research if the principle of equal consideration is to be accepted.

This paper addresses the principle of equal consideration for human and non-human animals and explores arguments for and against such equal consideration. It argues that the animal researcher has only two acceptable options: to explain why the principle of equal consideration is not valid, or accept the principle and therefore only carries out research on animals which he or she would be prepared to carry out on humans with similar characteristics.

If we ask the question "Why does animal research raise an ethical issue at all?" A natural answer seems to be "Because serious harms may be inflicted on non-human animals without their consent." We are fairly confident that it would be wrong to inflict serious harm on a typical human adult without his or her consent, even if there were a significant prospect of obtaining benefits for others. Why then are we not so confident that it is wrong to do the same thing to a non-human animal?

Probably most of us would answer this question in something like the following way: "Non-human animals are in various respects different to us, they have a different sort of mind and the mental states they can experience are different. Because of these differences, non-human animals do not have the same moral status as us and it is permissible to inflict some harm on them

when there is a significant prospect of a compensating benefit." The question then arises: what are the characteristics we possess which endow us with higher moral status than non-human animals? This is where the trouble starts. Whichever characteristics we select, we may be able to point to humans for whom it is doubtful that they possess these characteristics to a greater degree than a typical non-human animal. Consider, for example, a human with an IQ of 10. For each of the characteristics which might be plausibly thought to differentiate a typical human from a typical non-human – rationality, self-awareness, moral agency, and so forth – it is rather doubtful that this human possesses those characteristics to a greater degree than a typical non-human animal. Yet we are still quite confident that it would be wrong to inflict serious harm on the human with an IQ of 10, even if there were a significant prospect of obtaining benefits for others. On the other hand, we are not so confident that it would be wrong to do the same thing to a non-human animal.

These considerations suggest to some that there is more to the story than just characteristics like rationality, self-awareness, or moral agency. They speculate that it might be morally relevant to consider which species to which a being belongs. Sometimes, they claim, it would be morally permissible to

inflict certain harm on a sentient being of a different species to us when there is a certain prospect of benefit for others, even though it would not be morally permissible to do the same thing to a being of our own species with similar mental characteristics. The thesis that this is sometimes the case, I call speciesism, using the word as a descriptive, rather than pejorative, term. The term was first used by Richard Ryder; it has been used in different but related senses, probably the first use of the term in our sense was in Peter Singer's *Animal Liberation*. The question then arises: is speciesism ever defensible?

One of the first clear statements that speciesism is not defensible appeared in Peter Singer's *Animal Liberation*. In that work, Singer maintained that an acceptable moral theory must work to give equal consideration to the relevantly similar interests of all sentient beings. Equal consideration of relevantly similar interests does not necessarily entail equal treatment, since clearly beings of different species often have very different sorts of interests. In particular, many philosophers hold that a typical human loses more by dying than a typical non-human, in which case the interest that a typical human has in staying alive and the interest a typical non-human has in staying alive are not necessarily relevantly similar and need not receive equal consideration. However, Peter Singer maintained that the interests that two different beings had in avoiding a comparable amount of pain and suffering would be relevantly similar.

The ethical theory that Singer himself favours is a form of consequentialism. Consequentialist moral theories maintain, roughly, that an action is morally right if it will lead to the best possible outcome. One version of consequentialism is utilitarianism, which holds that an outcome is good to the extent to which it promotes the interests of all sentient beings affected overall. Deontological moral theories, on the other hand, maintain that being moral consists in observing certain constraints on our

behaviour, regardless of the consequences, such as not harming the innocent. The requirement of equal consideration is compatible with a broad range of ethical theories, both consequentialist and deontological. A version of utilitarianism in which the relevantly similar interests of any two beings are equally weighted in evaluating the quality of the outcome is consistent with equal consideration. A version of utilitarianism in which some sort of weighting factor based on species is introduced is not. A deontological theory in which the rights which any sentient being is held to have depend only on their actual or potential mental characteristics is consistent with equal consideration. If species is a relevant consideration, however, then it is not consistent with equal consideration. Some moral theories say that the correct moral principles are those that would be chosen by rational persons in a hypothetical bargaining situation. For example, John Rawls' theory of justice states that the correct principles of justice to govern a society are those that would be consented to by free and rational persons who were operating under a "veil of ignorance": they would know that after they finished negotiating the principles they would be incarnated as members of the society, but they would not know their position in the society, their wealth, social status, gender, race, class, or their conception of the good. However, it is usually assumed that they do know they will be incarnated as humans. So Rawls' theory as it stands is not consistent with equal consideration, though perhaps it could be adapted. The essential point is that the relevantly similar interests of two sentient beings of different species must always be given the same moral weight; discrimination on the basis of species alone is never acceptable. Indeed, Singer claimed, it is no more defensible than discrimination on the basis of race or sex.

Later on, in *Taking Animals Seriously*, David DeGrazia claimed that the issue of whether this principle of equal consideration of interests was correct, was the central issue in

animal ethics. He argued at length that there was a rebuttable presumption in favour of equal consideration – that those who would deny equal consideration had a burden of proof to meet, and until that burden was met, equal consideration was more reasonable than its denial.

He began by arguing that sentient non-human animals have some moral status – their interests matter in their own right and not merely because of considerations based on human interests. Kant maintained that our moral obligations towards non-human animals arose not because the animals' interests mattered in their own right, but because of the need to avoid "spillover" effects that may affect humans (someone who was in the habit of abusing non-human animals might be tempted to abuse humans as well). It is also possible to argue that abusing non-human animals is wrong because it manifests a bad character, rather than because the animals' interests are adversely affected. However, DeGrazia argued that these positions cannot adequately account for our conviction that gratuitously abusing non-human animals is wrong. The question of whether "spillover" effects would occur is an empirical question and as Robert Nozick observed, it is something of a puzzle as to why those effects would occur. If a non-human animal has no moral status, then surely we can recognize the fact that they are different to humans in this respect and there would seem to be no clear reason why doing certain things to non-human animals would tempt us to do the same things to humans. Our certainty that abusing non-human animals is wrong is much greater than what would be justified if its wrongness were tied to an empirical thesis about "spillover" effects. The position that cruelty to non-human animals manifests a bad character, DeGrazia argues, cannot be adequately explained unless we assume that the interests of the non-human animal matter in their own right. So, DeGrazia begins with the thesis that a satisfactory moral theory must entail that we

have some direct duties towards non-human animals.

To argue that there is a rebuttable presumption in favour of equal consideration, he began by observing that according to the principle of universality – that relevantly similar cases ought to be judged in the same way – someone who denied equal consideration would have to maintain that there was a morally relevant difference between two cases in which relevantly similar interests of two beings of different species were adversely affected. If they accepted the principle of universality, they would be committed to the existence of the morally relevant difference, the only issue would be where the burden of proof lies – whether they should be required to identify the difference and defend the claim that it is morally relevant. He maintained that to accept the existence of the morally relevant difference without insisting that the burden of proof be met would be unfair and given the likelihood of a pro-human bias, too inviting of error.

If we accept this argument, then we must grant that someone who would deny equal consideration has a burden of proof to meet. The question is whether it can be met. DeGrazia considers a number of attempts to meet the burden of proof, some of which I shall discuss. I also believe that an argument put forth by Carl Cohen, known as the "natural kinds" argument, constitutes another interesting attempt, which I shall also consider. Another argument I shall consider is that equal consideration would have untenable consequences. Let us begin with some of the arguments put forward by DeGrazia. The first argument that DeGrazia considers is a challenge based on contractarianism. Contractarians maintain that the best account of one's moral rights and duties is in terms of a contract which rational parties would reach in a hypothetical bargaining situation. In *The Animals Issue*, Peter Carruthers argued that this is the best account of morality and further, that since non-human animals are not rational agents of

the sort who can participate in designing a contract, they lack moral status. (Similar lines of thought have been advanced by John Rawls and Jan Narveson). DeGrazia criticizes this position on two fronts. First, Carruthers' argument entails that non-human animals have no moral status whatsoever, and DeGrazia has already argued that we have sufficient grounds to reject this view. Second, not all humans are actually, formerly, or potentially, rational agents of the sort who can participate in designing a contract. Carruthers acknowledges this yet claims that all postnatal humans have moral status. He argues for this based on slippery-slope considerations, and considerations of social stability. The argument from slippery-slope considerations claims that in order to avoid sliding down a slope to abuse of rational humans, we must draw a boundary which is clear-cut and such that we have no trouble deciding whether a being lies on one side or the other of the boundary. The boundary between humans and non-humans meets these criteria better than the boundary between rational and non-rational humans, so it is a better place to draw the line. Against this position DeGrazia argues that the claim that any criterion excluding someone with an IQ of 10 from the circle of bearers of moral status would have slippery-slope problems is an empirical claim and is somewhat uncertain, far more uncertain than our conviction that it would be wrong to use such a human in extremely painful toxicity tests. Furthermore, even in a hypothetical society in which people were able to judge others' rationality sufficiently well to avoid slippery-slope problems, it still seems clear that such a non-rational human ought to have some moral status. Carruthers also has an argument from social stability, based on the idea that most people would find it psychologically very difficult to withhold moral status from non-rational humans. However, as DeGrazia observes, there have been societies with very different attitudes about newborns and the elderly to the ones we have and it does not seem that the propriety of granting non-rational humans moral status depends on the psychological difficulty of

doing otherwise. DeGrazia concludes that, because of the difficulties Carruthers' contractarian position has in accounting for the moral status of non-human animals and non-rational humans; it does not succeed in displacing the presumption in favour of equal consideration.

The next argument that DeGrazia considers he calls the "sui generis" view. This view states that the property of being a member of the species *Homo sapiens* is a morally relevant characteristic and while it might be difficult to justify this to someone to whom it isn't obvious, justifications have to come to an end somewhere and this just is a correct moral axiom which one either recognizes or doesn't. DeGrazia replies, first of all, that this thesis is rather odd. A clear point in evolutionary history at which *Homo erectus* mutated into *Homo sapiens* is more something which we arbitrarily stipulate than something we find. We are very genetically close to our nearest living relatives, chimpanzees and gorillas. It is hard to understand why the species boundary is so morally important. Why not the boundary of the genus or family, to which we belong? DeGrazia also argues that the thesis has some implausible implications. If we genetically engineered some non-human animals so that they had similar levels of intelligence to us, or if we encountered intelligent extraterrestrials, it just doesn't seem that species would be at all morally relevant in determining these beings' moral status. Also, if we are entitled to say that species membership is morally relevant without any justifying argument, then what are we to say to someone who claims that membership in a particular race or sex is morally relevant?

The next argument that DeGrazia considers is that partiality towards members of our own species is an example of justified partiality towards others based on social bonds. DeGrazia takes Mary Midgley's arguments in *Animals and Why they Matter* as representative of this view. He replies that some forms of partiality, such as partiality for

our own children, may well be justified, but that these forms are consistent with equal consideration. He contends that Mary Midgley has not shown any form of partiality that is inconsistent with equal consideration is justified and the contention that it is, would run the risk of justifying racism and sexism as well. The next argument that DeGrazia considers is the argument that only moral agents have moral status. Like the contractarian argument, this argument is troubled by the problem of marginal cases – not all humans are actually, formerly, or potentially, moral agents, yet we tend to believe that they are entitled to equal consideration. DeGrazia also claims that moral agency is most reasonably viewed as a matter of degree which is not exclusively human, and points to the difficulty of specifying a threshold level of moral agency which entitles one to equal consideration which catches all humans and only humans. A defender of the argument from moral agency might concede DeGrazia's point that moral agency is a matter of degree and contend that the amount of consideration we should give to a being's interests should be weighted by the extent to which it is a moral agent. However, most would find the argument to have untenable consequences regarding humans who lack moral agency. DeGrazia also considers an argument based on a puzzle about whether we should attach more moral weight to a typical human's interest in staying alive than to a typical non-human's interest in staying alive. It seems highly plausible that at least sometimes we should do this, but in undertaking an extensive investigation in value theory, DeGrazia finds that there is a difficulty in cogently defending the claim that a human loses more by dying than a typical non-human. He suggests that the problem of whether this claim can be justified is the central problem in inter-specific value theory. Ultimately, however, he thinks that holding out for the possibility of a cogent defence of the claim is preferable to abandoning equal consideration.

DeGrazia also considers an argument that the fact that we have moderately extensive positive obligations to humans, in conjunction with equal consideration, has the untenable consequence that we ought to be actively striving to protect animals in the wild from all sorts of natural dangers. To this he replies that positive obligations are discretionary, that we have many opportunities to help others and we can only choose some of them, so that even if we assume equal consideration it is not clear that we have moderately extensive positive obligations towards non-human animals. Furthermore, it would frequently be unclear how we could intervene in the situation of animals living in the wild in a way that would not be counter-productive. DeGrazia concludes that ultimately these challenges to equal consideration do not succeed in displacing the presumption in favour of it.

Another interesting challenge to equal consideration comes from Carl Cohen. Cohen maintains that non-human animals are not entitled to equal consideration (more specifically, he maintains that unlike humans, they lack rights) because they are of a kind such that members of that kind typically are not moral agents, whereas all humans are of a kind such that members of that kind typically are moral agents. In his article "The case for the use of animals in biomedical research", in the *New England Journal of Medicine* 315, 14, p. 866, he writes "Persons who are unable, because of some disability, to perform the full moral functions natural to human beings are certainly not for that reason ejected from the moral community. The issue is one of kind. Humans are of such a kind that they may be the subject of experiments only with voluntary consent. The choices they make freely must be respected. Animals are of such a kind that it is impossible for them, in principle, to give or withhold voluntary consent or to make a moral choice. What humans retain when disabled, animals never had."

Nathan Nobis, in replying to this argument, in “Carl Cohen’s Kind Argument *FOR* animal rights and *AGAINST* human rights”, in *The Journal of Applied Philosophy*, 21, 1, pp. 43-59, says that it seems to rest on an implicit principle: If (1) an individual A is a member of some kind K and (2) some, most, or all of the other members of that kind K have property C and (3), on the basis of having property C, they have property R, then individual A has property R as well, even though A lacks property C. Nobis has two objections to the argument based on kinds: first, he maintains that there is no non-arbitrary way to classify things into kinds, and second, he challenges the proponent of the “kinds” argument to demonstrate a link between kind membership and moral rights. In making the first objection, Nobis points out that each individual can be classified into indefinitely many kinds. Each of us is a member of the kind “human being”, “attendee of the ANZCCART conference” and “object quite far from the sun.” Moreover, non-human animals belong to many of the kinds that humans do, such as “sentient being”, “being with desires, preferences, and a psychophysical identity over time” and so on. When we apply Cohen’s principle in these contexts, we get conflicting results. Nobis claims that this is a *reductio* of Cohen’s principle. In reply to Nobis’ discussion of Cohen’s argument, in “Cohen and Kinds: A Response to Nathan Nobis”, in *The Journal of Applied Philosophy*, Vol. 21, No. 2, pp. 213-217, Neil Levy writes “... it is far from clear that Nobis is right in asserting that kind membership is always arbitrary. In fact, there is good reason to think that animals, including human beings can be classified in ways that ‘cut nature at its joints.’”

Levy defines a “natural kind” to be a kind with explanatory value and suggests that Cohen’s principle might be defensible when applied to the narrowest natural kind to which an organism belongs: the species. That is, he suggests that the following principle might be defensible: If (1) an individual A is a member of some species S and (2) some, most or all of

the other members of the species have property C and (3), on the basis of having property C, they have moral property R, then individual A has moral property R as well, even though A lacks property C. Thus, on this account of Cohen’s argument a being is entitled to equal consideration if it is such that a typical member of its species is a moral agent.

In reply to Nobis’ second criticism, the challenge to demonstrate a link between kind membership and moral rights, Levy suggests that our pre-theoretical intuitions seem to track species membership to some degree, and suggests that the moral relevance of species membership might be supported by the idea that our morality is a product of our evolutionary history and that our moral emotions are inevitably triggered by conspecifics. James Rachels has offered a thought-experiment against the argument from species normality. He asks us to imagine a chimpanzee who demonstrates the same level of intelligence as a typical highly intelligent adult human. The question of what moral status we accord to this chimpanzee, Rachels claims, just doesn’t seem to have anything to do with what is normal for his species.

One argument I have seen raised against equal consideration is that it would have consequences which are too demanding, and untenable. No large-scale civilization can exist without inflicting some degree of harm on non-human animals, it is argued (for example, crop production harms animals), but any plausible moral theory consistent with equal consideration will rule out such harm and thus imply that morally, human civilization ought not to exist. This is clearly untenable, so there must be something wrong with the principle of equal consideration.

The best reply to this seems to be to question the premise that any plausible moral theory consistent with equal consideration will rule out such harm. For example, in Joan Dunayer’s *Speciesism*, she writes “When we

cause no more harm than we must to survive, we too are innocent. We're innocent when we sustain ourselves by growing crops for human consumption. Inadvertently, non-humans will be hurt and killed, but far fewer than in animal agriculture..." Thus, Joan Dunayer believes in equal consideration but thinks there are limits to the presumption against killing. Equal consideration will rule out such harm if we are not permitted to inflict such harm on humans with similar mental characteristics in relevantly similar circumstances. So the conjunction of two premises, (1) that we are not permitted to inflict such harm on humans with similar mental characteristics in relevantly similar circumstances, and (2) the principle of equal consideration, have untenable consequences. However, why should this lead us to question (2)? We might just as well decide to question (1), and decide that in extreme circumstances where civilization would be at stake, it would be permissible to inflict some harm on humans with similar mental characteristics to non-humans and this is similarly the case with non-human animals.

If DeGrazia is right to maintain that there is a presumption in favour of equal consideration, then on the whole it seems somewhat doubtful that any of the arguments considered here overturn that presumption. If the principle of equal consideration were accepted, what would the implications be for animal research? To some extent that is underdetermined: equal consideration is consistent with a great many different moral theories. However, any researcher who accepted that there was a presumption in favour of equal consideration which had not been overturned, in order to be acting in good faith, would have to avoid inflicting harm on a non-human in order to obtain a certain probability of benefit when he or she would not be prepared to inflict a similar harm on a human with similar mental characteristics in order to obtain a similar probability of benefit. It seems likely that there is a great deal of research going on today which most researchers would not feel able to defend in this way in good faith. Thus, the failure to overturn the presumption in favour of equal consideration raises a large question mark over the moral legitimacy of much animal research going on today.

The Role of the Monitoring Officer as Part of a Quality Assurance Program

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Abstract

This paper outlines the key roles and responsibilities of the monitoring officer as part of a quality assurance program. A quality assurance program can be defined as a planned and systematic pattern of actions and procedures to give adequate confidence that the highest standards are being maintained. The three key areas that need to be addressed are as follows.

- The integrity of the research cannot be compromised. The research team needs to be confident that the animals are kept to the highest standard, allowing as little variability as possible.
- The AEC needs to be confident that the research protocol is being adhered to and that all responsibilities and accountabilities of the research team are being achieved.
- The optimum level of animal welfare must be achieved and suffering kept to an absolute minimum.

In 2004 the Biological Testing Facility (BTF) staff at the Garvan Institute (Garvan) was expanded to include a monitoring officer to achieve these objectives on a daily basis.

The monitoring system at Garvan involves the classification of all rodent boxes into one of three monitoring categories. These three categories denote three increasing levels of invasiveness and this is displayed on the cage card. The monitoring officer checks all boxes daily in accordance with the monitoring category. Any welfare issues are reported to the relevant researcher straight away. There is also facility for the research team to request additional monitoring as required. On a weekly basis the monitoring officer inspects all animal records kept in the BTF to ensure that adequate records are being kept in accordance with particular AEC authorities.

A monitoring report is given at each AEC meeting. When assessing new protocols, the committee members have the opportunity include additional monitoring officer inspections or instructions that can become conditions of approval. The monitoring officer is the eyes and ears of the AEC in the animal facility and works with the research team to achieve the highest level of compliance.

The role of the monitoring officer is very much 'hands on' and therefore experience is required in areas of animal handling and husbandry, AEC procedures and protocols and legislative requirements

When carried out correctly the integration of these activities will enable the monitoring officer to play a key role in the implementation of a successful quality assurance program which caters to the needs of the researchers, the AEC and, most importantly, the animals themselves.

This paper outlines the key roles and responsibilities of the monitoring officer as part of a quality assurance program.

Objectives of the Quality Assurance Program

For the purpose of this presentation, a quality assurance program can be defined as a

planned and systematic pattern of actions and procedures to give adequate confidence that the highest standards are being maintained. When applied to the animal facility this defines three key areas that need to be addressed. These objectives are as follows:

1. The integrity of the research
The research team needs to be confident that their animals are getting

quality care and that they are kept constantly at the highest standard. This will ensure as little variability as possible.

2. The AEC

The AEC needs to be confident that the research protocol is being adhered to and that all responsibilities and accountabilities of the research team are being achieved.

3. Animal Welfare

The optimum level of animal welfare must be achieved and pain and suffering must be avoided.

In 2004 the role of monitoring officer was introduced at the Garvan Institute Animal Facility to help achieve these objectives on a daily basis.

Monitoring Classification

The monitoring system at Garvan involves the classification of all rodent boxes into one of three monitoring categories based on the level of invasiveness of the experimental plan. These three categories are:

1. “No File”
2. “See File”
3. “File Entry”

Choosing the correct category is carried out by the researcher, aided by the monitoring officer if required, and an individual animal may move from one category to another during its journey along the experimental protocol. The current monitoring category is displayed on the cage card.

“No File”: This category denotes non invasive studies, such as observation or behavioural studies with minor environmental manipulation. There are no expected animal welfare issues and there is no requirement to keep a file with monitoring criteria in the animal room.

“See File”: The “See File” category is slightly more invasive with the possibility of some minor welfare issues. Examples of this category would be minor conscious intervention or minor surgery with recovery. There are specific monitoring criteria and it is a requirement to keep a file stating these in the animal room at all times, but there is no requirement for daily sign off by the monitoring officer

“File Entry”: This is the most invasive of the three categories and includes major surgery with recovery or physiological challenge (eg transplant surgery, arthritis studies or prolonged deficient diet). A file of specific monitoring criteria is kept in the animal room. The major difference with animals in this category is that they are given a physical examination every day, their condition noted and the monitoring officer signs the monitoring file daily.

Monitoring Officer’s Duties

The monitoring officer checks all boxes daily in accordance with the monitoring category. “No File” boxes are checked for general health and well being by a relatively quick look into the cage. This ensures that the animals are alive, well and that there are no welfare issues. “See File” boxes are checked similarly, except that particular attention is paid to specific criteria as indicated in the monitoring file. All “File Entry” boxes are opened, each animal is examined and its condition is compared to the results of the previous day’s monitoring. Current condition is then noted and the monitoring officer signs the file.

On a weekly basis all animal records kept in the animal facility are checked to ensure that adequate records are being kept in accordance with particular AEC authorities.

There is also facility for the research team to request additional monitoring as required.

Reporting and Documentation

An essential part of a quality assurance program is reporting and documentation. Any welfare issues, sick and dead animals are documented on specific forms and reported to the relevant researcher straight away. The use of the forms allows for progress to be documented and ensures that the research group take appropriate action. A monitoring report is given at each AEC meeting.

Does This System Meet the Quality Assurance Objectives?

1) Research Integrity

The research team can be assured that their animals' welfare is of the highest possible level and that they will be notified of any issues immediately. Experimental variability and delays due to animal issues are kept at a minimum.

The researcher is confident.

2) The AEC

The AEC can be assured that all experimental animals are being used in accordance with:

- ◆ The relevant AEC authority.
- ◆ The Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

The committee can also be assured that all animal welfare issues will be notified and

there is the opportunity to include additional monitoring inspections or instructions that can become AEC conditions of approval.

The AEC is confident.

3) Animal Welfare

All Garvan experimental animals can be assured that all welfare issues will be detected and rectified straight away and, hence, pain and suffering are avoided.

The animals are confident.

Conclusion

The role of Monitoring Officer is very much 'hands on' and must be experienced in:

- ◆ Animal handling and husbandry
- ◆ AEC procedures and protocols
- ◆ Legislative requirements

It has been suggested that the monitoring officer is the eyes and ears of the AEC in the animal facility. The role not only encompasses this, but also works with the research team to achieve the highest level of compliance.

When carried out correctly the integration of all these activities described will enable the monitoring officer to play a key role in the implementation of a successful quality assurance program which caters to the needs of the researchers, the AEC and, most importantly, the animals themselves.

Humane Teaching Methods Demonstrate Efficacy in Veterinary Education

Andrew Knight

Animal Consultants International, www.AnimalConsultants.org.

Abstract

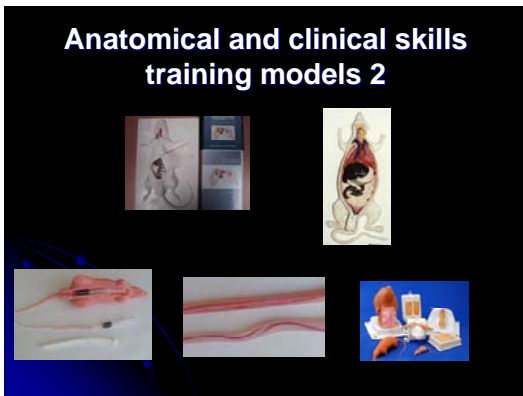
Animal use resulting in harm or death has historically played an integral role in veterinary education, in disciplines such as surgery, physiology, biochemistry, anatomy, pharmacology and parasitology. However, many non-harmful alternatives now exist, including computer simulations, high quality videos, ‘ethically-sourced cadavers’ such as from animals euthanased for medical reasons, preserved specimens, models and surgical simulators, non-invasive self-experimentation and supervised clinical experiences. Complaints by veterinary students in Australia, the US and elsewhere have shown that many veterinary academics remain opposed to their introduction, usually citing concerns about teaching efficacy. Consequently, studies of veterinary students were reviewed comparing learning outcomes generated by non-harmful teaching methods with those achieved by harmful animal use. Of eleven published from 1989 to 2006, nine assessed surgical training—historically the discipline involving greatest harmful animal use. 45.5% (5/11) demonstrated superior learning outcomes using more humane alternatives. Another 45.5% (5/11) demonstrated equivalent learning outcomes and one (9.1%) demonstrated inferior learning outcomes. Twenty nine papers in which comparison with harmful animal use did not occur illustrated additional benefits of humane teaching methods, including: time and cost savings, enhanced potential for customisation and repeatability of the learning exercise, increased student confidence and satisfaction, increased compliance with animal use legislation, elimination of objections to the use of purpose-killed animals, and integration of clinical perspectives and ethics early in the curriculum. The evidence demonstrates that veterinary educators can best serve their students and animals, while minimising financial and time burdens, by introducing well-designed teaching methods not reliant on harmful animal use. However, due to their lack of support for the concept, too many Australian veterinary educators remain among the world’s worst teachers of humane veterinary surgical courses. Instead, they should aim to be among the best. Such an achievement is within their ability; it simply requires a fundamental change in attitude.

Introduction

Humane teaching methods in veterinary education

Animal use, often resulting in harm or death to the animals, has historically played an integral role in veterinary education. This has been particularly true in disciplines such as surgery, physiology, biochemistry, anatomy, pharmacology and parasitology. However, during the last two decades there has been a substantial increase in the availability of non-harmful alternatives, such as computer simulations, high quality videos, ‘ethically-sourced cadavers’ obtained from animals that have been euthanased for medical reasons, or that have died naturally or in accidents, preserved specimens, models and surgical simulators, non-invasive self-experimentation and supervised clinical experiences (Rowan 1991, Bauer 1993, Knight 1999, Gruber & Dewhurst 2004, Martinsen & Jukes 2006).





Humane veterinary surgical courses ideally comprise several stages. Students commence by learning basic manual skills such as suturing and instrument handling using knot-tying boards, plastic organs and similar models. They then progress to simulated surgery on ethically-sourced cadavers. Finally students observe, assist with, and then perform necessary surgery under close supervision on real patients that actually benefit from the surgery—as distinct from on healthy animals that are later killed—similar to the manner in which physicians are trained (Knight 1999).



An important part of humane veterinary surgical courses worldwide are animal shelter sterilisation programs, in which homeless animals are neutered by students under supervision and returned to shelters. The popularity of these programs stems in part from the fact that all parties benefit from them. The animals have their adoption rates increased by neutering (Clevenger & Kass 2003), the numbers of unwanted animals subsequently killed due to uncontrolled breeding is decreased, the students gain invaluable experience at some of the most common procedures they will later perform in practice (Richardson *et al.* 1994, Howe & Slater 1997) and their veterinary school experiences the public relations benefits of

providing a valued community service (Knight 1999).

Australian opposition to humane teaching methods

Despite their potential benefits however, since at least 1986 to the present time (2006), it has been the experience of this author and veterinary student and faculty colleagues around the world that many veterinary academics remain opposed to the introduction of more humane teaching methods. As a veterinary student in 1998 at Western Australia's Murdoch University Division of Veterinary & Biomedical Sciences, I had to resort to initiating legal action and media exposure of curricular animal killing before Murdoch allowed me to use humane teaching methods. To its great credit, Murdoch then responded affirmatively by introducing Australia's first formal policy allowing conscientious objection by students, agreeing to provide them with alternatives to harmful animal use during teaching or assessment activities on request. Similar policies have since been adopted by at least two other Australian (University of Sydney Faculty of Veterinary Science, University of Woollongong), and several US universities (e.g. the University of California (Berkeley), Cornell University, University of Illinois and Virginia Commonwealth University).

In 2000 a classmate and I became Western Australia's first veterinary students to be granted alternatives to all of the fourth year terminal surgical laboratory classes (Knight 2001). We were effectively told that alternatives would be allowed, because the university was obliged by its conscientious objection policy to provide them. However, because certain academics did not agree with us, these alternatives would need to be self organised and would take the form of practical instruction elsewhere, e.g. in private veterinary clinics and animal shelters. Additionally, we had to source our own animals (e.g. from shelters) and bring them back to the university to neuter them. We

were also told that if we could not perform surgery or anaesthesia to the high standards of our academic examiners, they would fail us. Additionally, we still had to attend all of the terminal surgical laboratories as observers.

There are many alternative veterinary surgical courses worldwide but to my knowledge, this was the only such course in which the academics charged with providing practical instruction, instead required that students arrange their own instruction elsewhere and then required that they source their own animals to demonstrate their surgical abilities. Despite these and other obstacles placed in our way, the alternative program we created proved an outstanding success. Jointly we refused to participate as surgeon or assistant surgeon in at most 13 terminal surgeries at Murdoch. However, we performed or assisted with at least 62 additional surgeries instead - not including the simulated abdominal surgeries I performed on a 'DASIE' surgical simulator (Dog Abdominal Surrogate for Instructional Exercises—See Figure 1) I purchased from Canada. Quantitatively, we gained approximately five times the surgical and anaesthetic experience of our conventionally trained classmates. These surgeries were performed under supervision, mostly in private practice.

Our experiences had both depth and breadth—depth in the case of the large number of spays and castrations we performed, and breadth in that we also participated in a range of other surgeries as well. In total during 2000 we sterilised 45 dogs and cats.

The most important surgery for new graduates to be able to perform is the spay (female sterilisation). Although both positive and negative variation exists, most veterinary students worldwide and in Australia, perform at best, only part of a single spay (which beginning our final year. It felt is often shared between two students), prior to graduation. Jointly we performed 21 spays before even exceedingly good to be

contributing positively towards the dog and cat overpopulation problem by sterilising animals and thereby preventing unnecessary deaths, instead of causing them during our surgical training.

After another protracted period of negotiation lasting almost a year, I was able to convince our academics to provide two ethically-sourced canine cadavers obtained from animals euthanized for medical reasons, to allow us to perform five simulated abdominal and two simulated orthopaedic surgeries on

them. The result of this relatively high level of experience was that the skill and confidence deficiencies experienced by all new graduate veterinarians when beginning their surgical and clinical practice were substantially reduced in our case. To its considerable credit, Murdoch is presently seeking to establish an animal shelter sterilisation program that will similarly benefit all veterinary students, without compromising animal welfare or ethical standards.

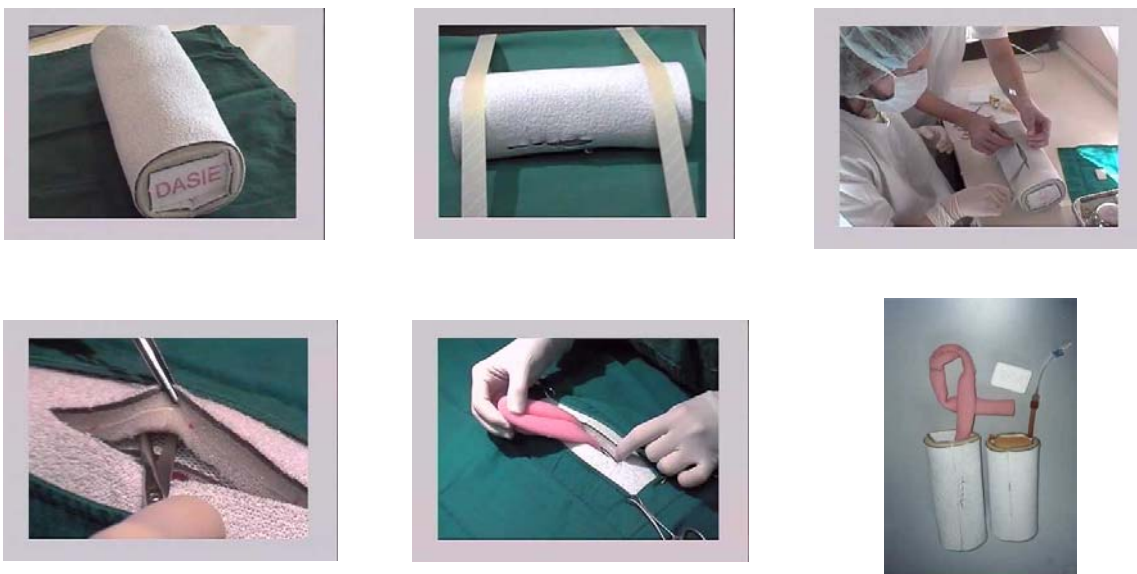


Figure 1: Dog Abdominal Surrogate for Instructional Exercises. These example images illustrate the basic principles that underlie the use of this simple yet effective alternative.

Veterinary students at two of Australia's three other established veterinary schools have experienced similar difficulties when seeking to use alternative teaching methods. The University of Sydney Faculty of Veterinary Science adopted very progressive policies with respect to humane alternatives in 2000 (elimination of all terminal surgical laboratories, implementation of a pound dog sterilisation program, adoption of a conscientious objection policy). Since 1999 this author has also corresponded with students requesting humane teaching methods at the University of Melbourne, Faculty of Veterinary Science and the University of Queensland, School of Veterinary Science. All of these students were ultimately

successful, so by 2005 the first students had graduated from all four established Australian veterinary schools without killing animals during their surgical training.

International opposition to humane teaching methods

Reports from veterinary students within the US and elsewhere indicate that although a growing number of veterinary schools worldwide have implemented humane teaching methods to varying degrees, opposition to their implementation remains common in veterinary schools around the

world. Previously published reports indicate that veterinary students requesting humane teaching methods have faced strong faculty opposition in at least the following veterinary schools:

- University of California (Davis) including the School of Veterinary Medicine: 1986-1992 (Rasmussen 1998);
- University of Florida College of Veterinary Medicine: 2000 (Pohost 2001);
- University of Illinois College of Veterinary Medicine: 1999-2000 (Stull 2003);
- Massey University Institute of Veterinary and Biomedical Sciences (New Zealand): 2001 (Beer 2002);
- Norwegian School of Veterinary Science: 1997-2002 (Martinsen 1998 & 2002);
- Ohio State University College of Veterinary Medicine: 1992 (Anon. 1997);
- Ontario Veterinary College, University of Guelph (Canada): 2002-2006 (Thompson 2003 and Papp 2006);
- Oregon State University College of Veterinary Medicine: 2000-2001 (McNamara 2001);
- Virginia-Maryland Regional College of Veterinary Medicine: 2001 (Chaves 2001); and,
- Washington State University College of Veterinary Medicine: 2002 (Anon. 2002);

Additionally, between 1998 and 2006, this author corresponded with students facing faculty opposition to their requests for humane alternatives in at least another 10 veterinary schools and a further 10 non-veterinary faculties, most of which were located in the US. Although not a definitive survey, these results nevertheless indicate that faculty opposition to student requests for humane teaching methods is an international, rather than an isolated problem, and that it is evident in some of the world's leading veterinary schools.

Occasionally, opposition of this kind has been described in veterinary journals. Fearon (2005), for example, describes an interview

with Professor Kumar, head of veterinary gross anatomy at the Tufts University Cummings School of Veterinary Medicine in Massachusetts. Prof Kumar established Tufts' pet body donation program in 1995 (Kumar *et al.* 2001) to facilitate the sourcing of the cadavers of animals euthanased for medical reasons, as an ethical replacement to the use of purpose-killed animals in anatomy dissection and clinical skills training. Prof. Kumar described the opposition of almost all of his academic peers at other veterinary schools to student requests for the establishment of similar programmes as "arrogant," and stated that the general attitude to requests of this sort is that "you don't let the inmates run the asylum." (Fearon 2005).

In 2002 a 'Petition for Rulemaking and Enforcement Under the Animal Welfare Act to Eliminate Violations of the Review of Alternatives Provisions' was filed by the US Association of Veterinarians for Animal Rights and several veterinary students, with the United States Department of Agriculture, who have jurisdiction over this federal Act. All US veterinary schools were subsequently inspected and nearly every school was cited for non-compliance with the Act. Most citations were issued for failing to search for alternatives to harmful or lethal animal use, or for failing to provide an adequate explanation as to why non-harmful alternatives were not being used. Many schools were also cited for duplicative use of animals and for the number of animals used, as well as for inappropriate species choice. Some were cited for lack of personnel training and animal identification, for conducting multiple potentially painful procedures and for lack of information regarding anaesthetics and methods used to kill animals (Anon 2005).

Opposition to the use of humane teaching methods is not unique to veterinary educators. Non-veterinary students requesting humane teaching methods have similarly faced strong faculty opposition in some institutions, as indicated by the following publications:

- University of Colorado School of Medicine: 1992-1995 (McCaffrey 1995);
- University of Frankfurt Faculty of Medicine: 1986-1990 (Völlm 1998);
- University of New Mexico in the Bachelor of Science (Biology) course: 1989-1991 (Hepner 2002);
- Portland Community College (Oregon) Science Department: 1997-1998 (Powell 1998);
- University of Santa Catarina, Biological Sciences (Brazil): 1998-1999 (Tréz 2002); and,
- University of Wales in the Bachelor of Science (Zoology) course: 1991 (Humphries 1998).

Again, this survey is not definitive, and it is possible that additional institutions have at some stage, also opposed student requests for humane teaching methods. Such opposition was demonstrated by the prestigious US National Association of Biology Teachers, which at first endorsed the use of humane alternatives in education but which later rescinded this policy because of opposition from biology teachers. Commenting on this reversal, van der Valk *et al.* (1999) stated: *“Often, they are not interested in the ethics of using animals. Textbooks, laboratories and equipment are still oriented toward animal experimentation. Convincing these teachers of the advantages and ethics of using alternatives is difficult, the situation being very much polarised. Incorporating the principles of the 3Rs into teachers’ initial training and post-qualification professional development would help to overcome some of these difficulties.”*

There may be some interesting psychological phenomena underlying the resistance demonstrated by some faculty members to the use of humane teaching methods, including the need to personally justify the large-scale killing of animals for courses within their area of responsibility. Gruber & Dewhurst (2004) further assert that: *“Human vanity is also a factor that should not be underestimated. For many university teachers, it is not acceptable*

to diverge from the methods one was taught and which one has always used in a life of teaching. Aversion towards accepting alternatives that were not developed in one’s own country also plays a role. Sometimes it appears that German, American and Japanese medicines are different entities.” Nevertheless, in the experiences of this author and some veterinary and non-veterinary student colleagues worldwide, the reasons most commonly cited by faculty members opposed to the introduction of humane teaching methods are concerns about their educational efficacy. Given the prevalence of such concerns, a review of relevant educational studies may be warranted.

A review by Patronek & Rauch (2007) systematically examined learning outcomes achieved via humane teaching methods, compared with those achieved by terminal live animal use. Seventeen studies were retrieved, of which five examined veterinary students, three examined medical students, six examined other undergraduate students and three examined high school biology students. For two of these studies of medical students, equivalent learning outcomes were achieved using alternatives to the dissection of human cadavers, and harmful animal use may not have occurred (Jones *et al.* 1978, Guy & Frisby 1992). Of the remaining 15 studies clearly involving comparisons with harmful animal use, four resulted in superior, and eleven resulted in equivalent learning outcomes, when humane teaching methods were used. Of the five veterinary student studies, two resulted in superior surgical skill acquisition when alternatives to terminal live animal use were employed, and three resulted in equivalent learning outcomes when alternatives to harmful animal use were employed in surgical and physiology courses. Consequently, Patronek & Rauch concluded that *“alternatives are a viable method of instruction in the field of biomedical education.”* They encouraged *“biomedical educators to consider how adopting alternative teaching methods could be of*

benefit to their teaching programs, students, and faculty members.”

By publishing one of the first such systematic reviews, Patronek & Rauch made a major contribution to this field. However, they only examined terminal live animal use, e.g., for animal dissection, live animal surgery and live animal physiology demonstrations. Other potentially harmful procedures, such as equine nasogastric intubation when conducted by novice practitioners, repetitive bovine rectal palpation, or even potentially stressful confinement and observation of non-domesticated species, were excluded from consideration. Additionally, only one bibliographic biomedical database (Pubmed) was searched for papers published from 1996 and 2004, and the search terms used were somewhat limited. Additional relevant comparative studies of student learning outcomes exist. Consequently I conducted a more comprehensive systematic review of student learning outcomes achieved via humane teaching methods in comparison to those achieved by harmful animal use.

Materials and Methods

The peer-reviewed biomedical literature was searched to locate studies of the learning outcomes achieved by veterinary students trained using non-harmful teaching methods, in comparison to those achieved by harmful animal use. To ensure comprehensive coverage, the following six biomedical bibliographic databases were searched:

1. CAB Abstracts, which is the most comprehensive bibliographic database for the applied life sciences, covering veterinary medicine and many other disciplines. It contains over 4.5 million records from 1973 onwards, sourced from over 6,000 biomedical journals and more than 3,500 other documents from over 140 countries (Anon. undated a & b).
2. The Cochrane Central Register of Controlled Trials (CENTRAL or CCTR), which is a bibliographic database of definitive controlled trials produced by the Cochrane Collaboration (www.cochrane.us) in co-operation with the National Library of Medicine in Washington, DC, who produce MEDLINE (see following), and Reed Elsevier of Amsterdam (the Netherlands), who produce EMBASE (see following). Over 350,000 bibliographic references to controlled trials in health care were included by 2003 (Anon. undated c).
3. The Cochrane Database of Systematic Reviews (COCH) is the main component of The Cochrane Library and includes regularly updated systematic reviews of the effects of healthcare prepared by The Cochrane Collaboration (Anon. undated c).
4. The Cumulative Index to Nursing & Allied Health (CINAHL) database, which provides authoritative coverage of the literature related to nursing and allied health. More than 1600 journals and many related documents are regularly indexed (Anon. undated d).
5. EMBASE, the Excerpta Medica database, which is a biomedical and pharmacological database containing over 10 million records from 1980 onwards covering veterinary medicine and many other disciplines, particularly those with relevance to pharmacology, sourced from over 3,500 biomedical journals (Anon. undated e).
6. MEDLINE, the United States National Library of Medicine's premier bibliographic database, covering veterinary medicine and many other medical and related disciplines. Medline contains over 12 million citations from 1966 onwards, sourced from more than 4,800 biomedical journals from over 70 countries (Anon. undated f).

All titles, abstracts, subject headings, and other key fields were searched for: 'endoscopic simulation' or 'endoscopy simulation' or 'endoscopic simulator' or 'endoscopy simulator' or 'surgery simulator' or 'surgical simulator' or 'surgery simulation' or 'surgical simulation' or 'veterinary curriculum' or 'veterinary education' or 'veterinary student' or 'veterinary physiology' or 'veterinary surgery.'

These search terms were chosen partly because endoscopic simulators are a large and important sub-category within surgical simulators, and because both historically and contemporarily veterinary physiology and surgery remain the disciplines in which the greatest harmful use occurs, and consequently the greatest efforts to replace such use with humane alternatives have also occurred in these disciplines.

The abstracts, and, occasionally, complete papers, were examined to locate studies of veterinary and non-veterinary student performance achieved using humane alternatives in comparison to harmful animal use. Cited references of retrieved papers were also reviewed to identify additional relevant papers.

Additionally, the main reference books within this field were searched (Balcombe 2000b, Knight 2002, Jukes & Chiuia 2003).

For the purposes of this review, animal use considered harmful included:

- invasive procedures, or those reasonably likely to be significantly stressful, such as:
 - equine nasogastric intubation (when conducted by novice practitioners);
 - most physiology, pharmacology and biochemistry demonstration laboratories using live animal subjects or living tissue from recently killed animals;
 - surgical procedures other than those described below; and,

- any use of animals resulting in death, other than genuine euthanasia performed solely for medical or severe and intractable behavioural reasons; and,
- the dissection of purpose killed animals.

Animal use considered non-harmful included:

- observation of wild, feral or companion animals in field studies;
- minimally-invasive or stressful procedures conducted on living animals, such as bovine rectal palpation (although repeated use in some veterinary practical classes can become stressful and/or harmful);
- invasive procedures conducted for the benefit of genuine animal patients, such as neutering operations and similarly beneficial elective surgeries performed on healthy animals, and emergency surgeries conducted on injured or unwell animals; and,
- dissection, clinical or surgical procedures performed on cadavers obtained from animals that had been euthanased for medical reasons, or had died naturally or in accidents (*ethically-sourced cadavers*, including the cadavers of humans donated for use in medical education).

With respect to studies of veterinary surgical training, in which surgery performed on living animals was compared with that conducted on cadavers or inanimate models, the source of the cadavers was unspecified in most studies. However, cadavers are usually obtained from ethically-questionable sources, such as the greyhound racing industry and animal control agencies ('pounds'). Consequently, when compared with a non-animal alternative (e.g., Griffon *et al.* 2000), the latter was considered the more 'humane' option for the purposes of this review.

However, cadavers may also be ethically-sourced, and a minority of veterinary schools, including at least nine in the US (the University of California (Davis) School of Veterinary Medicine (SVM), University of

Minnesota College of Veterinary Medicine (CVM), Mississippi State University CVM, University of Missouri-Columbia CVM,

University of Pennsylvania SVM, Texas A&M CVM, Tufts University Cummings SVM, Western University of Health Sciences CVM and the University of Wisconsin (Madison) SVM (Donley & Stull 2001, McCoy 2003, Anon. 2006b, Duda 2006), have established client donation programs in their teaching hospitals, to facilitate the use for teaching purposes of cadavers from animals euthanased for medical reasons.

Since 1998 similar programs have been established at Australian veterinary schools at Melbourne University, Murdoch University and the University of Sydney; however, by 2006 senior veterinary students interested in using humane alternatives at the latter two schools were unaware of the availability of any ethically-sourced cadavers, indicating that these two programmes were probably inactive.

Table 1: Veterinary student outcomes: humane teaching methods compared to harmful animal use

	Study	Veterinary discipline	Humane option	Total students (humane option)	Humane method superior	Equivalent learning outcomes	Humane method inferior
1	Abutarbush <i>et al.</i> 2006	clinical skills (equine)	CD-ROM	52 (27)	✓		
2	Bauer <i>et al.</i> 1992	surgery	cadavers			✓	
3	Carpenter <i>et al.</i> 1991	surgery	cadavers	24		✓	
4	Fawver <i>et al.</i> 1990	physiology	interactive videodisc	85	✓		
5	Greenfield <i>et al.</i> 1994	surgery	soft tissue organ models	36		✓	
6	Greenfield <i>et al.</i> 1995	surgery	soft tissue organ models	36		✓	
7	Griffon <i>et al.</i> 2000	surgery	plastic models	40 (20)	✓		
8	Johnson & Farmer 1989	surgery	models		✓		
9	Olsen <i>et al.</i> 1996	surgery	fluid haemostasis models	40 (20)	✓		
10	Pavletic <i>et al.</i> 1994	surgery	cadavers	48 (12)		✓	
11	Smeak <i>et al.</i> 1994	surgery	hollow organ simulators	40 (20)			✓
12	White <i>et al.</i> 1992	surgery	unspecified "alternative surgical program"			✓	
	Totals				5	6	1

Table 2: Non-veterinary student outcomes: humane teaching methods compared to harmful animal use							
	Study	Discipline	Humane option	Total students (humane option)	Humane method superior	Equivalent learning outcomes	Humane method inferior
1	Cohen & Block 1991	psychology	field study (feral pigeons)			✓	
2	Clark 1987	physiology	computer simulation			✓	
3	Cross & Cross 2004	biology (high school)	computer simulation	74 (38)			✓
4	Dewhurst <i>et al.</i> 1988	physiology	computer simulation			✓	
5	Dewhurst & Meehan 1993	physiology, pharmacology	computer simulations	65		✓	
6	Dewhurst <i>et al.</i> 1994	physiology	computer simulation	14 (6)		✓	
7	Downie & Meadows 1995	biology (undergraduate)	models (rats)	2913 (308)		✓	
8	Fowler & Brosius 1968	biology (high school)	video	156	✓		
9	Henman & Leach 1983	pharmacology	biovideograph videotape recordings	50	✓		
10	Hughes 2001	pharmacology	computer simulations			✓	
11	Kinzie <i>et al.</i> 1993	biology (high school)	interactive videodisc	61		✓	
12	Leathard & Dewhurst 1995	physiology (medicine)	computer simulation	156		✓	
13	Leonard 1992	biology (undergraduate)	interactive videodisc	142	✓		
14	Lieb 1985	biology (high school)	lecture			✓	
15	Matthews 1998	biology (undergraduate)	computer simulation	20 (12)			✓
16	McCollum 1987	biology (high school)	lecture	350 (175)	✓		
17	More & Ralph 1992	biology (undergraduate)	computer courseware	184 (92)	✓		
18	Phelps <i>et al.</i> 1992	physiology (nursing)	interactive videodisc		✓		
19	Samsel <i>et al.</i> 1994	physiology (medicine)	computer simulations	110	✓		
20	Strauss & Kinzie 1994	biology (high school)	interactive videodisc	34 (17)		✓	
21	Velle & Hal 2004	biology (high school)	computer simulation	64	✓		
Totals					8	11	2

Nevertheless, given their potential for ethical-sourcing when compared with 'terminal' (lethal) live animal use (the norm in veterinary surgical training), a cadaver was considered to be the more 'humane' option.

Results

Biomedical bibliographic databases are constantly updated. As of 22 Dec. 2006, 3,954 records were located using the specified search terms. These were examined to identify studies of veterinary and non-veterinary student learning outcomes comparing harmful animal use with humane teaching methods.

Increasing numbers of veterinary schools around the world have introduced non-harmful teaching methods, which have sometimes been accompanied by educational evaluations. Twelve papers published from 1989 to 2006 described studies of veterinary students comparing learning outcomes generated by humane alternatives with those achieved by traditional harmful animal use (Table 1).

Greenfield *et al.* (1994 & 1995) described the same study; hence 11 distinct studies of veterinary student learning outcomes were retrieved. Nine of these veterinary student studies assessed surgical training—historically the area of greatest harmful animal use. In 45.5% (5/11) of cases, superior learning outcomes (superior skill or knowledge, or equivalent performance with reduced activity times) resulted from the use of the humane option; equivalent learning outcomes also resulted in 45.5% (5/11) of cases; and in one case (9.1%) the humane option resulted in inferior learning outcomes.

Twenty one papers published from 1968 to 2004 described studies of non-veterinary

students in related academic disciplines, similarly comparing learning outcomes generated by humane alternatives with those achieved by traditional harmful animal use (Table 2).

The papers by Dewhurst *et al.* (1993 & 1994) may have described the same study; hence at least twenty distinct studies of non-veterinary student learning outcomes were retrieved.

Seven of these studies of related non-veterinary disciplines examined high school biology students, while 13 examined undergraduate biology, medical, nursing, pharmacology, physiology and psychology students. The seven studies of high school biology students published from 1968 to 2004 examined anatomical knowledge using alternatives to the dissection of purpose killed animals. Three studies demonstrated superior, three studies demonstrated equivalent, and one study demonstrated inferior knowledge acquisition, when humane alternatives were used.

Of the 13 studies examining undergraduate students published from 1983 to 2001, 38.5% (5/13) demonstrated that alternative students achieved superior learning outcomes, or achieved equivalent results more quickly, allowing time for additional learning. A further 53.8% percent (7/13) demonstrated equivalent educational efficacy, and only one study (7.7%) demonstrated inferior educational efficacy of humane alternatives.

Twenty nine papers published from 1983 to 2006 not involving comparisons with harmful animal use were also identified, illustrating additional benefits of humane teaching methods when used veterinary in education (Table 3).

Table 3: Additional benefits of humane teaching methods in veterinary education

	Study	Veterinary discipline	Humane option	Benefits of humane option (besides decreased harmful animal use)
1	Allen & Chambers 1997	surgery	computerised tutorial	increased surgical skill
2	Baillie <i>et al.</i> 2003	clinical skills (bovine)	virtual reality simulator	customization of learning experience, repeatability, superior skill acquisition and development
3	Baillie <i>et al.</i> 2005a	clinical skills (bovine)	virtual reality simulator	customization of learning experience, repeatability, superior skill acquisition and development
4	Baillie <i>et al.</i> 2005b	clinical skills (bovine)	virtual reality simulator	customization of learning experience, repeatability, superior skill acquisition and development
5	Buchanan <i>et al.</i> 2005	biochemistry	3D animations	superior understanding of complex biological processes
6	Dhein & Memon 2003	continuing education	internet based curriculum	overcomes obstacles of time and distance, decreased costs, facilitates lifelong learning
7	Dyson 2003	anaesthesia	CD-ROM	increased anaesthetic knowledge
8	Ellaway <i>et al.</i> 2005	unspecified	virtual learning environment	increased flexibility of use
9	Erickson & Clegg 1993	physiology	computer simulations	greatest student satisfaction
10	Galle U & Bubna-Littitz 1983	clinical skills (canine)	cadaver	repeatability
11	Greenfield <i>et al.</i> 1994	surgery	models	decreased student and faculty objections to harmful animal use
12	Hawkins <i>et al.</i> 2003	clinical skills (small animal)	video	increased diagnostic skills
13	Hines <i>et al.</i> 2005	pathology (systemic)	virtual learning environment	greater understanding, student satisfaction, increased flexibility of use
14	Holmberg <i>et al.</i> 1993	surgery	model	decreased student stress, repeatability
15	Howe & Slater 1997	surgery	sterilisation program	increased surgical and anaesthetic skills including atraumatic tissue handling, increased understanding of the pet overpopulation problem and the role of the veterinarian in combating it, increased awareness of the activities of humane organisations
16	Howe <i>et al.</i> 2005	surgery	CD-ROM	increased practice of techniques, enhanced preparedness for laboratories, greater student satisfaction
17	Josephon & Moore 2006	anatomy	DVD	customisation of learning experience to individual needs, possibly increased examination results

18	Kumar <i>et al.</i> 2001	anatomy	ethically-sourced cadavers	compliance with animal use regulations, elimination of student and faculty objections to the use of purpose-killed animals, integration of clinical perspectives and ethics early in the curriculum
19	Linton <i>et al.</i> 2005	anatomy	computer simulation	rapid access to related views such as radiographs, increased learning efficiency and student confidence
20	Modell <i>et al.</i> 2002	anaesthesia	human patient simulator	realism, increased confidence coping with complex clinical problems, increased examination results
21	Mori <i>et al.</i> 2006	surgery	model	repeatability, increased surgical skill
22	Pinkney <i>et al.</i> 2001	parasitology	computer tutorial	increased examination scores
23	Richardson <i>et al.</i> 1994	surgery	sterilisation program	increased surgical and anaesthetic skills including atraumatic tissue handling, increased understanding of the pet overpopulation problem and the role of the veterinarian in combating it, increased awareness of the activities of humane organisations
24	Rudas <i>et al.</i> 1993	unspecified	hypermedia	increased teaching efficiency, decreased cost
25	Silva <i>et al.</i> 2003	surgery	cadavers	increased surgical skill
26	Simpson & Meuten 1992	clinical skills	pathology specimens	repeatability
27	Smeak <i>et al.</i> 1991	surgery	haemostasis model	superior surgical skill acquisition
28	Waldhalm & Bushby 1996	unspecified	personal computer	enhanced information retrieval and communication, improved student attitudes towards computers, increased employer perception of computer literacy.
29	Whithear <i>et al.</i> 1994	microbiology	hypermedia database	greater autonomy and more active learning, facilitation of postgraduate learning

Nb: 'Hypermedia' refers to interactive information media in which graphics, audio, video, plain text and hyperlinks intertwine in a structure that is generally non-linear. In contrast, the broader term 'multimedia' may also be used to describe non-interactive linear presentations reliant on a variety of media, as well as hypermedia (Nelson 1965).

Discussion

Efficacy of humane teaching methods in comparison to harmful animal use

Veterinary surgical training

Humane surgical teaching methods compared with traditional harmful animal use have included models or surgical simulators

(Greenfield *et al.* 1994 & 1995, Griffon *et al.* 2000, Johnson & Farmer 1989, Olsen *et al.* 1996 and Smeak *et al.* 1994) and cadavers (Bauer *et al.* 1992, Carpenter *et al.* 1991 and Pavletic *et al.* 1994).

Skills assessed in surgical laboratories included psychomotor (all), ligation (Griffon *et al.* 2000 and Olsen *et al.* 1996), intestinal

anastomoses and celiotomy closures (Carpenter *et al.* 1991), gastrotomy closures (Smeak *et al.* 1994) and ovariohysterectomies (Griffon *et al.* 2000).

Overall, the surgical skills generated by these humane alternatives were at least equivalent to those achieved via traditional harmful animal use. Three surgical studies demonstrated superior surgical skills when humane alternatives were used. Johnson & Farmer (1989) found that inanimate models were superior to live animals in teaching basic psychomotor skills. Olsen *et al.* (1996) demonstrated that a fluid haemostasis model was at least as effective as a live dog splenectomy for teaching blood vessel ligation and division. In fact, students using the model completed their ligatures more quickly, with fewer errors. They successfully tied more square knots, their ligatures were tighter, and their instrument grip was superior. These students' initial scepticism regarding the use of properly designed inanimate models for teaching these surgical skills was dramatically altered. Griffon *et al.* (2000) found that 20 veterinary surgical students trained using plastic surgical simulators performed ovariohysterectomies on live dogs with greater skill than 20 classmates trained via cadavers. In all cases the ability to use the models repeatedly contributed to the superior surgical skills of the students who used them.

Five studies demonstrated equivalent surgical skills when humane alternatives were compared to harmful animal use (Carpenter *et al.* 1991, Bauer *et al.* 1992, White *et al.* 1992, Pavletic *et al.* 1994, Greenfield *et al.* 1994 & 1995). Carpenter *et al.* (1991) and Bauer *et al.* (1992) demonstrated equivalent surgical skill acquisition using cadavers as the humane option, while Greenfield *et al.* (1994 & 1995) demonstrated a similar result using soft tissue organ models. White *et al.* (1992) found that veterinary students from an alternative surgical laboratory program had surgical skills equivalent to those with a standard laboratory experience, after some initial

hesitancy in the alternative students during their first live animal surgery.

One study demonstrated inferior surgical skill acquisition using the humane option. Smeak *et al.* (1994) compared live animal gastrotomy skills of two groups of 20 students, one of which had practiced the procedure using a hollow organ model, and the other of which had practiced using a live animal. While they found no significant difference in overall gastrotomy closure technique, the students performing the procedure for a second time on a live animal were significantly quicker. Anaesthetic time is an important surgical consideration; hence this was considered a superior learning outcome. However, the plastic model used in this study was deficient, being more fragile and stiff than living gastric tissue, with suture pull-through occurring despite appropriate technique and tension; even though the model was found to be effective for teaching instrument use, needle placement, atraumatic tissue handling and tissue inversion.

Learning outcomes were compared both in the short-term (Johnson & Farmer 1989, Carpenter *et al.* 1991, Bauer *et al.* 1992, White *et al.* 1992, Smeak *et al.* 1994, Greenfield *et al.* 1994 & 1995, Olsen *et al.* 1996 and Griffon *et al.* 2000), and long term. Pavletic *et al.* (1994) studied new graduates from the Tufts University veterinary class of 1990, which included 12 students who had participated in an alternative small animal medical and surgical procedures course. This involved the use of ethically-sourced cadavers and additional clinical rotations in small animal surgery (4 weeks), small animal medicine (1 week) and intensive care (1 week). These students and 36 of their conventionally trained peers were assessed by questionnaires sent to their employers, who were asked to rate their competency at the time of hiring and 12 months later. There was no significant difference on either occasion in the abilities of the conventional and alternative graduates when performing common surgical, medical and diagnostic

procedures, in their attitudes towards performing orthopaedic or soft tissue surgery, confidence in performing the listed procedures, or ability to perform them unassisted.

The success of humane surgical training has also been reported for UK veterinary graduates. The UK is the only major region of the developed world where harmful animal use has been removed from the veterinary surgical curriculum for decades; instead students gain practical experience by assisting with beneficial surgeries during extramural studies at private veterinary clinics. In 1998 Fitzpatrick & Mellor (2003) surveyed graduates from all veterinary schools in Great Britain and Ireland who had graduated within the previous five years. Ninety-five per cent of respondents were working full time in veterinary practice. Graduates rated extramural studies as “*very useful*” for three subjects, two of which were small animal surgery and cattle surgery.

Veterinary disciplines other than surgery

Both historically and contemporarily, surgery and physiology respectively are the disciplines that have resulted in the greatest harmful animal use during veterinary education. Disciplines other than surgery were poorly represented in comparative studies of veterinary student performance, totalling only two studies.

Abutarbush *et al.* (2006) found that a CD-ROM was more effective than a live animal demonstration by an instructor of the correct method for inserting a nasogastric tube into a horse. Students using the CD-ROM performed significantly better on a test of knowledge, were more confident, and were significantly quicker at successfully inserting a nasogastric tube into a live horse, than their traditionally instructed peers.

Fawver *et al.* (1990) found that first year veterinary students learnt cardiovascular physiology principles more efficiently from interactive videodisc simulations than from live animal laboratories, resulting in both student and staff time savings.

Related non-veterinary disciplines

Thirteen studies examined learning outcomes of undergraduate biology, medical, nursing, pharmacology, physiology and psychology students. A very slightly higher proportion of non-veterinary students achieved superior or equivalent learning outcomes using humane alternatives, when compared to veterinary students.

Cardiovascular physiology students achieved equivalent learning outcomes using computer simulations (Clarke 1987 and Dewhurst *et al.* 1988), and superior learning outcomes using an interactive video program (nursing students, Phelps *et al.* 1992), compared to animal based laboratories, and rated computer simulations as superior for learning (medical students, Samsel *et al.* 1994). Intestinal physiology students working independently with a computer program gained equal knowledge, at one-fifth the cost, compared to students that used freshly killed rats (Dewhurst *et al.* 1994 and Leathard & Dewhurst 1995). Physiology and pharmacology students using computer simulations performed as well as students using traditional animal laboratories (Dewhurst & Meehan 1993). Pharmacology students achieved superior learning outcomes using biovideograph videotapes (Henman & Leach 1983) and equivalent learning outcomes overall (superior initially in each of five experiments but possibly with inferior long-term recall of experimental details) using computer simulations (Hughes 2001), in comparison to outcomes achieved via animal based laboratories. Biology students achieved superior (computer simulations, More & Ralph 1992) or equivalent (videodisc, Leonard 1992; models, Downie & Meadows

1995) learning outcomes using alternatives to dissections. Additionally, the videodisc group used only half the time required by the traditional laboratory group.

Only one study of non-veterinary students demonstrated inferior learning outcomes when the humane teaching option was used. Eight undergraduate biology students who dissected foetal pigs scored significantly higher on an oral test with prosected foetal pigs than twelve students who studied using a computer simulation ('MacPig,' Matthews 1998). However, MacPig is considered to be insufficiently detailed for college level biology instruction (Balcombe 1998).

Impact of chronology on comparative studies

Of the 12 papers comparing veterinary student learning outcomes, nine were more than a decade old (published prior to 1996). Of the 21 papers describing non-veterinary student learning outcomes, 18 were more than a decade old. Hence, a considerable number of these studies examined humane teaching methods such as films, interactive video discs, and early computer simulations, which have been largely superseded by more advanced alternatives, particularly in the field of computer simulations. The laboratories these alternatives were designed to replace, such as animal dissections and live animal experimental or surgical laboratories, have, on the other hand, remained largely unaltered. It is a damning indictment of harmful animal use that even such relatively antiquated alternatives almost always resulted in superior or equivalent learning outcomes. It is likely that comparative studies of modern alternative teaching methods would yield an even higher proportion of studies demonstrating superior learning outcomes when these are used.

Animal welfare benefits and improved legislative compliance

Advantages of humane alternatives other than educational efficacy include the saving of substantial numbers of animal lives. Few countries record the numbers of animals used for educational purposes, and of those that do, most consider only live vertebrate use, and fail to include invertebrates or vertebrates killed for dissections. Additionally, the small minority of non-harmful use is rarely, if ever, differentiated from overall animal use. Consequently, the numbers of animals harmed for educational purposes are difficult to ascertain. Nevertheless, it is clear that those numbers are substantial. It was estimated that approximately nine million vertebrate animals and a similar number of invertebrates were used in biomedical education in the United States in 2000 (Balcombe 2000b). From 1985 to 1996, the Canadian Council on Animal Care estimated that around 85,000 living vertebrates and some 'higher' invertebrates such as cephalopods were used annually in university teaching (Balcombe 2000a). The total number of animals used in Australian teaching is unclear, but in just four states that kept partial statistics (New South Wales, South Australia, Tasmania and Victoria) the recorded use was in excess of 100,000 annually, around 1996 (Office of Animal Welfare 1996; Animal Research Review Panel New South Wales 1997; Bureau of Animal Welfare, Agriculture & Resources 1997 and Public Health & Animal Welfare Section 1997).

Apart from directly saving large numbers of animal lives, humane teaching methods also facilitate increased compliance with legislative and Code of Practice requirements restricting educational or other scientific animal use, which exist in a large number of countries (Balcombe 2000a). In Australia, for example, the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*, which is legally enforceable in every state and territory, requires alternatives to the use of animals wherever possible for educational and other scientific purposes (NHMRC 2004).

The already considerable importance of these factors is expected to increase as society becomes ever more conscious of the importance of animal welfare (Siegford *et al.* 2005), and consequently, less willing to permit harmful animal use for educational purposes (Scalese & Issenberg 2005).

Additionally, as stated previously, where veterinary students participate in animal shelter sterilisation programs, uncontrolled companion animal breeding is decreased and adoption rates are increased, directly and positively impacting on animal welfare (Clevenger & Kass 2003).

Finally, there is evidence to suggest that veterinary education may result in the decreased likelihood of students viewing animals as sentient, a decreased empathy towards animals, a decreased propensity to administer peri-operative analgesics, and the impedance of normal development of moral reasoning ability (Self *et al.* 1991 & 1996, Hellyer *et al.* 1999, Paul & Podberscek 2000 and Levine *et al.* 2005). Along with inadequate curricular attention to animal welfare science, the human-animal bond and the development of critical reasoning ability and ethics (Self *et al.* 1994 and Williams *et al.* 1999), the harmful use of animals during veterinary education is a likely cause of such phenomena (De Boo & Knight 2005 & 2006). The apparent reduction in concern for animal welfare may, in some cases, represent psychological adaptations enabling veterinary students to withstand what could otherwise be intolerable psychological stresses resulting from curricular requirements to harm sentient creatures in the absence of overwhelming necessity (Capaldo 2004). Consequently, the replacement of harmful animal use with humane teaching methods is likely to result in veterinarians with more positive attitudes towards animal welfare, which is likely to directly benefit their animal patients.

Additional advantages of humane teaching methods

Veterinary disciplines

Twenty nine papers describing humane teaching methods in veterinary education that did not involve comparisons with harmful animal use (although comparison with non-harmful teaching methods did sometimes occur) illustrated other advantages of these methods (Table 3). These included:

- customization of the learning experience (e.g. ability to work at own pace and explore areas of deficient understanding) and repeatability of the learning exercise (Galle & Bubna-Littitz 1983, Simpson & Meuten 1992, Holmberg *et al.* 1993, Whithear *et al.* 1994, Baillie *et al.* 2003 & 2005a-b, Dhein & Memon 2003, Howe *et al.* 2005 and Josephon & Moore 2006), and increased flexibility of use (Dhein & Memon 2003, Ellaway *et al.* 2005 and Hines *et al.* 2005);
- increased clinical (Baillie *et al.* 2003 & 2005a-b, Hawkins *et al.* 2003), surgical (Smeak *et al.* 1991, Richardson *et al.* 1994, Allen & Chambers 1997, Howe & Slater 1997, Silva *et al.* 2003 and Mori *et al.* 2006) and anaesthetic (Richardson *et al.* 1994, Howe & Slater 1997 and Dyson 2003) skill acquisition and development;
- superior understanding of complex biological processes (specifically, interactions between intracellular molecules and their spatial relationships within cells, Buchanan *et al.* 2005), and of systemic pathology (Hines *et al.* 2005), rapid access to relevant anatomical views such as radiographs, and increased learning efficiency (Linton *et al.* 2005);
- enhanced preparedness for laboratories (Howe *et al.* 2005), and, on occasion, increased realism of the laboratory experience (Modell *et al.* 2002);

- improved examination results (parasitology, Pinkney *et al.* 2001; anaesthesiology, Modell *et al.* 2002 and anatomy, Josephon & Moore 2006);
- decreased student stress (Holmberg *et al.* 1993), increased student satisfaction (Erickson & Clegg 1993, Hines *et al.* 2005, Howe *et al.* 2005) and confidence (Linton *et al.* 2005), including when coping with complex clinical problems (Modell *et al.* 2002);
- enhanced student information retrieval and communication abilities, improved student attitudes towards computers, and increased employer perception of computer literacy (Waldhalm & Bushby 1996);
- facilitation of ongoing undergraduate and postgraduate learning (Whithear *et al.* 1994, Dhein & Memon 2003);
- increased teaching efficiency and decreased costs (Rudas *et al.* 1993, Dhein & Memon 2003);
- increased compliance with animal use regulations, elimination of student and faculty objections to the use of purpose-killed animals, and integration of clinical perspectives and ethics early in the curriculum (Greenfield *et al.* 1994, Kumar *et al.* 2001); and,
- increased understanding of the pet overpopulation problem and the role of the veterinarian in combating it, and increased awareness of the activities of humane organisations, when veterinary students participate in animal shelter sterilization programs (Richardson *et al.* 1994, Howe & Slater 1997).

Unusually, one alternative teaching model, the ‘Bovine Rectal Palpation Simulator,’ was described in three of these papers (Baillie *et al.* 2003 & 2005a-b). Bovine rectal palpation is most commonly conducted for the purposes

of pregnancy diagnosis. Designed to teach the necessary skills via a haptic system, this model applies anatomically appropriate tension to a student’s fingers depending on their spatial location inside a simulated cow. Haptic technology simulates the tactile feedback that would be experienced when manipulating real tissue, and is an important component of many virtual reality simulators.

Baillie *et al.* found that students using the simulator were able to customise their learning experiences according to individual need, and that they performed better when examining real cows for the first time than their traditionally trained peers. However, bovine rectal palpation is not normally harmful or particularly stressful unless performed repeatedly. Hence this animal use was not considered harmful for the purposes of this review; although some repeated use does occur in veterinary practical classes.

Related non-veterinary disciplines

Numerous papers describing related non-veterinary disciplines not involving comparisons with harmful animal use (although comparison with non-harmful teaching methods did sometimes occur) have illustrated additional advantages, and very occasionally, disadvantages, of humane teaching methods. Over 500 such papers published from 1974 to 2006 were identified by this review. Many of these described the development, validation, and affect on surgical planning, skill levels and other surgical or educational outcomes of the use of endoscopic other surgical simulators. Validation refers to the ability of a simulator to accurately predict real surgical skill levels, and is typically achieved when experienced and inexperienced surgeons demonstrate differing skill levels while using the simulator.

A rigorous analysis of these papers is beyond the scope of this review. However, examples

of papers of particular interest to veterinary educators include:

- twenty three papers demonstrating increased endoscopic diagnostic and surgical (Tsai & Heinrichs 1994, Edmond 2002, Garuda *et al.* 2002, Seymour *et al.* 2002, Watterson *et al.* 2002, Wilhelm *et al.* 2002, Ahmad *et al.* 2003, Sedlack *et al.* 2003 & 2004, Strom *et al.* 2003, Di Giulio *et al.* 2004, Grantcharov *et al.* 2004, Uribe *et al.* 2004, Clark *et al.* 2005, Hochberger *et al.* 2005, Long & Kalloo 2006, Maiss *et al.* 2005 and Matthes *et al.* 2006) or other surgical skills, particularly suturing skills, (O'Toole *et al.* 1999, Stefanich & Cruz-Neira 1999, Summers *et al.* 1999, Moody *et al.* 2002 and Chaer *et al.* 2006), achieved by medical students or practitioners through the use of computer based virtual reality or haptic endoscopic or other surgical simulators;
- three papers indicating equivalent learning outcomes when alternatives to the dissection of human cadavers (prosected specimens, a stereoscopic slide based auto-instructional program, interactive videodiscs and computer simulations) were used (medical students, Prentice *et al.* 1977 and Jones *et al.* 1978; human gross anatomy, pre-nursing and allied medical profession students, Guy & Frisby 1992);
- a paper by Szinicz *et al.* (1997) describing the use of the pulsatile organ perfusion ('POP trainer'), in which arteries in waste organs (commonly, from slaughterhouses, although ethically-sourced cadavers could also be used), are perfused with an artificial blood solution connected to a pulsatile pump, for training in both minimally invasive and conventional surgical techniques. Unlike many surgical simulators, this model allows practice of haemostatic techniques. Even complex operations, such as colorectal and antireflux procedures may be performed;
- two papers discussing the potential for globalised surgical teaching via telesurgery: the introduction of minaturised cameras into patients during surgery (Marescaux *et al.* 1999a & 1999b);
- a paper by Kunzel & Dier (2001) described the development of a realistic intubation simulator for practicing endotracheal intubation in dogs. A study by Hall *et al.* (2005) demonstrated that the human intubation skills of paramedical students who were trained using a simulator were equivalent to those trained on human subjects;
- a study by Huang & Aloji (1991), which demonstrated the improved learning outcomes of undergraduate biology students who used computer simulations of dissections. Similarly, Holt *et al.* (2001) demonstrated that computer assisted learning can be effective at teaching endocrinology to medical students;
- one study demonstrated increased student satisfaction and examination results for cardiovascular physiology students when computer simulations were used (Lilienfield & Broering 1994), while another demonstrated cardiovascular physiology knowledge acquisition equivalent to that gained from a textbook, although these medical students rated the computer simulation superior for reinforcement and review (Specht 1988); and,
- Dewhurst & Jenkinson (1995) demonstrated that computer simulations generally saved teaching staff time, were less expensive, and were an effective and enjoyable mode of undergraduate biomedical student learning.

A small number of studies overall demonstrated inferior learning outcomes when humane teaching methods were used.

For example, Rogers *et al.* (1998) demonstrated inferior basic surgical skill acquisition (the ability to correctly tie a square knot) acquired by medical students when a CAL program was used instead of a lecture and feedback seminar. Student comments suggested that the lack of feedback in this CAL model resulted in the significant difference between these two learning outcomes. Caversaccio *et al.* (2003) found that a virtual simulator enhanced understanding of endonasal surgery but failed to make an impact on operating room performance. The simulator's effectiveness was limited by the absence of force feedback, subtle handling of the joysticks, and considerable time consumption. Gerson & Van Dam (2004) found that medical residents trained to perform a sigmoidoscopy via traditional bedside teaching techniques achieved greater skill than those trained using an endoscopy simulator. Furthermore, a review of 30 randomized controlled trials assessing any training technique using at least some elements of surgical simulation found that none of the methods of simulated training (computer simulation, models, cadavers) were conclusively superior to one another or to standard surgical training, primarily of medical students and practitioners (Sutherland *et al.* 2006). These studies emphasise the importance of ensuring that humane teaching methods are well designed and are focused on achieving the specific learning outcomes desired.

Student concerns

Two key advantages of humane alternatives relate to students. The highly toxic chemicals used to preserve anatomy specimens between dissections present health hazards that may have the potential for legal and financial liability should students suffer exposure-related adverse health effects. In the experience of this author and his veterinary student colleagues from 1998-2006, recommended safety guidelines such as the use of gloves, gowns and masks are not

commonly met with full compliance in veterinary schools. Examples include the Murdoch University Division of Veterinary & Biomedical Sciences, 1998 (personal experience); the University of Sydney Faculty of Veterinary Science, 2003 (Anon. 2006); and the Ontario Veterinary College, University of Guelph (Canada), 2004-2006 (Papp 2006). These veterinary schools all had high standards, and once again this very limited survey suggests that there may be a wider problem internationally, rather than indicating a unique problem with these specific schools and do not take current practice into account.

Additionally, faculty opposition to strong student desires for humane teaching methods frequently result in conflict. A substantial number of countries have banned the harmful use of animals in primary and secondary school (mostly) or university education, outright. In a smaller group, including England, Germany, Italy, India, The Netherlands and the US, the rights of students to educational methods that do not violate their conscientiously held ethical or religious beliefs against harming animals are protected by various constitutional safeguards, legislation, policies or conventions, which have contributed to several successful lawsuits by students (Francione & Charlton 1992, Balcombe 2000a and 2000b). Examples include the University of Frankfurt Faculty of Medicine, 1988-1991 (Völlm 1998); the Ohio State University College of Veterinary Medicine, 1992 (Anon. 1997); the University of Santa Catarina, Biological Sciences (Brazil), 1998-1999 (Tréz 2002); and the University of Colorado School of Medicine, 1993 – 1995 (McCaffrey 1995). In the latter case, besides being required to introduce humane teaching methods, USD 95,000 in damages and costs was awarded against the University of Colorado in 1995.

Conclusions

Sufficient studies have been conducted to allow me to draw some conclusions about the efficacy of humane teaching methods in imparting surgical skills or knowledge. Well-designed humane alternatives generally perform at least as well as methods that rely upon harmful animal use, in some cases achieving superior learning outcomes. These have included superior surgical, anaesthetic and other clinical skill acquisition and development, superior understanding of complex biological processes, increased learning efficiency, and increased examination results. Additionally, increased teaching efficiency and decreased costs, along with enhanced potential for customisation and repeatability of the learning exercise, frequently result from the use of humane teaching methods. Increased student confidence and satisfaction, enhanced preparedness for laboratories and decreased student stress may also occur. Enhanced student information retrieval and communication abilities, improved student attitudes towards computers, and increased employer perception of computer literacy may also result from these methods. Increased compliance with animal use legislation or regulations, elimination of student and faculty objections to the use of purpose-killed animals, and integration of clinical perspectives and ethics early in the curriculum all result from the use of humane teaching methods. Substantial numbers of animal lives are saved, and some evidence also suggests veterinarians trained without harmful animal use may develop higher animal welfare standards, potentially benefiting their future patients. They may even gain increased understanding of the pet overpopulation problem and the role of the veterinarian in combating it.

Rather than continuing to rely upon harmful animal use, the evidence clearly indicates that veterinary educators can best serve their students and animals, while minimising financial and time burdens upon their

faculties, by introducing modern, humane teaching methodologies.

However, with the noteworthy exception of the program at the University of Sydney Faculty of Veterinary Science, existing Australian alternative veterinary surgical programs may still be seen as deficient in some of these areas. To the best of this authors knowledge, nowhere else are humane veterinary surgical courses so poorly supported that veterinary students are required to arrange their own practical instruction outside the veterinary school, and then required to source their own animal subjects for conducting elective surgeries within the veterinary school for assessment purposes.

Instead of being content with maintaining our dubious status among the world's worst instructors of humane veterinary surgical courses, it is time we Australians started aiming to be among the best. Such an achievement is within our ability; it simply requires a fundamental change in attitude.

Detailed information about the alternatives available for various academic disciplines is provided by Jukes & Chiuiia (2003) and by web sites such as:

[www.vetmed.ucdavis.edu/Animal Alternatives](http://www.vetmed.ucdavis.edu/Animal_Alternatives) and www.clive.ed.ac.uk. Synopses of surgical simulators designed for medical students and practitioners are provided at www.virtualsurgery.vision.ee.ethz.ch.

Comprehensive alternatives databases, alternatives lending libraries, reviews of leading alternatives, free on-line computer simulations, and hundreds of educational studies of alternatives organised by academic discipline are also available at web sites such as www.HumaneLearning.info and www.EURCA.org.

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Electrode-Tissue Interface: Development and findings of an *in vitro* model

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Abstract

When cochlear implants are first implanted, power requirements increase as biological matter grows over the electrodes. Previous work on the electrode-tissue interface has relied solely on animal models. While these models are able to provide useful information, the need for greater understanding of the interface has led to the development of the *in vitro* model. The *in vitro* model has not only reduced the number of animals that would have otherwise been used in this research, but provides additional information that could not be obtained with animal models.

The changes in the electrical properties of the electrode-tissue interface are measured using electrode impedance. Analysis using the *in vitro* model has shown that electrode impedance increases with protein adsorption and cell growth on the electrode surface. Changes in impedance with electrical stimulation have also been recorded. The *in vitro* model can now be used to test new methods, materials and stimulation protocols aimed at reducing the electrode-tissue interface changes that occur post-implantation. This will reduce power requirements of the cochlear implant, opening the way for improved performance or device miniaturisation.

Introduction

The cochlear implant provides adults and children with hearing that would otherwise be unavailable to them; thereby improving their quality of life and increasing their effective communication with others. Cochlear implant technology is however, still a work in progress. Power requirements are always going to be a limiting factor

for electrical devices and the cochlear implant is no different. It's a power hungry device and becomes even more so once it has been implanted inside the inner ear.

As with any other implant, when the body recognises its presence, the immune system and tissue repair processes are activated to deal with it. The body sees it as an invader, and when it can't destroy it or remove it, it works to cover it up – to hide it with tissue. It is this tissue that gets in the way of effective stimulation. The tissue creates an electrical barrier between the electrode and the nerves. This works to increase the level of power needed to maintain effective stimulation, thereby decreasing battery life. Currently, cochlear implant recipients will use at least one battery each day. That is a lot of batteries for the 70,000 adults and children around the world with a cochlear implant.

We know that these increases in power demand are due to tissue growth in the inner ear. What we don't know is how the body is

being signalled to do it, and how to reduce it. This work is centred on assessing how tissue growth and electrical stimulation is affecting power consumption. Once this has been established, we will then be able to modify our current designs and procedures to reduce the increases in power consumption that occur after implantation.

How we hear

By way of background to this work, Figure 1 illustrates the three sections of the ear: the outer, middle and inner ear. Sound enters the outer ear and is amplified as it travels through the middle ear into the cochlea of the inner ear. It is here that sound is translated into nerve impulses that go to our brain. People with sensorineural hearing loss have lost the hair cells in the inner ear that stimulate the nerves. The cochlear implant works to stimulate the nerves directly.

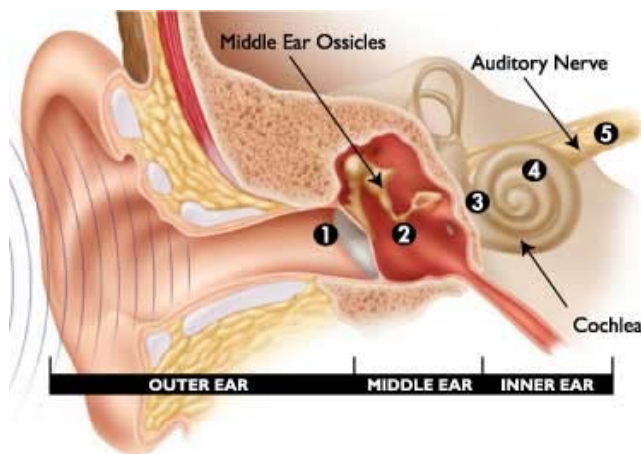


Figure 1 Diagram of the ear. 1) eardrum, 2 middle ear ossicles, 3 inner ear, 4 cochlea, and 5 auditory nerve (source: Cochlear Ltd)

Cochlear implant

The cochlear implant is located both inside and outside the body. The microphone, processor and radio-frequency link are placed on the outside of the head, behind the ear. The implant lives inside the body, and the electrodes (the portion of the implant most pertinent to this work) are placed inside the

inner ear. The location of the cochlear implant is shown in Figure 2 below. The electrodes curl inside the inner ear and it is here that fibrous tissue grows around the electrodes and causes the increased power requirements.

In an ideal environment, there would be a clean and efficient electrical pathway between the electrodes and the nerves. Unfortunately, it's not that simple. When the electrodes first enter the body, protein adheres to their surface straight away. Immune cells are then called into play, and these cells initiate the deposition of connective tissue cells. Eventually the whole electrode array is covered in a fibrous tissue capsule that is very similar in nature to scar tissue. Now when we try to stimulate the nerves on the other side of the tissue capsule, more power is needed to stimulate the same number of nerves.

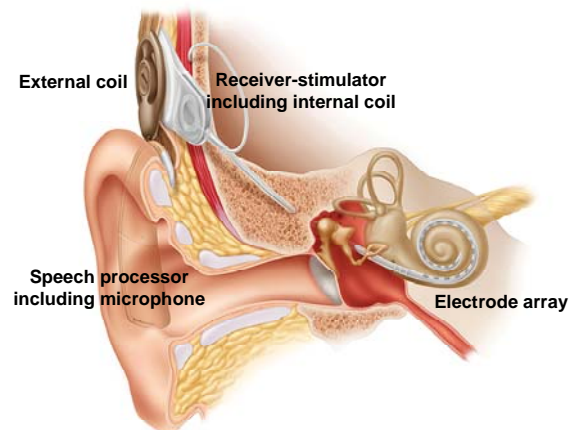


Figure 2 Illustration of the cochlear implant system. Sound is captured by the external microphone, coded by the speech processor and sent to the electrodes via the receiver-stimulator (source: Cochlear Ltd).

Methods

In the past, animal experiments have been used to design and develop the cochlear implant. Such animal experiments are vital for testing any implant or drug intended for use in humans. However, all laboratories are keenly aware of the need to limit animal usage as much as possible. The work in this

study centres on the development of an *in vitro* model of the electrode-tissue interface. Cells are grown directly on electrodes and the electrical properties of those cells are measured.

There are several advantages associated with this new method over existing ones: 1) Fewer animals are used. The information obtained with this model would have required over 200 animals, whereas cell lines were able to be used instead. 2) Results are obtained faster and cheaper than before. A three day experiment provides the equivalent of 3 months work and for an investment of \$1000, we are learning what would have otherwise cost up to \$20,000. 3) Of striking importance is the type of information available. The *in vitro* method provides detailed information on known components. This is not possible with animal work and as such provides us with a great advantage for further understanding.

So through the use of this *in vitro* model we have been able to increase our understanding of what is happening when the electrodes first enter the body. We can now use it to test any changes to the design or stimulation protocols and in this way, work to reduce the power

needs for recipients. While this model does not completely eliminate the need for animal experiments, it does allow ideas to be tested in detail before animal - based experiments are even considered.

In vitro model

The electrode-tissue interface has been modelled using planar gold electrodes on a microscope slide as shown in **Error! Reference source not found.** Each slide is covered with 8 plastic wells separating the two electrodes at the bottom of each well. The wells are filled with media and cells are grown over the entire surface. The properties of the electrodes can be assessed by measuring the voltage between the two electrodes in each well. The voltage curve will change with many factors, including cell growth, protein adsorption and electrical stimulation. At the end of each experiment, cells are fixed and stained, allowing them to be viewed under a fluorescent microscope.

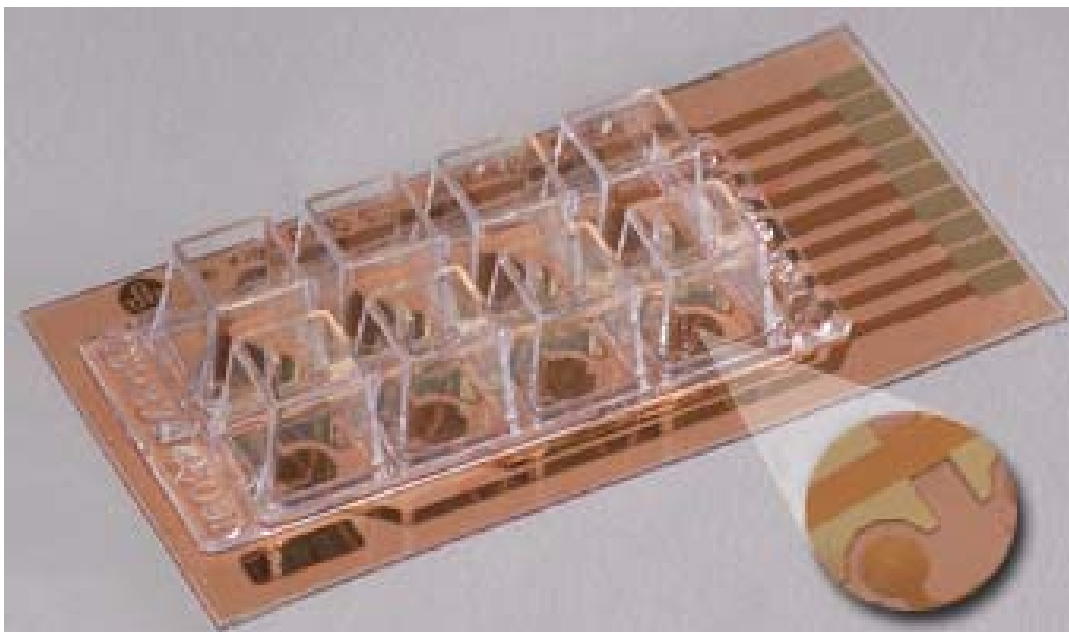


Figure 3 Thin-film gold electrodes on polycarbonate slides form part of the *in vitro* model of the electrode-tissue interface (source: Applied BioPhysics).

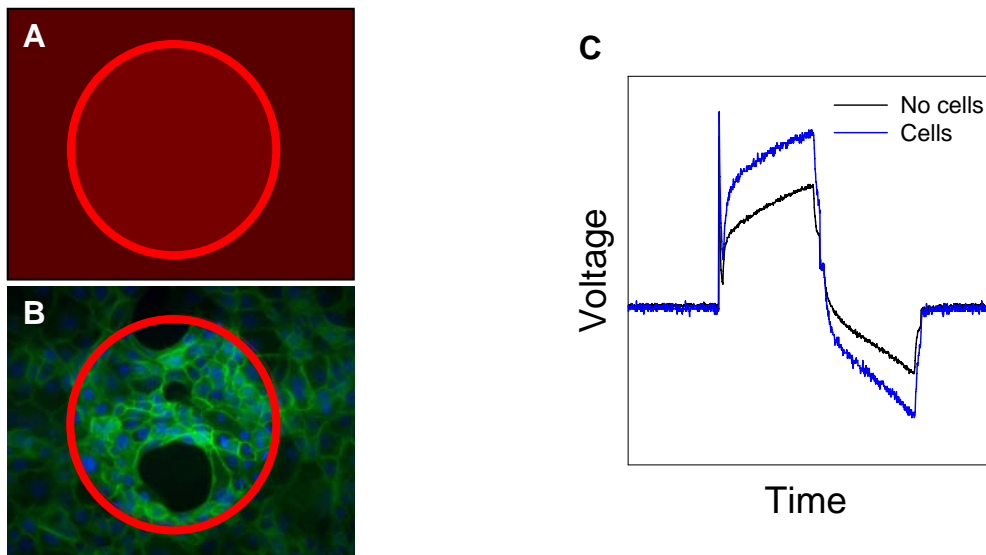


Figure 4 Results of cell growth study. The voltage waveform recorded from a clean electrode (A) is shown in black in (C). The voltage waveform from a cell covered electrode (B) is shown in blue in (C). A strong relationship was shown between the amount of cell cover over the electrode and the resulting voltage increase.

Results

In all experiments, it was necessary to first measure the voltage required to pass between the electrodes while they were free of cells. The voltage was measured again after cells were added. Figure 4 clearly shows the change in voltage that occurs with cell growth. The power used by the electrodes can be determined from these voltage plots. A distinct increase in the voltage required and thus power usage, exists when cell cover increases. The more cells you have over the electrodes, the more power you need to stimulate nerves. This work was repeated with different cell types and all showed an increase in power needs.

When electrical stimulation was applied, we saw an effect very similar to that seen clinically. That is, electrical stimulation caused a transitory reduction in voltage and

thus available power. The graph in Figure 5a illustrates the changes in power requirements of an electrode. Cells were added at the start of the experiment and as they grow over the electrode, power needs increase. Application of a stimulating voltage is shown by the shaded bars and after 6 hours of stimulation, the voltage required to traverse the cells had dropped. However, when stimulation stopped, the voltage required increased.

These power changes mimic those seen *in vivo*. The significance of the *in vitro* model is highlighted by the ability to visualise the effects on cell cover over the electrodes. The photomicrograph in Figure 5b shows the resulting cell cover loss over an electrode after stimulation. Electrodes that received less stimulation lost fewer cells. Through these and other experiments, we have been able to learn more about the electrode-tissue interface.

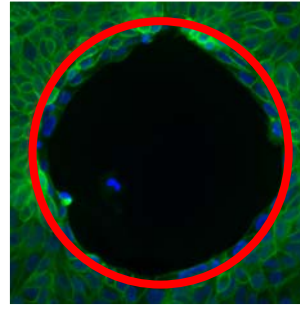
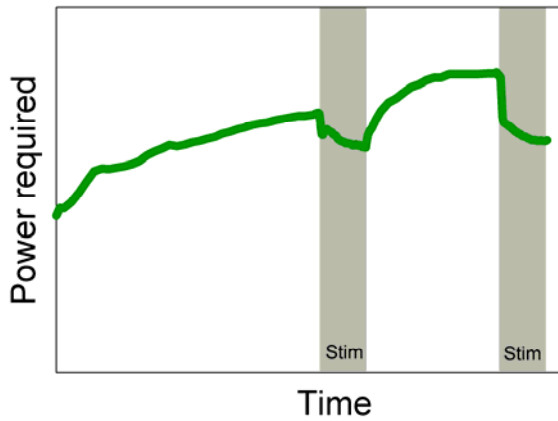


Figure 5 Results from the cell growth and stimulation study. A) An initial increase in voltage was measured following the growth of cells onto the electrode. This was consistent with cell growth over the electrode. When stimulation was applied (shaded bars), a rapid drop in voltage was recorded. Voltage recovered when stimulation was removed, only to drop again when reapplied. B) Cell cover over the electrode was reduced on electrodes exposed to electrical stimulation.

Future work

This *in vitro* model will now be used as a screening tool to test new electrode materials or chemical coatings on the electrode that may keep cells at bay. These may include therapeutic agents such as steroids or anti-inflammatory drugs. These can be made to stay within the coating, or released into the inner ear. The use of electrical stimulation to control cell growth can also be tested. A unique pulse rate may be found that is safe for the nerves, but inhibitory to the immune cells. These methods and others will help to provide a clear path between the electrode and the nerves, creating a place for efficient information transfer and lower power requirements.

Conclusion

The reduction of power requirements is paramount for the cochlear implant. Currently almost half the size of the external device is comprised of batteries. This not only limits the size of the processor, but also the ability for engineers to take the next evolutionary step for cochlear implants, which would be totally implantable devices. This work has been able to assess the electrode-tissue interface directly, filling the gaps of knowledge in this area. The model is cheap and quick to use, with the added advantage of requiring fewer animals for testing and development.

Carrie Newbold was a finalist in the 2006 years Eureka Prize for research that replaces the use of animals

Replacement of the Use of Animals in Inhalation Toxicology

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Abstract

Inhalation of airborne contaminants including gases, vapours, aerosols and mixtures of these are significantly associated with both acute and chronic health effects but, the precise mechanisms that derive such effects are not fully understood. Considering there are approximately 80,000 chemicals in commerce, and an extremely large number of chemical mixtures, conventional *in vivo* animal toxicity testing of this large number of chemicals is unachievable from ethical, scientific, economic and practical perspectives. Inhalation is considered the most important means by which humans are exposed to airborne chemicals however, inhalation studies are technologically more complicated than standard toxicity testing. Therefore, there is a need to explore new alternative approaches to provide toxicity data by developing *in vitro* techniques that are comparable to *in vivo* environments during inhalation exposures.

The aim of this experimental research was to investigate the potential of *in vitro* methods as an alternative for toxicity assessment of airborne contaminants. An integrated approach was designed in which appropriate exposure techniques were developed. A diversified range of *in vitro* assays looking at different toxic endpoints (cell death, energy metabolism, cytokine protein synthesis) and multiple human cell types (lung, liver, skin) was implemented. Direct exposure of human cells to airborne contaminants was developed by culturing human cells on porous membranes (0.4 μm) in conjunction with a Harvard horizontal diffusion chamber system. This research allowed the direct exposure of human cells to airborne contaminants at the air liquid interface. Dose-response curves were generated allowing the measurement of toxicity endpoints. Airborne IC_{50} (50% inhibitory concentration) values were calculated for selected volatile organic compounds (xylene; $5350 \pm 328 >$ toluene; 10500 ± 527 ; ppm) and gaseous contaminants (NO_2 ; $11 \pm 3.54 >$ SO_2 ; $48 \pm 2.83 >$ and NH_3 ; 199 ± 1.41 ; ppm). The implementation of a range of *in vitro* bioassays in conjunction with innovative *in vitro* exposure techniques have been developed in this research and may provide an advanced technology for toxicity testing and biomonitoring of airborne contaminants without the use of animal experimentation. The application of this research may open new possibilities for toxicity testing of industrial chemicals, environmental contaminants, respiratory drugs, workplace airborne contaminants and fire combustion products.

1. Introduction

Exposure to occupational and environmental airborne contaminants is a major contributor to human health problems (Chauhan and Johnston, 2003; Winder and Stacey, 2004). While data obtained from human experiences would be most useful in assessing the toxic effects of chemicals, human data is not

always available for developing safety evaluations on chemicals and airborne contaminants. Moreover, the risks of chemicals, new products and technologies need to be assessed before adverse human experiences occur (McClellan, 1999; Thorne, 2001; Greenberg and Philips, 2003). Therefore, as part of preventive strategies, it is critical to develop new approaches that are both informative and time/cost efficient to identify the potential hazards in the absence

of widespread human exposures (Silbergeld, 1998). In general, no single method can cover the complexity of general toxicity in humans (Barile, 1994). However, toxicity data can be obtained from several sources including toxicological studies, epidemiological studies, quantitative structure activity relationships (QSARs) and physiologically based toxicokinetic (PBTK) studies.

Toxicology has made a major contribution in providing chemical toxicity information for many years. Conventional animal toxicity test methods rely on whole animal experimental methods. These methods, particularly tests such as the LD₅₀ (50% lethal dose), have been criticised on ethical grounds due to the use of large numbers of animals and suffering such tests can cause. Hence the Organisation for Economic and Cooperative Development (OECD) has developed three alternative tests for acute oral toxicity in order to reduce the number of animals used per test substance.

Although an extensive background database from *in vivo* toxicological studies have been developed, most toxicity data is from oral and dermal chemical exposures rather than inhalation exposure (Agrawal and Winder, 1996; Miller and Klonne, 1997). Test animals are exposed via inhalation to air toxicants dissolved or suspended in air, and the concentration that causes lethality in 50% of the dosed group (LC₅₀) is determined. Recently, the OECD has proposed new test guidelines including Acute Inhalation Toxicity-Fixed Dose Procedure (433) and Acute Inhalation Toxicity-Acute Toxic Class (ATC) Method (436) which are in draft form (OECD, 2004). These guidelines will replace conventional guidelines to reduce the number of animals required for inhalation studies. However, there is a need to explore new alternative approaches to provide further toxicity information in this technologically demanding area.

The focus of toxicology has shifted somewhat, since the mid-1980s, from whole animal toxicity tests to alternative *in vitro* toxicity methods (Silbergeld, 1998; Gad, 2000; Bakand *et al.*, 2005a). The development of *in vitro* test systems has been influenced by a number of factors including animal welfare issues (Purchase *et al.*, 1998; Goldberg, 2004). Animal rights activists and increasing public awareness of certain animal testing requirements have forced researchers and regulatory agencies to increase and diversify the development and validation of alternative methods. Another social issue is the increasing public interest on the safety of chemicals and new products. Each year thousands of new cosmetics, pharmaceuticals, pesticides and consumer products are tested on animals. The necessity for determining the potential toxic effects of this large number of chemicals has provoked the need for rapid, sensitive and specific test methods (DelRaso, 1992; Goldberg, 2004).

The aim of this research was to investigate the potential of *in vitro* methods as an alternative for toxicity assessment of airborne contaminants. These methods were used to develop a practical strategy for *in vitro* toxicity testing of airborne contaminants, based on the knowledge of physicochemical properties of the test chemicals. Appropriate *in vitro* exposure techniques were developed in order to predict the cytotoxic effects of airborne contaminants directly to human target cells using a range of biological endpoints.

2. Human cells and culture conditions

Three different human cells including: a pulmonary type II-like epithelial cell line (A549, ATCC No. CCL-185), a hepatoma (liver derived) cell line (HepG2, ATCC No. HB-8065) and skin fibroblasts isolated from skin biopsies of healthy individuals (Cytogenetics Department, Westmead Hospital, Sydney, Australia) were used. Cells were cultured in sterile, vented 75-cm² cell

culture flasks with DMEM/F12 (Dulbecco's modified eagle medium: Ham's F-12 nutrient mixture; Gibco, USA) supplemented with 5% (v/v) foetal calf serum (FCS; JS Bioscience, Australia), and an antibiotic solution (Sigma, USA) containing: L-glutamine (2mM), penicillin (100 units/ml) and streptomycin (0.1 mg/ml). Cultured cells were kept at 37°C in a humidified 5% CO₂ incubator. For cytotoxicity experiments, newly confluent cell layers were enzymatically removed, cell viability assessed and cell number determined (Bakand *et al.*, 2005b, Lestari *et al.*, 2005).

3. *In vitro* cytotoxicity assays

Considering the diversity of cellular-biochemical pathways, several *in vitro* tests have been developed to assess the intrinsic cytotoxicity of chemicals (Bakand *et al.*, 2005a; Hayes *et al.*, in press). In this research, a number of *in vitro* cytotoxicity assays measuring different biological endpoints were used:

- The MTS assay was performed using the CellTiter 96[®] AQueous Non-Radioactive Cell Proliferation assay (Promega, 2001). The MTS (3-(4, 5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium) assay based on the ability of viable cells to convert a soluble tetrazolium salt to a formazan coloured product.

- The neutral red (3-amino-7-dimethyl-amino-2-methylphenazine hydrochloride) uptake (NRU; Sigma) assay, a cell survival/viability technique based on the ability of viable cells to incorporate and bind supravital neutral red dye (Babich and Borenfreund, 1992; Borenfreund and Babich, 1992).
- The ATP (Adenosine triphosphate) assay, quantifying ATP content as a valid marker of cell viability performed using the CellTiter-Glo[®] Luminescent Cell Viability Assay (Promega, 2004).

The details of these *in vitro* assays have been previously described (Bakand *et al.* 2006a; Bakand *et al.*, 2006b; Lestari, *et al.*, 2005).

4. Dose response relationship and cytotoxic endpoints

Dose-response curves were plotted for test chemicals using different *in vitro* cytotoxicity assays (Figure 1). Cytotoxicity endpoints were determined including the NOAEC, the no observed adverse effect concentration; IC₅₀, the 50% inhibitory concentration and TLC, total lethal concentration values, for all chemicals tested in 96 well microtitre plates. The IC₅₀ values were determined for test chemicals and compared to published *in vivo* data such as oral LD₅₀ or inhalation LC₅₀ values of test chemicals.

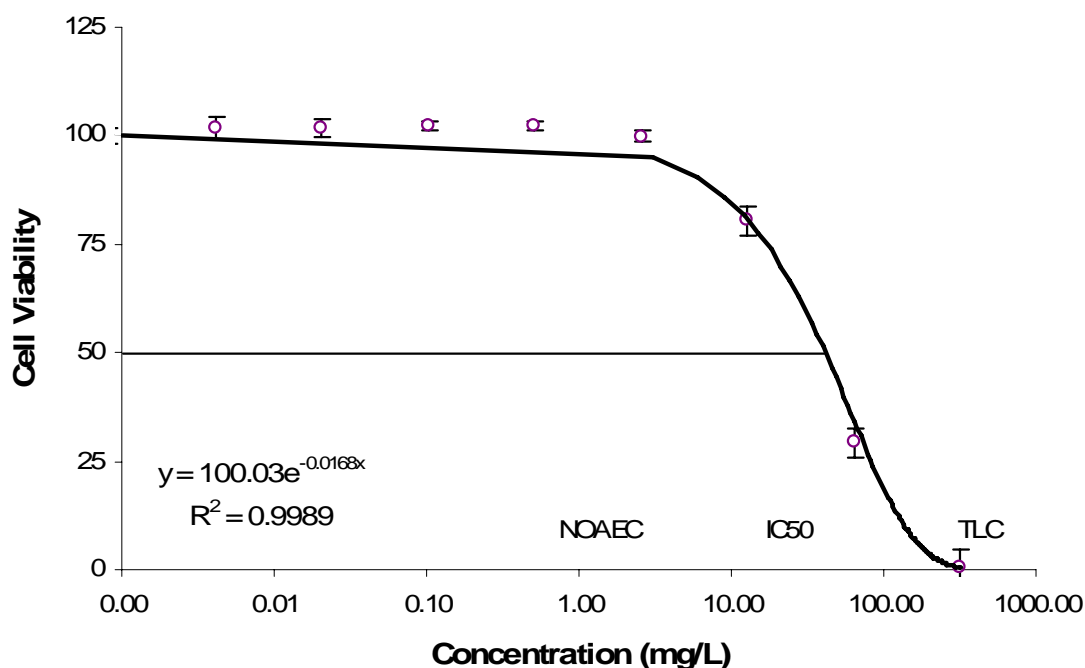


Figure 1. The dose response relationship and cellular toxicity endpoints

NOAEC: no observed adverse effect concentration, IC₅₀: 50% inhibitory concentration; TLC: total lethal concentration values.

5. Toxicity testing of airborne chemicals

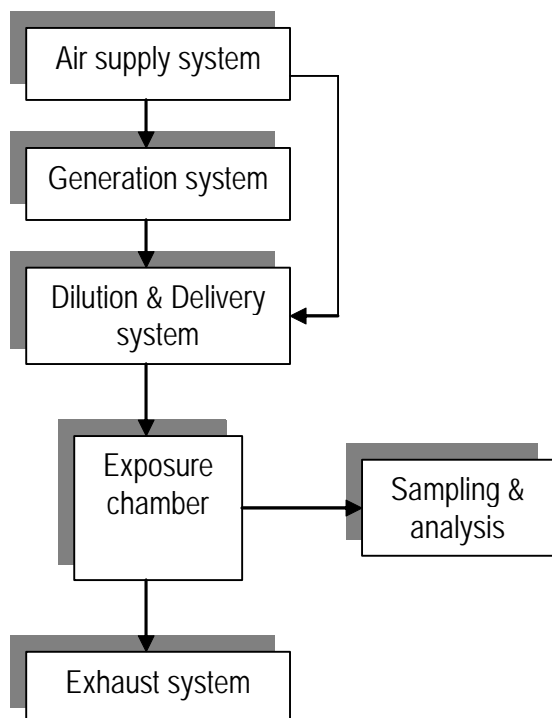
5.1. Generation of test atmospheres

Generation and characterization of known concentrations of airborne contaminants and reproducible exposure conditions is a more complicated and expensive procedure than that required for oral and dermal exposures. This process requires different equipment and techniques to generate, maintain and measure standard test atmospheres. Inhalation exposure systems involve several efficient and precise subsystems including a conditioned air supply system, a suitable gas or aerosol generator for test chemical, an atmosphere dilution and delivery system, exposure chamber, real time monitoring or sampling and analytical system, and an exhaust/filter or scrubbing system (Figure 2). Further, concentrations of test atmospheres of airborne contaminants were determined by appropriate sampling and analytical methods (Bakand *et al.* 2006a; Bakand *et al.* 2006b).

5.2. Direct exposure techniques at the air/liquid interface

Direct exposure of human cells to airborne contaminants was developed by culturing cells on porous membranes (0.4µm) in snapwell inserts. The snapwell insert was a modified transwell culture insert with a 12mm diameter membrane providing a growth area of 1.12cm² (clear polyster Snapwell™ insert, 3801, Corning), supported by a detachable ring that was placed in a six well plate. Once cells were established on the membrane, the upper layer of culture media was removed and the cells directly exposed to airborne contaminants at the air/liquid interface (Bakand *et al.*, 2006a; Bakand *et al.*, 2006b).

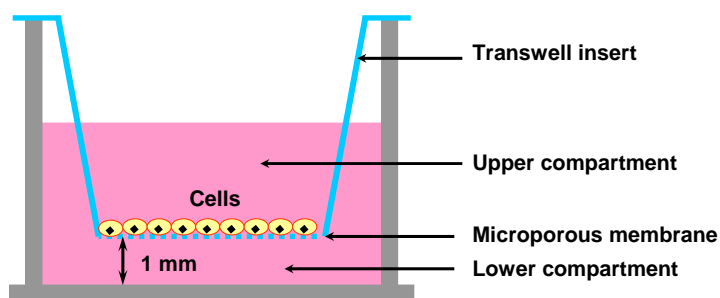
Figure 2.



Components of a test atmosphere generation system
(Adapted from Valentine and Kennedy, 2001)

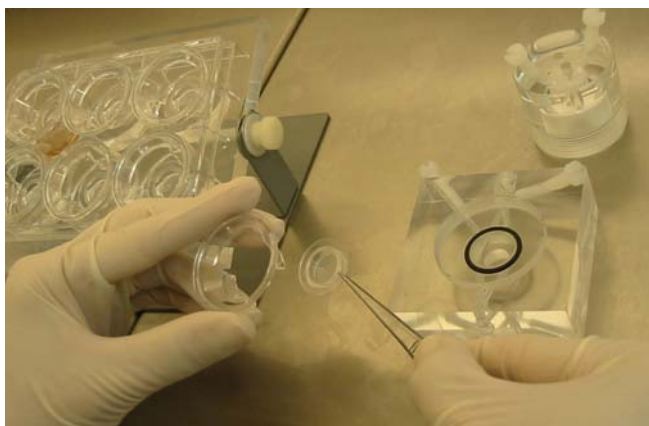
An innovative novel exposure technique was developed for the generation, exposure and delivery of test atmospheres to air contaminants. This included a horizontal diffusion chamber system (Harvard Apparatus, USA), which was adapted for dynamic delivery of test atmospheres to human cells grown on porous membranes (Figures 3, 4). Human cells grown on porous membranes were exposed to vapours of selected volatile organic compounds (VOCs) of xylene and toluene; and airborne gaseous contaminants including: nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and ammonia (NH₃) for an exposure of 1 hour. Airborne IC₅₀ values were calculated for selected volatile organic compounds and gaseous contaminants in all cell types. Results of this study in human A549 lung cells using a range of *in vitro* assays are summarised in Table 1. An identical toxicity ranking of selected airborne contaminants (NO₂ > SO₂ > NH₃ > xylene > toluene) was achieved using both *in vitro* and published animal *in vivo* LC₅₀ inhalation data (NIOSH, 2004).

Figure 3.



Growing human cells on porous membranes

Figure 4.



Direct exposure method: porous membranes and horizontal diffusion chambers

Table 1. Toxicity ranking of airborne chemicals using *in vitro* and *in vivo* data

Airborne Chemicals	<i>In Vitro</i> Toxicity Data		<i>In Vivo</i> Toxicity Data	
	IC ₅₀ (A549 cells) (m ± SD) ppm/h	<i>In vitro</i> assay	LC ₅₀ (Rat) ppm/h	Reference
Gases				
NO ₂	11 ± 3.54	NRU	117	RTECS
SO ₂	48 ± 2.83	ATP	2520	RTECS
NH ₃	199 ± 1.41	MTS	2000*	RTECS
Vapours				
Xylene	7400 ± 1389	NRU	5000*	RTECS
Toluene	12100 ± 2257	NRU	13000*	RTECS

Note:

* Exposure time: 4 hours

RTECS, The Registry of Toxic Effects of Chemical Substances. US National Institute for Occupational Safety and Health (NIOSH, 2004).

6. Conclusion

Heavy reliance on animal data in toxicology has long been a concern within the scientific community. Prediction of biological activities of toxic compounds in humans with reliance on animal data always creates some degree of uncertainty due to inter species differences between animals and humans (Blaauboer, 2002). The three R's introduced by Russell and Burch in their book: *the principles of humane experimental techniques* (1959) provides the conceptual basis for reconsideration of using animals in research and refers to the reduction in the number of test animals, refinement of test protocols in order to minimise suffering of test animals and replacement of whole animal tests with alternative methods such as *in vitro* test systems.

The systematic approaches and methodologies designed in this research have the potential to be implemented as an alternative method for risk assessment of occupational and environmental airborne contaminants. A diversified range of *in vitro* assays using multiple human cell systems including: lung, liver and skin were implemented. The use of human cells as bio-indicator targets in toxicity testing can potentially generate the representative data related to human chemical exposures. Further, a diversified battery of *in vitro* test methods including the MTS, NRU and ATP assays was used to measure different cytotoxic endpoints and provide a better understanding of mechanisms involved in the toxicity assessment of test chemicals.

Novel and innovative *in vitro* exposure techniques developed in this research allow for the study of toxic effects of airborne contaminants in human cells directly at the air/liquid interface. These methods were used to develop a practical strategy for *in vitro* toxicity testing of airborne contaminants, based on the knowledge of physicochemical properties of the test chemicals. In particular

these methods proved to be a practical and reproducible technique for toxicity testing of volatile organic compounds by overcoming problems associated with high volatility and/or low solubility of test compounds (Bakand *et al.*, 2006a). The implementation of methods developed enabled the establishment of airborne IC₅₀ values for selected airborne chemicals (Table 1). The obtained data was comparable to published animal *in vivo* inhalation data such as LC₅₀ values and oral data such as LD₅₀ values.

Identical toxicity ranking of selected VOCs (xylene > toluene) and gaseous airborne contaminants (NO₂ > SO₂ > NH₃) were achieved using both *in vitro* and published *in vivo* data (Table 1). A higher sensitivity of *in vitro* test methods was identified when *in vitro* data was compared to published *in vivo* toxicity data possibly due to the biotransformation and excretion process that exist in the intact organism compared to cultured human cells. Although *in vitro* data is not a direct substitute for whole animal studies, these comparable *in vitro* exposure techniques have a potential to substantially reduce the use of animals for future risk assessment of inhaled chemicals. Further, the application of predictive tools such physiologically based toxicokinetic (PBTK) models may provide a scientific basis for extrapolation of *in vitro* concentrations which produce cellular toxicity *in vitro*, to equivalent *in vivo* dosages (Bakand *et al.*, 2005a).

Considering the multitude of airborne chemicals that usually occur in real occupational and urban environments, techniques developed in this study can be used for the comprehensive toxicity assessment of air pollutants including gases, vapours, solid/liquid aerosols and complex atmospheres of air pollutants. Implementation of a range of *in vitro* bioassays in conjunction with innovative *in vitro* exposure techniques have been developed in this research and offer an advanced technology for toxicity testing and

biomonitoring of airborne contaminants both in the laboratory, workplace and the broader environment. The application of this research may open new possibilities for toxicity testing of industrial chemicals, occupational and environmental contaminants, combustion products (Lestari *et al.*, 2006) and respiratory therapeutics (Hayes *et al.*, in press). The outcomes of this research may reduce the uncertainty factors in future risk assessment and standard setting for air pollutants without the use of animal experimentation.

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Amanda Hayes, Shahnaz Bakand and Chris Winder won the 2006 Eureka Prize for research that replaces the use of animals

**The following papers were presented as posters
throughout the meeting.**

The Development and Implementation of Guidelines for the Housing and Care of Laboratory Animals.

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³Department of Pharmacology, University of Sydney SYDNEY 2006

Abstract

Guidelines for the housing and husbandry of animals used in research and teaching provide research establishments, institutional animal ethics committees (AECs), government regulators and the public with benchmarks against which housing and husbandry practices can be compared. Guidelines that are regularly reviewed to include current knowledge provide documentation of accepted best practice. In the state of New South Wales in Australia, guidelines have been developed by the State's Animal Research Review Panel (ARRP), a statutory body appointed under the NSW Animal Research Act, to advise the government on the legislation regulating the use of animals in research and teaching. Guidelines have been developed on the housing and care of dogs and rabbits in scientific institutions. Recently, draft guidelines have been released for rats and guinea pigs and guidelines are under development for mice, pigs and sheep. Utilising resources of the NSW Department of Primary Industries and recognised external authorities on particular species, the ARRP commissions an exhaustive search of published literature relating to the behaviour, husbandry and care of the species of interest. Information is collated in a standardised format on enclosure design, care and management, group housing, environmental enrichment, nutrition, the physical environment - lighting, temperature, humidity, ventilation and noise. Evidence-based recommendations are listed for each topic. Draft guidelines are circulated for 3 months to all accredited animal research establishments for comment, consultation and emendation. The document is made available to animal ethics committees, animal house managers, animal technicians and researchers. After consultation, the document is amended, and posted on the Animal Ethics Infolink website www.animaletics.org.au - Accredited Research Establishments and their appointed AECs may use the guidelines when new animal houses are being planned and designed, existing facilities renovated, or new equipment for housing animals is to be ordered. AECs and regulators use the guidelines in routine inspections of animal houses.

Animal Ethics Infolink: A Web-Based Information Resource

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Abstract

In the state of New South Wales in Australia, the Animal Ethics Infolink website www.animaethics.org.au has been developed by the State's Animal Research Review Panel (ARRP), utilising resources of the NSW Department of Primary Industries and with inputs from other government departments, universities and research organisations. The website provides researchers, animal house managers, technicians, institutional Animal Ethics Committees (AECs), administrators, students and the public with information about the legislation governing the use of animals in research and teaching in NSW, guidelines on topics such as housing and husbandry of particular species, wildlife research, production of monoclonal antibodies and policies covering a range of subjects such as collaborative research between institutions and the operation of AECs. The website includes a regularly updated newsletter and also has links to other organisations and codes of practice, including the nationally adopted Australian Code of Practice for the Care and Use of Animals for Scientific Purposes. The ARRP is a statutory body appointed under the NSW Animal Research Act, to advise the government on the legislation regulating the use of animals in research and teaching.

A Progressive Policy on Animal Use and Alternatives in Life Science Education and Training

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Abstract

The InterNICHE ‘Policy on the Use of Animals and Alternatives in Education’ is a comprehensive document in 10 sections that addresses all aspects of work with animals and alternatives in life science education and training. The Policy presents guidelines to ensure effective and fully ethical acquisition of knowledge and skills. It includes a definition of alternatives in education and of harm, and presents individual policies on dissection, the sourcing of animal cadavers and tissue, work with live animals for clinical skills and surgery training, and ethical field studies. It also addresses the use of animals for the production of alternatives themselves. While the ideal ‘replacement alternative’ is defined as ‘non-animal’ within the 3Rs philosophy of Russell and Burch (1959), the Policy highlights a shortcoming of the 3Rs approach for education. Not only is there a requirement for some students to work with animals, animal tissue and clinical procedures in their education, but there is widespread evidence of the ability to fully meet all teaching objectives in ways that are neutral or beneficial to individual animals and that do not involve animal experimentation or killing. As well as non-animal learning tools like advanced multimedia software, training models and mannekins, replacement alternatives also include the use of ethically sourced animal cadavers for dissection and skills training, and apprenticeship into clinical practice with animal patients. A definition of ‘ethically sourced’, and of ethical educational opportunities within clinical work, are included in the Policy which demonstrates the possibilities for full replacement of harmful animal use in education and training. Recommendations will be made for ethics committees, for university policy towards student choice, and for legislation.

Access to and training in alternatives to facilitate the implementation of best practice education

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Access to alternatives plays a crucial role in familiarising educators and trainers with the diversity and quality of tools that are available to support best practice within the life sciences. Equally important is training that allows for a more detailed exploration of specific alternative tools and approaches. To meet the need for access to and training in alternatives, InterNICHE maintains an Alternatives Loan System, and organises seminars across the world to provide expert training. The Loan System is an evolving library of alternatives available for free loan worldwide. It was established during 2001-2002 and includes over 100 software alternatives, videos, simulators and training mannequins, chosen for their pedagogical value and potential to replace common dissections and animal experiments. Borrowers include educators, students, animal ethics committees, government ministries, organisations and campaigners in over 40 countries. The facility has serviced over 200 loans, comprising over 4000 usages of individual alternatives. As a tool for facilitating implementation, the value of the Loan System is indicated by significant educator use and the high number and wide geographical range of loans; subsequent purchase and implementation of products; direct replacement of harmful animal use; and the provision of an international resource for campaigners. Small-scale 'micro-Loan Systems' have been established in Brazil, Russia, Ukraine, India and Japan.

Since its inception in 1988, InterNICHE has organised demonstrations and training at annual conferences and dedicated training seminars. The alternatives used are selected for their relevance to specific national and cultural realities in order to maximise the opportunities for replacement. Using the Loan System and the skills of local trainers, over 400 university educators were trained in alternatives and animal welfare in 2004 at seminars in over 10 cities across India. This project was organised by InterNICHE in conjunction with the World Society for the Protection of Animals (WSPA) and many committed local organisations, and was the first of its kind worldwide that provided training at a national level. The Multimedia Exhibition at the *5th World Congress on Alternatives and Animal Use in the Life Sciences* in 2005 was also organised by InterNICHE using Loan System items, with National Contacts and collaborators as trainers. Further demonstrations and training are planned for conferences and outreach tours in Europe, Latin America, Africa and the Middle East during 2006 and 2007.

Veterinary education based on humane alternatives

Siri Martinsen

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Abstract

Many veterinary students are drawn to the veterinary profession by their compassion for living beings, and are highly motivated to use their future skills to help and to care for animals. This motivation may be compromised by encountering animal experiments and the use of animals whose lives were terminated for learning purposes. Some students choose to conscientiously object to such use, and may take the initiative to search for and implement humane alternatives. The presentation describes this activity as achieved by Siri Martinsen, the first student to have graduated from the Norwegian School of Veterinary Science (NVH) without conventional, harmful use of animals, and with full commitment to the principle of "First, do no harm". The alternative methods employed include advanced computer simulations, student self-experimentation in physiology, dissections on waste material and on animals that died naturally, and surgical training through beneficial procedures in veterinary clinics. Describing practical solutions as well as discussing the reasons for an approach without harmful use of animals, the author argues that this approach can and should be implemented as the standard method of education for veterinary students.

Animal carcinogenicity studies: implications for the REACH system

Andrew Knight

Animal consultants International

Abstract

The 2001 European Commission proposal for the Registration, Evaluation and Authorisation of Chemicals (REACH) aims to improve public and environmental health by assessing the toxicity of, and restricting exposure to, potentially toxic chemicals. The greatest benefits are expected to accrue from decreased cancer incidences; hence the accurate identification of chemical carcinogens must be a top priority. Due to a paucity of human exposure data, the identification of potential human carcinogens has traditionally relied heavily on animal tests. However, our survey of the US Environmental Protection Agency's (EPA's) toxic chemicals database revealed that, for the majority of chemicals of greatest public health concern (58.1%; 93/160), the EPA found animal carcinogenicity data inadequate to support classifications of probable human carcinogen or non-carcinogen. A wide variety of species were used, with rodents predominating; a wide variety of routes of administration were used; and a particularly wide variety of organ systems were affected. These factors raise serious biological obstacles that render accurate extrapolation to humans profoundly difficult. Furthermore, significantly different International Agency for Research on Cancer assessments of identical chemicals indicate that the true human predictivity of animal carcinogenicity data is even poorer than indicated by EPA figures alone. Consequently, we propose the replacement of animal carcinogenicity bioassays with a tiered combination of non-animal assays, which can be expected to yield a weight-of-evidence characterisation of carcinogenic hazard of superior human predictivity. Additional advantages include substantial savings of financial, human and animal resources, and potentially greater insights into mechanisms of carcinogenicity. The impending demands of the REACH chemicals testing system are unprecedented in EU history. Consequently, the further development, validation and implementation of these non-animal carcinogenicity assays must be accorded the highest priority by regulatory authorities and the chemical industry.

Chimpanzee experimentation: the necessity of a ban

Andrew Knight

Animal consultants International

Abstract

The advanced sensory, cognitive, social and communicative abilities of chimpanzees also confer upon them a profound ability to suffer when captured from the wild or born into unnatural captive environments, and when subsequently subjected to confinement, social disruption, and involuntary participation in potentially harmful biomedical research. Advocates justify such research based on the crucial contributions they claim it has made towards the advancement of biomedical knowledge, and, in particular, towards combating human diseases. However, our systematic review of 95 randomly-selected studies of captive chimpanzees published during a recent decade revealed that half were not cited by any subsequently published papers, demonstrating minimal contribution towards the advancement of biomedical knowledge generally. Furthermore, close examination failed to identify any chimpanzee studies that made an essential contribution, or, in a majority of cases, a significant contribution of any kind, towards papers describing well developed methods for combating human diseases. We therefore call for—and believe it eminently reasonable to call for—the banning of biomedical research on captive chimpanzees in those remaining countries, notably the US, that continue to conduct it.