BEST MANAGEMENT PRACTICES FOR FEEDER RODENT PRODUCTION AND DISTRIBUTION

HUSBANDRY

■ Rodent Enclosures (cages, tubs, etc.)
  ● should be designed to prevent escape by feeder rodents, e.g., closed rack systems
  ● should allow for normal postural and behavioral movements
  ● should allow access to food and water and allow easy refilling and cleaning of the devices that contain food and water
  ● should be ventilated, maintained at appropriate temperature (typically 68°F - 80°F, 20°C - 26°C), and should avoid humidity extremes (preferred 30-70% relative humidity)
  ● should be free of sharp edges that could cause injury
  ● should have corrosion-resistant surfaces that can be sanitized with hot water, detergents, and disinfectants
  ● should have appropriate bedding for nesting and to absorb urine and feces

■ Bedding
  ● should have adequate absorbent capacity
  ● wood chips (pine, aspen) recommended
  ● scented or aromatic bedding (cedar) should be avoided because aromatic compounds may cause respiratory problems or liver abnormalities
  ● must be disposed of properly.
    o Avoid placing bedding in areas where nutrients can leach into wetlands.
    o Consider composting to avoid landfill costs (several laboratory rodent producers compost their bedding).

■ Buildings
  ● should provide barriers to entry by wild rodents and other animals (insects, birds, reptiles)
  ● should have adequate ventilation or air movement
  ● should maintain light-dark balance within practical limits (preferably 12 hrs light/12 hrs dark)
  ● should have isolation/quarantine areas for rodents acquired from outside sources
• should have non-porous floors with drains for ease of cleaning (or similar arrangement for cage/tub rack systems)
• should have secure feed storage

■ Nutrition/Diet
• should meet rodent nutritional requirements rather than generic animal chow
• could be commercial diet formulated for laboratory animals or a custom formulation for the producer
• labeling of significant diet constituents (protein, fat, carbohydrates, minerals, etc.) is recommended
• avoid consistent use of prophylactic antibiotics (may lead to resistant pathogen strains)

■ Rodent Disease Prevention and Management
• Consult with veterinarian familiar with rodent health, diseases, and nutritional requirements.
• Maintain an ongoing pest control program to prevent or minimize wild rodents, e.g., rodent traps at the perimeter of the facility, in rodent rooms, and in areas where feed is stored.
• Promptly remove and euthanize any wild rodents or colony rodents that escape from captivity.
• Train staff to recognize signs and symptoms of disease (e.g., abnormal or labored breathing, weight loss, ruffled coat, dry skin, abnormal posture, lethargic behavior, diarrhea, discharge, eye redness, abnormal gait, loss of balance, unusual head movement, tumors).
• Keep records (e.g., location, date, # animals affected) for animals exhibiting signs or symptoms of disease or death.
• Isolate or quarantine animals with symptoms of disease.
• New breeders should come from a source with adequate biosecurity to prevent rodent pathogens; alternatively, new breeders should be isolated until disease-free status is confirmed.
• Distributors should avoid combining animals from different shipments to prevent disease transmission.
• Feed, water containers, equipment for handling cages, and bedding should not be moved among facility units (depends on the configuration of the facility; e.g., racks, rooms, buildings) to prevent cross-contamination.
• Equipment should be disinfected regularly.
TRANSPORTATION OF LIVE RODENTS

- Animals should be examined for ectoparasites prior to transport.
  - consider use of parasite control dust in the substrate/bedding
- Animals must be transported in appropriate containers.
  - containers must be non-porous or leak-proof with clean, absorbent bedding
  - containers must have adequate ventilation
  - container surfaces should not have sharp edges of objects that might cause injury
  - containers must allow reasonable postural movements
  - containers should be clearly marked to indicate LIVE ANIMALS
  - containers should allow observation of animals during ground transport
- Extreme temperatures should be avoided; preferred temperature is 65-85°F.
  - ground transport vehicles should have adequate climate control for the size of the vehicle and density of animals per container, e.g., multiple air vents, fans to increase circulation
- Transportation of rodents by airline must follow IATA Live Animals Regulations.
- Animals should have access to food and water for longer trips (more than 6 hours).

EUTHANASIA

- Guidelines of the American Veterinary Medical Association (AVMA) should be followed; refer to https://www.avma.org/KB/Policies/Documents/euthanasia.pdf pages 48-50).
  - Neonates less than 7 days old may be euthanized by freezing provided that the rodents do not come into direct contact with “ice or pre-cooled surfaces.”
  - Carbon dioxide is an acceptable method for rodents > 7 days, preferably compressed CO₂ in a cylinder fitted with a regulator.

SANITATION/DISPOSAL

- Multi-step sanitation of rodent enclosures should be used.
  - solid material should be removed into appropriate container
  - surfactants and/or power spray should be used to remove remaining particulate material
  - tubs or cages should be washed in a detergent solution
  - after washing, tubs should be soaked in a sanitizing agent (e.g., diluted chlorine solution)
  - tubs and cages should be allowed to dry thoroughly before re-use
- Waste (including bedding and animal waste) should be disposed of properly.
  - avoid contamination of water supplies and wetlands
  - consider disposal in a dry bed or septic system
ZOONOTICS

■ Prevention

● Barriers to infectious agents should be in place (prevent entry or active removal of wild rodents, insects, birds and reptiles.
● General hygiene practices should be established to minimize bacterial or viral growth.
  ○ regular cleaning of cages, floors, feed storage areas
  ○ use of disinfectants or sanitizers, surfactants and hot water
  ○ Employees should not work in different areas of the facility; if employees service multiple areas, footbaths at entrances are recommended (footbath solutions must be changed regularly).
  ○ available hand washing stations for staff
● Staff should be informed regarding zoonotic diseases and methods of transmission.
● Drinking, eating, or smoking should not take place in rodent rooms.
● Staff should wear gloves when handling live or frozen rodents, used bedding, or dirty cages; hand washing should occur promptly when gloves are removed.
● In facilities that also culture reptiles, care should be taken to avoid transmitting Salmonella to rodents.
  ○ Rodent and reptile areas should be physically separate.
  ○ Where practical, employees should not work in both facilities.
● Pregnant women or persons with compromised immune systems should not directly handle rodents or their enclosures.
● Newly acquired breeder animals should be isolated or tested for Salmonella and LCMV.
● Records of animals leaving the facility should maintained for 36 months (in the event of undetected zoonotic carriers).
  ○ date of shipment
  ○ species, type/age and number of animals shipped
  ○ specific location within facility where shipped animals were housed (if applicable)
  ○ destination of animals
  ○ carrier
  ○ Trip logs are recommended for the carrier, e.g., vehicle identification, time of departure and arrival, other stops made, other cargo.

■ Remediation in the event of a zoonotic outbreak

● Movement of animals, cages and equipment within the areas of facility without prior sanitation and disinfection should be avoided.
● Staff working with infected (or potentially infected) animals should have access to appropriate personal protective equipment (respirator, gloves, washable coveralls and footwear).
● Producers should cooperate fully with the Centers for Disease Control, local or state health departments, and departments of agriculture or animal health.

● All recent records of shipments should be made available to inspectors.

● Customers that have received animals should be notified immediately.
  ○ customers of all animals shipped after the zoonotic was discovered
  ○ includes animals potentially exposed to the disease carriers prior to discovery

● Transporters of animals in transit should be notified immediately.

● Animals in the facility (or part of the facility) should be isolated until the extent of the zoonotic has been determined.

● In the case of suspected LCMV
  ○ Representative animals within potentially infected units within the facility should be tested via PCR and serology to determine the extent of infection.
  ○ Animals should not be moved between facility units.
  ○ Employees should wear waterproof washable (or disposable) footwear that should be cleaned between rooms, and disposable gloves; overwear should remain within its designated room.

● In the case of confirmed LCMV
  ○ All animals within potentially affected units should be euthanized.
  ○ People handling rodents, bedding, caging and exposed equipment should wear a respirator/filter with >N95 rating, fitted per OSHA regulations.
  ○ Gloves, waterproof washable footwear and coveralls should be worn.
  ○ Protective gear should be disinfected before re-use and employees should wash their hands after removing gear.
APPENDIX B - Feeder Rodent Zoonotic Diseases

Salmonellosis

Salmonellosis is caused by the bacterium *Salmonella*. The Centers for Disease Control and Prevention estimates 1.2 million cases annually with 23,128 hospitalizations, and 452 deaths each year in the United States (Scallan et al. 2011). While most *Salmonella* infections result from contaminated foods, an estimated 11% of all *Salmonella* infections are attributed to animal exposure (including reptiles), resulting from directly handling animals, as well as indirect contact through cleaning cages or bedding, handling food or food bowls, or touching other things where the animals live (Hale 2012). Most persons infected with *Salmonella* develop diarrhea, fever, and abdominal cramps 12 to 72 hours after infection. The elderly, infants, and those with impaired immune systems are more likely to have a severe illness.

In general, salmonellosis is preventable by thoroughly washing hands with soap and water after contact with a potentially contaminated surface. Children are more prone to *Salmonella* infection than adults, presumably because they are less likely to wash their hands after contact with contaminated items. Older people and those with compromised immune systems are also more vulnerable.

In 2010, CDC investigated an outbreak of salmonellosis involving 34 people from 17 states with illnesses reported between December 4, 2009 and June 9, 2010 (for more information on this outbreak, visit the CDC website [http://www.cdc.gov/salmonella/frozenrodents/index.html](http://www.cdc.gov/salmonella/frozenrodents/index.html)). This was part of a larger international investigation into over 500 human cases that spanned the U.S., the United Kingdom, and Canada (Harker 2011, CDC unpublished data). The cause was attributed to frozen rodents from a single U.S. rodent producer. On July 26, 2010, the producer announced a recall of its frozen reptile feed. CDC advised discarding recalled products in stores and homes in closed plastic bags and sealed trash cans.

Between August 29, 2011 and February 2, 2012, 46 additional cases of salmonellosis were reported from 22 states (CDC 2012). Twenty-seven of the 46 cases were interviewed; 20 of these reported reptile or amphibian exposure and 15 reported rodent exposure.

Lymphocytic Choriomeningitis

Lymphocytic choriomeningitis is a disease that develops after infection with the LCM virus. The principal transmission route to humans is via contact with urine, feces, saliva or blood from the house mouse (*M. musculus*), wild or cultured, which is the natural reservoir for this virus (Edling 2011). High densities of infected mice, which may be present during an outbreak in a breeding colony, may lead to aerosol transmission of the virus to humans. Syrian hamsters (*Mesocricetus auratus*) also carry LCMV, and in rare instances, rats, guinea pigs, or other rodents may become infected from contact with infected mice or hamsters. It is estimated that 5% of wild house mice in the U.S. carry LCMV (CDC 2013), although this can vary by location; locally, 9%
of house mice in Baltimore, MD were found to have antibodies to the virus (Edling 2011).

Among house mice and hamsters, LCMV is transmitted horizontally as well as vertically from infected dams to offspring, perpetuating the prevalence of the virus in wild and captive populations. Infected mice and hamsters can shed the virus for several months or throughout their lives, and there is no vaccine or treatment.

Typically, human exposure to the virus results in an asymptomatic or mild illness (aseptic meningitis) without need for treatment. Patients may experience a variety of symptoms including fever, headache, muscle aches, loss of appetite, and nausea. After a few days of apparent recovery, meningitis symptoms appear (return of fever, headache, stiff neck) along with symptoms of encephalitis (drowsiness, confusion, sensory disturbances, difficulty in moving).

Infection during pregnancy has been associated with severe symptoms in the fetus, including hydrocephalus, chorioretinitis and mental retardation (CDC 2013). Although the disease in healthy adults is rarely fatal, three organ transplant recipients died after receiving infected tissues from an organ donor who had been exposed to an infected pet hamster (Amman 2007).

Prevention in rodent breeding colonies centers on avoiding contact with wild mice using barriers to entrance along with an active pest control program. In the case of breeding and distribution facilities for feeder mice, secure confinement of stock is recommended to decrease the opportunity for contact with wild mice. For staff at culture/distribution facilities and pet owners, hands should be thoroughly washed with soap and water after exposure to pet rodents or cultured feeder mice.

Currently, blood tests are commercially available that can detect the virus or antibodies to LCMV. Post-mortem sampling of tissues (kidney, liver, and spleen) is most effective for virus testing, while serum or whole blood is used to detect antibodies. Edling (2011) has investigated the feasibility of testing breeding stock in commercial facilities using environmental swabs for genetic analysis.

In 2012, CDC investigated a rodent breeding facility where a staff member developed aseptic meningitis that was caused by LCMV infection. Subsequent testing revealed that 13 of 52 employees had current or past infection. Five employees sought medical treatment and four of these were diagnosed with aseptic meningitis. Testing discovered LCMV antibodies in 21% of frozen mice from the facility, leading to a quarantine on further shipments, a depopulation of all live mice and disposal of frozen mice. Live mice had been shipped to points in 21 states, but to date no further LCMV infections have been reported.

Rat Bite Fever

Rat bite fever (RBF) is a rare disease in North America, where the infectious agent is the bacterium Streptobacillus moniliformis. As the name implies, rats are a reservoir for these bacteria, although rats are largely immune to the disease and do not exhibit symptoms of illness. Bacteria are transmitted to humans through a bite or scratch, from contact with rat secretions, or consuming contaminated food or drink. Symptoms appear within three weeks of exposure (typically 3-10 days) and include fever, swelling around the wound, enlarged lymph
nodes and a rash on the extremities. Antibiotic therapy (penicillin, tetracycline) is effective for curing the infection. However, untreated infections can lead to severe complications and even death.

RBF has been reported in mice, gerbils and guinea pigs (CDC 2013, Center for Food Security & Public Health 2006), but rats are the primary reservoir. Because healthy rats harbor *S. moniliformis*, symptoms that appear following contact with rats should be evaluated and treated if appropriate.