Uncertain or biased input to sample size and power calculations in preclinical animal studies

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When planning a preclinical animal study, it is crucial to consider the number of animals and its consequences. Depending on the setting, the sample size can in fact be chosen, within practical and regulatory constraints, to obtain adequate statistical power or accuracy in detecting an effect of interest. If the number of animals cannot be chosen, then power/accuracy or the minimum detectable effect size should still be calculated to determine whether it is worth conducting the study. If not, the design of the experiment or the analysis plan needs to be changed.

These calculations and decisions require information on the effect of interest before data collection. There are different types of sources of this information, which carry different amounts of uncertainty and are prone to different biases. Uncertainties, once identified, may be incorporated in the form of prior distributions and can, in any case, be usefully explored in sensitivity analyses. A few simple approaches for addressing the likely inflation of expected effect sizes exist, but are not typically adopted in preclinical animal research.

We give an overview of the different uncertainties and biases for each of the typical sources of information. After critically discussing the existing mitigation strategies, we suggest adaptations for preclinical animal research, paying particular attention to the combination of different uncertainties and biases. Our aim is to encourage statisticians to improve the quality of preclinical animal studies and their results through improved sample size planning or power analysis.

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