Research Involving Human Subjects

1

Core Principles of the Ethical Conduct of Research (TCPS2)

- Three core principles - express the value of human dignity

1. **Respect for persons**
   - Autonomy – freedom to choose participation; adequate information
2. **Concern for Welfare**
   - Ensure participants not exposed to unnecessary risks
3. **Justice**
   - Treat people fairly – ensure no segment of the population is unduly burdened with risks of research or denied benefits of the knowledge generated from it

2

Core Principles of the Ethical Conduct of Research (TCPS2)

- Ethical Balance between providing the necessary protection of participants and serving the legitimate requirements of research
- The core principles provide the compass for navigating between these two main goals
  - Maintain free, informed and ongoing consent throughout the research process

3

Conflict of Interests: TCSP2

- **Tri-Council Policy Statement 2: Ethical Conduct for Research Involving Humans**
  - **When research activities and other activities conflict**
  - **Real, potential or perceived conflict between duties/responsibilities related to research AND personal interests**
  - **COIs create divided loyalties, distract researchers from concern for research participants**
  - **Compromised independence, objectivity or ethical duties of loyalty**

4

Human Research Ethics Review

Research involving human subjects:

- Requires ethics board approval
- Must comply with applicable external standards
  - Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans
  - Eg. Health Canada Regulations, US Regs
- Proportionate approach:
  - balance potential benefits and risks
  - Level of scrutiny by boards increases as risk increases

5

6

Position on Animals in Science

In favour of animal experiments:

- Experimenting on animals is acceptable if (and only if):
  - suffering is minimised in all experiments
  - human benefits are gained which could not be obtained by using other methods

Against animal experiments:

- Experimenting on animals is always unacceptable because:
  - it causes suffering to animals
  - the benefits to human beings are not proven
  - any benefits to human beings that animal testing does provide could be produced in other ways

7

Are animal experiments useful?

- Animal experiments only benefit human beings if their results are valid and can be applied to human beings:

- Nobel Prize Physiology or Medicine
  - 224 Recipients
  - 188 used animal models

- 2021 Nobel Prize in Physiology and Medicine:
  - David Julius and Ardem Patapoutian
  - Discoveries of receptors for temperature and touch

8

Jane Goodall 'Reason for Hope', 1999

...animals have not been as critical to the advancement of medicine as is typically claimed by proponents of animal experimentation.

Moreover, a great deal of animal experimentation has been misleading and resulted in either withholding of drugs, sometimes for years, that were subsequently found to be highly beneficial to humans, or to the release and use of drugs that, though harmless to animals, have actually contributed to human suffering and death.

9

Moral Status of the Experimenter

- Animal rights extremists often portray those who experiment on animals as being so cruel as to have forfeited any own moral standing.
- Argument is not about whether the experimenter is right or wrong. The general moral character of the experimenter is irrelevant.
- What is relevant is the ethical approach of the experimenter to each experiment.

10

Moral Standing

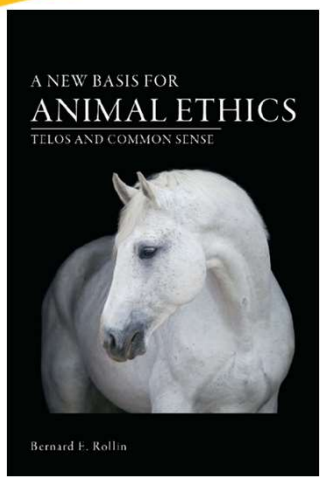
"The lack of ethical self-examination is common and generally involves the denial or avoidance of animal suffering, resulting in the dehumanization of researchers and the ethical degradation of their research subjects."

"The use of animals in research should evolve out of a strong sense of ethical self-examination. Ethical self-examination involves a careful self-analysis of one's own personal and scientific motives. Moreover, it requires a recognition of animal suffering and a satisfactory working through of that suffering in terms of one's ethical values."

John P. Gluck; Ethics and Behavior, Vol. 1, 1991

11

TELOS



…humans have a responsibility to treat animals ethically…

Rollin, B. E.(2017). A New Basis for Animal Ethics: Telos and Common Sense. Columbia: University of Missouri Press. Retrieved October 8, 2017, from Project MUSE database.

12

Telos – Bernard Rollin

- Bernard Rollin's claim that an animal's well-being involves "both control of pain and suffering and allowing the animals to live their lives in a way that suits their biological natures".

"As ordinary people know well, animals too have natures, genetically based, physically and psychologically expressed which determine how they live in their environments. Following Aristotle, I call this the telos of an animal, the pigness of the pig, the dogness of the dog – 'fish gotta swim, birds gotta fly'. (...) Social animals need to be with others of their kind; animals built to run need to run; these interests are species specific. Others are ubiquitous in all species with brains and nervous systems – the interest in avoiding pain, in food and water, and so forth"

13

FIVE FREEDOMS	FIVE OPPORTUNITIES
Freedom from hunger	Opportunity for a well-balanced diet
Freedom from thirst	Opportunity to self-maintain
Freedom from discomfort	Opportunity for optimal health
Freedom from pain, injury and disease	Opportunity to express species-specific behavior
Freedom from fear and distress	Opportunities for choice and control

Mellor D.J., Updating Animal Welfare Thinking: Moving beyond the "Five Freedoms" towards "A Life Worth Living" Animals 2016, 6, 21; doi:10.3390/ani6030021

Vicino, G.A. and Miller, L.J. In Prep. From prevention of cruelty to optimizing welfare.

14

Animal Welfare

- **Preventing suffering and a good quality of life**
  - Physical and Psychological needs of animals
    - High standards of veterinary care
    - High standards of housing
    - Opportunities to express species-specific behavior
    - Social interaction
    - Removal of unnecessary pain, fear and distress
- **Baseline/normal good health and psychological well-being**
  - Species as well as Individual
    - Behavioural indicators
    - Physiological Indicators
    - Health Indicators

15

Questions ?

What are your thoughts on the use of animals in research?

What are some of the ethical considerations?

What has been put in place to protect animals in research, teaching and testing?

16

Acceptability of Potential Suffering

- During government testing to ensure the safety and impact of medicine and medical devices
- When developing products or devices for humans or animals such as artificial organs
- In conducting medical research that relates to human or animal diseases or disorders

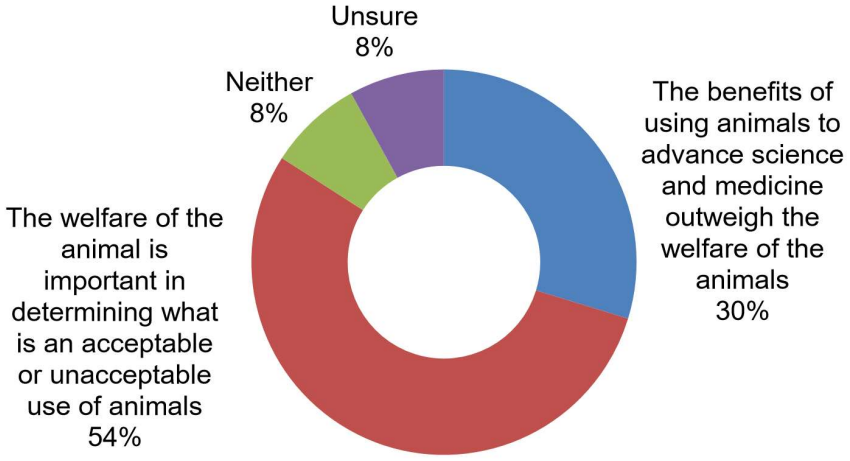
17

Acceptability of Potential Suffering

- Canadians do not differentiate when it comes to the potential suffering of animals. Almost as many think it is acceptable for safety testing of medicine as for conducting medical research
- The potential suffering of animals is at least somewhat acceptable to over half of Canadians. The reason for exposing animals to potential suffering does not play a significant role in how acceptable suffering is for the public. A significant minority thinks that the potential suffering is not acceptable
- 54% think that the welfare of the animal is important in determining what is an acceptable or unacceptable use of animals

18

Trade Off of Benefits and Animal Welfare



National Nanos RDD Crowdsource random survey of 1,000 Canadians conducted between June 8 and 11, 2013 for the Canadian Council on Animal Care (CCAC)

19

Questions

- What factors should be taken into account in the regulatory system?
  - animal welfare should be weighed against health benefits,
  - that cosmetic-testing should not be allowed,
  - that there should be supervision to ensure high standards of welfare,
  - that animals should be used only if there is no alternative, and
  - that spot-checks should be carried out.

EMBO Rep. 2007 Jun; 8(6): 526–530.

20

Regulatory Framework

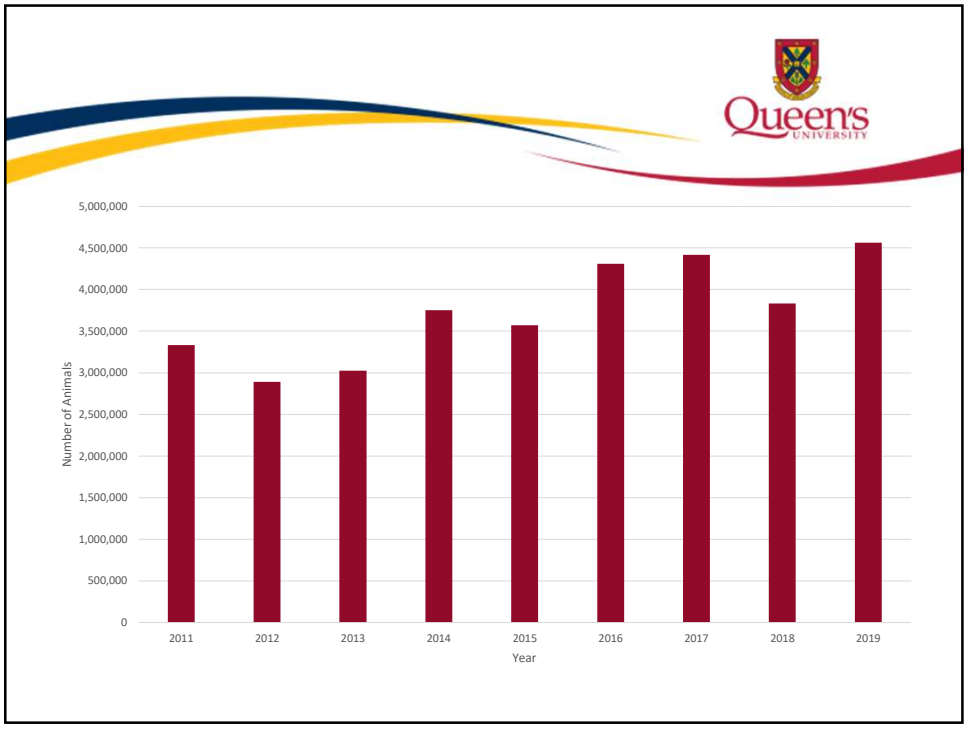
- Animals for Research Act (Provincial)
  - Unannounced Facility Inspections
  - License to operate a Research Facility
- Canadian Council on Animal Care (Federal)
  - Policies and Guidelines
  - Tri-annual facility Inspections
  - Certificate of Good Animal Practice

21

Three R's of Humane Animal Experimentation

- **Replacement** - use of an inanimate system as an alternative or the use of cell and tissue cultures
- **Reduction** - decrease in the number of animals used previously with no loss of useful information
- **Refinement** - reduction of any pain, stress or distress that animals may experience

22


Queen's University
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Number of Animals
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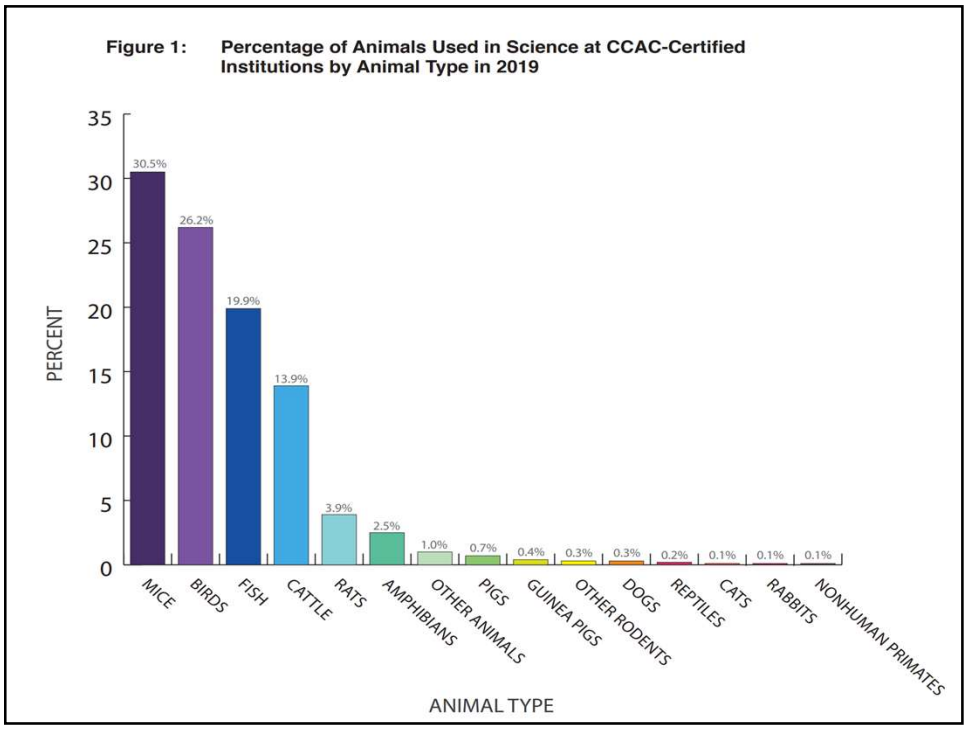
Figure 1: Percentage of Animals Used in Science at CCAC-Certified Institutions by Animal Type in 2019
PERCENT
35
30
25
20
15
10
5
0
30.5%
26.2%
19.9%
13.9%
3.9%
2.5%
1.0%
0.7%
0.4%
0.3%
0.3%
0.2%
0.1%
0.1%
0.1%
MICE
BIRDS
FISH
CATTLE
RATS
AMPHIBIANS
OTHER ANIMALS
PIGS
GUINEA PIGS
OTHER RODENTS
DOGS
REPTILES
CATS
RABBITS
NONHUMAN PRIMATES
ANIMAL TYPE

24

nature International weekly journal of science

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Archive > Volume 533 > Issue 7604 > News Feature > Article

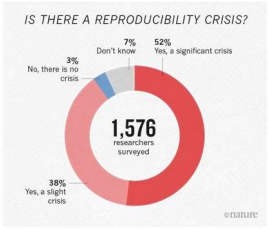
NATURE | NEWS FEATURE

1,500 scientists lift the lid on reproducibility

Survey sheds light on the 'crisis' rocking research.

Monya Baker

25 May 2016 | Corrected: 28 July 2016



More than 70% of researchers have tried and failed to reproduce another scientist's experiments, and more than half have failed to reproduce their own experiments. Those are some of the telling figures that emerged from *Nature*'s survey of 1,576 researchers who took a brief online questionnaire on reproducibility in research.

nature International weekly journal of science

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News & Comment > News > 2017 > May > Article

NATURE | NEWS

Swiss survey highlights potential flaws in animal studies

Poor experimental design and statistical analysis could contribute to widespread problems in reproducing preclinical animal experiments.

Ramin Skibba

20 December 2016

Pain management in pigs undergoing experimental surgery; a literature review (2012–4)

FREE

A. G. Bradbury, M. Eddleston, R. E. Clutton

Br J Anaesth (2016) 116 (1): 37-45. **DOI:** https://doi.org/10.1093/bja/aev301

Published: 03 October 2015

gs

with analgesic properties, but only 87/233 (37%) described postoperative analgesia. No article provided justification for the analgesic chosen, despite the lack of guidelines for analgesia in porcine surgical models and the lack of formal studies on this subject. Postoperative pain assessment was reported in only 23/233 (10%) articles. It was found that the reporting of postoperative pain management in the studies was remarkably low, reflecting either under-reporting or under-use. Analgesic description, when given, was frequently too limited to enable reproducibility. Development of a

25

Queen's University

Why is it taking so long to improve reproducibility?

Berti & Cima 1955, quoted in Öbrink and Rehbinder

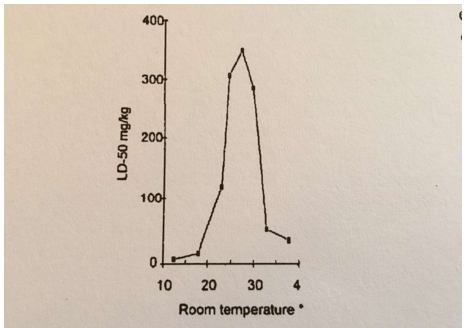

Fig 7 Influence of room temperature on LD-50 of the drug Chlorpromazine in mouse

26

Hurni 1969, quoted in Öbrink and Rehbinder

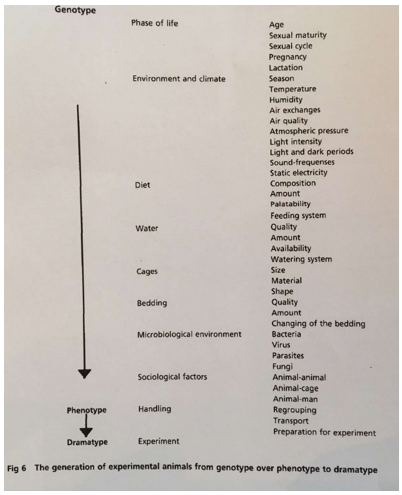

Fig 6 The generation of experimental animals from genotype over phenotype to dramatype

27

There is a reproducibility crisis despite the existence of reporting guidelines for over 20 years...

- Öbrink & Waller, 1996
- Jane Smith *et al.*, 1997
- Adrian Smith & Trond Brattelid, 2000 (fish)
- Öbrink & Rehbinder: Animal definition: a necessity for the validity of animal experiments? *Laboratory Animals,* 2000
- ARRIVE Guidelines, 2010 (Kilkenny *et al.*, NC3Rs)
- Gold Standard Publication Checklist, 2010 (SYRCLE)
- Institute for Laboratory Animal Research, NRC, 2011
- Instructions to authors, in many journals

  e.g. Nature's Reporting Checklist

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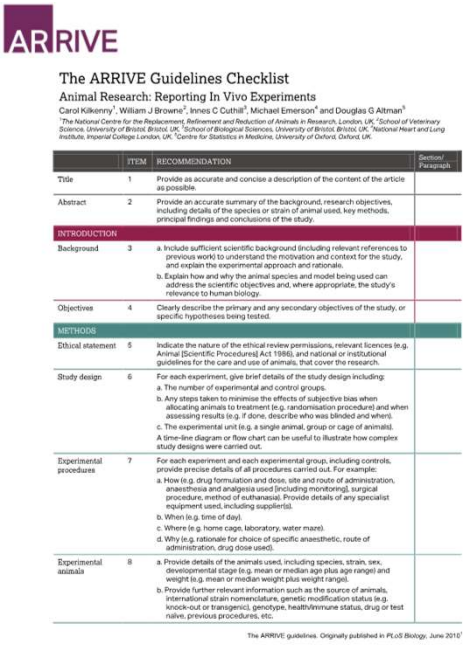
https://www.nc3rs.org.uk/arrive-guidelines



ARRIVE

The ARRIVE Guidelines Checklist

Animal Research: Reporting In Vivo Experiments

Carol Kilkenny[1], William J Browne[2], Innes C Cuthill[3], Michael Emerson[4] and Douglas G Altman[5]

[1]The National Centre for the Replacement, Refinement and Reduction of Animals in Research, London, UK, [2]School of Veterinary Science, University of Bristol, Bristol, UK, [3]School of Biological Sciences, University of Bristol, Bristol, UK, [4]National Heart and Lung Institute, Imperial College London, UK, [5]Centre for Statistics in Medicine, University of Oxford, Oxford, UK.

	ITEM	RECOMMENDATION	Section/ Paragraph
Title	1	Provide as accurate and concise a description of the content of the article as possible.	
Abstract	2	Provide an accurate summary of the background, research objectives, including details of the species or strain of animal used, key methods, principal findings and conclusions of the study.	
INTRODUCTION			
Background	3	a. Include sufficient scientific background (including relevant references to previous work) to understand the motivation and context for the study, and explain the experimental approach and rationale. b. Explain how and why the animal species and model being used can address the scientific objectives and, where appropriate, the study's relevance to human biology.	
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METHODS			
Ethical statement	5	Indicate the nature of the ethical review permissions, relevant licences (e.g. Animal [Scientific Procedures] Act 1986), and national or institutional guidelines for the care and use of animals, that cover the research.	
Study design	6	For each experiment, give brief details of the study design including: a. The number of experimental and control groups. b. Any steps taken to minimise the effects of subjective bias when allocating animals to treatment (e.g. randomisation procedure) and when assessing results (e.g. if done, describe who was blinded and when). c. The experimental unit (e.g. a single animal, group or cage of animals). A time-line diagram or flow chart can be useful to illustrate how complex study designs were carried out.	
Experimental procedures	7	For each experiment and each experimental group, including controls, provide precise details of all procedures carried out. For example: a. How (e.g. drug formulation and dose, site and route of administration, anaesthesia and analgesia used [including monitoring], surgical procedure, method of euthanasia). Provide details of any specialist equipment used, including supplier(s). b. When (e.g. time of day). c. Where (e.g. home cage, laboratory, water maze). d. Why (e.g. rationale for choice of specific anaesthetic, route of administration, drug dose used).	
Experimental animals	8	a. Provide details of the animals used, including species, strain, sex, developmental stage (e.g. mean or median age plus age range) and weight (e.g. mean or median weight plus weight range). b. Provide further relevant information such as the source of animals, international strain nomenclature, genetic modification status (e.g. knock-out or transgenic), genotype, health/immune status, drug or test naïve, previous procedures, etc.	

The ARRIVE guidelines. Originally published in *PLoS Biology*, June 2010[1]

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Why do we need to PREPARE when we have ARRIVE?

Queen's University

The ARRIVE guidelines claim that they 'provide a logical checklist with all the things that need to be considered when designing an experiment' *

In our experience when planning animal research, **a number of additional points need to be addressed at the planning stage**.

These items not only improve study quality and animal welfare (and therefore reproducibility), but also the safety of humans and animals affected directly or indirectly by the work.

*http://www.nc3rs.org.uk/sites/default/files/documents/Guidelines/ARRIVE%20Guidelines%20Speaker%20Notes.pdf

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https://www.bls.gov/ooh/images/3077.jpg

PREPARE

ARRIVE

https://www.dreamstime.com

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Some of the areas which can be neglected …

- poor literature searches
- lack of humane endpoints
- poor experimental design
- vague distribution of work and costs between the scientists and the animal facility
- insufficient evaluation of the facility's competence and infrastructure
- too little attention to transport and acclimation
- ignoring health risks for all involved
- lack of standard procedures for necropsy
- poor planning of waste disposal
- little discussion about the fate of the animals

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Check for updates

Original Article

PREPARE: guidelines for planning animal research and testing

Adrian J Smith[1], R Eddie Clutton[2], Elliot Lilley[3], Kristine E Aa Hansen[4] and Trond Brattelid[5]

Laboratory Animals
2018, Vol. 52(2) 135–141
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sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/0023677217724823
journals.sagepub.com/home/lan
SAGE

Abstract

There is widespread concern about the quality, reproducibility and translatability of studies involving research animals. Although there are a number of reporting guidelines available, there is very little overarching guidance on how to *plan* animal experiments, despite the fact that this is the logical place to start ensuring quality. In this paper we present the PREPARE guidelines: Planning Research and Experimental Procedures on Animals: Recommendations for Excellence. PREPARE covers the three broad areas which determine the quality of the preparation for animal studies: formulation, dialogue between scientists and the animal facility, and quality control of the various components in the study. Some topics overlap and the PREPARE checklist should be adapted to suit specific needs, for example in field research. Advice on use of the checklist is available on the Norecopa website, with links to guidelines for animal research and testing, at https://norecopa.no/PREPARE.

Keywords

guidelines, planning, design, animal experiments, animal research

Date received: 5 April 2017; accepted: 27 June 2017

Introduction

The quality of animal-based studies is under increasing scrutiny, for good scientific and ethical reasons. Studies of papers reporting animal experiments have revealed alarming deficiencies in the information provided,[1,2] even after the production and journal endorsement of reporting guidelines.[3] There is also widespread concern about the lack of reproducibility and translatability of laboratory animal research.[4–7] This can, for example, contribute towards the failure of drugs when they enter human trials.[8] These issues come in addition to other concerns, not unique to animal research, about publication bias, which tends to favour the reporting of positive results and can lead to the acceptance of claims as fact.[9] This has understandably sparked a demand for reduced waste when planning experiments involving animals.[10–12] Reporting guidelines alone cannot solve the problem of wasteful experimentation, but thorough planning will increase the likelihood of success and is an important step in the implementation of the 3Rs of Russell & Burch (replacement, reduction, refinement).[13] The importance of attention to detail at all stages is, in our experience, often underestimated by scientists. Even small practical details can cause omissions or artefacts that can ruin experiments which in all other respects have been well-designed, and generate health risks for all involved. There is therefore, in our opinion, an urgent need for detailed but overarching guidelines for researchers on how to plan animal experiments which are safe and scientifically sound, address animal

[1]Norecopa, c/o Norwegian Veterinary Institute, P.O. Box 750, Sentrum, Oslo, Norway
[2]Royal (Dick) School of Veterinary Studies, Easter Bush, Midlothian, UK
[3]Research Animals Department, Science Group, RSPCA, Southwater, Horsham, West Sussex, UK
[4]Section of Experimental Biomedicine, Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, Oslo, Norway
[5]Division for Research Management and External Funding, Western Norway University of Applied Sciences, Bergen, Norway

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Adrian Smith, Norecopa, c/o Norwegian Veterinary Institute, P.O. Box 750 Sentrum, 0106 Oslo, Norway.
Email: adrian.smith@norecopa.no

UFAW

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Published in the April 2018 issue of Laboratory Animals

http://journals.sagepub.com/doi/full/10.1177/0023677217724823

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PREPARE

norecopa

The PREPARE Guidelines Checklist

Planning Research and Experimental Procedures on Animals: Recommendations for Excellence

Adrian J. Smith[a], R. Eddie Clutton[b], Elliot Lilley[c], Kristine E. Aa. Hansen[d] & Trond Brattelid[e]

[a]Norecopa, c/o Norwegian Veterinary Institute, P.O. Box 750 Sentrum, 0106 Oslo, Norway; [b]Royal (Dick) School of Veterinary Studies, Easter Bush, Midlothian, EH25 9RG, U.K.; [c]Research Animals Department, Science Group, RSPCA, Wilberforce Way, Southwater, Horsham, West Sussex, RH13 9RS, U.K.; [d]Section of Experimental Biomedicine, Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine, Norwegian University of Life Sciences, P.O. Box 8146 Dep., 0033 Oslo, Norway; [e]Division for Research Management and External Funding, Western Norway University of Applied Sciences, 5020 Bergen, Norway.

PREPARE[1] consists of planning guidelines which are complementary to reporting guidelines such as ARRIVE[2].
PREPARE covers the three broad areas which determine the quality of the preparation for animal studies:

1. **Formulation of the study**
2. **Dialogue between scientists and the animal facility**
3. **Quality control of the components in the study**

The topics will not always be addressed in the order in which they are presented here, and some topics overlap. The PREPARE checklist can be adapted to meet special needs, such as field studies. PREPARE includes guidance on the management of animal facilities, since in-house experiments are dependent upon their quality. The full version of the guidelines is available on the Norecopa website, with links to global resources, at **https://norecopa.no/PREPARE**.
The PREPARE guidelines are a dynamic set which will evolve as more species- and situation-specific guidelines are produced, and as best practice within Laboratory Animal Science progresses.

Topic	Recommendation
(A) Formulation of the study	
1. Literature searches	☐ Form a clear hypothesis, with primary and secondary outcomes. ☐ Consider the use of systematic reviews. ☐ Decide upon databases and information specialists to be consulted, and construct search terms. ☐ Assess the relevance of the species to be used, its biology and suitability to answer the experimental questions with the least suffering, and its welfare needs. ☐ Assess the reproducibility and translatability of the project.
2. Legal issues	☐ Consider how the research is affected by relevant legislation for animal research and other areas, e.g. animal transport, occupational health and safety. ☐ Locate relevant guidance documents (e.g. EU guidance on project evaluation).
3. Ethical issues, Harm-Benefit Assessment and humane endpoints	☐ Construct a lay summary. ☐ In dialogue with ethics committees, consider whether statements about this type of research have already been produced. ☐ Address the 3Rs (Replacement, Reduction, Refinement) and the 3Ss (Good Science, Good Sense, Good Sensibilities). ☐ Consider pre-registration and the publication of negative results. ☐ Perform a Harm-Benefit Assessment and justify any likely animal harm. ☐ Discuss the learning objectives, if the animal use is for educational or training purposes. ☐ Allocate a severity classification to the project. ☐ Define objective, easily measurable and unequivocal humane endpoints. ☐ Discuss the justification, if any, for death as an end-point.
4. Experimental design and statistical analysis	☐ Consider pilot studies, statistical power and significance levels. ☐ Define the experimental unit and decide upon animal numbers. ☐ Choose methods of randomisation, prevent observer bias, and decide upon inclusion and exclusion criteria.

ARRIVE

The ARRIVE Guidelines Checklist

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Carol Kilkenny[1], William J Browne[2], Innes C Cuthill[3], Michael Emerson[4] and Douglas G Altman[5]

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The ARRIVE guidelines. Originally published in *PLoS Biology*, June 2010[1]

Two pages, translated into 16 languages so far

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PREPARE:
Planning **R**esearch and **E**xperimental **P**rocedures on **A**nimals:
Recommendations for **E**xcellence

PREPARE covers 15 topics:

Formulation of the study
1. Literature searches
2. Legal issues
3. Ethical issues, harm-benefit assessment and humane endpoints
4. Experimental design and statistical analysis

Dialogue between scientists and the animal facility
5. Objectives and timescale, funding and division of labour
6. Facility evaluation
7. Education and training
8. Health risks, waste disposal and decontamination

Methods
9. Test substances and procedures
10. Experimental animals
11. Quarantine and health monitoring
12. Housing and husbandry
13. Experimental procedures
14. Humane killing, release, reuse or rehoming
15. Necropsy

Items in pink are not highlighted in ARRIVE

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In addition to the checklist, much more information is available on:

norecopa.no/PREPARE

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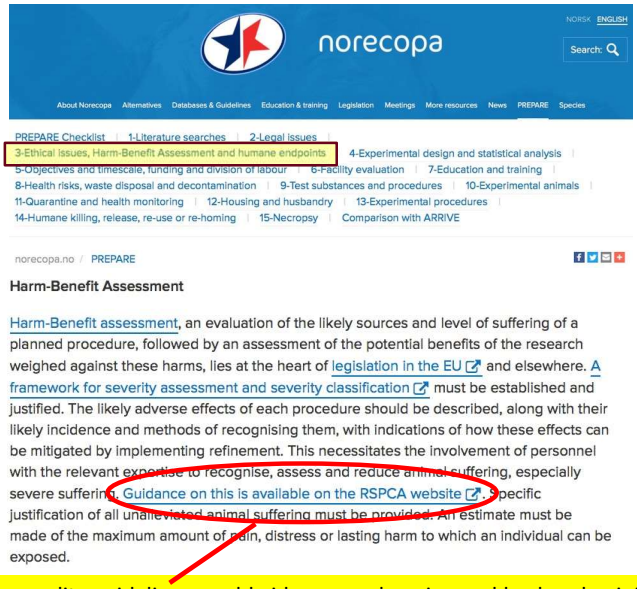
norecopa.no/PREPARE



Links to quality guidelines worldwide on e.g. housing and husbandry, injection volumes, blood sampling, anaesthesia and analgesia, humane endpoints, experimental design

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Even experienced pilots use checklists...

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Laboratory Mouse

Education

Caltech, Oxford, Stanford, Harvard, MIT, Princeton, Cambridge, Imperial, Berkely, Chicago, Yale, ETH Zurich, Columbia, UPenn, John Hopkins, UCL, Cornell, Northwestern, UMichigan, Toronto, Carniege Mellon, Duke, UWashington, UTexas at Austin, GA Tech, Tokyo, Melbourne, Singapore, UBC, Wisconsin-Madison, Edinburgh, McGill, Hong Kong, Santa Barbara, Karolinska Institute, UMinnesota, Manchester ... and just about every other major university, medical school & research institution in the world.

Nobel Prizes

1905 - Transmission and treatment of TB
1906 - Structure of Nervous System
1907 - Role of protozoa in disease
1908 - Immunity to infectious diseases
1928 - Investigations on typhus
1929 - Importance of dietary vitamins
1939 - Discovery of antibacterial agent, Prontosil
1945 - Discovery of penicillin
1951 - Yellow fever vaccine
1952 - Discovery of streptomycin
1954 - Culture of the polio virus
1960 - Understanding of immunity
1970 - Understanding of neurotransmitters
1974 - Structural & functional organisation of cells
1975 - Tumour-viruses and genetics of cells
1977 - Hypothalamic hormones
1984 - Techniques of monoclonal antibody formation
1986 - Nerve growth factor and epidermal growth factor
1990 - Organ transplantation techniques
1992 - Regulatory mechanisms in cells
1996 - Immune-system detection of virus-infected cells
1997 - Discovery and characterisations of prions
1999 - Discovery of signal peptides
2000 - Signal transduction in the nervous system
2004 – Odour receptors and organisation of olfactory systems
2008 - Role of HPV and HIV in causing disease
2010 - Development of in vitro fertilization
2011 - Discoveries around innate and adaptive immunity
2012 - Reprogramming mature cells to pluripotent ones

Overview

- Involved in around 75% of research
- Short life-span and fast reproductive rate means mice are suitable for studying disease across whole life cycle
- 98% of genes have comparable genes in humans
- Similar reproductive and nervous systems and suffer many of the same diseases as humans including cancer diabetes and anxiety
- Can be genetically modified to include human genes in enhance biological relevance
- Can act as an avatar for a human cancer to allow drug therapies to be trialled safely

Research Areas

Alzheimer's disease, anaesthetics, AIDS & HIV, anticoagulants, antidepressants, asthma, blindness, bone and joint disease, brain injury, breast cancer, cardiac arrest, cystic fibrosis, deafness/hearing loss, Down's syndrome, drugs for high blood pressure, transplant rejection, Hepatitis B, C & E, Huntington's disease, influenza, leukaemia, malaria, motor neurone disease, multiple sclerosis, muscular dystrophy, Parkinson's disease, prostate cancer, schistomiasis, spinal cord injury, stroke, testicular cancer, tuberculosis,

CV of a Lifesaver

Contact

www.understandinganimalresearch.org.uk
www.animalresearch.info
www.amprogress.org
www.speakingofresearch.com

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Additional Information

- CCAC Website – www.ccac.ca
- Office of the University Veterinarian - http://www.queensu.ca/animals-in-science
- NC3Rs - www.nc3rs.org.uk/
- Understanding Animal Research - www.understandinganimalresearch.org.uk
- www.animalresearch.info/

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