

# Reduction Search Strategies for Animal Research

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## Federal Regulations

**Information Requirements of the Animal Welfare Act (AWA)**  
*Code of Federal Regulations*  
*Title 9, Chapter 1, Subtitle A, Animal Welfare*

"...the IACUC shall determine that the principal investigator (PI) has considered alternatives to procedures that may cause more than momentary or slight pain or distress to the animals."

**Consideration of Alternatives to Painful/Distress Procedures**  
*USDA/ Animal Care Policy #12*

"...the performance of a database search remains the most effective and efficient method for demonstrating compliance with the requirement to consider alternatives to painful/distressful procedures."



REFINED



A singly housed non-human primate becomes pair housed. This refined housing condition more closely resembles the animal's natural habitat.

Photos courtesy: Animal Welfare Institute

## Methods

• To retrieve bibliographic information regarding animal alternatives for a study investigating the use of ultrasound to visualize arteriosclerosis in the rabbit animal model, literature searches were conducted in the databases:

- OVID MEDLINE
- OVID Agricola
- Embase.com

• Results from a search utilizing the Phase I AWIC model were examined for relevancy and compared with results retrieved with novel reduction search strategies, shown in this poster.

• Novel search strategies aimed for high recall versus precision.

## OVID Medline Search Strategy

• Adjacency statements with reduction keywords

• (((rabbit\$ or animal\$) adj3 (reduc\$ or fewer or less or decrease\$) adj3 (number\$ or research or laboratory)).mp.) and exp research/

• ((animal\$ or rabbit\$) and reduc\$).ti,hw. and (alternatives or experimentation).hw.

• Statistical subject headings--terms were not exploded or focused

- research design/
- statistics/
- sample size/
- data interpretation, statistical/

• Adjacency statements with statistical keywords

• ((power or sample) adj2 size\$).ti.  
• ((statistic\$ or power) adj2 analysis\$).ti.  
• ((statistic\$ adj2 (significance or power)).ti.

**Note:** Statistical keywords and subject headings should be combined (Boolean operator AND) with terminology from the specific research study and subject heading words relating to the 3 R's such as "alternative", for the best retrieval.

## OVID Agricola Search Strategy

• Adjacency statements with reduction keywords

• (((animal\$ or rabbit\$) adj5 (reduc\$ or fewer or less or decrease\$).ti.) and "laboratory and experimental animals".cc.

• (((animal\$ or rabbit\$) adj2 (reduc\$ or fewer or less or decrease\$).ab.) and "laboratory and experimental animals".cc.

• Animal experiment subject heading

• animal use reduction and "laboratory and experimental animals".cc.

• Statistical subject headings--terms were not exploded or focused

- experimental design/
- statistical analysis/
- data collection/
- group size/
- sampling/

• Adjacency statements with statistical keywords

• ((power or sample) adj2 size\$).mp.  
• ((statistic\$ or power) adj2 analysis\$).mp.  
• (statistic\$ adj2 (significance or power)).mp.

**Note:** Statistical keywords and subject headings should be combined (boolean operator AND) with terminology from the specific research study, for the best retrieval.

## Embase.com Search Strategy

• Title field search (combine with Emtree terms below to increase precision)

• (rabbit\* or animal\*) and (reduc\* or fewer or less or decrease\*)

• Statistical Emtree terms--extensive search (combine with research terminology for additional retrieval)

- experimental design
- factorial design
- statistical analysis
- sample size
- data analysis

• Animal experiment Emtree terms

- experimental animal (do not explode)
- animal welfare (extensive search)

**Note:** adjacency statements are not easy completed in Embase.com, and therefore were not used in this database.

## Sample of Retrieved Article Titles

• Dutch University scientists increase research productivity using fewer animals per project. (Hagelin, Carlsson, & Hau)

• Fundamental steps in experimental design for animal studies. (de Aguiar-Nascimento)

• Good experimental design and statistics can save animals, but how can it be promoted? (Festing)

• Guidelines for the design and statistical analysis of experiments using laboratory animals. (Festing & Altman)

• Introduction to the 3Rs (refinement, reduction and replacement). (Gühad)

• Instrumentation aspects of animal PET. (Tai & Laforest)

• Reduction by well-defined objectives. (Fry)

• Reduction strategies in animal research: a review of scientific approaches at the intra-experimental, supra-experimental and extra-experimental levels. (de Boo & Hendriksen)

• Sample size determination. (Dell, Holleran, & Ramakrishnan)

## Results

• The majority of articles retrieved with the AWIC Phase I approach were relevant to the researcher, as they contained information regarding:

- specific surgical techniques (refinement)
- various models for arteriosclerosis research (replacement)
- animal sample size (possible reduction)

• However, most of these articles did not thoroughly address any methodologies to reduce the number of animals used in the study.

• In comparison, articles retrieved using the novel search strategies focused on ways to reduce animal numbers through such methods as:

- employing factorial research designs
- using non-invasive imaging techniques
- and/or discussed the general concept of the 3 R's

## Conclusion

• The AWA requires PIs to put forth a "good faith" effort to locate animal research alternatives. In order to meet these requirements, PIs and/or information professionals need to employ a combination of search strategies, including the AWIC approach and strategies utilizing statistical terminology.

## 3 R's

• Literature searches should be conducted using the 3 R's as a guide.

• Russell and Burch introduce the 3 R's in their classic publication *The Principles of Humane Experimental Technique*.

• **Refinement:** Use techniques and protocols that reduce pain and distress

• **Replacement:** Substitute animals with non-animal models or lower organisms

• **Reduction:** Minimize the number of animals used without compromising statistical power



REPLACED



A rabbit animal model is replaced with a computer simulation model.

Left photo courtesy: Animal Welfare Institute

## AWIC Suggested Search Strategies

• The Animal Welfare Information Center (AWIC) suggests utilizing a two phase approach when searching databases for animal alternatives.

• **Phase I: Reduction and Refinement**

Retrieves citations pertinent to PI's field of study and includes information on surgical techniques and common animal models used.

• **Phase II: Replacement**

Retrieves citations addressing potential alternatives such as computer simulation, cadavers, animals lower on the phylogenetic scale, etc.



REDUCED



The number of rats needed for a toxicology study is reduced without compromising statistical power.