



National Centre
for the Replacement
Refinement & Reduction
of Animals in Research

The ARRIVE guidelines:

Animal Research: Reporting of In Vivo Experiments

ARRIVE Guidelines

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What are the ARRIVE guidelines?

The ARRIVE guidelines were developed as part of an NC3Rs initiative to improve the reporting of biomedical research using animals.

The ARRIVE guidelines consist of a checklist of 20 items, containing key information necessary to describe a study comprehensively and transparently.

The ARRIVE guidelines can be used to ensure reproducibility of animal research and avoid unnecessary animal use.

The ARRIVE Guidelines: Animal Research: Reporting of *In Vivo* Experiments

The ARRIVE (Animal Research: Reporting of *In Vivo* Experiments) guidelines were developed as part of an NC3Rs initiative to improve the design, analysis and reporting of research using animals. Comprehensive information is included on minimizing unnecessary studies. The guidelines were published in the online journal *PLoS Biology* in June 2010 and are currently endorsed by scientific journals, and/or scientific bodies and learned societies.

The guidelines are intended to:

- Improve the quality of scientific reporting of *In Vivo* research
- Reduce unnecessary animal use

The guidelines are 100% applicable to:

- Basic research, clinical research, and research on animal models of human disease

What kind of research uses the guidelines?

- Research on human subjects or on animal models of human disease
- Research on animal models of human disease

How might these guidelines be used?

- To improve the quality of scientific reporting of *In Vivo* research
- To reduce unnecessary animal use

ARRIVE.org/nc3rs

The ARRIVE guidelines are available in a number of languages and formats. For more information, visit www.nc3rs.org.uk/ARRIVE

ITEM	RECOMMENDATION	Reporting not mandatory	Reporting mandatory
1	Title	1	1
2	Abstract	2	2
3	Introduction	3	3
4	Objectives	4	4
5	Statistical methods	5	5
6	Results	6	6
7	Discussion	7	7
8	Conclusions	8	8
9	References	9	9
10	Supplementary information	10	10
11	Animal numbers	11	11
12	Randomisation	12	12
13	Blinding	13	13
14	Statistical analysis	14	14
15	Reporting of results	15	15
16	Reporting of adverse events	16	16
17	Reporting of animal welfare	17	17
18	Reporting of funding	18	18
19	Reporting of conflicts of interest	19	19
20	Reporting of ethics approval	20	20



Why were the ARRIVE guidelines developed?

- The ARRIVE guidelines were proposed following an extensive review on the reporting of animals in research (Kilkenny et al., 2009). This was the largest survey of the quality of reporting of publically funded animal research in the UK and US.

OPEN ACCESS Freely available online



Survey of the Quality of Experimental Design, Statistical Analysis and Reporting of Research Using Animals

Carol Kilkenny^{1*}, Nick Parsons², Ed Kadyszewski³, Michael F. W. Festing⁴, Innes C. Cuthill⁵, Derek Fry⁶, Jane Hutton⁷, Douglas G. Altman⁸

- The survey identified key areas for improvement:

Experimental design

Most papers did not report randomisation (88%) or blinding (86%) to reduce bias in animal selection and outcome measurements.

Statistical analysis

Only 70% of publications fully described statistical methods and presented the result with a measure of variability.

Reporting of studies

Only 59% included three important pieces of information: hypothesis, number of animals and characteristics of animals.

- The ARRIVE guidelines were created in response to this survey to improve the reporting of animal research.

Why do we need to improve the reporting of animal research?

- Improved reporting is needed to maximise information published and minimise unnecessary animal studies leading to improved translation of pre-clinical research.
- Failures in reporting of animal research have been demonstrated in a variety of research fields.

Cancer

Hess, KR. Statistical design considerations in animal studies published recently in Cancer Research. [Cancer Research](#) (2011) 71:625.

Stroke

Macleod, MR et al., Systematic review and metaanalysis of the efficacy of FK506 in experimental stroke. [Journal of Cerebral Blood Flow & Metabolism](#) (2005) 1-9.

Pain

Rice, ASC et al., Animal models and the prediction of efficacy in clinical trials of analgesic drugs: A critical appraisal and call for uniform reporting standards. [Pain](#) (2008) 139(2):243-7.

Multiple sclerosis

Vesterinen, HM et al., Improving the translational hit of experimental treatments in multiple sclerosis. [Multiple Sclerosis](#) (2010) 16(9): 1044-55.

Who supports the ARRIVE guidelines?

The ARRIVE guidelines are endorsed by journals, funders and learned societies.

Journals



Over 1000 journals have incorporated the ARRIVE guidelines in their Instructions to Authors

Funders



The major funding bodies of biomedical research in the UK support the ARRIVE guidelines.

Universities



Universities endorse the ARRIVE guidelines by encouraging staff and students to use the guidelines.

Learned Societies



A growing number of learned societies endorse the ARRIVE guidelines and share the guidelines with their members.

How can you use the ARRIVE guidelines?

The guidelines can be used when reporting research. In brief, the ARRIVE guidelines include the following:

Title

1. Accurate & concise description

Abstract

2. Background, objectives, methods, key findings and conclusions

Introduction

3. Background
4. Objectives

Methods

5. Ethical statement
6. Study design (blinding/randomisation)
7. Experimental procedures (How? When? Where? Why?)
8. Experimental animals (species, sex, weight)
9. Housing and husbandry
10. Sample size
11. Allocation experimental groups
12. Experimental outcomes
13. Statistical methods

Results

14. Baseline Data
15. Numbers Analysed
16. Outcomes & estimation
17. Adverse events

Discussion

18. Interpretation & implications
19. Generalisability and translation
20. Funding

Why should you use the ARRIVE guidelines?

The ARRIVE guidelines can help the reporting of your research to be:

- Reproducible
- Transparent
- Accurate
- Comprehensive
- Concise
- Logically ordered
- Well written

The ARRIVE guidelines can be used when:

- Writing a manuscript
- Preparing a PhD thesis
- Designing experiments

The ARRIVE guidelines can help promote the 3Rs by ensuring maximal output from animal experiments and reduce the need for excessive animal use.

What resources are available?

The following resources are available :

Checklist

A checklist that can be used when writing manuscripts to record each item of the ARRIVE guidelines.

Examples

Examples for each point of the ARRIVE guidelines demonstrating how they can be used in practice to report animal research across a variety of research fields.

Presentation

A copy of this presentation and accompanying speaker notes can be used as reference.

Resources can be downloaded by visiting www.nc3rs.org.uk/ARRIVE

Pocket Guidelines

A handy pocket sized reference guide of the ARRIVE guidelines, available upon request from the NC3Rs



Conclusions & Further Information

The ARRIVE guidelines are designed to improve reproducibility and reporting standards.

To download the ARRIVE guidelines and for further information, please visit:

www.nc3rs.org.uk/ARRIVE



Kilkenny, C., Browne, W. J., Cuthill, I. C., Emerson, M., & Altman, D. G. (2010). Improving bioscience research reporting: the ARRIVE guidelines for reporting animal research. *PLoS Biol*, 8(6), e1000412. doi:10.1371/journal.pbio.1000412