

External Statistical Resources Provided by Dr. Penny Reynolds
OLAW Webinar March 9, 2023: "Foundations for Evaluating Study Design and Statistical Approaches for the IACUC"

Disclaimer: These resources are for educational purposes only; their inclusion on this page does not constitute an endorsement or approval by OLAW.

Study planning resources



Smith, A.J., et al. PREPARE: guidelines for planning animal research and testing. *Laboratory Animals* 52, 135-141 (2017)

<https://norecopa.no/PREPARE>

Animal research technical resources



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

<https://www.nc3rs.org.uk/3rs-resources>

Best-practice guidelines and refined methods for anesthesia, analgesia, transport, micro-sampling, blood sampling, habituation, handling and restraint.

ARRIVE 2.0 reporting guidelines



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

Percie du Sert, N., et al. The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research. *PLoS Biol* 18, e3000410 (2020).

Percie du Sert, N., et al. Reporting animal research: Explanation and Elaboration for the ARRIVE guidelines 2.0. *PLoS Biol* 18, e3000411 (2020).

Model-specific systematic reviews and best-practice guidelines



Model-specific, systematic reviews for stroke and neurological injury animal models

Oncology models

Workman P, Aboagye EO, Balkwill F, Balmain A, Bruder G, Chaplin DJ, Double JA, Everitt J, Farningham DA, Glennie MJ, Kelland LR, Robinson V, Stratford IJ, Tozer GM, Watson S, Wedge SR, Eccles SA; Committee of the National Cancer Research Institute. Guidelines for the welfare and use of animals in cancer research. *Br J Cancer*. 2010 102(11):1555-77. doi: 10.1038/sj.bjc.6605642.

Ischaemia models

Percie du Sert N et al. The IMPROVE Guidelines (Ischaemia Models: Procedural Refinements of in Vivo Experiments). *J Cereb Blood Flow Metab*. 2017. doi:10.1177/0271678X17709185

Sepsis models

Osuchowski MF, et al. Minimum Quality Threshold in Pre-Clinical Sepsis Studies (MQTiPSS): An International Expert Consensus Initiative for Improvement of Animal Modeling in Sepsis. *Shock*. 2018. 50(4):377-380. doi: 10.1097/SHK.0000000000001212

Zingarelli B, et al. Part I: Minimum Quality Threshold In Preclinical Sepsis Studies (Mqtipss) For Study Design And Humane Modeling Endpoints. *Shock*. 2019. 51(4):10-22.

Libert C, et al. Part II: Minimum Quality Threshold In Preclinical Sepsis Studies (Mqtipss) For Types Of Infections And Organ Dysfunction Endpoints *Shock*. 2019. 51(4):23-32.

Hellman J, et al. Part III: Minimum Quality Threshold In Preclinical Sepsis Studies (Mqtipss) For Fluid Resuscitation And Antimicrobial Therapy Endpoints. *Shock*. 2019. 51(4):33-43.

Spinal Cord models

Lilley E, et al. Refining rodent models of spinal cord injury. *Experimental Neurology*. 2020. 328:113273

Colitis models

Bramhall M, et al. Quality of Methods Reporting in Animal Models of Colitis. *Inflamm Bowel Dis* 2015;21:1248–1259

Cardiac arrest models

Idris AH, et al. Utstein-style guidelines for uniform reporting of laboratory CPR research. A statement for healthcare professionals from a task force of the American Heart Association, the American College of Emergency Physicians, the American College of Cardiology, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Institute of Critical Care Medicine, the Safar Center for Resuscitation Research, and the Society for Academic Emergency Medicine. Writing Group. *Circulation*. 1996 94(9):2324-36. doi: 10.1161/01.cir.94.9.2324.

ALS models

Ludolph AC, et al (2010) Guidelines for preclinical animal research in ALS/MND: A consensus meeting, *Amyotrophic Lateral Sclerosis*, 11:1-2, 38-45, DOI:10.3109/17482960903545334

Epilepsy

Pitkänen A, Nehlig A, Brooks-Kayal AR, Dudek FE, Friedman D, Galanopoulou AS, Jensen FE, Kaminski RM, Kapur J, Klitgaard H, Löscher W, Mody I, Schmidt D (2013). Issues related to development of antiepileptogenic therapies. *Epilepsia*, 54 Suppl 4(4):35-43. doi: 10.1111/epi.12297.

Galanopoulou AS, Pitkänen A, Buckmaster PS, Moshé SL (2017). What do models model? What needs to be modeled? In *Models of Seizures and Epilepsy* (Eds Pitkänen A, Buckmaster PS, Galanopoulou AS, Moshé SL) Second edition: Elsevier

Design of experiments resources



www.ASQ.org: [What Is Design of Experiments \(DOE\)? | ASQ](#).

Statistically-based practical methods and tools for building in quality to any process:

[Learn About Quality | ASQ](#)



American Association for Laboratory Animal Science (AALAS)

AALAS Learning Library [AALAS Learning Library](#): module on DESIGN AND STATISTICAL ANALYSIS OF LABORATORY ANIMAL STUDIES



Experimental
Design
Assistant

Experimental design Assistant <https://www.nc3rs.org.uk/experimental-design-assistant-eda>

Books

Lazic SE. 2017. *Experimental Design for Laboratory Biologists*. Cambridge University Press, 229 pp. Appendix with introduction to R coding.

Bate ST, Clark RA. 2014. *The Design and Statistical Analysis of Animal Experiments*. Cambridge University Press 310 pp. More emphasis on analysis, with links to free author-developed analysis software. Comprehensive, clearly laid out, easy to read and understand, with great examples.

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Festing MFW, et al. 2016. *The Design of Animal Experiments*. 2nd edition, SAGE Publications, 144 pp
Emphasis on randomized block and factorial designs, and shows how both males and females can be included in an experiment without the need to increase the total number of animals. It also includes guidance on the choice of experimental animals and how to minimize variability.

Reynolds PS. *A guide to sample size for animal-based studies*. Wiley-Blackwell. Release date 8 Sep 2023

Peer-reviewed literature

Festing MFW, Altman DG. Guidelines for the design and statistical analysis of experiments using laboratory animals. *ILAR J*. 2002. 43(4): 244-256

Festing MFW. Reduction of animal use: experimental design and quality of experiments. *Laboratory Animals*. 1994;28: 212-221

Festing MFW. The design and statistical analysis of animal experiments *ILAR J*. 2002. 43(4): 191-3

Karp NA, Reavey N (2019). Sex bias in preclinical research and an exploration of how to change the status quo. *British Journal of Pharmacology*, 176(21):4107-4118. doi: 10.1111/bph.14539.

Karp NA, Wilson Z, Stalker E, Mooney L, Lazic SE, Zhang B, Hardaker E (2020). A multi-batch design to deliver robust estimates of efficacy and reduce animal use - a syngeneic tumour case study. *Scientific Reports*, 10(1):6178. doi: 10.1038/s41598-020-62509-7.

Miller LR, Marks C, Becker JB, Hurn PD, Chen WJ, Woodruff T, McCarthy MM, Sohrabji F, Schiebinger L, Wetherington CL, Makris S, Arnold AP, Einstein G, Miller VM, Sandberg K, Maier S, Cornelison TL, Clayton JA (2017). Considering sex as a biological variable in preclinical research. *FASEB Journal*, 31(1):29-34. doi: 10.1096/fj.201600781R.

Richter H (2017). Systematic heterogenization for better reproducibility in animal experimentation. *Lab Animal* (NY), 46:343-349. doi: 10.1038/labani.1330

Voelkl B, Vogt L, Sena ES, Würbel H (2018). Reproducibility of preclinical animal research improves with heterogeneity of study samples. *PLoS Biology*, 16(2):e2003693. doi:10.1371/journal.pbio.2003693

von Kortzfleisch VT, Karp NA, Palme R, Kaiser S, Sachser N, Richter SH (2020). Improving reproducibility in animal research by splitting the study population into several 'mini-experiments'. *Scientific Reports*, 10(1):16579. doi: 10.1038/s41598-020-73503-4.

Wilson LAB, Zajitschek SRK, Lagisz M, Mason J, Haselimashhadi H, Nakagawa S (2022). Sex differences in allometry for phenotypic traits in mice indicate that females are not scaled males. *Nature Communications*, 13: 7502 doi.org/10.1038/s41467-022-35266-6

Würbel H (2017). More than 3Rs: the importance of scientific validity for harm-benefit analysis of animal research. *Lab Animal*, 46:164-167. doi.org/10.1038/labani.1220