

AN INSTITUTIONAL SUMMARY OF:

**THE NATIONAL RESEARCH
COUNCIL “GUIDE FOR THE
CARE AND USE OF
LABORATORY ANIMALS”**

by

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This summary is provided to members of the IACUC & other appropriate readers, to help them begin to become familiar with the “Guide” contents, related to our Vivarium and stimulate their use of the complete “Guide.” It is not meant to replace the “Guide”. Rather, the summary aims to encourage “Guide” reading and use, as needed for references on most issues, much more complete understanding of animal care issues, and safe, humane operation of individual endeavors that use animals. *Copies of the “Guide” can be obtained from S.S. Singer.*

Chapter 1:

INSTITUTIONAL POLICIES AND RESPONSIBILITIES

Each institution will establish and provide resources for an animal care and use program managed in accord with the *Guide, summarized, here*, complying with federal, state, and local laws/regulations, such as the federal Animal Welfare Regulations, or AWRs, Public Health Service Policy on Humane Care and Use of Lab Animals, or PHS Policy. Responsibility for directing the program is given to a veterinarian or another qualified professional. In addition, a veterinarian qualified by experience or by training in lab animal science and medicine or species used must be associated with the program. The institution is responsible for keeping records of activities of the IACUC and conducting occupational health and safety programs.

MONITORING THE CARE AND USE OF ANIMALS

Institutional Animal Care and Use Committee (IACUC)

The IACUC also referred to as “the committee,” oversees all facets of institutional animal use and care. The institution is responsible for providing suitable orientation, background material, access to appropriate resources, and if necessary, specific training to assist all IACUC members in understanding and evaluating issues.

IACUC Membership:

- A doctor of veterinary medicine with training or experience in lab animal science and medicine or in use of species in question.
- At least one practicing scientist experienced in research involving animals.
- At least one public member to represent general community interests. Such members are not lab-animal users, affiliated with the institution, or in the immediate family of any person who is affiliated with the institution.
- Others, as needed.

The IACUC oversees and evaluates the animal care and use program and its components, as described in the *Guide*. It inspects facilities; evaluates programs and animal-activity areas; submits reports to responsible institutional officials; reviews proposed animal use in research, all testing, or education (i.e., protocols); and establishes the mechanism used for receipt and review of concerns involving institutional care and use of animals.

The committee should meet at least once every 6 months. Records of committee meetings and results of deliberations should be maintained. The committee should review the animal-care program and inspect the animal facilities/activity areas at least once every 6 months. After review and inspection, a written report, signed by a majority of the IACUC, is made to the responsible administrative officials of the institution on the status of the animal care and use program and other activities, as stated herein and as required by federal, state, or local regulations and policies. All protocols should be reviewed in accord with the AWRs, the PHS Policy, the *U.S. Government Principles for Utilization and Care of Vertebrate Animals (Guide Appendix D)*.

Animal Care and Use Protocols

These protocols must contain information on:

- Rationale and purpose of proposed use of animals.
- Justification of species and number of animals requested.
- Availability/appropriateness of using less-invasive procedures, other species, isolated organ preparations, cell/tissue cultures, computer simulations (*Guide Appendix A*).
- Adequacy of training and experience of personnel in **all** procedures used.
- Unusual housing and husbandry requirements.
- Appropriate sedation, analgesia, and anesthesia. Pain or invasiveness scales may aid in preparation/review of protocols (*Guide Appendix A*).
- Lack of unnecessary duplication of experiments.
- Conducting multiple major operative procedures.
- Criteria and process for timely intervention, removal of animals from a study, or euthanasia, if painful or stressful outcomes are anticipated.
- Postprocedural care.
- Method of euthanasia or disposition of animal.
- Safety of working environment for personnel.

Occasionally, protocols, include procedures not previously encountered or having potential to cause pain or distress that cannot be reliably controlled. Relevant objective information regarding these procedures and study purposes must be sought from the literature, veterinarians, investigators and any other knowledgeable individuals. Some guidelines follow.

Physical restraint

Physical restraint is allowed for brief periods, manually or with restraint devices. It must minimize animal discomfort or injury. Prolonged use is avoided unless essential. Restraint device design must realize research goals impossible/impractical by other means or prevent animal and personnel injury.

- Restraint devices are not normal housing methods and they are not used as a convenience.
- The period of restraint must be the minimum necessary time interval.
- Animals should be given training to adapt them to the devices and personnel.
- Veterinary care and advice must be provided if lesions or illnesses associated with the restraint are observed.

Multiple Major Surgical Procedures

Multiple major survival surgical procedures on an animal are discouraged. The IACUC may approve them after appropriate user justification. Then, the IACUC must pay particular attention to animal well-being through continuing evaluation of outcomes.

Food or Fluid Restriction

This must be scientifically justified and monitored physiologically/behaviorally. In cases of fluid restriction, avoidance of acute or chronic dehydration must include daily records of fluid intake and body weights taken at least weekly. This and appropriate diet are required to minimize restriction required to achieve the desired scientific objective.

VETERINARY CARE

Adequate veterinary care must be provided, including access to all animals used. Visits by a consulting or part-time veterinarian should occur at intervals appropriate to program needs.

PERSONNEL QUALIFICATIONS AND TRAINING

AWRs and PHS Policy; ensure that people caring for or using animals are qualified. Personnel caring for animals should be appropriately trained and the institution will provide for formal or on-job training to facilitate effective implementation of the program and humane care/use of animals. People using and caring for animals should also participate regularly in continuing-education activities relevant to their responsibilities. They are encouraged to be involved in local and national meetings of AALAS and other relevant professional organizations. Coordinators of institutional training programs can seek aid from the Animal Welfare Information Center.

OCCUPATIONAL HEALTH AND SAFETY OF PERSONNEL

Hazard Identification and Risk Assessment

Professional staff who conduct and support research programs using hazardous biologic, chemical, or physical agents (including ionizing and nonionizing radiation) should be qualified to assess all the dangers associated with the programs and to select safeguards appropriate to the risks. All potential hazards -- such as animal bites, chemical cleaning agents, allergens, and zoonoses -- that are inherent in or intrinsic to animal use should be identified and evaluated. The extent and level of participation of personnel in the occupational health and safety program should be based upon the hazards posed by the animals and materials used; on the exposure intensity, duration, and frequency. Personnel at risk must be provided with clearly defined procedures for conducting their duties, should understand all hazards involved, and should be proficient in implementing required safeguards. These include chemical safety, microbiologic and physical hazards, unusual conditions or agents, handling of waste materials, personal hygiene.

Personal Hygiene & Related Topics

All personnel must maintain a high standard of personal cleanliness. Personnel should wash their hands and change clothing as often as necessary to maintain personal hygiene. Personnel will not eat, drink, use tobacco products, or apply cosmetics in animal rooms. The facilities, equipment and procedures should be designed, selected, and developed to provide for ergonomically sound operations that reduce potential physical injury to personnel. Safety equipment is properly kept up and calibrated. All Experimental animals should be housed so potentially contaminated food, bedding, feces, and urine are handled in a controlled manner. Facilities, equipment, and procedures are provided for appropriate bedding disposal. Appropriate methods should be used to assess exposure to potentially hazardous biologic, chemical, and physical agents where the possibility of exceeding permissible exposure limits exists.

Animal Experimentation Involving Hazards

Careful attention should be given to procedures for animal care and the housing, storage and disbursement of agents, dose preparation, and administration, body-fluid and tissue handling, waste and carcass disposal and personal protection. Institutions must have written policies governing experimentation with hazardous biologic, chemical and physical agents. An oversight process (such as use of the safety committee) should be developed to involve persons who are knowledgeable in the evaluation of hazards and safety issues. The Centers for Disease Control and Prevention and the National Institutes of Health publication *Biosafety in Microbiological and Biomedical Laboratories* (1993) and National

Research Council (document in press) recommend practices and procedures, safety equipment, and facility requirements for working with hazardous biologic agents and materials.

- Floor drains should always contain liquid or be sealed effectively by other means.
- Exposure to anesthetic waste gases should be limited.

More complete information is found in the *Guide*. Problems associated with anesthetic waste gas are usually avoided by using various scavenging techniques. For example, with ether, personnel safety should be ensured by proper signs and using equipment and practices to minimize risks associated with its explosiveness.

Personal Protection

Personal protective equipment should be provided, and other safety measures should be adopted when needed. Animal-care personnel should wear correct institution-issued protective clothing, shoes or shoe covers, and gloves, as needed. Clean protective clothing should be provided as necessary.

Medical Evaluation and Preventive Medicine for Personnel

Development and implementation of a program of medical evaluation and preventive medicine should involve input from trained health professionals. A health-history before work assignment is advisable to assess potential risks for individual employees. Periodic medical evaluations are advisable. An appropriate immunization schedule should be adopted.

- It is essential to assure immunization of all animal-care personnel against tetanus.
- Pre-employment or pre-exposure serum collection is advisable.
- Zoonosis surveillance should be a part of an occupational-health program.
- Clear procedures should be established for reporting all accidents, bites, scratches, and allergic reactions.

Chapter 2: Animal Environment, Housing, and Management

A good management program provides the environment, housing, and care that permit animals to grow, mature, reproduce, and maintain good health; their well-being; and minimizes variation that can affect research results. Factors considered are:

- Species, strain, and breed of animal and individual characteristics, such as sex, age, size, behavior, experiences, and health.
- Ability of animals to form social groups through sight, smell, and possibly contact, whether they are maintained singly or in groups.
- Design and construction of housing.
- Project goals and experimental design.
- Presence of hazardous or disease-causing materials.
- Duration of holding period.

Animals should be housed with the goal of maximizing species-specific behavior and minimizing stress-induced behaviors. A strategy for achieving desired housing should be developed by the animal-care personnel with review and IACUC approval. Decisions by the IACUC, in consultation with both investigators and veterinarians, should aim to achieve high standards for professional and husbandry

practices appropriate for health and well-being of the species and consistent with research objectives. The environment in which animals are maintained should be appropriate to the species, its life history, and intended use.

PHYSICAL ENVIRONMENT

Housing

Primary Enclosures

Cages: limits of an animal's immediate environment.

- Allow normal physiologic/behavioral needs of animal: urination, defecation, maintenance of body temperature, normal movement/postural adjustments, and needed reproduction.
- Assure that animals remain clean and dry, as consistent with requirements of the species.
- Allow adequate ventilation.
- Allow access to food and water and permit easy filling, refilling, changing, servicing, and cleaning of food and water utensils.
- Yield secure environment preventing escape or accidental entrapment of animals or their appendages between opposing surfaces or in structural openings.
- Are free of sharp edges or projections that could injure the animals.
- Allow observation of the animals with minimal disturbance of them.

Primary enclosures must have smooth, impervious surfaces with minimal ledges, angles/corners, and overlapping surfaces so accumulation of dirt, debris, moisture is reduced and satisfactory cleaning and disinfecting are possible. They must be made of durable, corrosion-resistant materials and withstand rough handling without chipping, cracking, rusting. All primary enclosures should be in good repair to prevent escape of or injury to animals, promote physical comfort, and facilitate sanitation and servicing. Solid-bottom caging, with bedding, is preferred by rodents.

Space Recommendations

Animal space needs are complex, and consideration of only animal body weight or surface is not sufficient. Minimally, an animal must have: space to turn around in and express normal posture adjustments; ready access to food and water; enough clean-bedded or unobstructed area to move and rest in. Need for and type of adjustments in amounts of primary enclosure space recommended in the table that follows should be approved at the instructional level by the IACUC.

Recommended Space for Commonly Used Group-Housed Laboratory Rodents

Animals	Weight, g	Floor Area/Animal, sq. in.	Height, in
Mice	<10	6	5
	Up to 15	8	5
	Up to 25	12	5
	>25	>15	5
Rats	<100	17	7
	Up to 200	23	7
	Up to 300	29	7
	Up to 400	40	7
	Up to 500	60	7
	>500	>70	7

Assessment of animal space needs should be a continuing process. With the passage of time or long-term protocols, adjustments in floor space and height should be considered/ modified as needed .

When appropriate, social animals should be housed in pairs or in groups, not individually, provided that such housing is not contraindicated by a protocol in question and does not pose undue risk to the animals.

Temperature and Humidity

Body temperature regulation within normal ranges is required for the well-being of all homeotherms. Generally, exposure of unadapted animals to temperatures above 85 F (29.4 C) or below 40 F (4.4 C), without shelter or other protection mechanisms may cause life-threatening clinical effects. Environment temperature and relative humidity can depend on husbandry and housing design and differ considerably between primary and secondary enclosures. Factors contributing to variation in temperature/humidity are housing material and construction, use of filter tops, number of animals per cage, forced ventilation of enclosures, frequency of bedding change and bedding type. Conditions that cause needed increased environment temperatures are postoperative recovery and housing of neonates separated from their mothers. In the absence of well-controlled studies, professional judgment and much experience have led to recommended dry-bulb temperatures of 64-79° F for rats and mice. Daily temperature fluctuation should be minimized to avoid repeated large demands on animal metabolic and behavioral processes to compensate for changes in thermal environment. Relative humidity should be kept between 30-70%.

Ventilation

The guideline, 10-15 fresh-air changes per hour has been used for secondary enclosures for many years and is considered an acceptable general standard. To identify more accurately ventilation required, the minimal ventilation rate (usually, cubic ft per minute) required to accommodate heat loads generated by animals can be calculated with the aid of mechanical engineers. A total-heat-gain formula is published by the American Society of Heating, Refrigeration and Air-Conditioning Engineers. Using appropriate ventilation prevents harmful/unacceptable concentrations of toxic gases, odors, or particles in primary enclosures.

Use of recycled air to ventilate animal rooms saves energy but may entail risk. Animal patho-gens are often airborne or travel on fomites such as dust. Exhaust air to be recycled should be HEPA-filtered (high-efficiency particulate air-filtered) to remove out all airborne particles before recycling; extent and efficiency of filtration is inversely proportional to estimated risk. Toxic or odor-causing gases (e.g., NH₃) are kept within acceptable limits if removed by ventilation and replaced with air that lacks them or holds them at lower concentrations. Treating recycled air for these materials by chemical absorption or scrubbing can be effective. However, use of nonrecycled air is preferred for ventilation of animal use and holding areas.

Illumination

Lighting should be diffused throughout an animal holding area, provide sufficient illumination for well-being of the animals, good housekeeping practices, and the adequate inspection of all animals. Animal holding rooms should provide adequate vision and for neuroendocrine regulation of diurnal and circadian cycles. A time-controlled lighting system should be used to ensure a regular diurnal cycle, and timer performance should be checked periodically to ensure proper cycling. Light levels of ~325 lux (30 ft-candles) about 1.0m (3.3 ft) above the floor appear to be sufficient for animal care and do not cause clinical

signs of phototoxic retinopathy in albino rats. Young albino or pigmented mice prefer much-lower illumination than adults, though potential retina damage due to housing these rodents at higher light levels is mostly reversible.

Noise

Noise control should be considered in facility design and operation. Separation of human and animal areas minimizes disturbances to both human and animal occupants of a facility. Personnel should minimize making unnecessary noise. Excessive and intermittent noise can be minimized by training personnel in practices that reduce noise and by use of cushioned casters and bumpers on carts, trucks, and racks. Radios, alarms, and other sound generators should not be used in animal rooms.

BEHAVIORAL MANAGEMENT

Social Environment

When it is appropriate and compatible with the protocol, social animals should be housed in physical contact with conspecifics.

Activity

Forced activity for reasons other than attempts to meet therapeutic or approved protocol objectives should be avoided. In most species, physical activity that is repetitive, non-goal-oriented, and excludes other behavior is considered undesirable.

HUSBANDRY

Food

Animals are fed palatable, uncontaminated, nutritionally adequate food, according to particular requirements, unless a protocol used requires otherwise. Animal-colony managers judiciously buy, transport, store and handle food to minimize introducing disease, parasites, potential disease vectors (e.g., insects or other vermin) and chemical contaminants to colonies. Purchasers are encouraged to consider manufacturer and supplier procedures and practices for protecting and ensuring diet quality. Institutions should urge vendors to provide data from feed analysis for critical nutrients, periodically. Manufacture date and other factors affecting food shelf-life should be known by users. Stale food or food transported/stored inappropriately becomes nutritionally deficient.

Areas in which diets and diet ingredients are processed or stored should be clean and enclosed, to prevent pest entry. Food should be stored off floors on pallets, racks, or carts. Unused, open bags of food are stored in vermin-proof containers. Most natural-ingredient, dry lab-animal diets hold preservatives. Stored properly, they are usable for ~6 months after manufacture. Vitamin C in feed, however, has a shelf-life of only 3 months.

Feeders should be designed and set to allow easy food access and minimize contamination with urine and feces. When animals are housed in groups, there should be enough space and feeding points to minimize competition for food and ensure food access for all animals, especially if food is restricted in a protocol or management routine.

Water

Animals should have access to potable, uncontaminated drinking water according to particular requirements. Watering devices (drinking tubes and automatic waterers) should be checked daily. It is better to replace water bottles than refill them, because of potential for microbiologic contamination. If bottles are refilled, each bottle is replaced on the cage from which it was taken.

Bedding

Softwood beddings have been used, but the use of untreated softwood shavings and chips is contraindicated for protocols where they affect animal metabolism. Cedar shavings are not usually recommended, because they emit aromatic hydrocarbons that induce hepatic microsomal enzymes and cytotoxicity. Manufacturing, monitoring, and storage methods used by vendors should be considered when choosing bedding products. Bedding should be transported and stored off the floor on pallets, racks, or carts in a fashion consistent with maintenance of quality and minimization of contamination. It should be used in amounts sufficient to keep animals dry between cage changes, and, in the case of small laboratory animals, great care should be taken to keep bedding from coming into contact with the water tube, because this could cause leakage of water into the cage.

Sanitation

This involves appropriate bedding change, cleaning, and disinfection. Frequency and intensity of cleaning and disinfection depend on what is needed to yield a healthy environment for the lab animal, in accord with its normal behavior and physiologic characteristics. Agents masking animal odor should not be used in animal facilities. They cannot replace good sanitation or adequate ventilation, and they expose animals to volatile compounds that may alter normal physiologic and metabolic processes.

Bedding Change

Frequency depends on factors such as number and size of animals in a primary enclosure, the size of the enclosure, urinary and fecal output, appearance and wetness of the bedding. It varies from daily to weekly. In some instances, frequent bedding changes are contraindicated, such as during some parts of prepartum or postpartum periods, when pheromones are essential for successful reproduction. In general, animal enclosures and accessories, such as tops, should be sanitized at least once every two weeks. Solid-bottom cages, bottles, and sipper tubes usually require sanitation at least once weekly. These may include large cages with very low animal density and frequent bedding changes, cages that house animals in gnotobiotic conditions, with frequent changes.

Primary enclosures can be disinfected with chemicals, hot water, or both. Washing times and conditions must be sufficient to kill vegetative forms of common bacteria and other organisms that are controllable by such sanitation. When only hot water is used, it is the combined effect of temperature and time length that a given temperature is applied to the surface of the item that disinfects. Detergents and chemical disinfectants enhance effectiveness of hot water but should be thoroughly rinsed from surfaces before equipment reuse. It is specially important to ensure that surfaces are rinsed free of any residual chemicals and that all personnel have appropriate equipment to protect them from exposure to hot water or chemical agents used. Water bottles, sipper tubes, stoppers, feeders, and other small equipment are washed with detergent, hot water, and as needed, chemicals to destroy microorganisms.

Cleaning and Disinfection of Secondary Enclosures

All components of an animal facility, including animal rooms and support space (such as storage areas, cage-washing facilities, corridors, and procedure rooms) are cleaned regularly and disinfected as appropriate and at a frequency based on area use and nature of likely contamination. Cleaning utensils should be assigned to specific areas. Utensils are cleaned regularly and constructed of materials that resist corrosion. Monitoring sanitation practices uses visual inspection of materials. The intensity of animal room odors, particularly NH₃ should not be used as a sole means of assessing effectiveness of

sanitation. Altering frequency of cage-bedding change or cage-washing is based on such concentration of ammonia, cage appearance, bedding condition, and animal number and size in a cage.

Waste Disposal

Contracts with licensed commercial waste-disposal firms provide assurance of regulatory compliance and safety. On-site incineration should comply with all federal, state and local regulations. Waste containers must be leakproof and equipped with tight-fitting lids. It is expected that disposable liners and regular washing of containers and implements is done. There should be a dedicated waste-storage area kept free of insects and other vermin. If cold storage is used to hold material before its disposal, a properly labeled, dedicated refrigerator, freezer, or cold room should be used. Hazardous wastes must be made safe by sterilization, containment, or other appropriate means before removal from the facility. Infectious carcasses are incinerated on site or collected by licensed contractors.

Pest Control

Programs aimed to prevent, control, or eliminate presence or infestation by pests are essential in animal environments. Control and monitoring must be implemented. An ideal program prevents the entry of vermin into and eliminates their harborage from a facility. Pesticides can induce toxic effects on research animals and interfere with chosen experimental procedures. They should be used in animal areas only when necessary. Use of pesticides should be recorded, coordinated with the animal-care management staff and be in compliance with federal, state, or local regulations. Traps used should be humane, catch pests alive, be examined often, and humane euthanasia should follow capture.

Emergency, Weekend, and Holiday Care

Animals are cared for by qualified personnel every day, including weekends and holidays. This safeguards their well-being and satisfies research requirements. Emergency veterinary care should be available after work hours, on weekends, and on holidays. In emergencies, institution security personnel and fire or police officials are able to reach people responsible for animals. Emergency procedures, names, and telephone numbers are kept in the facility, security department, or telephone center. A disaster plan that handles personnel and animals is prepared as part of the overall safety plan for the institution. The colony manager/veterinarian is a member of the institutional safety committee.

POPULATION MANAGEMENT

Identification and Records

Animal identification includes room, rack, pen, stall, and cage cards with written or bar-coded information; collars, bands, plates, and tabs; colored stain; ear notches and tags; tattoos; subcutaneous

transponders; and freeze brands. Identification includes source of each animal, strain or stock, names and locations of responsible investigators, pertinent dates, and protocol number.

Genetics and Nomenclature

Outbred animals are widely used and founding populations must be large enough to ensure long-term heterogeneity of colonies. Inbred strains of species, especially rodents, have been developed to address specific research needs. Homozygosity of these animals enhances data reproducibility.

Chapter 3: Veterinary Medical Care

Adequate veterinary care consists of effective programs for:

- Preventive medicine.
- Surveillance, diagnosis, treatment/control of disease and zoonoses.
- Management of protocol-associated disease, disability, or other sequelae.
- Anesthesia and analgesia.
- Assessment of animal well-being.
- Euthanasia.

A veterinary-care program is the responsibility of the attending veterinarian, certified, trained or experience in laboratory animal science and medicine or in care of the species being used. Mechanism for direct and frequent communication should be established to ensure timely and accurate information getting to the veterinarian on problems of animal health, behavior, and well-being. Guidance is given to investigators and all personnel involved in animal care and use, to ensure correct handling, sedation, analgesia, anesthesia, and euthanasia.

ANIMAL PROCUREMENT AND TRANSPORTATION

All animals are acquired lawfully. Use of purpose-bred research animals may be desirable if it is consistent with research, teaching, and testing objectives. Vendors should be evaluated for the quality of animals they supply. Transportation of animals, including ininstitution movement minimizes transit time and risk of zoonoses, protects against environment extremes, avoids overcrowding, provides food and water when indicated, and protect against physical trauma. All animal shipments are inspected for compliance with procurement specifications. Signs of clinical disease lead to quarantine.

PREVENTIVE MEDICINE

Effective preventive-medicine programs enhance research value of animals by maintaining their health and minimizing nonprotocol sources.

Quarantine, Stabilization, and Separation

Quarantine is separation of new animals from those in the facility until health and possibly microbial status of the new animals have been determined. Rodents do not require quarantine if data from vendor or provider are sufficiently current and complete to define the health status of incoming animals and their potential pathogen exposure during transit is considered. Newly received animals are to be given a sensible period for physiologic, psychologic and nutrition stabilization before use. Physical separation of animals by species is a must, and different species are housed in separate rooms. Intra-species separation may be essential, when animals come from multiple sites or commercial/institutional sources yield different pathogen status, e.g., sialodacryoadenitis virus in rats, mouse hepatitis virus.

Surveillance, Diagnosis, Treatment, and Control of Disease

All animals are observed for signs of illness, injury, or abnormal behavior. Unexpected deaths and signs of illness, distress, or other deviations from normal in animals should be reported promptly to ensure appropriate/timely delivery of veterinary medical care. Diagnostic lab services facilitate veterin-

ary medical care and include gross/microscopic pathology, pathology, hematology, microbiology, clinical chemistry, and serology. Medication or therapy choice should be made by a veterinarian in consultation with the investigator. Transplantable tumors, hybridomas, cell lines, and other biologic materials can be sources of murine viruses that contaminate rodents.

Surgery

Appropriate attention to presurgical planning, personnel training, aseptic and surgical technique, animal well-being, and animal physiologic status during all phases of a protocol will enhance outcomes of surgery. A continuing, thorough assessment of surgical outcomes should be performed to ensure that appropriate procedures are followed and timely corrective changes instituted. Modification of standard techniques might be desirable or required (for example, in rodent or field surgery). Both preoperative animal-health assessment and postoperative care are essential.

It is important that persons have had appropriate training to ensure good surgical technique is practiced, that is, asepsis, gentle tissue handling, minimal correct use of suture materials and patterns. Training guidelines for research surgery commensurate with a person's background are available to assist institutions in developing appropriate training programs.

Surgical procedures are categorized as major or minor and in the lab setting are further divided into survival and nonsurvival types. Any major survival surgery penetrates and exposes a body cavity or produces substantial impairment of physical or physiologic functions (e.g., laparotomy, thoracotomy, craniotomy, joint replacement, and limb amputation). Minor survival surgery does not expose a body cavity and causes little or no physical impairment (e.g., wound suturing; peripheral-vessel cannulation).

Minor procedures are often performed under less stringent conditions than major procedures but require aseptic technique and instruments and appropriate anesthesia. In nonsurvival animal surgery, an animal is euthanized before recovery from anesthesia. At a minimum, the surgical site is clipped, the surgeon wears gloves, and instruments and surrounding area are clean.

Aseptic methods are used to reduce microbe contamination to very low levels. Asepsis includes patient preparation, such as hair removal and disinfection of operative site; preparation of the surgeon, with decontaminated surgical attire, surgical scrub and sterile surgical gloves, sterilized instruments, supplies, and

implanted materials, and use of surgery techniques to reduce infection probability. Liquid chemical sterilants are used with adequate contact times, and instruments should be rinsed with sterile water or saline before use. Alcohol is not a sterilant or high-level disinfectant.

Careful surgical monitoring and attention to problems greatly increase likelihood of successful outcomes. Monitoring includes checking anesthetic depth and physiologic function, as well as assessment of clinical signs and conditions. Maintaining normal body temperature minimizes cardiovascular and respiratory disturbances caused by anesthetics.

Presurgical planning should specify requirements of postsurgical monitoring, care, and record-keeping, including personnel who perform these duties. Intensity of needed monitoring will vary with species and procedure. It might be greater during immediate anesthetic recovery than later in postoperative recovery. During anesthetic-recovery, the animal should be in a clean, dry area where it can be observed often by trained personnel. After anesthetic recovery, monitoring is often less intense but should include attention to basic biologic functions of intake and elimination and any behavioral signs of postoperative pain, monitoring for postsurgical infection, monitoring of incisions, bandaging as is needed, and timely removal of skin sutures, clips, or staples.

PAIN, ANALGESIA, AND ANESTHESIA

An integral component of veterinary medical care is prevention or alleviation of pain. Proper use of anesthetics/analgesics in research animals ethically and scientifically imperative. Some species-

specific behavioral manifestations of pain or distress are used as indicators, for example, vocalization, depression or other behavior changes, abnormal appearance or posture, and immobility. It is therefore essential that personnel caring for and using animals are familiar with species-specific and individual behavior, physiologic, and biochemical indicators of well-being. The preoperative or intraoperative administration of analgesics may enhance post-surgical analgesia and is used as needed.

EUTHANASIA

Euthanasia is killing by inducing rapid unconsciousness and death without pain or distress to an animal. Unless a deviation is justified for scientific or medical reasons, methods should be consistent with the *1993 Report of the AVMA Panel on Euthanasia*. In evaluating appropriateness of methods, some of the criteria that should be considered are ability to induce loss of consciousness and death with no or only momentary pain, distress, or anxiety; reliability; nonreversibility; time required to induce unconsciousness; species and age limitations; compatibility with research objectives; and safety of and emotional effect on personnel. Protocols should include criteria for initiating euthanasia, such as degree of a physical or behavioral deficit or tumor size, that will enable a prompt decision be made by the veterinarian and the investigator to ensure humane end points and achieved protocol objectives.

Euthanasia should be done in a manner that avoids animal distress. Therefore, other animals should not be present when euthanasia is performed. Generally, inhalant or noninhalant chemicals (such as barbiturates, nonexplosive inhalants, and CO₂) are preferable to physical methods (e.g., cervical dislocation, decapitation, and the penetrating captive bolt). However, scientific considerations may preclude chemical agents for some protocols. Death must be confirmed by personnel recognizing the cessation of vital signs in the species being euthanized.

Chapter 4:

Physical Plant

A well-planned, well-designed, well-constructed, properly maintained facility is an important element of good animal care and use. Design and size depend on scope of research activities, animals housed, physical relationship to the rest of the institution, geographic location, as well as state and local building codes. Good animal management and human comfort/health protection require separation of animal facilities from personnel areas. Animals should not be housed in lab merely for convenience. Building materials: durable, moisture-proof, fire-resistant, seamless materials are most desirable for interior surfaces. Surfaces should be highly resistant to effects of cleaning agents, scrubbing, high-pressure sprays, and impact. Paints and glazes should be nontoxic.

FUNCTIONAL AREAS

Space is required for

- Animal housing, care, and sanitation.
 - Receipt, quarantine, and separation of animals.
 - Separation of species/isolation of individual projects when necessary.
 - Storage.
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- Space contiguous: surgery, intensive, care, preparation of special diets.
 - Containment facilities/equipment, if hazardous biologic, physical or chemical agents are used.
 - Receiving and storage areas for food, bedding, pharmaceuticals, biologics, and supplies.
 - Space for washing and sterilizing equipment/supplies and, depending on the volume of work, machines for washing cages, bottles, glassware, racks, and waste cans; a utility sink; an autoclave for equipment, food, and bedding; and separate areas for holding soiled and clean equipment.
 - Space for storing wastes before incineration or removal.
 - Space for cold storage or disposal of carcasses.
 - Security features: alarms.

Corridors

These must be wide enough to facilitate movement of personnel and equipment. Wherever it is possible, water lines, drainpipes, electric-service connections, and other utilities should be accessible through access panels or chases in corridors outside animal rooms. Fire alarms, fire extinguishers, and telephones should be recessed or installed high enough to prevent damage from the movement of large equipment. Doors with viewing windows are preferable for safety and other reasons. Doors should be large enough (approximately 42 x 84 in) to allow the easy passage of racks and equipment. The doors should fit tightly within frames, and both doors and frames should be appropriately sealed to prevent vermin entry or harborage. The doors should have locks but be opened from inside without a key.

Exterior Windows

Where temperature cannot be regulated properly because of heat loss or gain through windows or where photoperiod is important (as in breeding colonies of rodents), exterior windows usually are inappropriate.

Floors

Floors should be moisture-resistant, nonabsorbent, impact-resistant, and smooth, resistant to action of urine and other biologics and to the adverse effects of hot water and cleaning agents. They must easily support racks, equipment, and stored items without becoming gouged, cracked, or pitted.

Drainage

Upon floor drain use, floors should be sloped and traps kept filled with liquid. Drainpipes should be at least 4 in (10.2 cm) in diameter. **Floor drains are not essential in animal rooms housing rodents. Rodent room floors can be sanitized adequately by wet vacuuming/mopping with appropriate cleaning compounds or disinfectants.**

Walls

Walls should be smooth, moisture-resistant, nonabsorbent, and resistant to damage from impact. Materials must withstand detergent and disinfectant cleaning and impact of water under high pressure.

Ceilings

Ceilings should be smooth, moisture-resistant, and free of imperfect junctions. Surface materials should be capable of withstanding cleaning with both detergents and disinfectants. Ceilings of plaster or fire-proof plasterboard should be sealed and finished with a washable paint. Suspended ceilings are undesirable unless they are fabricated of impervious materials.

Heating, Ventilation, and Air-Conditioning (HVAC)

Air-conditioning is an effective means of regulating temperature/humidity. HVAC systems should be designed for reliability, ease of maintenance, and energy conservation. They should be able to meet requirements for animals as discussed in Chapter 2. A system should be capable of adjustments in dry-bulb temperatures of $\pm 1^{\circ}\text{C}$ ($\pm 2^{\circ}\text{F}$). The relative humidity should generally be maintained within a range of 30-70% throughout the year. Temperature is best regulated by having thermostatic control for each room. The regular monitoring of the HVAC system is important and best done at individual-room level. Previously specified temperature and humidity ranges can be modified to meet special animal needs in circumstances in which all or most of facility is designed exclusively for acclimated species with similar requirements.

Power and Lighting

The electric system should be safe and provide appropriate lighting, a sufficient number of power outlets, and suitable amperage for specialized equipment. In the event of a power failure, an alternative/emergency power supply should be available to maintain critical services (HVAC system, freezers, ventilated racks and isolators). Light fixtures, timers, switches and outlets should be properly sealed to prevent vermin from living there. Recessed energy-efficient fluorescent lights are most often used in animal facilities.

Time-controlled lighting should be used to ensure uniform diurnal lighting. Light bulbs or fixtures should be equipped with protective covers to ensure the safety of animals and personnel. Moisture-resistant switches and outlets and ground-fault interrupters should be used where water use is high, such as cage washing areas.

Storage Areas

Adequate space should be provided for storage of equipment, supplies, food, bedding, and refuse. Corridors used for the passage of personnel or equipment are not appropriate storage areas. Bedding and food should be stored in a separate area in which materials posing a risk of contamination from toxic or hazardous substances are not stored. Refuse-storage should be separated from other storage areas.

Noise Control

Noise-producing support functions, such as cage-washing, are to be separated from housing and experimental functions. Great attention should be paid to attenuating noise generated by equipment.

Facilities for Sanitizing Materials

A dedicated, central area for sanitizing cages and ancillary equipment should be provided. Mechanical cage-washing equipment is generally needed and should be selected to match the types of caging and equipment used.

- Location with respect to animal rooms and waste-disposal and storage areas.
- Ease of access.
- Sufficient space for staging and maneuvering of equipment.
- Provision for safe bedding disposal and prewashing activities.
- Separation of animal and equipment movement between clean and soiled areas.
- Utilities, such as hot and cold water, steam, floor drains, and electric power.
- Ventilation/provision for dissipating steam/fumes from sanitizing processes.

FACILITIES FOR ASEPTIC SURGERY

A surgical facility should accommodate the species to be operated on and procedure complexity. For most rodent surgery, it may be small and simple (e.g., dedicated space in a laboratory managed to minimize contamination from other activities in the room during surgery). Control of contamination and easy cleaning are key considerations in the facility. To aid cleaning, operating rooms have as little fixed equipment as possible. Surgical lights provide illumination, electric outlets support equipment and gas-scavenging capability. The surgical-support area is designed for instrument washing, sterilization, and storage/supply storage. Here, are found : autoclaves and a large sink. A postoperative-recovery area should provide the physical environment to support needs of animals during the period of anesthesia and immediate postsurgical recovery.