

## WVU IACUC Guidelines: Administration of Substances to Research and Teaching Animals

### Purpose

This document is designed to provide general guidelines about administration of substances to research and teaching animals. All procedures *must* be approved by the IACUC and described in the animal use protocol. The route of administration, intervals between substance administration, dose range, and volume to be administered should be listed in the approved protocol specific to each study.

### Definitions

Parenteral: Administration of substances outside of the gastrointestinal tract. Routes of parenteral administration are listed below.

- Intravenous (IV): Administration of substance into venous circulation
- Intraperitoneal (IP): Administration of substance into the peritoneal space
- Subcutaneous (SC): Administration of substance into the subcutaneous space
- Intradermal (ID): Administration of substance into the dermis
- Intramuscular (IM): Administration of substance into the muscle
- Intranasal (IN): Administration of substance into the nose
- Intratracheal (IT): Administration of substance within the trachea
- Intracranial: Administration of substance into the brain
- Epidural (ED): Administration of substance into the epidural space
- Intrathecal: Administration of substance into the subarachnoid space (in the spinal canal but not within the spinal cord)
- Transdermal (percutaneous): Application of substances directly to the skin for systemic effect
- Topical (epicutaneous): Application of substance directly to the skin for topical effect

Enteral: Administration of substances into the gastrointestinal tract. Routes of enteral administration are listed below.

- Per os (PO): Administration of substance by mouth
- Gavage: Administration of substance via a tube that is passed through the nose or mouth into the esophagus or stomach
- Rectal: Administration of substance into the rectum

Bolus (injection): Administration of a substance by injection (typically IV) quickly (< 1 minute).

Oral Bolus: Entire dose is given all at once via oral route.

Slow infusion: Administration of a substance by injection (typically IV) over a longer period of time (>5 minutes).

### Procedures

#### 1. Administration of Substances

- a. Care should be taken to select an appropriate route of administration, method of restraint, dosing interval and dose volume.

- b. **All personnel should be trained to safely perform the selected route of administration. Contact the veterinary staff (OLAR or Agricultural) for assistance.**

## 2. Needle Use

- a. Best practice is to use a new needle only once for an injection and discard after use. Use of the same needle on multiple animals can spread infectious disease and lead to adverse outcomes due to needle dulling/spurring. Once a needle is inserted into an animal it cannot be re-inserted into a stock container of solution (vial, tube, bag).
- b. Re-use of single-use supplies (needles/syringes) **must** be described and justified in the animal use protocol.

## 3. Parenteral Administration

- a. Substances given via parenteral injection should be:
  - i. Isotonic (the same concentration of solute as the blood)
  - ii. Close to physiologic pH (6.8-7.2)
    - o If pH is outside of physiologic range, administer the substance through a central vessel (such as the jugular or femoral vein) or buffer the solution such that the pH is appropriate.
  - iii. Sterile
  - iv. Endotoxin free
  - v. Delivered aseptically

## 4. Routes of Parenteral Administration (See Appendix A)

- a. Intravenous (IV)
  - i. Substances can be given as a bolus or as an infusion.
    - o Infusions are often given with specific equipment (pump or infusion set).
  - ii. Site selection for external venous access is species-specific. Common sites listed below:
    - o Rodents: lateral tail vein, saphenous vein, or retro-orbital venous sinus
    - o Rabbits: lateral ear, saphenous, jugular or cephalic vein
    - o Larger species: jugular, cephalic, femoral or saphenous vein
- b. Subcutaneous (SC)
  - i. Tent the skin. Holding the syringe parallel to the animal, direct the needle into the subcutis. Aspirate, then inject.
  - ii. The rate of absorption from the subcutis may be slower than with other parenteral routes.
  - iii. Subcutaneous infusions can be administered with the use of an oily depot or osmotic minipump. Consult veterinary staff for additional information.
  - iv. SC injections in the same animal should be no more than 3 sites per day.
- c. Intraperitoneal (IP)
  - i. Injections are administered into lower abdominal quadrants. Aspirate before injecting to avoid inadvertent administration into the bladder or gastrointestinal tract.
  - ii. Repeated daily IP dosing for up to one month is well-tolerated in rodents. Doses should be administered to alternating sides of the abdomen.
  - iii. Administration of irritating substances may cause ileus (stasis of the gastrointestinal tract) and peritonitis (inflammation of the abdominal cavity).
- d. Intramuscular (IM)
  - i. IM dosing is best used in larger species with greater muscle mass.

- ii. In rodents, use the gluteal or quadriceps muscles.
- iii. In larger (non-agricultural) animals use the gluteal, quadriceps, biceps or epaxial muscles.
- iv. Take care to avoid the sciatic nerve which runs along the caudal aspect of the femur. Inadvertent injection into nerves can result in paralysis and localized muscle necrosis.
- v. Typically, no more than 2 IM sites should be used per day in the same animal.
- vi. Drug labels administration recommendations should be adhered to.
- e. Topical (epicutaneous)
  - i. Avoid application of caustic or irritating substances.
  - ii. Apply substances to skin that is unbroken and free of hair.
  - iii. Avoid application of substances to sites available for grooming by the animal.
- f. Transdermal (percutaneous)
  - i. Typically accomplished by application of a patch impregnated with the substance.
  - ii. Apply the patch in a location which avoids inadvertent ingestion or removal by the animal.
  - iii. Systemic absorption is not immediate. Patches should be applied prior to the time of anticipated need according to manufacturer's instructions.
  - iv. **Do not cut patches** to reduce dose size. If appropriate dose of patch is not commercially available, consider an alternative route of administration.
- g. Intradermal (ID)
  - i. Tent the skin. Holding the syringe parallel to the animal, direct needle into the dermis. Aspirate, then inject.
  - ii. Inadvertent subcutaneous administration is common. Consult OLAR veterinary staff for assistance.

5. Routes of Enteral Administration

- a. Voluntary consumption
  - i. Substances typically mixed with the daily diet, flavored water, or other palatable items to encourage consumption. Care should be taken to maintain an appropriate daily caloric intake and to habituate animals to any novel food items before adding drug.
  - ii. Care should be taken to ensure animals consume all agent offered. Laboratory personnel are responsible for ensuring that food and water intake is adequate.
  - iii. Food or water containing additives should be clearly labeled and disposed of properly.
- b. Gavage
  - i. Gavage is often used to administer an exact PO dose.
  - ii. The gavage tube size should be appropriate for the species being dosed. Contact veterinary staff for assistance.

**Needle Size Recommendations (gauge\*)**

Species	SQ	IP	IM	IV	ID
Mouse	20 or less	21 or less	23 or less	25 or less	25 or less
Rat/Hamster	20 or less	21 or less	21 or less	23 or less	25 or less
Rabbit	20 or less	21 or less	20 or less	21 or less	25 or less
Swine	20	N/A	20	20	25 or less
Sheep	20	N/A	20	20	25 or less
Bovine	18 or 16	N/A	18 or 16	18 or 16	
Poultry	23 or less	N/A	23 or less	23 or less	N/A

\*Needle diameter decreases with increasing gauge size. The "or less" designation is referring to needle diameter and not gauge number.

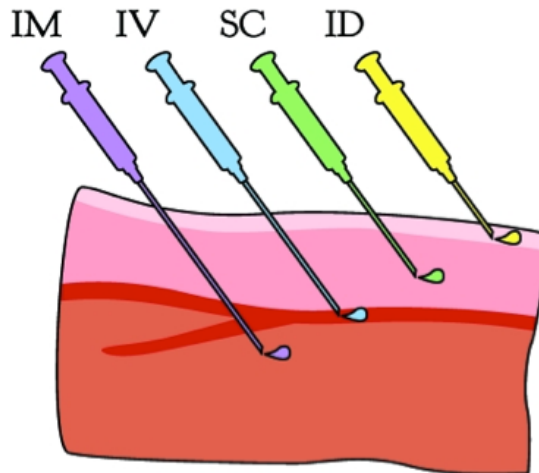
**Administration Volumes (ml/kg unless stated): Best Practice per administration (maximum administration)**

*For agricultural animals, contact veterinary staff for best recommendations*

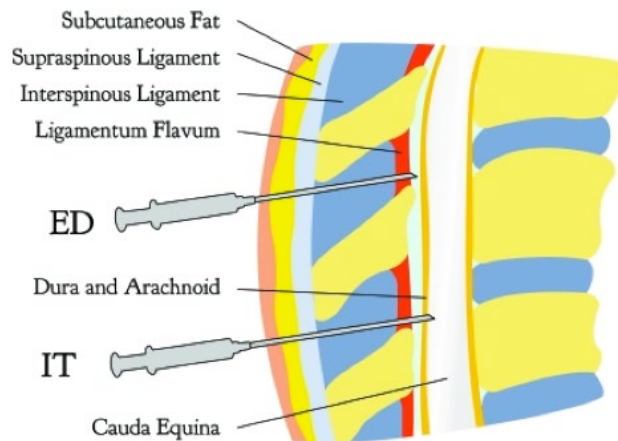
Species	PO	IV (bolus)	IV slow infusion	IP	SC	ID (mL/inj)	IM <sup>a</sup>	IN (mL/inj)
Mouse	10 (20)	5	25	20(80)	10(40)	0.05 – 0.1	0.05 (0.1)	0.03 – 0.05
Rat/Hamster	10(20)	5	20	10(20)	5(20)	0.05 – 0.1	0.1(0.2)	0.03 – 0.05
Rabbit	10(15)	2(5)	10	5(20)	5(10)	0.05 – 0.1	.25 (0.5)	0.2 – 0.5
Sheep	5-20	1-5	2-4 ml/kg/hr	N/A	1-5	0.05 – 0.1	0.05-0.1	0.2 – 0.5

<sup>a</sup> Maximum single IM dose per site is 5.0 mL for most animals > 10.0 kg. If the volume exceeds 5 mL, give over multiple sites.

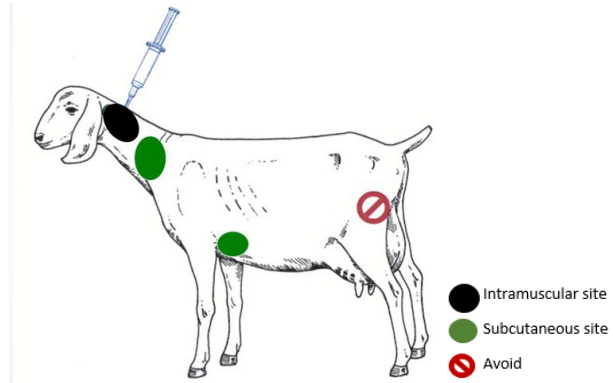
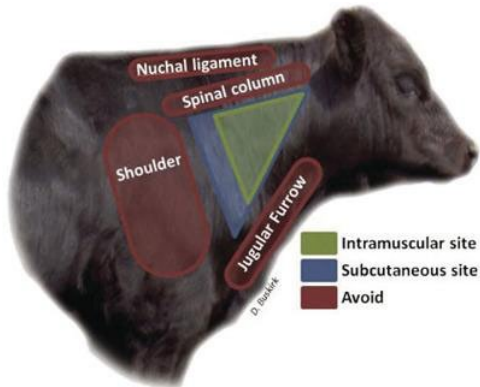
**Appendix A: Administration of Substances into the Skin or Muscle (Turner et al., 2011)**



**Appendix B: A Comparison of Epidural and Intrathecal Injections (Turner et al., 2011)**



**Appendix C: Injection Location Food Animals**



## References

This document was adapted from “ULAM Guidelines on Administration of Substances to Laboratory Animals”: <https://az.research.umich.edu/animalcare/guidelines/guidelines-administration-substances-laboratory-animals>

1. Diehl, K-H, et al. 2001. A good practice guide to the administration of substances and removal of blood including routes and volumes. *J Appl. Toxicol.* 21:15-23.
2. Flecknell PA, Waynforth HB. 1992. *Experimental and Surgical Techniques in the Rat*. Second ed. Academic Press. San Diego, CA.
3. Morton DB, et al. 2001. Refining procedures for the administration of substances. *Laboratory Animals.* 35: 1-41.
4. Nebendahl, K. 2000. Routes of administration. In: Krinke GJ, ed. *The Laboratory Rat*. Academic Press. London. pp. 463-483.
5. Turner PV, et al. 2011. Administration of substances to laboratory animals: Routes of administration and factors to consider. *JAALAS.* 50(5): 600-613.
6. Turner PV, et al. 2011. Administration of substances to laboratory animals: Equipment considerations, vehicle selection, and solute preparation. *JAALAS.* 50(5): 614-627.