



แนวทางเพิ่มเติมสำหรับกรรมการในการพิจารณาโครงการวิจัย

(จาก ARENA/OLAW. Institutional Animal Care and Use Committee Guidebook, 2nd edition, 2002)

1. Replacement, or utilizing non-animal models;
2. Reduction of numbers of animals used; and
3. Refinement, or elimination or reduction of unnecessary pain and distress in animals.

Replacement alternatives utilize:

- living systems, e.g., in vitro cell or organ cultures, invertebrate animals, microorganisms and plants. If not applicable, *use species lower on the phylogenetic scale.*
- non-living systems, e.g., physical or mechanical systems and chemical techniques
- computer simulations.

Reduction alternatives

Rational selection of group size	<ul style="list-style-type: none">• Pilot studies to estimate variability and evaluate procedures and effects• Power analysis
Careful experimental design	<ul style="list-style-type: none">• Appropriate choice of control groups• Standardizing procedures to minimize variability
Maximizing use of animals	<ul style="list-style-type: none">• Performing several terminal procedures per animal• Animals euthanized by one investigator used for tissue needed by another
Correct choice of model	<ul style="list-style-type: none">• Use of healthy, genetically similar animals decreases variability
Minimizing loss of animals	<ul style="list-style-type: none">• Good post-operative care• Avoid unintended breeding• Plan ahead so the appropriate number of animals needed for studies are ordered or bred
Statistical analysis	<ul style="list-style-type: none">• Appropriate use of statistical software can generate maximum information from minimum number of animals

Refinement alternative

Consider alternatives to painful procedures, and to avoid or minimize discomfort, distress and pain. If unable to determine, utilize one or more of the following:

- pilot studies,
- evaluations of clinical signs,
- clinical pathology,
- gross and histological necropsy studies,
- review of comparable literature, and
- consultation with experts.



Procedures consistent with sound scientific practice and the goals of the research.

Other refinement opportunities:

- pain-relieving drugs,
- non-pharmacologic techniques,
- new diagnostic and therapeutic techniques, e.g., use of sophisticated imaging equipment to replace invasive procedures, and blood and tissue sampling techniques that allow for easier collection and the processing of smaller sample sizes.
- environmental enrichment programs, such as reduction of noises, odors, infrequent or inexperienced handling, or boredom from lack of environmental stimulation
- establishment of more humane endpoints.

Methods of Euthanasia

Acceptable

- a. Barbiturates (most species)
- b. Carbon dioxide (CO₂)-bottled gas only (most species)
- c. Inhalant anesthetics (most species)
- d. Microwave irradiation (mice and rats)
- e. Tricaine methane sulfate (TMS, MS222) (fish, amphibians)
- f. Benzocaine hydrochloride (fish, amphibians)
- g. Captive penetrating bolt (horse, ruminant, swine)
- h. Ether and carbon monoxide are acceptable for many species, but relatively dangerous to personnel.

Conditionally Acceptable (Requires IACUC Approval of Scientific Justification)

- a. Cervical dislocation (birds, small rodents and rabbits)
- b. Decapitation (birds, rodents, some other species)
- c. Pithing (some ectotherms)
- d. Various pharmacological and physical methods

Unacceptable

- a. Chloral hydrate, chloroform and cyanide
- b. Decompression
- c. Neuromuscular blockers
- d. Various pharmacological and physical methods
- e. Dry ice-generated CO₂

Conditionally acceptable e.g., KCl or formalin by intracardiac injection, or exsanguination are acceptable only under deep general anesthesia.

Humane endpoint examples:

- Tumor exceeds 10% of normal body weight; necrosis, infection, ulceration, interference with ambulation or eating/drinking



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- Rapid loss of weight (>20% of normal body weight) and/ or condition
 - Prolonged recumbency
 - Respiratory: rapid or labored breathing, coughing, rales
 - Cardiovascular: shock, hemorrhage, anaphylaxis
 - Gastrointestinal: severe diarrhea or vomiting
 - Peripheral Nervous System: flaccid or spastic paralysis
 - CNS Signs: circling, blindness, dementia, convulsion
 - Decrease of 4-6°C in body temperature in rodents
 - Moribund or pre-moribund state: Define with specific clinical signs and euthanize when reached