

## NIH Anesthesia/Analgesia Formulary

The following pages provide tables of drugs commonly used at the National Institutes of Health (NIH) for pre-anesthesia, anesthesia, analgesia, sedation, tranquilization, and restraint of laboratory animal species.

The dosage recommendations and other data presented on the following pages are based upon current data in the literature and the professional judgement of veterinarians on the NIH Animal Care and Use Committee Subcommittee on Training. Doses published in the literature are often variable.

Proper drug doses may vary greatly depending on species, strain, sex, age, physiologic status of the animal, and the level of anesthesia/analgesia desired.

***Although these lists provide a ready source of information on drug doses, individuals should not use these drugs without prior experience.***

Your institute or animal facility veterinarians are available for consultation and additional information.

The page facing each table provides species specific information.

Controlled drugs are identified by a "C." The Roman numeral classifies the drug into one of the five established schedules of controlled substances (e.g., sodium pentobarbital, C-II).

### Abbreviations:

IV	= intravenous
IM	= intramuscular
IP	= intraperitoneal
SC	= subcutaneous
PO	= per os, oral
IH	= inhalation
qXh	= every X hours

## SPECIES INFORMATION

### MOUSE (*Mus musculus*)

Physiologic parameters:

Body temperature = 36.5-38.0°C

Heart rate = 325-780/min

Respiratory rate = 94-163/min

Tidal volume = 0.09-0.23 ml

The use of chloroform as an anesthetic agent is discouraged. Chloroform can cause renal tubular calcification and/or necrosis, particularly in male mice; DBA/2 strain most susceptible.

Avertin is made by mixing equal amounts of tribromyl ethyl alcohol and tertiary amyl alcohol (2.5% dilution). If Avertin is improperly prepared or stored in the light, it will break down into dibromoacetic acid and hydrobromic acid which can be lethal in 24 hours. **Freshly mixed solutions are strongly recommended for safe use.** The solution can be kept as long as 4 months if it is stored in the dark at 4 degrees C. The solution should be tested to ensure that it has a pH >5.

\* The therapeutic dose for carbon dioxide is close to the lethal dose; very short acting. Concurrent administration of 10-50% O<sub>2</sub> is recommended.

\*\* Best for minor surgery procedures only.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**MOUSE (*Mus musculus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.02-0.05 mg/kg	IM
Diazepam, C-IV (Valium®)	5 mg/kg	IP
Ketamine, C-III (Ketaset®, Vetalar®)	22-44 mg/kg	IM
Telazol®, C-III (for restraint)	100-160 mg/kg	IM IP
Carbon dioxide* + 10-50% O <sub>2</sub>	To effect	IH
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	50-90 mg/kg	IP
Ketamine**, C-III	50-200 mg/kg	IP
	40-60 mg/kg	IM
Avertin (Tribromoethanol)	125-250 mg/kg	IP
	0.02 ml/g (1.2% solution)	
Ketamine/Xylazine:		
- Add 7 mg xylazine <sup>†</sup> to 35 mg ketamine (dose based on ketamine)	70-80 mg/kg	IM IP
or		
- Add 1.0 ml xylazine (20 mg/ml) and 1.0 ml ketamine (100 mg/ml) and 4.6 ml sterile water.	0.1 ml/20 g	IM IP
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
<b>Analgesia</b>		
Morphine, C-II	5-10 mg/kg q2-4h	SC IP
Butorphanol tartrate (Torbugesic®), C-IV	2.5-5 mg/kg q1-2h	SC
Buprenorphine, C-V	2 mg/kg q12h	SC IP
Oxymorphone, C-II	0.15 mg/kg q4h	IM
Ketorolac	0.7-10 mg/kg q24h	PO

## SPECIES INFORMATION

### RAT (*Rattus norvegicus*)

Physiologic parameters:

Body temperature = 35.9-37.5°C

Heart rate = 250-450/min

Respiratory rate = 70-115/min

Tidal volume = 0.6-2.0 ml

Male rats and animals receiving low calorie diets require higher doses of barbiturates.

Avertin has been reported to cause ileus in rats

The therapeutic dose for carbon dioxide is close to the lethal dose; very short acting. Concurrent administration of 10-50% O<sub>2</sub> is recommended.

The reversal agent, yohimbine, is only effective when xylazine or medetomidine has been used.

- \* The projected duration of action for an analgesic is an approximation because the nature of the procedure and the level of pain that is experienced affect it.
- † Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**RAT (*Rattus norvegicus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.04-0.1 mg/kg	SC
Diazepam, C-IV (Valium®)	0.5-15 mg/kg	IP
Ketamine, C-III (Ketaset®, Vetalar®)	22-50 mg/kg	IM
Carbon dioxide + 10-50% O <sub>2</sub>	To effect	IH
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	30-60 mg/kg	IV IP
Ketamine, C-III (10 mg/ml solution)	50-90 mg/kg	IM
	50-100 mg/kg	IP
Ketamine/Xylazine <sup>†</sup> :		
ketamine	40-80 mg/kg	IM IP
xylazine <sup>†</sup>	10 mg/kg	IM IP
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
Carbon dioxide	To effect	IH
Telazol®, C-III	20-40 mg/kg	IP
	20 mg/kg	IM
Ketamine/Medetomidine		
Ketamine	60-75 mg/kg	IP
Medetomidine (Domitor®)	0.25-0.5 mg/kg	SC
Chloral hydrate	300-400 mg/kg (5% solution)	IP
<b>Analgesia*</b>		
Morphine, C-II	1.5-6 mg/kg q2-4h	SC
Butorphanol tartrate, C-IV (Torbugesic®)	2.5-5 mg/kg q1-2h	SC
Carprofen	5 mg/kg q12h	SC
Ketorolac	3-5 mg/kg q12-24h	PO
	1 mg/kg q12-24h	IM
Buprenorphine, C-V	0.01-0.05 mg/kg	SC IP
<b>Reversal Agents</b>		
Yohimbine (reverses xylazine)	1-2 mg/kg	IM IP

## SPECIES INFORMATION

### HAMSTER (*Mesocricetus auratus*)

Physiologic parameters:

Body temperature = 37-38°C

Heart rate = 250-500/min

Respiratory rate = 35-135/min

Tidal volume = 0.6-1.4 ml

Syrian or golden hamster is very resistant to morphine - no sedation or hypnotic effects.

Syrian or golden hamster has an increased tolerance to pentobarbital.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**HAMSTER (*Mesocricetus auratus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.1 mg/kg	IP IM SC
Ketamine, C-III (Ketaset®, Vetalar®)	22-44 mg/kg	IM
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	30-90 mg/kg	IP
Ketamine/Xylazine <sup>†</sup> :		
Xylazine <sup>†</sup>	10 mg/kg	IP IM
Ketamine	100 mg/kg	IP
Telazol®, C-III	20-80 mg/kg	IP IM
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
Ketamine/Diazepam, C-IV	0.5mg/kg	IM IP
<b>Analgesia</b>		
Buprenorphine, C-V	0.05-0.1 mg/kg q8-12h	SC IM
Butorphanol tartrate, C-IV (Torbugesic®)	1-5 mg/kg q2-4h	SC IM

## SPECIES INFORMATION

### GUINEA PIG (*Cavia porcellus*)

Physiologic parameters:

Body temperature = 37.2-39.5°C

Heart rate = 230-380/min

Respiratory rate = 42-104/min

Tidal volume = 2.3-5.3 ml/kg

Large cecum can act as reservoir for anesthetics. Depending on drug solubility, the cecum can alter the pharmacologic effect.

Induction of anesthesia using volatile anesthetics (e.g., halothane and isoflurane) should be done with caution due to initial breath holding when animals are first exposed to irritating gas vapors.

Repeated exposure to halothane can cause hepatotoxicity. Isoflurane is a safer inhalant anesthetics to use.

Self mutilation has been reported in guinea pigs after ketamine administration.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.



**GUINEA PIG (*Cavia porcellus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.05 mg/kg	SC
Diazepam, C-IV (Valium®)	2.5-5.0 mg/kg	IP IM
Acetylpromazine	5-10 mg/kg	IM SC IV
Ketamine, C-III (Ketaset®, Vetalar®)	22-30 mg/kg	IM
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	15-40 mg/kg	IP
Sodium Thiopental, C-III	20 mg/kg	IV
Ketamine, C-III	40-50 mg/kg	IM
Ketamine/Xylazine <sup>†</sup> :		
Xylazine <sup>†</sup>	5-13 mg/kg	SC
Ketamine	44 mg/kg	SC
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
<b>Analgesia</b>		
Buprenorphine, C-V	0.05 mg/kg q8-12h	SC
Morphine, C-II	10 mg/kg q2-4h	SC IM
Aspirin	86 mg/kg	PO
Butorphanol tartrate, C-IV (Torbugesic®)	0.25-0.4 mg/kg	IV SC
<b>Reversal Agent</b>		
Atipemazole (Antisedan®)	1 mg/kg	IM IV SC IP

## SPECIES INFORMATION

### **RABBIT (*Oryctolagus cuniculus*)**

Physiologic parameters:

Body temperature = 38-39.6°C

Heart rate = 130-325/min

Respiratory rate = 32-60/min

Tidal volume = 4-6 ml/kg

Many rabbits have serum atropinesterase which causes reduced response to atropine. Glycopyrrolate, another anticholinergic, can be used instead of atropine.

Unique hypnotism or immobilization reflex has been observed in rabbits in the absence of drug use.

Large cecum can act as reservoir for anesthetics. Depending on drug solubility, the cecum can alter the pharmacologic effect.

Induction of anesthesia using volatile anesthetics (e.g., halothane and isoflurane) should be done with caution due to initial breath holding when animals are first exposed to irritating gas vapors.

Give IV injections via marginal ear veins.

Self mutilation has been reported in rabbits after IM ketamine administration. Dilution of ketamine with saline will limit this side effect.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**RABBIT (*Oryctolagus cuniculus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Ketamine, C-III (Ketaset®, Vetalar®)	15-50 mg/kg	IM
Acetylpromazine	1.0-10 mg/kg	IM SC IV
Ketamine/Acetylpromazine (10:1)	15-50 mg/kg	IM
Diazepam, C-IV (Valium®)	5-10 mg/kg	IV IM
Glycopyrrolate	0.005-0.011 mg/kg	IM
Butorphanol & Acepromazine		
Butorphanol tartrate, C-IV (Torbugesic®)	1 mg/kg	SC
Acetylpromazine	1 mg/kg	SC
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II (3% solution given slowly to effect)	15-40 mg/kg	IV
Ketamine/Xylazine <sup>†</sup> /Acepromazine:		
Xylazine <sup>†</sup>	5-10 mg/kg	IM
Ketamine, C-III	35-50 mg/kg	IM
Acepromazine	0.75 mg/kg	IM
Ketamine/Midazolam		
Ketamine, C-III	25 mg/kg	IM
Midazolam, C-IV	1 mg/kg	IM
Ketamine/Diazepam		
Ketamine, C-III	15-50 mg/kg	IM
Diazepam, C-IV	5-10 mg/kg	IM
Ketamine/Acepromazine/Butorphanol		
Ketamine, C-III	35 mg/kg	SC
Acepromazine	0.75 mg/kg	SC
Butorphanol tartrate, C-IV (Torbugesic®)	0.1 mg/kg	SC
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
<b>Analgesia</b>		
Morphine, C-II	5 mg/kg q2-4h	SC IM
Acetylsalicytic Acid (Aspirin)	500 mg/kg	PO
Buprenorphine, C-V	0.02-0.1 mg/kg q8-12h	SC
Butorphanol tartrate, C-IV (Torbugesic®)	0.1-1.5 mg/kg q4h	IV
	1.0-7.5 mg/kg q4h	IM SC
Flunixin meglumine (Banamine®)	1.1 mg/kg q12h	IM SC
Carprofen	1.5 mg/kg q12h	PO
Ketoprofen	3 mg/kg q12h	IM
<b>Reversal Agents</b>		
Yohimbine ( reverses xylazine)	0.2 mg/kg	IV

## SPECIES INFORMATION

### CAT (*Felis catus*)

Physiologic parameters:

Body temperature = 38.5°C

Heart rate = 110-140/min

Respiratory rate = 26/min

Tidal volume = 20 ml

Morphine should be used with caution in cats. It causes extreme hyperexcitement if overdosed.

Nonsteroidal anti-inflammatory drugs should generally not be used in cats. Acetaminophen, ibuprofen, flunixin meglumine, and phenylbutazone are contraindicated. Aspirin is toxic to cats and must be dosed very carefully. Aspirin can cause bone marrow depression, anemia, gastric lesions, and death.

Ketamine at a dose of 44 mg/kg IM can produce mortality in some cats; 25 mg/kg IM is usually adequate for most individuals.

The dosage and frequency of administration of all analgesic agents must be tailored to the animal, procedure, and magnitude of pain present. Combinations of narcotics and non-steroidal agents are commonly used. Consult your veterinarian for specific recommendations.

\* Pre-medication with Atropine or Glycopyrrolate is suggested to avoid bradycardia and cardiac arrhythmias with these agents.

\*\* Poor analgesia. Adequate for superficial procedures only!

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

CAT (*Felis catus*)

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.02-0.04 mg/kg	IM SC IV
Glycopyrrolate	0.02 mg/kg	IM SC
Ketamine, C-III (Ketaset®, Vetalar®)	11 mg/kg	IM
Ketamine/Acetylpromazine (10:1) (dose based on ketamine)	11 mg/kg	IM
Acetylpromazine	0.055-0.11 mg/kg	IM SC
	1.1-2.2 mg/kg	PO
Xylazine <sup>†*</sup>	0.04-0.9 mg/kg	IM
Diazepam, C-IV (Valium®)	1 mg/kg	IV
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	20-30 mg/kg	IV
Sodium Thiopental, C-III (2.5%)	8-12 mg/kg	IV
Ketamine, C-III (Ketaset®, Vetalar®)	10-25 mg/kg	IM
Ketamine/Acetylpromazine (10:1) (dose based on ketamine)	10-25 mg/kg	IM
Ketamine/Xylazine <sup>†*</sup>		
Xylazine <sup>†</sup>	1 mg/kg	IM
Ketamine, C-III	10 mg/kg	IM
redose ketamine as needed	4-8 mg/kg	IM
Ketamine/Diazepam <sup>**</sup> (2:1)		
Ketamine, C-III	0.5-1 mg/lb	IV
Diazepam, C-IV	0.1-0.2 mg/lb	IV
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
<b>Analgesia</b>		
Morphine, C-II	0.5-5.0 mg/kg q2-4h	IM SC
Butorphanol tartrate, C-IV (Torbugesic®)	0.055-0.11 mg/kg q6-12h	SC
Buprenorphine, C-V	0.01-0.02 mg/kg q12 h	SC
Flunixin meglumine (Banamine®)	0.5-2.2 mg/kg daily	IM, IV
Acetylsalicytic Acid (Aspirin)	25 mg/kg q8h	PO
Morphine, C-II	0.1 mg/kg	SC IM
Carprofen (Rimadyl®)	4mg/kg q24h	SC IV
	1-2 mg/kg q12h	PO
Ketoprofen	1-2 mg/kg q24h	SC IM IV PO
<b>Reversal Agents</b>		
Yohimbine (reverses xylazine)	0.1 mg/kg	IV
Atipamezole (reverses medetomidine)	0.05 mg/kg	IM
Nalaxone	0.005-0.02 mg/kg	IV

## SPECIES INFORMATION

### DOG (*Canis familiaris*)

Physiologic parameters:

Body temperature = 39°C  
Heart rate = 100-130/min  
Respiratory rate = 22/min  
Tidal volume = 250 ml

Ketamine should not be used alone in dogs as it may cause seizures in some individuals. Ketamine should be used in combination with a tranquilizer.

Nonsteroidal anti-inflammatory drugs should be used with caution in dogs. Acetaminophen and ibuprofen are contraindicated. Aspirin must be dosed very carefully.

The dosage and frequency of administration of all analgesic agents must be tailored to the animal, procedure, and magnitude of pain present. Combinations of narcotics and non-steroidal agents are commonly used. Consult your veterinarian for specific recommendations.

- \* Pre-medication with Atropine or Glycopyrrolate is suggested to avoid bradycardia and cardiac arrhythmias with these agents.
- \*\* Poor analgesia. Adequate for superficial procedures only!
- † Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**DOG (*Canis familiaris*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.02-0.05 mg/kg	IM SC IV
Glycopyrrolate	0.01-0.02 mg/kg	IM SC
Acetylpromazine	0.055-0.11 mg/kg	IM SC IV
	0.55-2.2 mg/kg	PO
Diazepam, C-IV (Valium®)	1-5 mg/kg	IM
	0.2-0.6 mg/kg	IV
Medetomidine	0.1-0.8 mg/kg	IM SC IV
Xylazine <sup>†*</sup>	1.0-2.0 mg/kg	IM SC
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	30 mg/kg	IV
Thiopental Sodium, C-II	10-35 mg/kg	IV
Ketamine/Xylazine <sup>†*</sup> :		
Ketamine, C-III	5-10 mg/kg	IM
Xylazine <sup>†</sup>	1-2 mg/kg	IM
Ketamine/Diazepam (2:1)**		
Ketamine, C-III	5.5 mg/kg	IV
Diazepam, C-IV	0.33 mg/kg	IV
Ketamine/Medetomidine*		
Ketamine, C-III	2.5-7.5mg/kg	IM
Medetomidine (Domitor®)	0.04 mg/kg	IM
Ketamine/Midazolam**		
Ketamine, C-III	5-10 mg/kg	IV
Midazolam, C-IV	0.28-0.5 mg/kg	IV
Propofol**	5.0-7.5 mg/kg	IV
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
Halothane/Nitrous Oxide (50% O <sub>2</sub> + 50% N <sub>2</sub> O)	To effect	IH
<b>Analgesia</b>		
Morphine, C-II	0.5-5 mg/kg q2-4h	SC IM
Acetylsalicytic Acid (Aspirin)	25 mg/kg q8h	PO
Flunixin meglumine (Banamine®)	0.5-2.2 mg/kg daily	IM IV
Butorphanol tartrate, C-IV (Torbugesic®)	0.055-0.11 mg/kg q6-12h	SC
	0.55 mg/kg q6-12h	PO
Buprenorphine, C-V	0.01-0.02 mg/kg q12h	SC IM
Carprofen (Rimadyl®)	4 mg/kg q24h	SC IV
	1-2 mg/kg q12h	PO
Ketoprofen	1-2 mg/kg q24h	SC IM IV PO
<b>Reversal Agents</b>		
Yohimbine(reverses xylazine)	0.1 mg/kg	IV
Atipamezole (Antisedan®)	0.05 mg/kg	IM
Naloxone (reverses opioids)	0.005-0.02 mg/kg	IV

## SPECIES INFORMATION

### SHEEP (*Ovis aries*) and GOAT (*Capra hircus*)

Physiologic parameters:

#### Sheep

Body temperature = 39.5°C

Heart rate = 60-120/min

Respiratory rate = 19/min

Tidal volume = 300 ml

#### Goat

Body temperature = 39°C

Heart rate = 70-135/min

Respiratory rate = 20/min

Tidal volume = 325 ml

Anesthetic combination: Mix 1 ml xylazine (100 mg/ml), 1 ml butorphanol tartrate, C-IV (Torbugesic®), and 8 ml sterile water. Dose at .05 mg/kg IV and give 1 ml ketamine IM.

Sheep and goats should be fasted for 18-24 hours prior to induction of anesthesia to control regurgitation. Water should be withheld for about 6 hours.

Positioning of ruminants during anesthesia is an important consideration. Right lateral recumbency should be avoided, as this results in excessive intra-abdominal pressure, pressure on the diaphragm, and the collection of gas in the rumen.

Saliva may continue to flow in considerable quantities during general anesthesia in ruminants.

\*Xylazine must be used with caution because some animals become hypoxic.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used. Xylazine should be used in the 20 mg/ml concentration since it allows better dosage control.



**SHEEP (*Ovis aries*) and GOAT (*Capra hircus*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Ketamine, C-III (Ketaset®, Vetalar®)	5-7 mg/kg	IV
Acetylpromazine	0.05-1.0 mg/kg	IM SC IV
Diazepam, C-IV (Valium®)	0.2-0.5 mg/kg	IV IM
Glycopyrrolate	0.25 mg/10 lbs	IV SC IM
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	30-40 mg/kg	IV
Sodium Thiopental, C-III (5%)	10-15 mg/kg	IV
Xylazine <sup>†</sup> /Ketamine:		
Xylazine <sup>†</sup>	0.1 mg/kg	IM
Ketamine, C-III	5 mg/kg	IM
Xylazine <sup>†</sup> /Butorphanol	See under <i>Species Information</i>	
Halothane (Fluothane®)	To effect	IH
Halothane/Nitrous Oxide (50% O <sub>2</sub> + 50% N <sub>2</sub> O)	To effect	IH
<b>Analgesia</b>		
Flunixin meglumine (Banamine®)	2.2 mg/kg	IV
Meperidine, C-II (Demerol®)	5 mg/kg	IV
Phenylbutazone	4-8 mg/kg q24h	PO
	2-5 mg/kg q24h	IV
Xylazine <sup>†</sup> * (Rompun®)	0.05 mg/kg	IV
Butorphanol tartrate, C-IV (Torbugesic®)	0.3 mg/kg	SC IV
Buprenorphine, C-V	0.005 mg/kg q12h	SC
<b>Reversal Agents</b>		
Yohimbine( reverses xylazine)	0.2 mg/kg (ovine)	IV

## SPECIES INFORMATION

### SWINE (*Sus scrofa*)

Physiologic parameters:

Body temperature = varies by breed: 37-39°C

Heart rate = varies by breed: 58-105/min

Respiratory rate = varies by breed: 10-25/min

Tidal volume = varies by breed

Larger swine require a lower dose of many drugs in the given ranges due to higher percent body fat.

† Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

**SWINE (*Sus scrofa*)**

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.05 mg/kg	IM
Sodium Pentobarbital, C-II	8-11 mg/kg	IV
Acetylpromazine	1.1-2.2 mg/kg	IM
Xylazine <sup>†</sup>	2 mg/kg	IV
Diazepam, C-IV (Valium®)	0.5-10 mg/kg	IM
	0.44-2 mg/kg	IV
Midazolam, C-IV	0.1-0.5 mg/kg	IM IV
Glycopyrrolate	0.004-0.01 mg/kg	IM
<b>Anesthesia</b>		
Telazol®, C-III	2.0-8.8 mg/kg	IM
Sodium Pentobarbital, C-II	20-40 mg/kg	IV
Sodium Thiopental, C-III (5%)	6.6-30 mg/kg	IV
Ketamine, C-III (Ketaset®, Vetalar®)	11-33 mg/kg	IM
Xylazine <sup>†</sup> /Ketamine:		
Xylazine <sup>†</sup>	2 mg/kg	IV
Ketamine, C-III	20 mg/kg	IM
Acetylpromazine/Ketamine:		
Acetylpromazine	1.1 mg/kg	IM
Ketamine, C-III	33 mg/kg	IM
Ketamine/Diazepam:		
Ketamine, C-III	15 mg/kg	IM
Diazepam, C-IV	2 mg/kg	IM
Ketamine/ Medetomidine:		
Ketamine, C-III	10 mg/kg	IM
Medetomidine (Domitor®)	0.2 mg/kg	IM
Isoflurane	To effect	IH
<b>Analgesia</b>		
Acetylsalicytic Acid (Aspirin)	10-20 mg/kg q8h	PO
Meperidine, C-II (Demerol®)	4 mg/kg	IM
Buprenorphine, C-V	0.05-0.1 mg/kg q8-12h	IM
Butorphanol tartrate, C-IV (Torbugesic®)	0.1-0.3 mg/kg q4-6h	SC IM IV
Carprofen (Rimadyl®)	0.5-4.0 mg/kg daily	SC IM IV
Ketoprofen	1.0-3.0 mg/kg daily	SC IM IV
<b>Reversal Agents</b>		
Yohimbine (reverses xylazine)	0.05 mg/kg	IV
Atipamezole (reverses medetomidine)	1 mg/kg	SC IM IV
Naloxone (reverses opioids)	0.05-0.2 mg/kg	IV

## SPECIES INFORMATION

### NONHUMAN PRIMATES

Physiologic parameters:

Rhesus

Body temperature = 37-39°C

Heart rate = 120-180/min

Respiratory rate = 32-50/min

Tidal volume = 21 ml

Baboon

Body temperature = 39°C

Heart rate = 150/min

Respiratory rate = 35/min

Tidal volume = 50 ml

The dosage and frequency of administration of all analgesic agents must be tailored to the animal, procedure, and magnitude of pain present. Combinations of narcotics and non-steroidal agents are commonly used. Consult your veterinarian for specific recommendations.

- \* Pre-medication with Atropine or Glycopyrrolate is suggested to avoid bradycardia and cardiac arrhythmias with these agents.
- \*\* Poor analgesia. Adequate for superficial procedures only!
- † Xylazine is available in **two strengths** (20 mg/ml, 100mg/ml). Ensure the dose calculated is based on the strength being used.

## NONHUMAN PRIMATES

<u>Drug indication and Drugs</u>	<u>Dosage and Route of Administration</u>	
<b>Restraint/Preanesthesia</b>		
Atropine	0.02-0.05 mg/kg	IM SC
Glycopyrrolate	0.005-0.01mg/kg	IM SC
Diazepam, C-IV (Valium®)	0.5-1.0 mg/kg	IM
Xylazine <sup>†</sup>	0.5-2.0 mg/kg	IM
<b>Anesthesia</b>		
Sodium Pentobarbital, C-II	20-30 mg/kg	IV
Sodium Thiopental, C-III (2.5%)	15-20 mg/kg	IV
Ketamine/Xylazine <sup>†*</sup> :		
Ketamine, C-III	7-10 mg/kg	IM
Xylazine <sup>†</sup>	0.25-2.0 mg/kg	IM
Ketamine/Diazepam <sup>**</sup> :		
Ketamine, C-III	15 mg/kg	IV
Diazepam, C-IV (Valium®)	1 mg/kg	IV
Ketamine/Midazolam <sup>**</sup> :		
Ketamine, C-III	15 mg/kg	IV
Midazolam, C-IV	0.5-0.15 mg/kg	IV
Telazol®, C-III	4.0-6.0 mg/kg	IM
Halothane (Fluothane®)	To effect	IH
Isoflurane	To effect	IH
<b>Analgesia</b>		
Morphine, C-II	1-2 mg/kg q4h	IM SC
Oxymorphone, C-II	0.15 mg/kg q4-6h	IM
Buprenorphine, C-V	0.01-0.03 mg/kg q8-12h	IM SC
Acetylsalicytic Acid (Aspirin)	10-20 mg/kg q6h	PO
Acetaminophen	10 mg/kg q8h	PO
Flunixin meglumine (Banamine®)	0.5 mg/kg daily	IM
Butorphanol tartrate, C-IV (Torbugesic®)	0.025 mg/kg q3-6h	IM
Naproxen	10 mg/kg q12h	PO
Ketorolac	15-30 mg/kg	IM
<b>Reversal Agents</b>		
Yohimbine (reverses xylazine)	0.05 mg/kg	IV
Naloxone (reverses opioids)	0.1-0.2 mg/kg as needed	IV

**AMPHIBIANS****Anesthesia**

Amphibians must be kept moist over their entire bodies during anesthesia and recovery. Care must be taken that they do not become immersed, as this will result in drowning.

Tricaine (MS 222) -ethyl m-amino benzoate methanesulfonate (tricaine methane sulfonate)  
Should be buffered to neutral pH before use. Must be disposed as chemical waste.

Immerse in water with agent added: 1:2000 to 1:1000 for adults  
(i.e. 5-10mg of tricaine in 1000 ml water)  
1:3000 to 1:5000 for larvae

Induction in 5-20 minutes; maintain by moist cloth contact with MS 222 solution.  
Recovery - keep at 22-26°C; takes 3-6 hours; keep moist.

Benzocaine - 100 mg/1000 ml water

Halothane/Isflurane - 5% in anesthetic chamber; maintain at 3%.

Sodium Pentobarbital - 60 mg/kg; inject into dorsal lymph sac.

**Analgesia**

Chlorpromazine	32 mg/kg; inject into dorsal lymph sac
Chlordiazepoxide	90 mg/kg; inject into dorsal lymph sac
Buprenorphine, C-V	14 mg/kg; inject into dorsal lymph sac
Diphenhydramine	51 mg/kg; inject into dorsal lymph sac

## FISH

Because fish breathe through gills rather than lungs, anesthesia must be delivered through an aquatic medium. Most fish are induced by adding the anesthetic agent to the tank water. It is important to have two separate tanks; one for anesthesia and one for recovery. Water for anesthesia should be well-aerated to provide adequate oxygen and minimize the stress of induction. Food should be withheld for several hours prior to induction.

Tricaine (MS 222) -ethyl m-amino benzoate methanesulfonate (tricaine methane sulfonate)  
Should be buffered to neutral pH before use. Must be disposed as chemical waste.

Immerse in water with agent added; doses vary according to species:

1:20,000 (50 mg/liter) for tranquilization

1:10,000 (100 mg/liter) for surgical anesthesia

Induction occurs within 3 minutes, recovery takes 10-15 minutes after removal.

Benzocaine 20-30 mg/1000 ml water for tranquilization  
50 mg/1000 ml water for surgical anesthesia

Etomidate is an analog of propofol and provides sedation only. It should not be used for procedures requiring surgical anesthesia.

0.05 -0.5 mg/1000 ml for tranquilization during transportation

2-4 mg/1000 ml for sedation