



## Animal research ethics in Africa: An overview

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### ABSTRACT

With research projects that use animals on the increase worldwide and in Africa in particular, animal research ethics should continue to be reviewed to improve the welfare of animals used in research. The welfare of animals used in research has gained attention globally that has led to the development of guidelines and in some instances national laws governing animal experimentation. Although there may not be empirical data on the existence or adequacy of national and/or institutional policies and guidelines on the use of animals in research in Africa, most African countries are not yet at the same level as developed countries. Consequently, some researchers based at institutions in developed countries may be tempted to 'export' their research activities to collaborating African institutions where ethical and legal frameworks on use of animals may be less stringent than in the developed countries.

An appreciation of the intrinsic value of animals should be enough driving force for human beings to strive to promote humane treatment of animals. This paper gives an overview of uses and potential abuses of animals in research for the benefit of stakeholders such as researchers, research institutions, Ethics Review Committees (ERCs) and policy makers and ends with suggestions on possible ways of ensuring humane treatment of animals used in research in Africa in particular and globally in general.

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### 1. Introduction

Although there may be a general agreement that use of animals in research is not wrong in principle, it is critical that animals used in research are treated humanely. In Africa there are many research and academic institutions that use animals for research or teaching purposes. Some research institutions use animal models for various diseases. For instance, the Institute of Primate Research (IPR), which is located in Nairobi, Kenya, is a well developed research institution that conducts biomedical, conservational and ecological research using non-human primates ([www.ipr.or.ke](http://www.ipr.or.ke)). The main ultimate goals of IPR are to improve human health while at the same time maintaining biodiversity of the non-human primates that are central to the research activities of not only the IPR but also other research organizations. In order to ensure that animals are used humanely, the institute has a well established Animal Resources Department, equipped with modern diagnostic, therapeutic and surgical facilities, that takes care of all animals used in research at the institution.

Research on many diseases that affect Africa has been conducted in animal models in various African countries. Vervet monkeys have been used as non-human primate model for leishmaniasis in studies conducted in African countries such as Ethiopia (Hailu et al.,

1995). Vaccine development studies also make use of animal models. Inbred mice have been used in many types of studies conducted in some African countries. For instance, DNA vaccine candidates for cowdriosis were tested in DBA2 mice in studies conducted in Zimbabwe (Nyika et al., 1998, 2002). Studies to investigate the immunological effect of schistosomiasis and malaria co-infection were done in BALB/c mice in Kenya (Kanyugo et al., 2009). The study showed that concomitant infections with schistosomiasis and malaria worsened the severity of malaria in the mouse model, which could have practical implications for people in some African regions where the two diseases are prevalent.

In other studies conducted in South Africa researchers used outbred rabbits as a model to demonstrate the therapeutic potential of immunization of people infected with low-risk type of Human Papillomavirus (HPV) with HPV virus-like particles (VLP) vaccines (Govan et al., 2008). In addition, most universities in Africa use animals for teaching purposes in such fields as veterinary medicine, animal science and some biomedical studies. Indeed research and academic activities conducted in Africa that involve use of different types of animals are too many to enumerate, which highlights the importance of collective and continuous efforts to enhance mechanisms of protecting the welfare of animals used in research or teaching. It should be acknowledged that some African countries have been developing ethical or legal frameworks aimed at safeguarding the welfare of animals used for research or teaching purposes. However, for most of the African countries the unavailability of the information in the public domain is a major challenge

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that needs to be addressed if the developed frameworks are to effectively serve the purpose for which they were developed.

This paper gives an overview of the use and potential abuses of animals in health research or teaching, and explores some approaches as well as some ethical and legal guidelines that have been developed in some countries in an effort to protect the welfare of animals used in research or teaching. The ultimate goal is to enhance knowledge among researchers, ERCs, policy makers and other stakeholders about the best possible humane treatment of animals. It is hoped that most countries will intensify the development of their own national guidelines, appropriate legal frameworks, and/or Animal Ethics Committees (AECs) for animal experimentation. It is therefore important for the various stakeholders to be aware of the pertinent issues and take any necessary steps to continually improve the welfare of animals used in research or for teaching purposes.

## 2. Uses of animals in Africa

### 2.1. Non-research uses of animals

Animals have a number of different uses in Africa. Domestic animals, such as cattle, donkeys, horses and camels are used for transport purposes as well as for ploughing fields. Thus the domestic animals play a significant role in the economic activities of people, especially peasant farmers. Some domestic animals such as cattle, sheep, goats, pigs and rabbits are also reared for human consumption as a source of proteins. Animals such as dogs and cats are considered important for security of premises. In African communities, dogs are important for economic purposes such as hunting in rural areas, although the villagers in most countries are gradually depending more on organized farming than on hunting and wild fruits. Dogs are also used for security purposes, alerting their owners when they spot trespassers, and in some cases even attacking the 'enemy', while cats help to keep rodents like rats away from people's homes. Other 'working animals' include sheep and bird dogs, while landmine detection dogs could be considered to be one of the most well trained types of animals.

Animals are also used as pets, in which case they are considered to be 'friends' who keep people company. The common pets from an African perspective are such animals as dogs and cats. However, other animals such as baboons and monkeys may also be kept as pets. In contrast, in other parts of the world such as the western countries a wide range of animals may be kept as pets; these include chimpanzees, hyenas and some rodents.

### 2.2. Use of animals in medical and veterinary research and teaching

For purposes of this paper, the term animal in the context of research and teaching is defined as all living non-human vertebrates and lower vertebrates such as amphibians and fish and invertebrates of the class Cephalopod, like octopus, crab, lobster and squid that may be used for research or teaching purposes. Thus the term goes beyond the general notion that animals are 4-legged creatures.

Generally, animal experimentation is a pre-requisite for experimentation in human beings, which means that medical products that eventually get tested in humans would have been tested in animals at some early stages. Animals are also used in teaching in health sciences such as Medicine, Biological sciences, Biochemistry and Agriculture. Although most developed countries now have ethical and legal requirements for animal experimentation, most developing countries are lagging behind.

Research with animals refers to any manipulation aimed at gathering knowledge about specific medical conditions (such as disease pathogenesis, which includes development of animal mod-

els of diseases that affect humans), physiological effects of certain conditions, immune pathways induced by particular infections or production of antisera for various biomedical research purposes. Testing of products includes toxicity or potency of investigational products and testing of medical devices. Rodents (mice and rats) and non-human primates (mainly macaques) are the main animals used in pre-clinical research.

Use of animals in teaching is generally in schools and universities where animals are used in experiments meant to give students a practical background to the theory that they learn. In veterinary academic institutions, which most probably exist in the majority of African countries, animals are used for teaching in such fields as gross anatomy, applied anatomy and surgery. An example is the dissection of animals by students in order to learn the location, structure and/or anatomy of particular internal organs. In general, use of animals in research, testing and teaching is any manipulation or interference that affects the normal behavioural, physiological or anatomical state of the animals through such deliberate actions as:

- (i) Introducing a non-living drug, biological product like recombinant plasmids, or chemical into the animals.
- (ii) Introducing a living organism such as a parasite or microorganism into animals.
- (iii) Subjecting the animals to certain potentially adverse conditions such as radiation, electrical current and abnormal environmental conditions.
- (iv) Subjecting the animals to excessive restraint or improper diet.
- (v) Surgical interventions such as removal of some organs (e.g. splenectomy).
- (vi) Genetically modifying the animal through such techniques as gene-knock out and mutations.

### 3. Welfare of animals used in research or teaching

The welfare of animals used in research, testing and teaching is affected by a combination of a number of factors. It is the combined effect of biological factors, environmental factors and interactions with the researchers that determine the welfare of animals used for research or teaching purposes. The various factors are summarized in Table 1.

Although it may be less obvious than biological and environmental factors, interactions of researchers with animals kept for research or teaching could equally affect the wellbeing of the animals. For instance, rough handling of animals negatively affects them psychologically and physically. Whenever possible, research procedures should be scheduled in such a way that the animals will have time to recover and rest before the next procedure is due to be done. For instance, if pre-injection sera is required, the period between the collection of blood samples and the injections could be made as long as possible in accordance with the scientific objectives and methodology of the study, instead of bleeding the animals and then immediately start injecting them.

### 4. Some possible ways of protecting the welfare of animals used in research or teaching

#### 4.1. The principle of the 3Rs

As part of effort to ensure the best welfare of animals used in health research, 3 principles aimed at promoting the use of the fewest possible animals and as humanely as possible, were formulated by William Russell and Rex Burch (Russell and Burch, 1959). The principles, known as the 3Rs, stipulate that efforts should be made to (i) reduce the number of animals used in experiments by using the minimum possible number that meets statistical sample size requirements and scientific validity, (ii) refine experimental

**Table 1**  
Types of independent factors that may affect welfare of animals used in research or teaching.

| Biological factors                                   | Environmental factors  | Interaction with researchers or teachers   |
|--|--|--|
| Age of the animals                                   | Ventilation of the room where the animals are kept             | Nature of handling (gentle or rough; pain or distress could be caused)   |
| Sex of the animals                                   | Room temperature   | Frequency of research procedures could be stressful  |
| Reproductive status of the animals                   | Relative humidity of the room                                  | Duration of manipulations or procedures (e.g. a class of students using animals in 5-h practical). The same animals may be used by more than one class over a certain period of time |
| Genetic factors based on the genotype of the animals | Diet during breeding and experimentation                       | Management practices such as number tags, castration, dehorning and tail docking   |
| Stress of the animals                                | Water availability for the animals                             |  |
| Physiological/metabolic state of the animals         | Light cycle and quality in the room where the animals are kept |  |
|  | Noise in the vicinity of the room where the animals are kept   |  |
|  | Bedding in the cages   |  |
|  | Size of cages and number of animals per cage                   |  |
|  | Transportation of animals                                      |  |

procedures to minimize pain, discomfort and distress, and (iii) replace animals with *in vitro* methodologies that use such techniques as tissue and cell culture.

The practical implementation of the 3Rs requires alternative *in vitro* methods that would generate scientifically valid data that could equally answer the research questions of interest. For instance, if one wants to find out if a gene of interest cloned in an eukaryotic expression plasmid vector is being expressed, one could explore the possibility of transfecting appropriate eukaryotic cells with the recombinant plasmid DNA and then checking if the protein of interest is being synthesised in the cells instead of injecting some experimental animals with the plasmid DNA just to confirm expression of the gene of interest.

Another example of the implementation of the principle of replacement is the real life case of the Macquarie University, Sydney, Australia, where artificial devices that simulate living arteries, veins and organs are being used by neurosurgical trainees to learn surgical skills instead of practicing the skills on live animal models (Macquarie University, 2009). There are various non-animal methods that have been used in research and teaching, but their use in African settings may be hindered by the limited resources available to the African research or academic institutions. Other examples include:

- (i) Molecular Biology technologies such as genomics, proteomics and metabonomics.
- (ii) *In vitro* models such as eukaryotic cells (especially human rather than animal cells), tissues and organs. For teaching purposes, donated or 'waste' organs provide a source of real tissue for training.
- (iii) Multimedia computer simulations or modelling: examples include models of human skin, organs and limbs which can be used to train students on such techniques as use of instruments, surgical operations and suturing.
- (iv) Films and videos developed specifically for training purposes; an example is videos of professionally performed dissections.

#### 4.2. Promotion of the implementation of 3Rs through development of alternatives to animals

Application of the 3Rs should start at the design stage, where the researchers plan experimental procedures that will be performed in order to answer research questions. It is therefore at this early stage in research that issues of reducing the numbers of animals, refining the experimental procedures and replacing animals with

non-animal alternatives should be explored. It is for that reason that the US Animal Welfare Act (policy 12) requires that researchers give evidence of efforts made to find alternatives to animals as part of justification for proposing to use animals in research. Such evidence should not be just a statement in the proposal to the effect that efforts were made to find alternatives to animals, but should include details of databases searched, the dates when the searches were done, the years covered, and the key words used in the researches. Any other possible ways, which are not searches of databases, used to get information should be given in such detail that assessment as to whether or not enough effort to find alternatives to animals was made by the researchers is possible.

Various organizations are making efforts to assist researchers and teachers to determine possible ways of implementing the 3Rs. For instance, the Fund for the Replacement of Animals in Medical Experiments (FRAME) is a UK based charitable organization that provides funding for research aimed at developing methods that could potentially replace animals in health research (FRAME. Available at: [frame@frame.org.uk](mailto:frame@frame.org.uk)). Although FRAME is an initiative that may not benefit Africa directly and immediately, research findings aimed at improving the welfare of animals used in research would eventually benefit Africa as and when resources are available. Thus the mechanisms for improving the welfare of animals may be applicable in Africa even if they were discovered and developed elsewhere. Another point is that such an endeavour could also be initiated specifically for Africa by African researchers, provided funds are available.

#### 4.3. Dissemination of information about the existing alternatives to animals for the benefit of researchers and teachers

It is one thing to conduct research on possible alternatives to use of animals in research, and another to ensure that potential users are aware of the established alternatives. Lack of awareness could lead to underutilization of existing alternatives. It is in light of this potential underutilization that the requirement for evidence that researchers actively searched for alternatives could be viewed as a step in the right direction on the part of policy makers. It is in that context that efforts by some organizations to package findings of research into alternative methods and make them easily available in the public domain are an encouraging development that should be promoted by all means possible.

Some of the players involved in one way or another in promoting the implementation of the 3Rs and the dissemination of information about alternatives to animals in research and/or teaching are shown in Table 2.

**Table 2**  
Some organizations involved in promoting implementation of the 3Rs.

| Organization  | Web site address  |
|---|---|
| European Centre for the Validation of Alternative Methods (ECVAM)   | <a href="http://ecvam.jrc.it/index.htm">http://ecvam.jrc.it/index.htm</a> (Accessed on 04 June 2009).   |
| Interagency Coordinating Committee on Validation of Alternative Methods (ICCVAM) in the USA   | <a href="http://iccvam.niehs.nih.gov/">http://iccvam.niehs.nih.gov/</a> (Accessed on 04 June 2009).   |
| National Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM) which provides support to the ICCVAM  | <a href="http://ntp.niehs.nih.gov/ntpweb/index.cfm?objectid=7182FF48-BDB7-CEBA-F8980E5DD01A1E2D">http://ntp.niehs.nih.gov/ntpweb/index.cfm?objectid=7182FF48-BDB7-CEBA-F8980E5DD01A1E2D</a> (Accessed on 04 June 2009). |
| Norwegian Reference Centre for Laboratory Animal Science and Alternatives that maintains the NORINA database containing guidelines on use of animals in research as well as audiovisual aids and other teaching materials | <a href="http://www.norinadatabase.org">www.norinadatabase.org</a> (Accessed on 04 June 2009).  |
| Alternative to Animal Testing Web Site (Altweb) developed by the John Hopkins Center for Alternatives to Animal Testing (CAAT)  | <a href="http://www.altweb.jhsp.edu">http://www.altweb.jhsp.edu</a> (Accessed on 04 June 2009).   |
| InterNICHE which promotes humane use of animals in education  | <a href="http://www.interniche.org">www.interniche.org</a> (Accessed on 04 June 2009).  |
| The Netherlands Centre for Alternatives to Animal Use   | <a href="http://www.nca-nl.org">www.nca-nl.org</a> (Accessed on 04 June 2009).  |
| Australian and New Zealand Council for the Care of Animals in Research and Teaching (ANZCCART)  | <a href="mailto:anzccart@adelaide.edu.au">anzccart@adelaide.edu.au</a> (Accessed on 04 June 2009).  |

#### 4.4. Training of researchers on ways of protecting the welfare of animals

The researchers who design and implement research have a major role in protecting the welfare of animals used in research. It is therefore imperative that appropriate training programs for researchers be made available. Since it may be difficult for researchers to be away from their workstations for long periods of time, availability of web based training programs could go a long way in making training that includes animal research ethics accessible to as many researchers as possible. It is also critical for the researchers to ensure that junior researchers and post-graduate students that they supervise undergo the necessary training on handling of animals in research before they start their research projects if the research involves animals.

#### 4.5. Animal Ethics Committees to review and monitor research on animals

Just like protocols for health research involving humans have to be reviewed by an independent ERC, protocols that involve animals should be reviewed by an Animal Ethics Committee (AEC) prior to the commencement of the research. The mandate of AECs is to review research proposals and thereafter monitor approved research to ensure that the welfare of the animals used in the research is protected. The monitoring would basically cover the categories of factors that affect the welfare of animals given in Table 1. An ideal AEC should be composed of members with diverse educational and professional background, and should always include expertise in animal related fields such as veterinary medicine, animal science and agriculture.

#### 4.6. Development of guidelines and legal frameworks

It is important that guidelines and legal frameworks are developed nationally and internationally through broad consultations in order to take into account views of as many stakeholders as possible. In developing the guidelines and laws, the aim should be to equally promote the health of animals and humans through research. One could argue that animals and humans need each other; animals do not have the capacity to conduct research in order to improve their own wellbeing, while on the other hand humans use animals, just as they use other humans, in health research or teaching.

Most African countries have laws aimed at protecting the welfare of animals, but for some countries the laws seem to cover the welfare of animals in general without specifically addressing animals used in research or teaching. Indeed various African countries have been revising their laws in order to enhance the protection of

animals used in research or teaching among other categories of animals. For instance, in Tanzania the relevant law has been revised and the Animal Welfare Act of 2008 (*Animal Welfare Act, 2008*) stipulates that a permit should be obtained from the Minister responsible for livestock or from the Director responsible for the welfare of animals before animals can be used in research. The minister or director is required to get advice from the Animal Welfare Council established by the same act of parliament.

Another example of such African countries is South Africa where national guidelines on the use of animals in research were recently developed by the South African Medical Research Council (MRC) (*Use of Animals in Research Book 3, 2004*), under provision of the South African MRC Act (1991), to complement the relevant law that had been in place since the early 60s (South Africa National Legislation List. *Animal Protection Act, 1962*). However, it is possible that some African countries have developed the necessary legal frameworks and guidelines which may not yet be available in the public domain, hence may not be known to the author as well as to the wider scientific community within and outside the particular countries. If dissemination of relevant information to potential users is a major problem in Africa, then efforts have to be made to address that gap otherwise the frameworks would not serve the purpose for which they were developed.

The majority of developed countries have developed ethical guidelines and laws pertaining to the protection of animals used in research or teaching which are easily available in the public domain. For instance, in Australia the Animal Research Act was introduced in the late 80s by parliament in recognition of the need to actively protect animals used in research (New South Wales Government. *NSW Legislation, 1985*). In addition, an Animal Research Review Panel was established and given the mandate to inspect approved projects using animals. In the UK, the Animals (Scientific Procedures) Act was passed by parliament in 1986 (Office of Public Sector Information, *OPSI, 1986*). In New Zealand, the Animal Welfare Act of 1999 went a step further to clearly state punitive measures for breach of the Act (*Animal Welfare Act, 1999 No 142*). Fines were up to US\$25,000.00 for an individual and up to US\$125,000.00 for corporate culprits, while imprisonment, which could be in addition to fines or as alternative to fines, was up to 6 months. Another example is the USA, where the Animal Welfare Act is in place (United States. *Animal Welfare Act, 1966*).

#### 4.7. Sensitization of ERCs that protect humans on the need to protect the welfare of animals used in research

Another possible way of ensuring that animals used in research are treated humanely is for ERCs that review protocols for research

involving humans to emphasize that data that are used as scientific justification for conducting research in humans should be based on research that was ethically conducted, including humane treatment of animals if such research involved animals. Thus although ERCs for research involving humans should not review research protocols dealing with animals, they should be sensitive to the value and importance of animals to an extent that if data generated from animals were presented as justification for a proposal to conduct a study in humans, the ERC could consider requesting for proof of approval from Animal Ethics Committee in cases where such committees exist. The bottom line is that ERCs that review protocols for research on humans should not seem to be promoting research that compromise the welfare of animals by ignoring circumstances in which data presented in support of research in humans were collected.

#### 4.8. Dialogue among stakeholders involved in the protection of the welfare of animals or humans used in research

Promoting dialogue among stakeholders interested in the welfare of animals or humans used in research could help to minimize the potential risk of antagonism between various players. For instance, it would be improper and counter-productive for ERCs whose mandate is to protect the welfare of humans participating in health research and AECs whose mandate is to protect the welfare of animals used in research to be at logger heads at institutional, national or international level. Thus researchers, animal rights campaigners, AECs, policy makers, research institutions and other stakeholders should strive to promote ethical research for the betterment of the health of animals and humans.

### 5. Concluding remarks

The contribution of animals used in research to the good health of humans as well as animals should be appreciated. As moral agents, human beings should always make efforts to ensure that animals are treated humanely in research or teaching. Efforts should always be made to uphold the principles of the 3Rs, which stipulate that researchers should replace animals with other alternatives whenever possible, and if not possible then the number of animals used should be reduced to the minimum possible sample size as per the required statistical power and refine the methodologies in order to minimize any harm that may be caused by the experimental procedures. Formation of Animals Ethics Committees, development of appropriate national ethical and legal frameworks, training of researchers on humane treatment of

experimental animals and dialogue among various stakeholders concerned with the welfare of animals used in research could go a long way in promoting ethical research that does not compromise the welfare of the animals. All these efforts should be done because that is the right thing to do and not because we are compelled to do so.

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